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Phytoplankton Community Structure of River Chenab, Jammu and Kashmir (J&K)

D. I. Baba[1], K. K. Sharma[2], Shvetambri[3]

[1]Co ordinator Campuses, University of Jammu, Jammu – 180006, J&K, India

[2]Professor, Department of Zoology, University of Jammu, Jammu – 180006, J&K, India

[3]Principal Investigator, Department of Zoology, University of Jammu, Jammu – 180006, J&K, India

Abstract: ***Phytoplankton are imperative part of lentic and lotic waters. The primary productivity of phytoplankton provides the base for the aquatic food chains as well as the fish populations. They also generate 70% of the world's oxygen. Therefore, it becomes important that the diversity and dynamics of the phytoplankton be figured out. In connivance with this, a study on the phytoplanktonic populations inhabiting the river Chenab was carried out from 2000 to 2002. Phytoplankton collection during the two years of study in river Chenab and its tributaries recorded 20 species belonging to 3 major groups namely, Chlorophyceae, Bacillariophyceae and Cyanophyceae. On the whole, Chlorophyceae was represented by 11 species (55%), Bacillariophyceae by 7 species (35%) and Cyanophyceae by 2 species (10%).***

Keywords: Phytoplankton, Community Structure, Indicator, River Chenab

1. Introduction

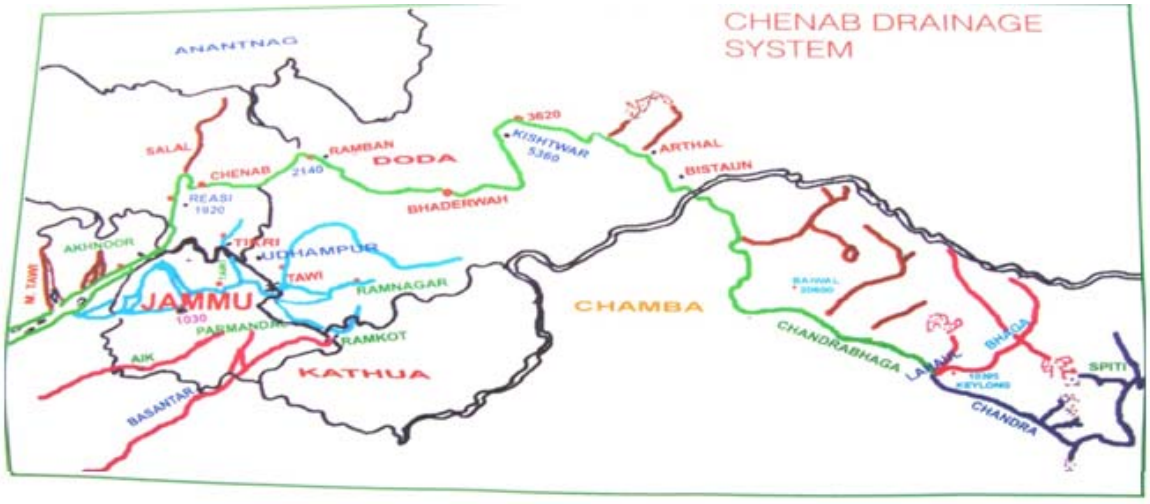
Phytoplankton is algae suspended in the water column and transported by currents. Their biomass and species composition are important in determining rates of primary productivity and food availability to consumer species. Phytoplankton primary production provides the base upon which the aquatic food chains culminating in the natural fish populations are exploited by man are founded, at the same time generating 70% of the world's atmospheric oxygen supply. The relationships between total phytoplankton biomass and changes in abiotic conditions are well established and quite significant as an increased biomass is generally associated with higher rates of production and consumption in the aquatic ecosystem. Phytoplankton could be considered as suitable indicators of water quality in that they are simple, capable of quantifying changes in water quality, applicable over large geographic areas and can also furnish data on background conditions and natural variability. More so micro algal components respond rapidly to perturbations and are suitable bio-indicators of water condition which are beyond the tolerance of many other biota used for monitoring.

2. Study Area

The river was horizontally divided into zones and a study station for each zone was established. The division of river into study zones was made on the basis of variations in bottom structure or close to confluence of a stream / nallah with the main river.

Apart from studies on the main river, some study stations were carved along major tributaries, which influence the river ecology through influx of abiotic and biotic materials, which they produce or import from the catchment areas.

The river along its length was divided into 12 study stations namely Bhandarkot, Thatri, Pul-Doda, Ramban, Reasi and Akhnoor, Neota, Pouni, Anji, Jhajjer Kotli, Katal Batal and Jammu Tawi so that a comprehensive picture about the river ecosystem could be brought forth.



Six study stations on different streams that enter river Chenab at different locations along its course was raised namely Neota, Pouni, Anji, Jhajjar Kotli, River Tawi (Katal Batal and Jammu City).

