Environment Conservation Journal 16(3) 127-131, 2015
ISSN 0972-3099 (Print) 2278-5124 (Online)
Abstracted and Indexed

Seasonal variations in physico-chemical parameters of River Beas, Himachal Pradesh with special reference to planktonic population

Ashok Kumar[1], D.R. Khanna [2] and R. Bhutiani[2]✉

Received:25.06.2015 **Accepted: 12.09.2015**

Abstract

The present communication highlights the seasonal abundance and fluctuations trends of planktonic population of River Beas in relation to its physico-chemical parameters. Plankton plays an important role for maintaining the productivity of the water body. Plankton refers to microscopic aquatic plant having little or no resistant to water current and living free floating and suspended in open or pelagic water. Present investigation revealed the presence of Bacillariophyceae, Chlorophyceae, Rodophyceae and Cyanophyceae among phytoplankton groups and Copepods followed by Rotifers, Protozoans, and Cladocerans among Zooplankton. A total of 26 phytoplankton genera were encountered with most dominant being Closteridium, Schroederia, Ulothrix, Closteriopsis, Gomphonema and Batrachospermum. Maximum population of phytoplankton was observed during winter season where as minimum was observed in rainy season.

Key Words: Physico-chemical, phytoplankton, River Beas, seasonal variation, zooplankton

Introduction

The Beas is the principal river of Himachal Pradesh and has also great importance for the neighboring state. The river has also a large impact on the quality of aquatic ecosystem as a consequence of its water penetrating into lakes and canals waters. The river serves important functions such as the supply of drinking water, irrigation and drainage of human wastes, furthermore this is vital as water sports route like rafting, kike etc.. The five main rivers viz., Beas, Satluj, Ravi, Chenab and Yamuna have their catchments in Himachal Pradesh. These rivers rise in the Himalayas and have perennial source of water being fed by snow during summer. Except, for the Yamuna, the other rivers meet the Indus, falling in the Arbanian sea. The river Beas originates from southern slope of Rohtang pass (Beas Kund) at an elevation of 4062 m (msl). This river while fulfilling the thirst of many local travelers also quenches the thirst of the fields of Punjab and Pakistan before flowing into the Arabian Sea. The river receives a number of tributaries both on right and left banks during its downward, drift of over 470 km. Its principal tributaries are Solang, Manalsu, Sujjain, Fojal and Sarvari on the right bank and Allain, Chhaki, Parbati, Tirthan and Sainj on the left bank. Out of its total length, a stretch of 60 km. between Manali and Bhunter is chosen for study. Till date, limited work has been done on the ecology of river Beas. Khan and Tandon (1941) reported the reappearance of trout food in trout water in Kullu valley. Sehgal (1973) conducted survey of fisheries of Himachal Pradesh with special reference to trout, mahseer and allied species. Shah (1975) reported the food and feeding habits of brown trout in river Beas. Dhanze and Dhanze (1998) reported impact of habitat shrinkage of fish fauna of river Beas due to drainage system. Dhanze, (2002) studied water quality analysis of Hill streams in Himachal Pradesh with focus on mahseer fishery. Various aspects related to water quality of different Rivers in India and its tributaries have been studied by various researchers (Khanna et al. 2006; Khanna et al., 2007; Khanna et al, 2005; Khanna et al., 2012; Singh *et. al.* (2012); Yadav *et al.* (2013); Khanna et al. 2013; Bhutiani et al. 2015; Bhutiani and Khanna 2015a; Bhutiani and Khanna 2016). Observations were therefore made with an objective to study the seasonal variation in physico-chemical parameters

Author's Address
[1] Environment, Health, Safety & Social Division
LNJ Bhilwara Group- ADHPL, Manali District Kullu (H.P.)
[2] Department of Zoology and Environmental Science
Gurukula Kangri University, Haridwar
E-mail: rbhutiani@gmail.com

in relation to plankton population in upper stretches of the river Beas.

