Environment Conservation Journal 7 (1-2) 55-58, 2006
(ISSN 0972-3099)

Impact Of River Flow Regulation On The Planktonic Population In Ganga River At Rishikesh (Uttaranchal)

K.S. Negi, D.S. Malik and P.K. Bharti
Department of Zoology and Environmental Science
Gurukula Kangri University, Hardwar (India).

Abstract

Biological monitoring is an essential element to assess the environmental health of aquatic biotopes. Any stress imposed in aquatic ecosystem manifests its impact on the inhabitant communities and result in restructuring the present biotic components. The present study is an effort to assess the impact of damming of river water on the physico-chemical characteristics and their relations to planktonic population of Ganga river. Results indicated remarkable changes in some physico-chemical factors in upstream and downstream of Ganga river at Pashulok barrage. Rich planktonic concentration were observed as 1273.67 ± 598.124 and 1184.25 ± 588.724 units/l in the upstream and downstream section respectively. Phytoplankton always dominated (88.4 to 91.7%) over zooplankton and mainly constituted by Bacillariophyceae (65.07-78.95%) followed by Chlorophyceae (25.34-17.14%) in Ganga river.

Key Words *: Plankton, Ganga river, Pashulok barrage, Bacillariophyceae*

Introduction

Uttaranchal have included 2700 km. of rivers and their tributaries, which receives water from melting snow in higher peaks and rainfall in the lower altitudes. Most rivers of the state are dammed or regulated for power generation, irrigation and domestic uses for the water. One of them Chilla Hydroelectric Power Project on the river Ganga extends over a stretch of 20 km. between Rishikesh and Hardwar. The Pashulok barrage at Veerbhadra (Rishikesh) dammed the water and a large amount of water have diverted into the chilla canal and only little amount of water flows in the mainstream of the Ganga river (Negi, 2002). Due to reduction in water discharge, the temperature of water has affected and the current velocity and other abiotic parameters of river have also changed. Such changes affect the population of plankton and ultimately reduce the population of primary consumer and herbivore animals in the riverine ecosystem.The present paper describes the correlation between certain physico-chemical factors and planktonic population of river Ganga in upstream and down-stream section of Pashulok barrage at Rishikesh.

Materials and Methods

The Rishikesh is a township of district Dehradun located in the foothills of Shiwalik Himalaya at 365 m asl. (Long. 78^0 19' E and Lat. 30^0 06' N). Two sites covering upstream and downstream of Pashulok barrage were selected for sampling at monthly intervals over a period of 2000-2002. The physical and chemical parameters selected for the study were analysed following the standard methods (Adoni, 1985 and APHA, 1995). For river plankton, 50 liter of water sample was filtered randomly through the plankton net (25 No.) and preserved in 1 ml. Lugol's solution. The planktonic density was studied with the help of Lackey (1938) and Edmondson (1974).

Results and Discussion

The results of physico-chemical parameters of upstream and downstream section of Ganga river are given in Table 1 and the average quantitative analysis and percentage of different groups among phytoplankton are

shown in Table 2 and Table 3 respectively.The planktonic life of any aquatic ecosystem is directly influenced by the conditions existing in its ambient environment. The physico-chemical parameters of a river have a direct linkage on its planktonic communities. In the present study average annual water temperature ranged between 16.93- 17.32^{0}C observed in the upstream and downstream section of Ganga river, which is favorable for planktonic growth in any aquatic ecosystem. Similar thermal regime (12.0-19.8^{0}C) observed by Sharma (1968) in river Bhagirathi around Tehri, while Das and Srivastava (1959) pointed out the role of temperature as limiting factor for phytoplanktonic production in the riverine ecosystem.Velocity and transparency directly affects the planktonic number in the river. Higher velocity and low transparency in rainy season obscure the sun light penetration to deep water and reduce the photosynthetic activity. In the present study planktonic population were inversely proportional to velocity but show reverse relationship with transparency which have supported by Allen (1920) and Berner (1951). Similarly Khanna (1993) and Khanna and Singh (2000) observed high plankton peak during winter months when water velocity was lowest and transparency was higher in Ganga and Suswa river respectively.

