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Analysis of Physico-Chemical and Biological Parameters of Different Water Bodies of Doon Valley

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ABSTRACT:

The present study is focused on the diversity of biotic / plankton components (phytoplankton and zooplankton) and a correlation with water quality parameters. The objectives of this study are 1) Estimation of Physiochemical parameters of different sites. 2) Quantification of Zooplankton and Phytoplankton of different sites. 3) Comparative analysis of biotic (Planktons) and abiotic (Physico-chemical) parameters of different sites. During the study, survey application was done for sampling water and planktons. Analysis of water and identification of planktons was done in the College laboratory with the help of standard methods and Keys & Catalogues respectively. For the analysis of water different parameters like Temperature, pH, Conductivity, DO, CO_2, Alkalinity and Hardness were considered. When a relationship between plankton diversity and physico-chemical parameters of water was made, it was found that physical parameter *i.e.*, temperature and chemical parameter *i.e.*, alkalinity had good effect on the quantitative abundance of planktons. Chemical parameters, such as pH and hardness showed negative relation with the growth of planktons.

Keywords: Physico-Chemical Parameters, Phytoplankton and Zooplankton

I. INTRODUCTION

Freshwater considered to be the most important component of earth. To describe best quality of water its physic, chemical and biological parameters is used. Water maintains an ecological balance between various groups of living organisms and their environment (Khanna *et al.*, 2012). The physical and chemical characteristics of water bodies affect the species composition, abundance, productivity and physiological conditions of aquatic organisms. Biological assessment is a significant alternative for assessing the ecological quality of aquatic ecosystems since biological communities integrate the environmental effects of water chemistry of falls and hill streams (Stevenson and Pan, 1999). Phytoplantons are considered to be very sensitive towards the environment where they live and any changes in the environment may leads to alteration in species habit and their habitat (Amarsinghe and Viverberg, 2002; Elliott *et al.*, 2002). In waterfalls, a great variation in the composition of plankton occurred not only in different regions on different depths but also at different periodically time scales and seasons. The present studies covered the quantitative and qualitative differences in phytoplankton population of all the three sites and indicate that nutrient composition influences phytoplankton inhabitant of the water. It is also expected that maximum variation in phytoplankton and zooplankton density is influenced by physicochemical factors.

REVIEW OF LITERATURE

The study of physical and chemical characteristics of water provides a considerable insight into the quality of water present in the waterfalls. The increasing concentration of various chemicals generating from the industries and their subsequent release to their surroundings as well as the domestic water released into the waterfalls raised a wide spread and increasing public concern over their adverse effects on human health and environment. Phytoplankton is one of the most essential characteristics of the aquatic ecosystem for maintaining its stability and a means of coping with any environmental change (Hambright and Zohary, 2000). Over the last few decades, there has been much interest in the processes influencing the development of phytoplankton communities, primarily in relation to physico-chemical factors (Akbay *et al.*, 1999; Peerapornpisal *et al.*, 1999). Several qualitative observations and reports are available on both lotic and lentic aquatic ecosystems, especially in Garhwal region of Himalaya. Such ecological studies have been initiated for the last one and half decades in the Himalayan streams, which have global importance to biological productivity in relation to biodiversity (Nautiyal 1986; Dobriyal and Singh 1989; Ormerod *et al.*, 1997; Pathani and Mahar 2006; Bhutiani and Khanna 2007; Malik and Bharti, 2012; Ishaq *et al*., 2013 and Negi *et al*., 2013). But still lacunae exist between the

diversity of biotic components and a correlation with water quality in various waterfalls. This present approach is also an attempt in estimating quantification of phyto and zoo planktons.

I. METHODOLOGY

STUDY AREA

The present study has been performed at the following 4 location *viz.*, Gularghati, Lacchiwala A brief description of each site is being presented as under –

METHODS

Sampling and Analysis of water:

