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RESEARCH ARTICLE

LIMNOLOGICAL PROFILE OF A HIGH ALTITUDE STREAM, BISHLERI OF BANIHAL OF JAMMU AND KASHMIR, INDIA

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ABSTRACT

The present investigation was carried out from January 2011 to December 2011 for Bishleri stream of Banihal, to study the physico-chemical properties of water for assessment of its quality. This stream is one of the feeding channels of mighty river Chenab. The stream was characterized by variant temperature differentiation (4.41 ^{o}C to 22.83 ^{o}C), high DO (4.46 to 8.40 mg/l), alkalinity (HCO_3^- 56.93 to 104.10mg/l), less FCO_2 conc.(1.6 to 5.5 mg/l), less Cl^- concentration (4.6 to 8.5 mg/l), and hard water body having Ca^{2+} (13.06 to23.70 mg/l) and Mg^{2+} (14.09 to 25.66 mg/l) which is an indication of favorable environment for growth and sustainability of specific species.

INTRODUCTION

The physical and chemical characteristics of fresh water bodies are determined by their climatic, geochemical, pollution and geomorphological conditions. A relatively smaller portion of the earth's surface is occupied by fresh water as compared to marine and terrestrial habitats but their importance to man is far greater. The increased population growth, agriculture and industrial development, building construction has increased the demand of water and thereby has forced the environmentalists to determine the physical, chemical and biological characteristics of natural waters. In order to preserve and protect the natural ecosystem, it is essential to analyze the water quality. Water quality deals with the physical, chemical and biological characteristics in relation to all other hydrological properties (Shinde *et al*, 2010). Water quality is being degraded due to the increasing anthropogenic influences in and around aquatic system and thereby deteriorating the water bodies. Lakes, rivers and streams are the sources of drinking water, irrigation fishery and energy production (Iscen *et al*, 2008).

Almost all the fresh water bodies are being polluted by expanding human population and in consequence, industrialization, intensive agricultural practices and discharges of massive amount of waste water etc. which results in deterioration of water quality(Sinha1986).The physico-chemical parameters such as temp, pH and DO of water are affected by pollution and meteorological events. These parameters in turn influence the biochemical reactions that occur within the water. Changes in these parameters indicate the changing water condition. The physico-chemical factors influence the biological productivity of water body. The present account is therefore an attempt to study detailed information on some important physico-chemical parameters of Bishleri stream of Banihal so as to utilize it successfully for fish production.

MATERIALS AND METHODS

Study area

The present investigation was conducted for a period of one year (January 2011 to December 2011) for Bishleri stream to study the various physico- chemical characteristics of the stream. This stream originates from Zaban which is about 7500 feet above main sea level and lies close to a significant southern mountain range of state viz Pirpanchal range. The stream extends up to battery chashma near digdol where it merges with river Chenab. This stream is one of the major feeding channels of the mighty river Chenab. Bishleri stream falls in district Ramban of J&K state. J&K state comprise of the following seasons: summer (May – mid July), monsoon

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(Mid July – September), autumn (September-October), winter (December – February) and spring (March –April).

Estimation of physico- chemical parameters

The seasonal variation of the physico-chemical parameters of water were studied from January 2011 to December 2011. Monthly samples of water were collected from the six selected sites. Some of the basic physical and chemical parameters like (Air and water temperature, depth, DO, pH and FCO_2) were determined at the sampling sites while others were analyzed in the laboratory. Utmost care was taken to avoid spilling of water and bubbling of air during sampling in iodine treated polythene bottles.

The air and water temperature were recorded using mercury bulb thermometer, depth by meter rod, transparency by Secchi disc, pH of water was determined by using pH meter (Hanna, model HI 98130). Dissolved oxygen of water was determined by sodium azide modification of Winkler's method, free carbon dioxide of water was estimated using titrimetric method (Adoni, 1985 and APHA, 1985). Bicarbonates were determined using Indian standard method and (APHA, 1985) Agrometric method using potassium chromate as indicator was used for estimation of chloride content of water sample. Calcium and magnesium was estimated using EDTA method (Adoni, APHA, 1985).

