Zooplankton Diversity and their Relationship with Physico-Chemical Parameters of Song River, Dehradun

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Abstract: This paper is focused on zooplankton diversity and their correlation with physic-chemical parameters of Song River. Study was done from March, 2017 to March, 2018 in Song river of Doon Valley, District Dehradun. Monthly samples were taken for the identification of zooplankton and water quality analysis. During the present study Rotifera (30%) was most dominant group and shows positive correlation with dissolved oxygen and negative correlation with biochemical oxygen demand, turbidity and total solids. Protozoa (25%) and Cladocera (25%) and copepod constituted 20% of total zooplankton diversity. Various physic-chemical parameters such as Temperature, pH, turbidity, dissolved oxygen, bio-chemical demand were also analyzed. It was also observed that site-II i.e. Maldevta was slightly polluted as compared to Site-I i.e. Lacchiwala.
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Key words: Zooplankton, Song River, Physico-chemical analysis

1. Introduction:

Water is one of the essential requirements for the survival for all forms of life. Even though 75% of the earth's surface is covered by water, but 97% of earth's water is saline and cannot be used for human consumption. 2.14% of water remains trapped in the glaciers and polar ice caps. Therefore, less than 1% quantity of water is available for its various uses such as drinking, agriculture, domestic and industrial consumption and for the use of aquaculture, sports and tourism etc. Due to rapid pace in industrialization and population explosion, the demand of water has been increased varieties of synthetic chemicals and other anthropogenic activities degrade the quality of large share part of this limited quantity of water. Freshwater bodies are very essential for the existence of natural and dynamic ecosystems contributing immensely in determining and evolving the biotic and abiotic systems. The scientific and technological advancement coupled with population explosion has not only brought change in life but has also resulted in exerting enormous pressure on natural resources and ecosystem. The ecosystem functions and stability need to the maintained which are controlled by both the quantity and quality of water so that its ability lift as blood stream of biosphere is maintained. The ecosystem service provided by stagnant or running waters as liquid of life are innumerable. Maintaining the integrity of the system supporting the inherent biota, maintaining the climatic system also comes under this service. Zooplankton are important animals in aquatic ecosystem and they act as primary consumers and transfer the energy of phytoplankton to higher trophic levels. Seasonal variations in the Physio-chemical and biological properties of fresh water eco-system have great importance in aquatic system. The song river flows in the eastern part of Doon Valley and it forms the main arterial system of valley. The Doon Valley, which is surrounded by outer Himalayas (Mussoorie hills) in the North, Shiwalik ridge in the South, river Ganga in the East and river Yamuna in the West. The Doon Valley has total run 6.5 km in width and 77 km in length. The Song River is the main river which bears drainage of eastern Doon Valley forest. The physicochemical factors individually or collectively have effect on biotic life. Therefore this study conducted to find out zooplankton diversity and their correlation between hydro-biological parameters at two different sites of Song River at Dehradun.

2. Materials And Methods

Study Area:

The Dehradun Valley is enclosed by the Shiwalik hills and the outer parts of the Himalayan ranges. It occupies an area of about 1200 sq.km between 77°35' and 78°2' longitude and 29°57' and 31°2 latitude. The physical features of the Dehradun Valley are the unique natural boundaries within which it is enclosed. The Siwalik hills are, in fact, the obstacles which confine the detritus swept down by the torrents from the greater Mountains on the North. Therefore, the resultant valley is considerably raised above the level of the Great Plains to the south. There are number of permanent habitats in the form of rivers, hill streams and slow running streams. In the Western part of the valley the water is drained into Yamuna by river Asan.

In the eastern side the water is drained into Ganga by river Song which enters the valley at Mal Devta.

Station I (Song River at Lacchiwala): It is about 19 km. from the city. It has got two main perennial hill streams, which comes from Koal Kundi side and the river Song coming down from Goolar Ghati. The river Reh joins the Song River at Lacchiwala.

Station II (Song River at Maldevta): It is about 20 km. from the Dehradun city. It is located near Raipur. On the eastern side the water is drained into Ganga by river Song which enters the valley at Mal Devta.

Collection Of The Sample

Plankton samples were collected by filtering water through plankton net made up by bolting silk No. 20 by vertical and horizontal hauling and collected in iodine treated polyethylene bottles.

The water samples were collected from the Song River at two sampling stations viz. Station I at Lacchiwala and Station II at Maldevta, with the help of plankton net. Iodine treated polyethylene sampling bottles (21 capacity) were used for the collection of water samples. Some of the physical and chemical characteristics of water including water temperature, transparency depth, dissolved oxygen, free carbon dioxide. Alkalinities, hardness, were determined at sampling stations while others were analysed in the laboratory within 4 to 6 hours of sample collection.