The water samples from waterfalls of Doon valley were collected from three different sites namely (Tapkeshwar, Lacchiwala and Sahastradhara). Water and plankton samples (phytoplankton and zooplankton) were collected monthly from April 2019 to March 2020 between 9:00 - 11:00 am from each site throughout the study period. The collected water samples were brought to the laboratory immediately after the collection for the examination of different water parameters including Temperatue, pH, DO, TDS, Hardness and Alkalinity. The parameters were analyzed at the time of sample collection using sample kit and in the laboratory by the help of titration method (APHA, 1988 and Trivedi and Goel, 1986). During the sampling of water, ten liters of water from each sites was filtered through plankton net (Mesh size No. 20) to get the planktons and preserved immediately in 100 ml. plastic bottle by using 4% formalin. Preserved algal samples were scanned under microscope and identified. Phytoplankton species composition was examined from preserved water sample in acid Lugol's solution. The phytoplanktons were made identified following Alfred *et al*. (1973) Tonapi (1980) and Edmondson (1992). Phytoplankton data was also analyzed by statistical approaches like mean and standard deviation (SD). Different algal groups counted separately by using Sedgwick-rafter cell and Lacky's drop method. Pearson correlation coefficient (r) was calculated using standard statistical software packages (Microsoft-Excel).

Estimation of Planktons

1) Sedgewick Rafter Cell Method

2) Lacky's Drop method

Table 1 : Average (Mean ± SD) physico-chemical parameters of water.

Study sites	Physico-chemical parameters of water						
	Temperature (°C)	pH	Conductivity (µmho/cm)	DO mg./l	CO_2 mg./l	Alkalinity mg./l	Hardness mg./l
Lacchiwala	17.42 ± 3.72	7.74 ± 0.39	0.79 ± 0.04	44.78 ± 0.018	19.76 ± 0.23	180.60 ± 1.08	216 ± 8.94
Tapkeshwar	17.22 ±3.48	7.28 ± 0.31	0.45 ± 0.03	41.93 ±0.32	15.66 ± 0.18	175.8 ± 1.10	254 ± 8.94
Sahastradhara	18.51 ± 1.05	7.64 ± 0.23	0.83 ± 0.01	42.5 ± 0.3	17.57 ± 0.28	193.4 ± 1.36	246 ± 5.47

Table 2: Pearson correlation coefficient between physico-chemical parameters.

	Temperature (°C)	pH	Conductivity (µmho/cm)	DO mg./l	CO_2 mg./l	Alkalinity mg./l	Hardness mg./l
Temperature	1						
pH	0.133	1					
Conductivity	0.676	0.125	1				
DO	-0.030	-0.365	0.650	1			
CO_2	0.134	0.236	0.808	0.814	1		
Alkalinity	0.802	-0.362	0.793	0.486	0.353	1	
Hardness	0.126	-0.127	-0.640	-0.863	-0.96	-0.184	1

RESULTS

Physico-chemical composition of water

Analysed chemical parameters of water samples of the selected waterfalls have been shown in Table 1. Table 2 shows the Mean ± SD of the chemical parameters of water samples collected from all the 3 sites. Highest temperature was recorded in the water of Sahastradhara (18.51±1.05), followed by Tapkeshwar (17.42 ± 3.72) and Lacchiwala (17.22 ±3.48). The water of Tapkeshwar showed highest pH *i.e.*, 7.74 ± 0.3, 7.64 ± 0.23 (Sahastradhara) and 7.28 ± 0.31 (Lacchiwala). Conductivity was found highest in water of Sahastradhara (0.83 ± 0.01) and least in water of Tapkeshwar (0.45 ± 0.03). Dissolved oxygen (DO) was found in the range of 41.9 to 44.78 and found highest in water of Lacchiwala (44.78 ± 0.018) and lowest in Tapkeshwar (41.93 ±0.32). Dissolved carbon dioxide (CO_2) was found highest in water of Lacchiwala (19.76 ± 0.23), followed by Sahastradhara (17.57 ± 0.28), and least in Tapkeshwar (15.66 ± 0.18).

Relation between chemical parameters

Karl Pearson correlation (r-values) calculated for the quantification of relationship between various physical and chemical parameters (Table 3) revealed that the temperature was significantly positively correlated with conductivity and alkalinity ($r = 0.67$, $p > 0.01$) and ($r = 0.8$, $p > 0.01$) respectively. DO was negatively correlated with temperature ($r = -0.03$, $p > 0.01$). conductivity was also significantly positively correlated with DO, CO_2 and alkalinity ($r = 0.65$, $p > 0.01$; $r = 0.8$, $p > 0.01$; $r = 0.79$, $p > 0.01$). TDS was negatively correlated with hardness ($r = -0.64$, $p > 0.01$). DO was positively correlated with CO_2 and alkalinity ($r = 81$, $p > 0.01$ and $r = 48$, $p > 0.01$). CO_2 was also positively correlated with alkalinity ($r = 0.35$, $p > 0.01$ and $r = -0.96$, $p > 0.01$) and but negatively correlated with hardness ($r = -0.96$, $p > 0.01$). And also alkalinity was negatively correlated with hardness ($r = -0.18$, $p > 0.01$).