RESULTS

Seasonal fluctuations of the physico-chemical characteristics of Bishleri stream are summarized in Table-1 and their graphical representation is shown from Fig. A to J. The Physico-chemical parameters depicted a varied range in their values throughout the investigative period. During the present study from Jan. 2011 to Dec. 2011, the mean values of the atmospheric temperature were found to vary between 9.6 ^{0}C to 30.5 ^{0}C. Similar trend was followed by water temperature showing its maxima (22.83 ^{0}C) in summers and minima (4.41^{0}C) in winters. Maximum water depth (143 cm) was recorded in monsoon and winters and minimum (28.33cm) in summers. pH of water remained alkaline throughout the year and ranged from 7.40 to 7.93 . The value of DO fluctuated from 4.46 mg/l (minima) to 8.40 mg/l (maxima). Free carbondioxide showedits maximum value of 5.5 mg/l in summers and minimum 1.6mg/l in winters. The value of bicarbonates ranged from 56.93 mg/l to 104.10 mg/l. Chloride content of the presently studied stream varied from 4.60 mg/l to 8.5 mg/l showing their peak in summers and fall in winters.

The values of calcium and magnesium followed the same trend showing maximum concentration in summers and minimum in winters. Calcium concentration fluctuated from 13.06 mg/l to 23.7 mg/l whereas the concentration of Magnesium varies from 14.09 mg/l to 25.66 mg/l. The range of variation, mean and standard deviation of different physico-chemical parameters are given in Table 2

Table2 Range of variation, Mean and Standard deviation of physico- chemical parameters of Bishleri stream for the year 2011

Parameters	Range of variance		Mean and standard deviation
	Minima	Maxima	
Air temp.	9.6	30.5	20.78 ± 6.06
Water temp.	4.41	22.83	14.64 ± 6.08
Depth	28.33	143	69.85 ± 31.37
pH	7.4	7.93	7.65 ± 0.14
DO	4.46	8.4	6.37 ± 1.09
FCO_2	1.6	5.5	3.28 ±1.06
HCO_3^-	56.93	104.1	75.01 ± 13.37
Ca^{2+}	13.06	23.70	18.43 ± 3.10
Mg^{2+}	14.09	25.66	19.28 ± 3.55
Cl-	4.60	8.50	6.2 ± 1.13

Table3 Summary Analysed Parameters and WHO Guideline Levels

S.No	Parameters	Units	Minimum	Maximum	WHO level	ICMR levels
1	Temperature	0_C	4.41	20.5	.	.
2	pH	-	7.4	7.93	6.5- 9.2	7.0- 8.5
3	DO	mg/l	4.46	8.4	4.0	-
4	FCO_2	mg/l	1.6	5.5	-	-
5	HCO_3	mg/l	56.93	104.1	-	-
6	Cl^-	mg/l	4.5	8.5	250- 600	200
7	Ca^{2+}	mg/l	13.06	23.7	100	75
8	Mg^{2+}	mg/l	14.09	25.66	30-150	50

DISCUSSIONS

The physico-chemical characteristics provide a fair idea of the water quality in any water body.

Temperature

Temperature is significant for the influence it enforces on the chemical and biological reactions taking place in water and aquatic organisms (Shrivastava and Patil, 2002). Temperature fluctuations are dependent upon the season, time of sampling and also upon the temperature of effluents which are being added into the river. The low air temperature was recorded in winters in the month of December (9.6 ^{0}C) and higher values were recorded in the month of July (30.5 ^{0}C) in summers. Variation in water temperature closely followed air temperature and varied between 4.41 ^{0}C (December) to 22.83 ^{0}C (July),

Table1 Mean values of physico-chemical parameters of Bishleri stream during the year 2011**.**

Parameters	units	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Air temp.	℃	11.83	13.00	20.33	21.75	24.66	26.50	30.50	24.83	24.66	20.33	21.33	9.60
Water temp.	℃	6.16	9.30	11.33	14.16	17.00	20.50	22.83	24.58	18.83	14.00	12.60	4.41
Depth	cm	58.00	64.83	104	143	83.5	79.8	94.16	42.33	28.33	37.33	46.83	56.16
pH	-	7.46	7.53	7.58	7.65	7.71	7.93	7.8	7.78	7.75	7.63	7.58	7.4
DO	mg/l	8.4	7.6	7.1	6.5	6.03	4.96	4.46	5.4	5.7	6.2	6.8	7.33
FCO_2	mg/l	1.8	2.8	3	3.5	4.0	4.3	5.5	4.1	3.5	3.0	2.3	1.6
CO_3^{2-}	mg/l	0	0	0	0	0	0	0	0	0	0	0	0
HCO_3^-	mg/l	75.23	72.79	58.56	63.44	56.93	64.25	72.38	77.26	76.45	86.21	92.60	104.1
Ca^{2+}	mg/l	17.86	18.93	15.46	15.20	15.60	13.06	17.33	20.13	20.00	21.90	22.00	23.70
Mg^{2+}	mg/l	21.70	20.65	14.82	14.82	14.09	15.46	20.00	19.40	20.32	21.22	23.32	25.66
Cl^-	mg/l	5.6	4.6	5.3	5.6	6.1	7.3	8.5	7.8	7.0	6.0	5.5	5.1

these variations in temperature may be attributed to shorter day length and decreased atmospheric temperature (Baba,2004; Sawhney, 2004; Shafiq, 2004).