The average value of total solids and total dissolved solids were recorded 282.85-284.05 mg/l and 84.77-85.55 mg/l in both section of Ganga river. According to Welch (1948) TDS vary quantitatively in different waters depending upon the season, locations and other factors. pH of water is an important factor for plankton production, pH range from 7.2 to 8.5 is favorable for growth of plankton (Das, 1961). In the present study pH of Ganga river analysed 7.43-7.85 in both section. Moitra and Bhattacharya (1965) have stated that high pH coincided with phytoplankton peak and low with zooplankton. Rao *et al*. (1993) also reported that presence of myxophyceae is related with high level of pH and water temperature.

Due to photosynthetic and respiratory activity of biota, the dissolved oxygen and free CO_2 were inversely related in both the sites of Ganga river, which was early reported by Badola and Singh (1981) and Bhowmick and Singh (1985) in different lotic ecosystem. The average value of free CO_2 and DO ranged between 1.58-2.33 mg/l and 8.17-9.52 mg/l respectively. The high level of DO shows good sign of planktonic communities in the system which have supported by Khanna *et al*. (1998) and reported that DO content usually correlated with the abundance of phytoplankton in Ganga river.

The present study reveals that both sites have few common characteristics as the high value of total alkalinity (74.03-75.70 mg/l) which show highly productive nature of water. Moyle (1946) considered that alkalinity above 48 ppm is a good sign of productivity. Hardness is the property of water and the natural source are sedimentary rocks, seepage and runoff water from soils. While the chloride concentration might be attributed to the increased discharge of domestic waste and sewage which is the main source of chloride, rainfall also contributed to the chloride level in water. Most of the water gets chloride, when it flows through the area where salt is deposited (Gondave, 1985).

The present study revealed that the phytoplanktonic population constituted the bulk contribution 88.4 to 91.7% of total plankton assemblages. The total standing crop of phytoplankton in the river 1168.58 ± 538.581 units/l in upstream and 1046.50 ± 520.522 units/l in downstream of barrage. The important genera encountered were *Acnanthes, Nitzchia, Synedra, Diatoma, Naviculla, Tabellaria, Cocconeis* and *Cymbella* among Bacillariophyceae; *Spirogyra, Zygnema, Ulothrix, Cladophora, Schizogonium* and *Chlorella* among Chlorophyceae and *Anabena, Oscillatoria, Spirulina* and *Rivularia* among Myxophyceae. Bacillarophyceae group was the most dominant group (65.07-78.95%) among the total phytoplankton, which have also supported by Khanna *et al*. (1993) and Joshi *et al*. (1996) in the similar water body. In the present observation shows Bacillariophyceae, Chlorophyceae and Myxophyceae are the principle constituents of phytoplankton and are found in decreasing trend in the Ganga river.

References

Adoni, A.D. 1985: *Work Book on Limnology*. Pratibha Publishers, Sagar, M.P. pp: 215.

Allen, W.E. 1920: A quantitative and statistical study of the plankton of the San Joaquin river and its tributaries in and near Stockton California 1913, ***Univ. Calif. Publ.*** *Zool*. 22(1): 1-124.

APHA 1995: *Standard methods for examination of water and waste water*. American Public Health Association, New York, Washington D.C. pp: 1193.

Badola, S.P. and Singh H.R. 1981: Hydrobiology of the river Alaknanda of Garhwal Himalaya. ***Indian J. Ecol***. 8: 269-276.

Barner, L.M. 1951: Limnology of the lower Missouri river. ***Ecology*** 32: 1-12.

Bhowmick, B.N. and Singh, A.K. 1985: Phytoplankton population in relation to physico-chemical factors of river Ganga at Patna. ***Indian J. Ecol***. 12(2): 360-364.

Das, S.M. 1961: ***Nature***, 20, Porte South, 4-Crinan Street, London.

Das, S.M. and Srivastava, V.K.1959: ***Proc. Nat. Acad. Sci. India***, 29: 174.

Edmondson, W.T. 1974: A simplified method of counting phytoplankton. In: *A manual on methods for measuring primary producers in aquatic environment*. (R.A. Vollen Weeider Ed.). Oxford Blackwell Sci. Pub. pp: 14-16.

Gondave, E.S. 1985: *Supply of chloride in ground water*. 2nd World Congress on Engg. And Environment 7-9, New Delhi.

Joshi, T.N., Joshi, B.D. and Singh, R. 1996 : A report on the diurnal variations of some eco-biological parameters of Kalpanigad (Distt. Pithoragarh, U.P.). ***Him. J. Env. Zool***. 10: 78-82.

