PHYSICO-CHEMICAL LIMNOLOGY OF DAGWAN STREAM IN KASHMIR

Saima Munshi and A. R.Yousuf
P.G. Department of Environmental Sciences, University of Kashmir, Srinagar-190006, J&K India

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The Dagwan Nallah (also called Telbal Stream) has its origin in the high attitude tranquil lake of Marsar and snow melt slopes of Harwan, Barzwas and Mahadeo mountains. The stream passes through the Dachigam National Park. Enroute it receives a large number of tributaries after passing through Dachigam, it enters the Dal lake on the north side at place called Hanzheeul.

Different aspects of Dachigam National Park were studied by postgraduate students of Department of Environmental Science during 2004. The present study was undertaken to understand the behavior of the stream under the impact of increasing anthropogenic pressure as it moves from Dachigam National Park towards Dal lake so that the stream could be better managed.

Four study sites were selected for the collection of data (Fig.1). First three sites were located inside the Dachigam National Park and the fourth i.e. Telebal Nallah was located outside the park. Water samples were collected from the stream by dipping one liter polyethylene bottle just below the surface of water. Temperature, depth, transparency were recorded on the spot, while analysis of other parameters were done in the laboratory within 24 hours in accordance with CSIR Pretoria (1974), Golterman and Clymo (1969), APHA (1998), Mackereth (1963).

Data regarding various physico-chemical parameters are given in Table 1.

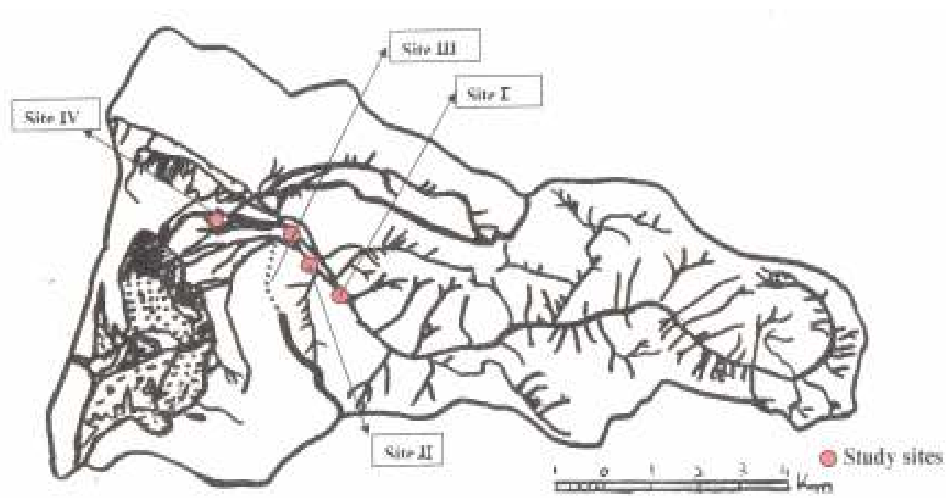

Fig.1: Map showing various study sites on Dagwan Stream

Table 1: Physico – chemical characteristics of water in Dagwan stream during June – November, 2004

Parameter	Sites	Months					
		June	July	August	Sept.	Oct	Nov.
Depth (cm)	I	32.0	53.0	40.0	42.0	30.0	34.0
	II	15.0	16.0	14.0	11.0	13.0	8.0
	III	40.0	60.0	48.0	51.0	26.0	23.0
	IV	170.0	150.0	115.0	120.0	120.0	105.0
Transparency (cm)	I	100.0	100.0	100.0	100.0	100.0	100.0
	II	100.0	100.0	100.0	100.0	100.0	100.0
	III	100.0	100.0	100.0	100.0	100.0	100.0
	IV	42.0	72.0	41.0	69.0	44.0	75.0
Air Temperature (^{0}C)	I	22.0	22.0	20.0	24.0	20.0	14.0
	II	24.0	20.0	21.0	23.0	20.0	15.0
	III	25.0	22.0	23.0	22.0	22.0	13.0
	IV	23.1	21.0	25.0	23.0	22.0	18.0
Water Temperature (^{0}C)	I	18.0	16.0	17.0	17.0	12.0	8.0
	II	20.0	17.0	19.0	18.0	13.0	7.0
	III	20.0	17.0	18.0	15.0	15.0	9.0
	IV	20.0	19.0	20.0	22.0	16.0	12.0
pH	I	7.42	8.16	7.40	7.65	7.28	8.02
	II	7.45	8.26	7.38	7.67	7.26	8.03
	III	7.38	8.14	7.42	7.51	7.29	8.05
	IV	6.84	7.95	7.20	7.20	7.14	7.91
Conductivity (µS/cm)	I	121.0	125.0	130.0	89.0	162.0	194.0
	II	124.0	126.0	134.0	93.0	153.0	172.0
	III	133.0	135.0	142.0	123.0	180.0	213.0
	IV	217.0	255.0	212.0	291.0	215.0	329.0
Dissolved Oxygen (mg/L)	I	11.6	9.8	8.4	10.4	14.2	11.2
	II	13.8	6.8	8.9	11.4	14.0	11.6
	III	10.0	7.0	9.0	8.4	11.4	12.4
	IV	6.4	6.8	5.4	4.3	5.2	6.9