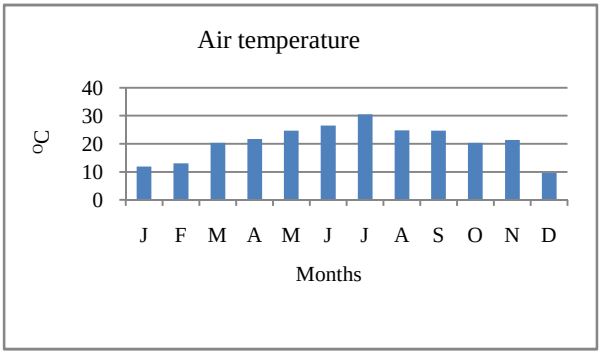

Fig. A Seasonal variation of air temperature

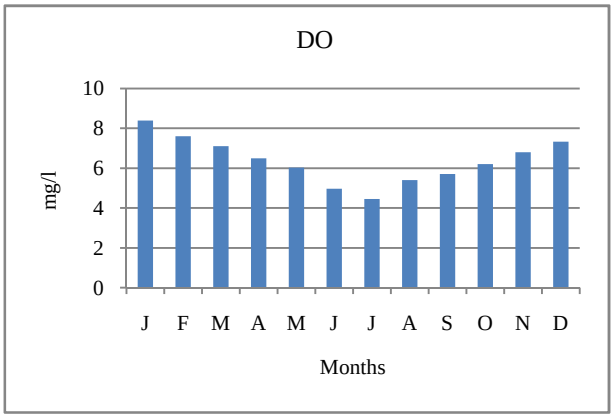

Fig. B Seasonal variation of dissolved oxygen

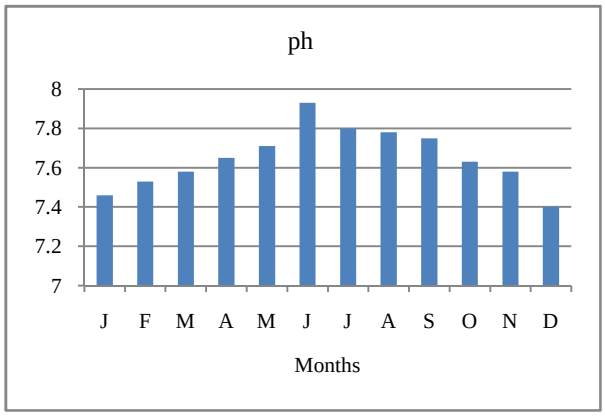

Fig.C. seasonal variation of Ph

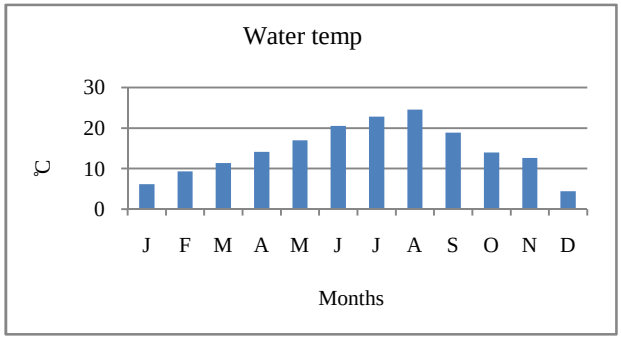

Fig. D Seasonal variation of water temperature.

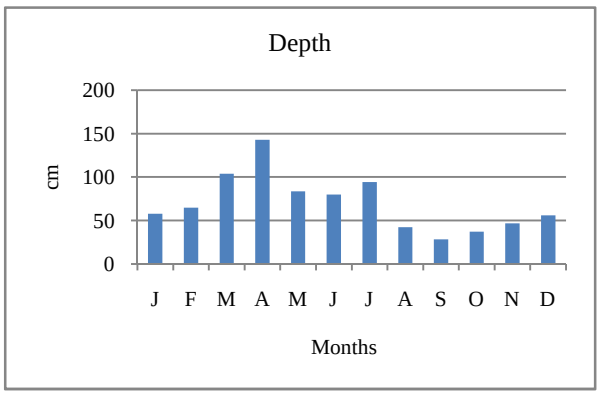

Fig.E. Seasonal variation in water depth.