Materials and Methods

The physico-chemical parameters of water of the river Beas viz. water temperature, air temperature, pH, turbidity, dissolved oxygen, total alkalinity were analyzed fortnightly following APHA (1998) and Khanna and Bhutiani (2007). Due to shallow depth, stony bottom and fast current, the transparency was measured by bright pin head method (Saha *et al.,* 1971). Hydrogen ion concentration of water was determined by digital pH meter. For dissolved oxygen, unmodified Winkler's method was adopted (Welch, 1948), while carbonate and bicarbonate (total alkalinity) were determined by titration method with N/50 Sulphuric acid using phenolphthalein and methyl orange as indicators.The plankton were collected monthly from pre-selected sites of the river, by enclosing one square meter of river bed with square-meshed cloth (256 mesh cm^{-2}). The samples were collected and fixed with Lugol's solution (1.0 ml/0.1water). Qualitative and quantitative studies were carried out after following the works of Edmondson (1959), Needham and Needham (1962), Pennak (1978) and Tonapi (1980). The estimation of phytoplankton population was made by 'numerical method'. The species composition of phytoplankton was done group-wise, genera-wise and where ever possible, species wise.

Results and Discussion

The physico-chemical parameters investigated in the river Beas includes water temperature, transparency, dissolved oxygen and total alkalinity Monthly variations in physico-chemical parameters of river water are shown in Fig. 1.The plankton concentration in general was poor in the hilly rivers due to faster current. The average number of total plankton (Phytoplankton and Zooplankton) encountered during the period of study was 185 units/litre. The maximum plankton population was observed in the month of February whereas minimum plankton was observed in the month of August. The phytoplankton contributed 92% during the study period the cycle of standing crop of plankton indicated that February was the peak during the investigation period. Their yearly average number was 91.8% (169.9 units/lts). Monthly fluctuation of phytoplankton in the river Beas during the year 2011-12 is shown in fig.2. Phytoplankton were comprised of members of *Bacillariophyceae, Chlorophyceae, Rodophyceae* and *Cyanophyceae.* Qualitatively the algal flora of the river was largely composed of *Chlorophyceae,* as the dominant group followed by *Bacillariophyceae* and *Cyanophyceae* and *Rodophyceae* was placed fourth in order of abundance but quantitatively *Bacillariophyceae* took the lead during most of period of investigation. In case of diatoms belonging to *Bacillariophyceae*, *Gomphonema, Cymbella*, *Cyclotella*, *Navicula*, *Synedra* and *Amphora* were dominant. *Chlorophyceae* group was mainly represented by *Schroederia, Closteridium, Ulothrix, Clostoriopis, Selenastrum, Microspora,* and *Actinastrum* etc. in order of abundance. *Rodophyceae* group was represented by two genera viz., *Lemanea and Batrachospermum*. Among blue-green algae (*Cyanophyceae*) *Microcystis* were found. Various groups of phytoplankton of river Beas were abundant during the winter season this may be due to low temperature, low water velocity and low turbidity in winter months and these provide favourable condition for the growth of plankton and other biotic communities. On the other hand, zooplankton population increased with the increase of the temperature i.e. a direct co-relationship exists between copepods development and temperature. The same has been observed by Kofoid, 1903; Allen, 1920; Griffith, 1955 and Bhutiani and Khanna, 2015. The average contribution of Zooplankton in total planktonic fauna was 8%. Zooplankton was represented by four groups namely, Copepoda, Rotifera, Protozoa, and Cladocera. The whole year commuted mean was 15.08 units/litre. The minimum value of zooplankton was 6.0% while the maximum value was 30.0% in total plankton production. Maximum of zooplankton was recorded i.e. in June of the investigation period. Monthly fluctuation of zooplankton in the river Beas during the year 2011-12 is shown in fig.2. The taxonomic analysis of phytoplankton revealed the presence 26 genera. Out of these, 6 (Six) genera belonged to *Bacillariophyceae,* 17 (Seventeen) genera to *Chlorophyceae,* 2 (Two) genera to *Rodophyceae* and 1 (One) *Cyanophyceae*. The *Chlorophyceae*

had the maximum representation with 15 genera followed by *Bacillariophyceae* with 6 genera. With respect to the total number of individuals of the contributory genera, an overall dominance was shown by the diatom followed by green algae. Phytoplankton dominated over zooplankton in all the sites irrespective of seasons. The maximum phytoplankton population was observed in winter