Table 3: Pearson correlation between physico-chemical parameters and plankton diversity.

Biotic / Planktons	Physico-chemical Parameters						
	Temperature (°C)	pH	Conductivity (µmho/cm)	DO mg./l	CO_2 mg./l	Alkalinity mg./l	Hardness mg./l
Chlorophyceae	0.942	-0.095	0.446	-0.179	-0.164	0.771	0.397
Bacillariophyceae	0.909	-0.207	0.787	0.325	0.290	0.977	-0.081
Cynophyceae	0.480	-0.468	0.815	0.825	0.615	0.892	-0.539
Protozoa	0.236	0.682	0.709	0.419	0.868	0.138	-0.768
Rotifera	0.364	-0.859	0.336	0.477	0.007	0.787	0.016
Crustacea	0.444	-0.701	0.612	0.694	0.335	0.888	-0.282

Pearson correlation coefficient (r values) calculated between physico-chemical variables and Plankton population was done and shown in Table 3. The physical parameter temperature showed positive correlation with the diversity of all plankton. Highest correlation was found with Chlorophyceae ($r = 0.942$, $p > 0.01$) and Bacillariophyceae ($r = 0.909$, $p > 0.01$). pH showed negative correlation with all the groups except Protozoa ($r = 0.682$, $p > 0.01$). The parameter conductivity showed positive correlation with all the groups of planktons but with Cynophyceae and Bacillariophyceae showed highest significant positive correlation ($r = 0.815$, $p > 0.01$) and ($r = 0.787$, $p > 0.01$) respectively. Dissolved oxygen also showed positive correlation with all the groups of plankton except Chlorophyceae ($r = -0.179$, $p > 0.01$) and highest positive correlation with Cynophyceae ($r = 0.825$, $p > 0.01$). Carbondioxide also showed positive correlation with abundance of major groups of planktons except Chlorophyceae. All the plankton groups showed positive correlation with alkalinity of water but significant correlation was found with Bacillariophyceae ($r = 0.977$, $p > 0.01$) and Cynophyceae ($r = 0.892$, $p > 0.01$). Major groups showed negative correlation with hardness of water except Chlorophyceae ($r = 0.397$, $p > 0.01$) and Rotifera ($r = 0.016$, $p > 0.01$).