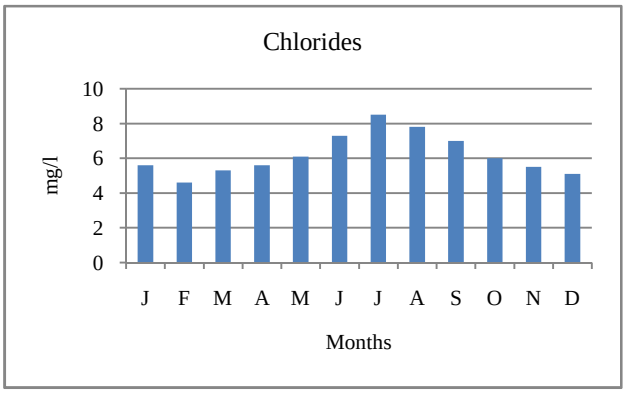

Fig. F Seasonal variation in chlorides.

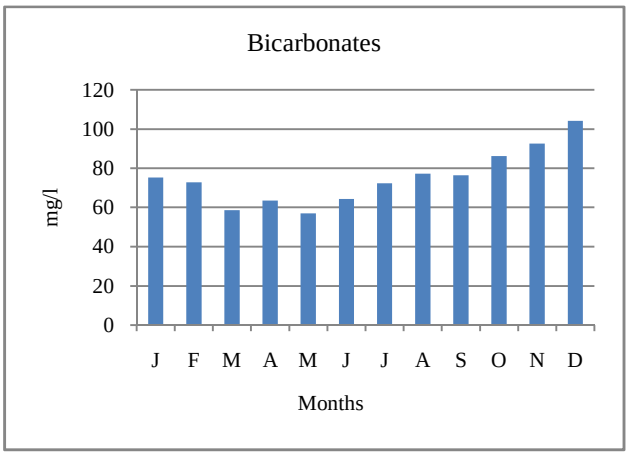

Fig. G. Seasonal variation in bicarbonates.

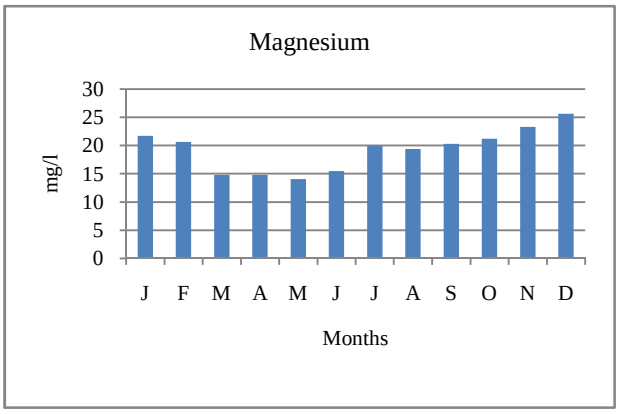

Fig.H. Seasonal variation in Magnesium.

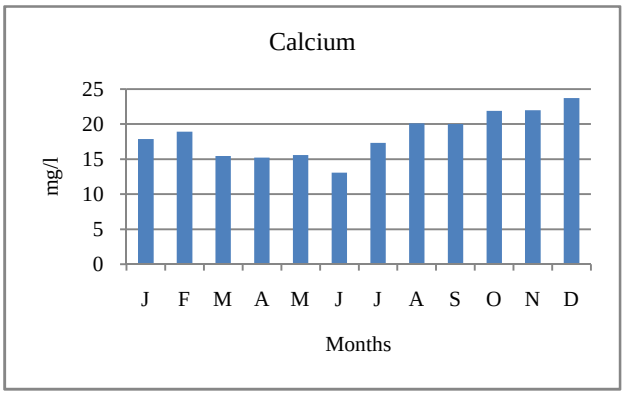

Fig I. Seasonal variation in calcium.

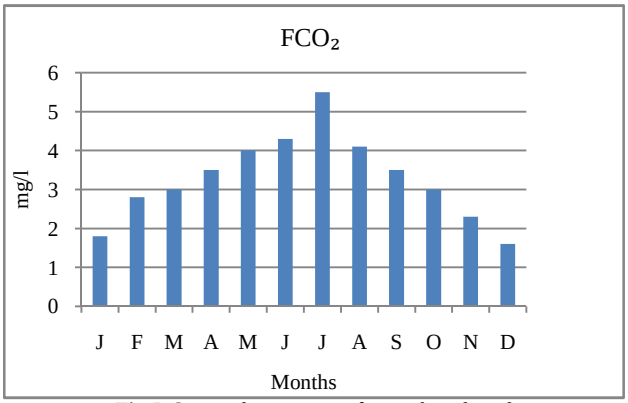

Fig J. Seasonal variation in free carbon dioxide.