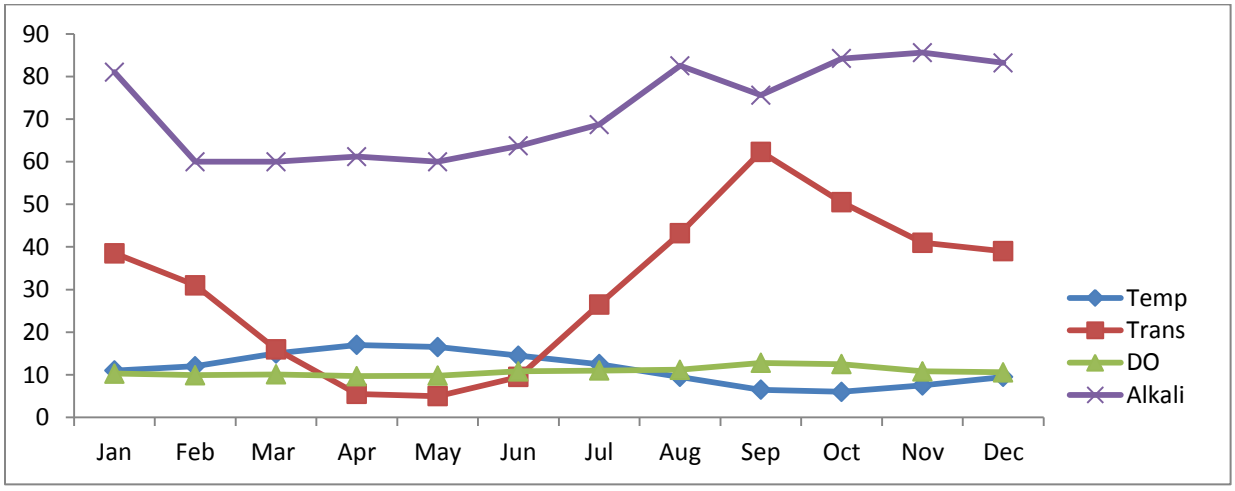

Fig. 1 Monthly fluctuations in Physico-Chemical factors (average) in River Beas during 2011-2012.

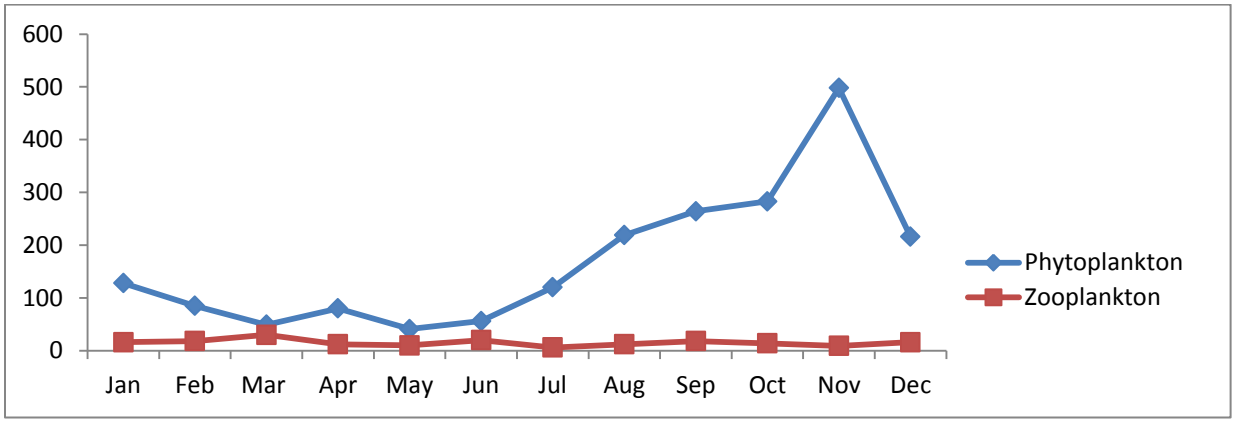

Fig. 2 Month wise fluctuation (number (u)*10/litre) of plankton in River Beas during 2011-2012.

months at all sites, it may be inferred that with the decrease in the water temperature planktonic growth is increased. During these months, values of dissolved oxygen were observed maximum at all the sites, thus promoting the planktonic population. Similar trend was observed in case of alkalinity, where maximum values were reported during winter months when planktonic growth was maximum and the minima in the river were during August when the streams carry floods. Similar observations were observed by Kumar & Bhagat, 1978, while studying on ecology of two trout streams in Kashmir, Joshi et al. (1993) in river Bhagirthi, Agarwal and Thapliyal (2005) in Bhilangana river, Khanna et al. (2006) in Suswa River, Khanna and Bhutiani (2005) in River Ganga, Bhutiani et al. (2009) and Khanna et al. (2009) conclude that maximum fauna density in winter and minima in monsoon season.

Thus in the present study water temperature, dissolved oxygen, and alkalinity appears to be prime factors in determining the total plankton density and has a direct influence on the planktonic

growth while pH, have no link with the planktonic growth.

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