3. Material and Methods

3.1 Collection, Qualitative and Quantitative Studies of Zooplankton

3.1.1 Collection

For the study of zooplankton, water samples from the river was collected by filtering 50 liters of water with the help of a hand net having a mesh size 60-70 µm. The samples so collected were fixed by adding 5% formaldehyde solution.

3.1.2 Qualitative Analysis

Preserved samples from the field, were brought to the laboratory and identified [2 3,4,5,6,7,8,9,10,11,12,13]

3.1.3 Quantitative Analysis

For the quantitative analysis of zooplankton, the samples were centrifuged and concentrated to 5ml. 1 ml of this concentrate was filled in the Sedgwick-Rafter (S-R) cell by keeping the cover slip diagonally across the cell and the sample was then transferred with a dropper. The cover slip rotated slowly and covered the surface of the cell. S-R cell were allowed to stand for 15-20 minutes for the settling of the plankton. The planktons were then counted by the field count method [14, 15]. Organisms in fifty random fields were counted. The number of zooplankton per ml. of the concentrate was calculated by the formula:

$$\text{Number/ml} = \frac{C \times 1000m^3}{A \times D \times F}$$

Where,

C = Number of organisms counted
A = Area of field
D = Depth of field (mm.)
(S-R cell depth) = 1mm.
F = Number of field counted

To reduce error, correction factor was used:

$$\text{Correction factor} = \frac{\text{Volume of pond water filtered}}{\text{Volume of concentrate (ml)}}$$

4. Results and Discussion

The Phytoplankton studied in the presently investigated River Chenab constituted 54.05% of the total plankton population (with Zooplankton constituting 45.94%).

Phytoplankton exhibited seasonal variation in composition (n/l) with periodic maxima and minima of *Chlorophyceae*, *Bacillariophyceae* and *Cyanophyceae* species (Table -1).

Table 1: List of Phytoplankton inhabiting River Chenab

Chlorophyceae	*Bacillariophyceae*	*Cyanophyceae*
Volvox sp.	*Navicula cuspidate*	*Nostoc sp.*
Pediastrum simplex	*Gomphonema sp.*	*Synechocystis sp.*
Actinastrum sp.	*Fragillaria sp.*	
Treubaria sp.	*Cyclotella sp.*	
Ulothrix zonata	*Diploneis sp.*	
Spirogyra sp.	*Frustulia sp.*	
Elakatothrix sp.	*Nitzchia sp.*	
Coelastrum sp.		
Closteridium sp.		
Uronema sp.		
Micospora sp.		

The number of phytoplankton count was observed to increase during the post monsoon months (September - October) and maintained their high level upto springs (March-April) including the winter months (November - February). While explaining the causes related to fluctuations in phytoplankton, Minima may be associated to the rise in temperature (summer) and drifting impact of rains during monsoon along with high turbidity and dilution of water. A similar effect of dilution causing decline in the total phytoplanktonic count has also been noted in River Yamuna [16, 17, 18, 19, 20].

At Bhandarkot, the maximum phytoplankton population 2850 unit l^{-1} was observed in January whereas 2450 unit l^{-1} in October and minimum 100 unit l^{-1} in August was observed. At Thatri, the maximum population 4100 unit l^{-1} was observed in November and minimum 50 unit l^{-1} in the month of August. At Pul-Doda, maximum 4450 unit l^{-1} was observed in the month of January and minimum 250 unit l^{-1} was observed in the month of August. At Ramban, maximum population 2350 unit l^{-1} was observed in the month of January and minimum 200 unit l^{-1} in the month of June. The occurrence of plankton in small numbers at this station compared to the other stations may be attributed to high water current. At Reasi, maximum population 4600 unit l^{-1} was observed in January and minimum 100 unit l^{-1} in August. At Akhnoor, maximum population 4400 unit l^{-1} was observed in March and 100 unit l^{-1} was observed in June and July (Table -2)

Table 2: Minimum and Maximum range of total phytoplankton community in river Chenab and its tributaries (u/l)

S.No.	*Station*	*Main River*		*Station*	*Tributaries*	
		Min	*Max*		*Min*	*Max*
1.	Bhandarkot	100	2850	Neota	450	5200
2.	Thatri	50	4100	Pouni	700	3450
3.	Pul-Doda	250	4450	Anji	300	3200
4.	Ramban	200	2350	J-Kotli	250	2750
5.	Reasi	100	4600	K-Batal	400	4100
6.	Akhnoor	100	4400	J. Tawi	500	8050

4.1 Chlorophyceae

Members of *Chlorophyceae* were observed to be maximally present in the phytoplankton collected from river Chenab and its tributaries. Among *Chlorophyceae*, the dominant species were *Volvox sps., Pediastrum simplex, Treubaria sps., Spirogyra sps., Uronema sps., Microspora sps.*

The quantitative variations in *Chlorophyceae* at different study stations presently observed is depicted in the table below:

Table 3: Minimum and Maximum range of Chlorophyceae in river Chenab and its tributaries (u/l)