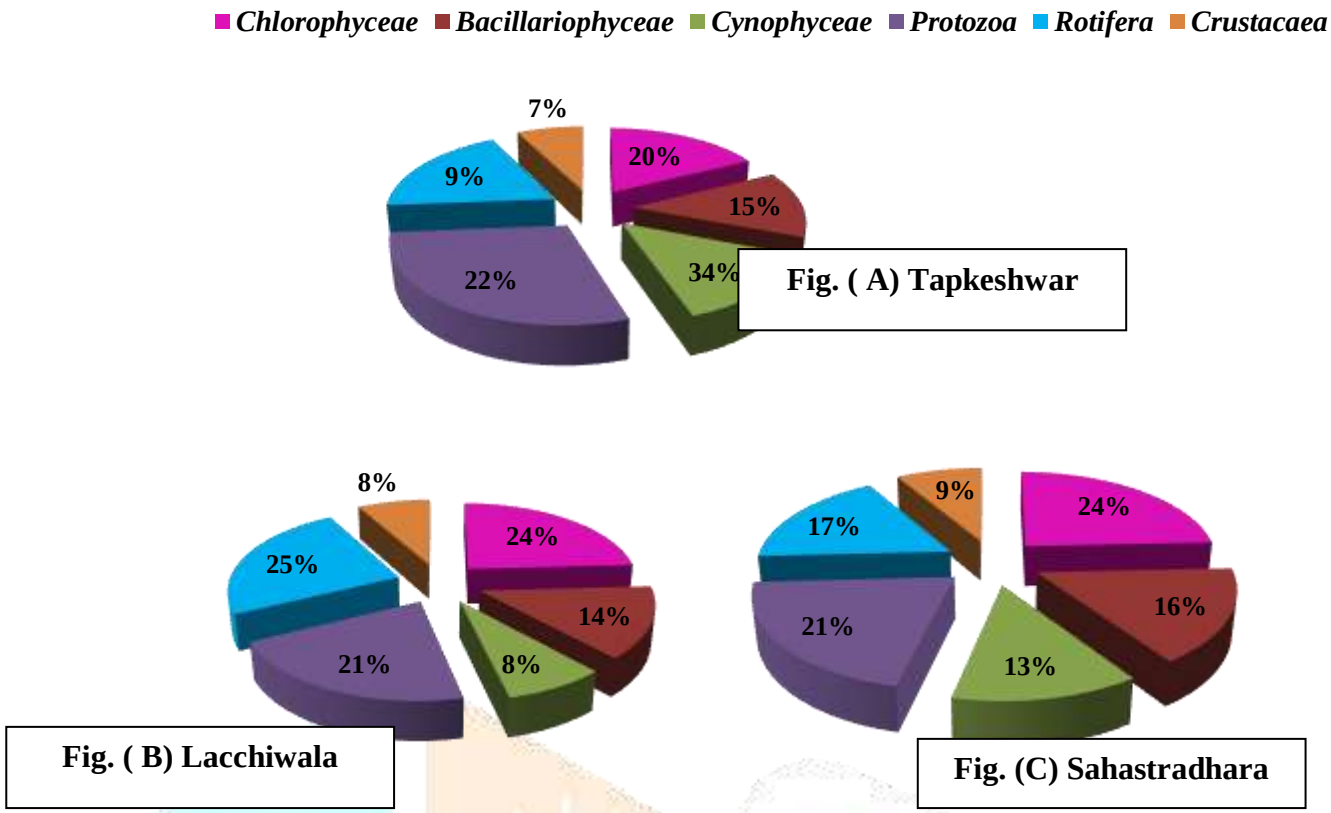

Fig1(a-c): Showing the plankton diversity in selected waterfalls during the study period.

DISSCUSSION

Regarding the biological parameters of freshwater habitat the present study found little bit similar Khanna et al. 2000, 2006. Similary Fauzia Ishaq and Amir Khan (2013) have performed the comparative study of the physico-chemical condition and the plankton diversity of the River Ton and revealed that water quality of river Tons was fairly good for the growth and survival of phytoplankton, and as a result it sustains the higher phytoplankton diversity of Tons river. The alarming deterioration has been observed by them in their monitored perimeters, the Asan River was observed more contaminated as compared to the Tons river in some extend. The species diversity of the river also observed as high depleting tendency occurred. Present study also found related with Gagan Mata and bhutani in 2010 who studied the Water Quality characteristics of River Tons at District- Dehradun, Uttarakhand (India) and explained that Dissolved oxygen is the only parameters that shoed highest value in summer seasons and least in winter season. On the other hand DO showed reversed pattern by reveling maximum values in winter which may be due to higher solubility of oxygen at lower ambient temperature. Physicochemical variables such as water temperature, Dissolved oxygen, nutrients influence community structure and functions of aquatic organisms. According to Unni and Pawar, 2000 different studied have been reported regarding the positive correlation between spwecifc groups of phytoplanktons. Similary Bhade et al. (2001) recorded positive correlations between phytoplanktons and hardness of different freshwater ecosystem. In the present study the parameters like temperature, velocity, pH and D.O have direct impact on the growth of biotic communities. However the other physico-chemical variables have a direct as well as indirect effect on the biological diversity.

CONCLUSION

The overall results of the present study indicate that the all the three study sites showed good conditions of physico-chemical parameters that lead a healthy ecosystem. When relationship between plankton diversity and physico-chemical parameters of water is made, it was found that temperature (physical) and alkalinity (chemical) have good effect on the quantitative abundance of planktons. Chemical parameters like pH and hardness showed negative relation with the growth of planktons.

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REFERENCES

Akbay, N., Anul, N., Yerti, S., Soyupak, S. and Yurteri, C. (1999): Seasonal distribution of large phytoplankton in Keban dam reservoir. *Plank. Res*., 21(4): 771-787.

Alfred, J.R.B., Bricice, S., Issac, M.L., Michael, R.G., Rajendran, M., Royan, J.P., Sumitra, V. and Wycliffe, J. (1973): A guide to the study of freshwater organisms. *J. Madras. Univ. Suppl.*, 1: 103-151.

Amarsinghe, B.P. and Viverberg, J. (2002): Primary production in a tropical reservoir in Sri Lanka. *Hydrobiologia*, 487: 85-93.

APHA (1998): *Standard methods for the examination of water and waste water*, 20th Ed., Washington D.C. New York.