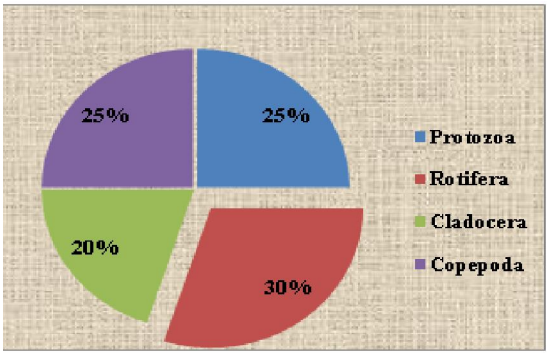
Seasonal variations in the qualitative and quantitative presence and abundance of zooplankton differ environment depending upon the Physico-chemical region of the system. The zooplanktonic samples were collected from the surface water at two stations. For qualitative analysis zooplanktons the sample were collected in one litre capacity water sample was filtered through nets of small mesh size (100 mesh MM2) the filtered samples were fixed with 4% neutralized formalin lugol's solution and a few drops of glycerine, allowed to settle overnight. Volumes of the concentrate were counted in zooplankton counting chamber under 150x magnification of a carl Zeiss invertoscope. The zooplanktonic organisms were identified according to standards of Welch (1952), Ward and Whipple (1959), Ruttner-Kolisko (1974), Koste (1978), Victor and Fernando (1979), Sehgal (1983), Battish (1992) and Dhanpati (2000), Edmodshon (1959).

3. Results:

The results of present study have described below and also summarized in table-1 and Table-2. Zoplankton species belonging to 4 classes; Protozoa represented five species (*Arcella discoides, Difflugia sp, Paramecium aurelia, P. caudatum, P. multimicronucleatum*), Rotifera constituted six species (*Brachionus calyciflorus, B. plicatilis, Asphlanchna brightwelli, Stentor sp, Rotararia sp., Philodina sp.*), Cladocera constituted four species (*Daphnia duplex, Bosmia sp., Ceriodaphnia sp., Chydorus sp.*), and Copepoda five species (*Nauplius larva, Macrocyclops ater, Senecella calanoidea, Cyclops, Limnocalanus* macrurus) represented were identified. Protozoa constituted 25%, rotifera constituted 30%, Cladocera constituted 20% and Copepoda constituted 25% of total zooplankton diversity.

Table-1: Zooplankton diversity found in Song River at two different stations

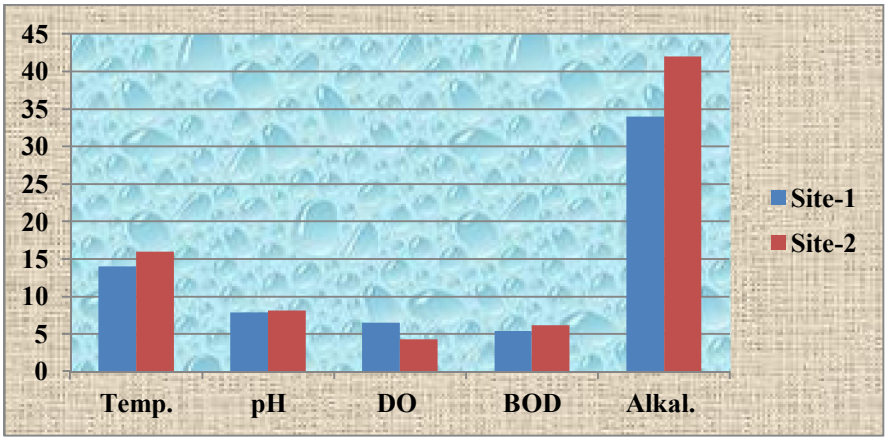
S. N.	Name of Zooplankton	Site-1	Site-2
Protozoa			
1.	*Arcella discoides*	P	P
2.	*Difflugia*	P	A
3.	*Paramecium caudatum*	P	P
4.	*P. multimicronucleatum*	P	P
5.	*P. aurelia*	P	P
Rotifera			
6.	*Brachionus calyciflorus*	P	A
7.	*B. plicatilis*	A	P
8.	*Asphlanchna brightwelli*	P	P
9.	*Stentor sp*	P	P
10.	*Rotararia sp.*	P	P
11.	*Philodina sp.*	P	P
Cladocera			
12.	*Daphnia pulex*	P	A
13.	*Bosmia sp.*	P	P
14.	*Ceriodaphnia sp.*	P	P
15.	*Chydorus sp.*	P	P
Copepoda			
16.	*Nauplius larva*	P	A
17.	Macrocyclops ater	P	P
18.	Senecella calanoidea	P	P
19.	*Cyclops*	P	P
20.	Limnocalanus macrurus	P	P