S.No.	Station	Main River		Station	Tributaries	
		Min	Max		Min	Max
1.	Bhandarkot	50	2400	Neota	350	3800
2.	Thatri	50	3000	Pouni	200	2150
3.	Pul-Doda	50	2100	Anji	300	2800
4.	Ramban	100	1350	J-Kotli	150	2050
5.	Reasi	50	3700	K-Batal	150	2450
6.	Akhnoor	50	2700	J. Tawi	450	4050

Chlorophyceae as a group recorded its presence in river Chenab throughout the present investigation. The concentration of dissolved oxygen, free carbon dioxide and transparency value are the controlling factors for the development and distribution of the members of *Chlorophyceae* [21] contrarily, however, extreme hypoxic and hypercarbic condition of the medium is not suitable for their growth. The increase in total *Chlorophyceae* count during autumn and winter presently recorded may also be attributed to similar factors. High pH may be favourable for the development of *Chlorococcales*. As has been recorded in the present study.

4.2 Bacillariophyceae

The existence of *Bacillariophyceae* in a wide range of ecological conditions has already been discussed by [22, 23, 24, 25].

The quantitative variations in *Bacillariophyceae* at different study stations presently observed is depicted in the table below (Table - 4):

Table 4: Minimum and Maximum range of Bacillariophyceae in river Chenab and its tributaries (u/l)

S.No.	Station	Main River		Station	Tributaries	
		Min	Max		Min	Max
1.	Bhandarkot	50	850	Neota	150	1550
2.	Thatri	50	1400	Pouni	200	950
3.	Pul-Doda	150	1750	Anji	150	1050
4.	Ramban	50	650	J-Kotli	150	1050
5.	Reasi	100	1250	K-Batal	100	1400
6.	Akhnoor	150	1550	J. Tawi	250	3750

Bacillariophyceae number was found to be minimum during rainy season. The gradual fall in total count of *Bacillariophyceae* from May onwards with minima during monsoon is due to increasing turbidity and water speed as has also been advocated for Ganges [19]. As observed presently increase in population of diatoms at low temperature, low water current and falling turbidity was reported by [26, 19, 25].

4.3 Cyanophyceae

Cyanophyceae, a group of phytoplankton which dominates in polluted waters was minimally present in Chenab and its tributaries indicating therefore that the water quality is good as water is little polluted. The quantitative variations in *Cyanophyceae* at different study stations presently observed is depicted in the table below (Table - 5):

Table 5: Minimum and Maximum range of Cyanophyceae in river Chenab and its tributaries (u/l)

S.No.	Station	Main River		Station	Tributaries	
		Min	Max		Min	Max
1.	Bhandarkot	50	350	Neota	100	1050
2.	Thatri	100	1200	Pouni	200	1350
3.	Pul-Doda	150	850	Anji	50	500
4.	Ramban	100	350	J-Kotli	100	400
5.	Reasi	100	850	K-Batal	150	1650
6.	Akhnoor	50	1050	J. Tawi	150	1800

Perusal of table – 5 reveals that *Cyanophyceae* showed well marked seasonal and spatial changes in its community structure. In the present investigation, it was indicated that the higher number of blue green algae were recorded in the winter months. Similar finding has been made by [24]. According to [27] factors like shallowness and warm temperature promotes the abundant growth of algae which is totally contrast in river Chenab presently investigated because the water temperature of river Chenab always remains below 20^{o}C.

The quantitative variations in total phytoplankton community at different study stations presently observed is depicted in the table below (Table – 6):

Table 6: Minimum and Maximum range of total phytoplankton community in river Chenab and its tributaries (u/l)

S.No.	Station	Main River		Station	Tributaries	
		Min	Max		Min	Max
1.	Bhandarkot	100	2850	Neota	450	5200
2.	Thatri	50	4100	Pouni	700	3450
3.	Pul-Doda	250	4450	Anji	300	3200
4.	Ramban	200	2350	J-Kotli	250	2750
5.	Reasi	100	4600	K-Batal	400	4100
6.	Akhnoor	100	4400	J. Tawi	500	8050

This variation in the number of phytoplankton between main river and tributaries could be attributes to speed and transparency of the water. These fluctuations recorded in the total phytoplanktonic count in river Chenab and other tributaries may be attributed to the speed of water as well as transparency and temperature of the medium.

5. Conclusions

Phytoplankton are the primary producers of any aquatic ecosystem. Their study gives a thorough understanding of many aspects of the hydrobiology of the water body concerned. The structure and abundance of the phytoplankton populations are mainly controlled by inorganic nutrients such as nitrogen, phosphorus, silica and iron. Thus, they provide a firsthand information about the productivity, the kind of fish inhabiting the water and also the pollution levels of water in particular and the health of the aquatic ecosystem in general. The excess of phytoplankton may be hazardous for the water body and should be removed. The present study may prove to be quite useful, therefore, in providing detailed information about the diversity and dynamics of the phytoplankton of this important river.

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