Bhade, C., Unni, K. S. and Bhade, S. (2001): Limnology andEutrophication of Tawa Reservoir, M.P. State, India, Verh.Internat. Verein. Limnol., 27:3632-3635

Bhutiani, R. and Khanna, D.R. (2007): Ecological study of river Suswa: modeling DO and BOD. *Environ. Monit. Assess.*,125:183-195.

Dobriyal, A.K. and Singh, H.R. (1989): Observation on temporal trends of phytoplankton diversity in the river Nayar of Garhwal Himalaya. *J. Fresh water Biol*., 1:1-6.

Edmondson, W. T. (1992): Fresh water biology second edition, pp.1248.

Elliott, J.A., Irish, A.E. and Reynolds, C.S. (2002): Predicting the spatial dominance of phytoplankton in light limited and incompletely mixed eutrophic water column using the PROTECH model. *Fresh. Bio*., 47: 433-440.

Fauzia, I., Khanna., D. R. and Amir Khan (2013): Physico-chemical and Phytoplanktonic characteristics of river Tons at Dehradun (Uttarakhand), India. Journal of Applied and Natural Science 5 (2): 465-474.

Hambright, K.D. and Zohary, T. (2000): Phytoplankton species diversity control through competitive Exclusion and physical disturbances. *Limnol. Oceanogr*., 45(1): 110-122.

Ishaq, F., Khanna, D.R. and Khan, A. (2013): Physico-chemical and phytoplankton characteristics of river Tons at Dehradun (Uttarakhand), India. *J. Appl. & Natural Sci.*, 5(2): 465-474.

Khanna, D.R. and Fouzia Ishaq (2012): Analysis of Heavy Metals and their interrelationship with some water quality parameters of River Yamuna in Dehradun, Uttarakhand. *Biochem. Cell. Arch*., 12(2): 273-280.

Khanna, D.R., Pathak, S.K., Bhutiani, R. and Chandra, K.S. 2006.Study of water quality of river Suswa near Raiwala, Uttaranchal.Env. Cons. J. 7(3): 79-84.

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

Malik, D.S. and Bharti, U. (2012).Status of plankton diversity and biological productivity of Sahastradhara stream at Uttarakhand, India. *J. Appl. & Natural Sci*., 4(1): 96-103.

Nautiyal, P. (1986). Studies on the riverine ecology of the torrential waters in Indian uplands of Garhwal region- Floristic faunistic survey. *Trop. Ecol.*, 27:157-165.

Negi, R.K.., Yadav, N. and Vishnoi, V. (2013): Phytoplankton diversity of some selected streams of Dehradun district of Uttarakhand state. *Biolife*, 1(4): 165-170.

Ormerod, S. J., Baral, H. S., Brewin, P. A., Buckton, S. T., Juttner, I., Rothfritz, H. and Suren, A.M. (1997): River habitat surveys and biodiversity in the Nepal Himalaya. In: *Freshwater Quality: Defining the Indefinable*, Boon P. J. & Howell, D. L. eds. HMSO, Edinburgh. pp.640.

Pathani, S. S. and Mahar, S. (2006): A study of population of plankton in the river Suyal of Uttranchal, India. *Flora and Fauna*, 11(2): 250-256.

Peerapornpisal, Y., Sonthichai, W., Somdee, T., Mulsin, P. and Rott, E. (1999): Water quality and phytoplankton in the Mae Kuang Udomtara Reservoir, Chiang Mai, Thailand. *J. Sci. Fac. Cmu*., 26(1): 25-43.

Stevenson, R.J. and Pan, Y. (1999): Assessing environmental conditions in Rivers and streams using diatoms, In: Stoermer, E. F. and Smol, J. P. (eds.) *The diatoms. Applications for the environmental and earth sciences*, Cambridge University Press, Cambridge. pp. 11 – 40.

Tonapi, G.T. (1980): *Fresh water animals of India: an ecological approaches*. Oxford & IBH, pp. 341.

Trivedi, R.K. and Goel, P.K. (1986): Chemical and Biological method for water pollution studies. Karad Environmental Publications, 1-251.

Unni, K. S. and Pawar, S. (2000): The phytoplankton along a pollution gradient in the river Mahanadi (M. P. State) India-a multivariable approach. Hydrobiologia, 430: 87-96.

Whitton, B.A. and Patts, M. (2000). *The Ecology of Cyanobacteria*. Kluwer Academic Publishers, Netherlands.