Graph-1: Showing Zooplankton diversity of Song River, Dehradun

Table-2: Water Quality of Song River at two different stations

Parameters	Site-I	Site-II
Colour	Clear	Clear
Smell	Odourless	Odourless
Temperature (^{0}C)	14-25	16-27
Turbidity (NTU)	53-900	89-1000
pH	7.90	8.10
DO (mg/l)	6.50	4.30
BOD (mg/l)	5.4	6.2
Alkalinity (mg/l)	34	42



Graph-2: Showing variation in Physico-chemical parameters of Song River, Dehradun

Arcella discoides *Brachionus sp.* *Cyclops*
Daphnia sp. *Difflugia sp.* *Nauplius Larva*

Brachionus calyciflorus *Paramecium sp.*

Fig-1: Microscopic photographs of zooplankton diversity of Song River

4. Discussion:

Zooplankton are microscopic and they can be a great tool to analyze the health status of any aquatic ecosystem. Environmental factors and their correlation with environmental factors are discussed below:

Arcella discoides which belongs to phylum protozoa and easily identified with testate amoeba, organic test, with lobose pseudopodia emerging from central basal aperture. The shell is yellow or brown, circular, and has shallow conical aboral region with basal border or collar. The whole of the shell surface appears to have small pores. Diameter of test 83-124 microns, depth 23-30 microns and diameter of aperture 21-48 microns. Arcella discoides showed positive correlation with dissolved oxygen and negative correlation with turbidity, BOD and showed no correlation with alkalinity, calcium. *Difflugia* is one of the several genera of amoebozoa that produce shells or tests from granules of sand. These are swallowed by the cell and during the process of budding or fission they pass into the daughter, where they are joined by organic cement. The test has a single terminal opening. Difflugia are particularly common in marshes. The *Difflugia* use pseudopods to move around. It is a heterotroph and it engulfs its food. *Paramecium* is a unicellular ciliate protozoon, which is common studied as a representative of the ciliate group. Paramecium easily identified with presence of hair like structure i.e. cilia. Three species of Paramecium (caudatum, aurelia and multimicronucleatum) identified with cilia, oral grooves. Multimicronucleatum species showed 4-5 micronuclei. There is also deep oral groove containing inconspicuous tongue like compound oral cilia used to draw food inside. They generally fed on bacteria and other small cells. This makes them heterotrophs. They are relatively large animals and can easily be seen with a medium- power microscope. Rotifers such as *Brachionus calyciflorus* are favoured test animals in aquatic toxicology because of their sensitivity to most toxicants. Copepods are a group of small crustaceans found in the sea and nearly every fresh water habitat. Some species are planktonic, some are benthic, and some continental species may live in limno-terrestrial habitats and other wet terrestrial places, swamps, under leaf fall wet forests, bogs, springs, ephemeral ponds and puddles etc. Nauplius larvae swim with the help of three pairs of extremities. The foremost two pairs develop first into antennae. The third pair became components of the upper jaw (mandibles). In the middle of the frontal area of the carapace the Nauplius eye is situated. *Nauplius* larvae are usually quite distinct with their triangular shape, long frontal-lateral horns and usually an outgrowth that projects backwards.

Daphnia are small and ranges between 0.2 and 5 mm in length. Daphnia are members of the order Cladocera, and are one of the several small aquatic crustaceans commonly called water fleas because of their saltatory swimming style. They live in various aquatic environments ranging from acidic swamps to freshwater lakes, ponds, streams and rivers **(Bhadula and Joshi, 2012)**. Daphnia also serves as good water quality indicator. Water sample collected from the same two stations. The average analyzed experiment value obtained. The pH of water was found to be slightly alkaline. During the present study, pH ranged from 7.91 to 8.12. The pH was thus within acceptable range. pH range was found maximum at station II and minimum at Station I. Temperature recorded at Station I was 14-25°c and at Station II it was 16-27°C. Similarly, **Bhadula *et. al.*** (2013), studied the physico-chemical parameters of Sahashtradhara stream and described that anthropogenic activities are responsible for water quality degradation. Zooplanktons are the microscopic and free-swimming animals and also regarded as primary consumer of aquatic ecosystems. They provide main food to fishes. Some of the Physico-chemical factors like dissolved oxygen, temperature; turbidity showed their relation with another and their seasonal fluctuation effect the distribution of zooplankton and other aquatic animals **(Bhadula and Joshi, 2012**). Similarly, **Bisht et. al (2013)** studied on water pollution effect on fishes and described that physico-chemical parameters are responsible for distribution, abundance and density of

ichthyofauna. **Bisht et. al. (1989)** also described similar types of results. If we conclude the study we can state that physic-chemical parameters of water play very important role in the distribution of zooplankton diversity of aquatic ecosystem.

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