Fig: A-J Showing seasonal dynamics of different physico-chemical parameters of Bishleri stream of Banihal.

Depth

Water depth has important bearing on the physico-chemical properties of water. Depth is the minimum vertical distance between the surface and underlying bottom of the water body at any point. Water depth was observed to vary between 28.33 cm. to 143 cm. seasonally; water depth depicted an initial increase from January to April due to melting of snow at higher altitudes (Qadri and Shah, 1984). And later increase in July may be due to monsoon rains (Dutta, 1978; Sehgal, 1980; Malhotra *et al*, 1986; Puri, 1989; Sharma, 1984; Sunil, 1990; Veena, 1990; Kumar, 1990).

pH

pH controls the chemical state of many nutrient including dissolved oxygen, phosphate, nitrate etc. (Goldman and Horne, 1983) pH regulates most of the biochemical reactions and biological processes (Verma *et al*, 2006). The values of pH showed a decrease in winters and slight increase in summers which may be due to decreased photosynthetic activity in the rivers and shorter day length (Salve and Hiware, 2006). The low pH in winters may be due to heavy rainfall and dilution effect (Agarkar and Garode, 2001; Shiddamallayya and Pratima, 2008).

Dissolved oxygen

Dissolved oxygen is one of the most important parameters of water quality, directly affecting survival and distributing flora and fauna in an ecosystem. The maximum values of DO were observed in the month of December (8.40 mg/l) and minimum in the month of July (4.46 mg/l). The high concentration of dissolved oxygen during winter may be because of low biological activities (Vass *et al.* 1977; Qadri *et al.*1981). Further, the higher level of DO in winter as compared to summer could possibly be linked with its miscibility with water at low temperature because of enhancement in gas retaining capacity of oxygen at lower temperature (Jhingaran, 1975; Khalaf and Mac Donald, 1975).

Free carbon dioxide

Free carbon dioxide bears an inverse relationship with dissolved oxygen and its value increased in summer season (5.5 mg/l) while decreased in winters (1.6 mg/l). Higher concentration of FCO_2 during warmer period may be due to the decomposition of organic matter utilizing dissolved oxygen and liberating carbon dioxide. Carbonates were absent at all sites during the study period.

Alkalinity

The alkalinity is usually caused by carbonates, bicarbonates and hydroxyl ions and less frequently by borates, silicates and phosphates (APHA, 1985). In the present investigative studies, the bicarbonates were present in permissible limit. Maximum bicarbonates were recorded during winters and minimum during summer season. Similar observations were recorded by Negi, 1989.A decline in alkalinity during summer may be due to an increase in volume of water by monsoon rains (Pahwa and Mehortra, 1988; Singh and Shrivastava, 1988; Kant and Raina, 1990).

Calcium and Magnesium

The presence of organic waste in water primarily of animal origin is indicated by chloride concentration (Thresh *et al.*, 1949).The chloride content was found to be high (8.50 mg/l) during summers and slightly lower (4.60 mg/l) during winters which could be due to increased temperature, sewage mixing and evaporation by water (Govindan and Sudersan,1979; Jana,1973). Chloride enrichment may also be due to addition of excreta (Dutta, 1978; Sehgal, 1980; Malhotra *et al.*, 1986). During the present studies, it was observed that chloride content was slightly higher at station I than other stations of the stream. This is probably due to anthropogenic effects at station I. Overall low value of chlorides were observed from all stations. The high concentration of chlorides is considered to be an indicative of higher pollution due to higher organic waste of animal origin.

Calcium and Magnesium

Cation of Calcium, Magnesium, Iron and Manganese contribute to hardness of water (Shrivastava and Patil, 2002). Hard waters are more productive than soft waters (Barrette, 1953). The maximum value of Calcium (23.70mg/l) was observed in winters and minimum in summers (13.06 mg/l). The maxima in winters could be due to its greater solubility at lower temperature (Basant *et al.*, 2011). Some workers hold rains responsible for increase in calcium directly or indirectly from the run off of the catchment area (Dutta, 1978; Puri,1989;

Sunil,1990;Veena,1990; Kumar,1990).Similarly Mg^{2+} concentration showed its maxima (25.66 mg/) during winters and minima (14.09 mg/l) during summers. Values of Magnesium rise in winters (Sehgal, 1980; Kumar, 1990; Wetzel, 1975; Jain *et al*, 1996).

CONCLUSION

In this study it was found that physico-chemical parameters of Bishleri stream are under the permissible limit as given by WHO and ICMR (Table-3) which indicates that these water bodies are productive and suitable for fish culture, irrigation and domestic purposes.

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