Khanna, D.R. 1993: *Ecology and Pollution of Ganga river*. Asish Publishing House, New Delhi. pp: 1-241.

Khanna, D.R. and Singh, R.K. 2000: Seasonal fluctuation in plankton of Suswa river at Raiwala (Dehradun). ***Env. Cons. J***. 1 (2&3): 89-92.

Khanna, D.R., Malik, D.S. and Rana, D.S. 1998: Phytoplanktonic communities in relation to certain physico-chemical parameters of Ganga canal at Hardwar. ***Him. J. Env. Zool***., 12: 193-197.

Khanna, D.R., Badola, S.P., Dobriyal, A.K. and Singh, H.R. 1993: Observations on temporal trends in diatomic diversity in river Ganga at Saptsarovar, Hardwar. In: *Recent trends of Researches in Coldwater Fisheries* (K.L. Sehgal Ed.) Today and Tommorow Printers and Publishers, New Delhi, India. pp: 335.

Lackey, J.B. 1938: The manipulation and counting of river plankton and changes in some oganisms due to formalin preservation. *US Public Health Reports*, 50 : 2080-2093.

Moitra, S.K. and Bhattacharya, B.K 1965: ***Ichthyologica***, IV: 7.

Moyle, J.B. 1946: Some indices of lake productivity. ***Trans Amer. Fish. Soc***. 76: 322-334.

Negi, Kamal Singh 2002: *Impact of barrage on the biology of mahseer in river Ganga at Rishikesh*. Ph.D. Thesis submitted in Gurukula Kangri University, Hardwar. pp: 159.

Rao, V.N.R., Mohan, R, Hariprasad, V. and Ramasubhamanian, R. 1993: Seasonal dynamics of physico-chemical factors in a tropical high altitude lake in relation to phytoplankton. ***J. Environ. Biol***. 14(1): 63-75.

Sharma, R.C. 1986: Effect of physico-chemical factors on benthic fauna of Bhagirathi river of Garhwal Himalaya. ***Indian J. Ecol***. 13(1): 133-137.

Welch, E.B. 1948: *Limnology*. McGraw Hill Book Company Inc., London. pp: 588.

Table 1: Physico-chemical characteristics of Ganga river in upstream and downstream section of Pashulok barrage.

Sl.No.	Parameters	Upstream	Downstream
1	Water Temperature (^{0}C)	16.93 ± 4.175	17.32 ± 4.282
2	Transparency (%)	60.75 ± 29.749	53.63 ± 27.596
3	Water Current (m/sec)	0.54 ± 0.301	1.12 ± 0.635
4	Total Solids (mg/l)	282.85 ± 163.159	284.05 ± 167.272
5	Total Dissolved Solids (mg/l)	84.77 ± 30.756	85.55 ± 39.375
6	pH	7.43 ± 0.610	7.85 ± 0.241
7	Free Carbon Dioxide (mg/l)	2.33 ± 0.976	1.58 ± 0.842
8	Dissolved Oxygen (mg/l)	8.17 ± 1.479	9.52 ± 1.206
9	Total Hardness (mg/l)	74.03 ± 8.781	75.70 ± 9.206
10	Total Alkalinity (mg/l)	80.46 ± 13.790	83.87 ± 13.776
11	Chlorides (mg/l)	13.50 ± 2.493	14.29 ± 2.918

Table 2: Quantitative analysis of planktonic population of the Ganga river.

Sl.No	Parameters	Upstream	Downstream
1.	Phytoplankton (nos./ml)	1168.58 ± 538.581	1046.50 ± 520.522
2.	Zooplankton (nos./ml)	106.75 ± 64.962	137.75 ± 74.291
3.	Total Plankton (nos./ml)	1273.67 ± 598.124	1184.25 ± 588.724

Table 3: Number and percentage of different groups among the phytoplankton of Ganga river in upstream and downstream section of Pashulok barrage at Rishikesh.

S.No.	Group	Upstream		Downstream	
		Density (units/l)	%age	Density (units/l)	%age
1.	Bacillariophyceae	760.42 ± 330.406	65.07	826.25 ± 348.951	78.95
2.	Chlorophyceae	296.08 ± 135.640	25.34	179.42 ± 143.794	17.14
3.	Myxophyceae	111.75 ± 92.153	9.56	40.83 ± 33.017	3.90