Free CO_2 (mg/L)	I	2.0	4.0	4.0	4.0	6.0	11.0
	II	4.0	4.0	3.0	2.0	4.0	10.0
	III	4.0	4.0	4.0	4.0	4.0	14.0
	IV	11.0	16.0	16.0	16.0	17.0	19.0
Chloride (mg/L)	I	4.0	6.0	5.0	6.0	4.0	7.0
	II	6.0	7.0	6.0	8.0	4.0	4.0
	III	5.0	8.0	7.0	8.5	4.5	5.0
	IV	9.5	9.0	8.0	8.5	7.0	9.0
Calcium Hardness (mg/L)	I	68.0	46.2	44.0	33.6	73.5	69.3
	II	92.0	46.2	44.0	35.7	73.5	73.5
	III	74.0	65.1	60.0	37.8	81.9	77.7
	IV	103.0	84.0	80.0	105.0	96.9	126.0
Magnesium Hardness (mg/L)	I	10.0	8.8	9.0	0.4	2.5	6.7
	II	12.0	17.8	18.0	0.3	0.5	4.5
	III	9.0	0.9	4.0	5.2	9.1	2.3
	IV	17.0	32.0	30.0	21.0	11.4	12.0
Total Hardness (mg/L)	I	78.0	55.0	53.0	34.0	76.0	76.0
	II	104.0	64.0	62.0	36.0	74.0	78.0
	III	83.0	66.0	64.0	43.0	91.0	80.0
	IV	120.0	116.0	110.0	126.0	108.0	138.0
Total Alkalinity (mg/L)	I	50.0	54.0	53.0	37.0	84.0	66.0
	II	50.0	54.0	51.0	41.0	82.0	64.0
	III	50.0	49.0	48.0	36.0	96.0	74.0
	IV	90.0	92.0	90.0	140.0	110.0	119.0
Total Phosphate Phosphorus (µg/L)	I	N.O	20.0	18.0	82.0	20.0	40.0
	II	N.O	32.0	43.0	82.0	92.0	61.0
	III	N.O	35.0	45.0	82.0	43.0	49.0
	IV	N.O	50.0	64.0	85.0	101.0	82.0
Nitrate Nitrogen (µg/L)	I	466	402	204	123	471	607
	II	556	333	342	149	529	587
	III	504	295	278	124	417	382
	IV	996	492	523	129	633	666
Ammonical	I	18.0	20.0	17.0	25.0	14.0	22.0

Nitrogen (µg/L)	II	37.0	26.0	34.0	40.0	22.0	24.0
	III	15.0	46.0	38.0	42.0	21.0	19.0
	IV	45.0	83.0	52.0	58.0	32.0	30.0
Nitrite Nitrogen (µg/L)	I	N.D	7.0	N.D	11.0	13.0	2.0
	II	N.D	8.0	N.D	21.0	21.0	8.0
	III	N.D	9.0	N.D	4.0	7.1	Trace
	IV	N.D	14.0	N.D	10.0	25.0	14.0
Sodium (mg/L	I	2.0	8.0	4.0	8.0	N.D	5.0
	II	2.0	10.0	5.0	5.0	N.D	8.0
	III	2.0	8.0	4.0	5.0	N.D	10.0
	IV	9.0	15.0	11.0	26.0	N.D	26.0
Potassium (mg/L)	I	0.0	2.0	1.0	5.0	N.D	1.0
	II	0.0	2.0	2.0	6.0	N.D	1.0
	III	0.0	1.0	1.0	3.0	N.D	2.0
	IV	0.0	5.0	3.0	6.0	N.D	4.0

N.D - Not detected

There were fluctuations in water depth with an average lowest depth at site II and highest at site IV. Except at site IV water was found clear throughout the year with 100% transparency. The low transparency at site IV could be attributed to the run off from immediate neighborhood being the main contributor to the flow from the higher reaches.

The water temperature gradually increased downstream. The increase in temperature down stream may be attributed to the decrease in altitude; the air temperature subsequently affects the water temperature. Decrease in velocity also results in an increase of temperature (Imevbore, 1970).

On an average the highest concentration of dissolved oxygen (12.4mg/l) was recorded during October and the lowest (7.6mg/l) during July. The dissolved oxygen showed negative correlation with temperature.

The lowest value of DO at site IV may be due to increased amount of organic matter which needs oxygen for decomposition, a fact in agreement with the findings of Yousuf and Shah (1980).

There was increase in conductivity downstream with maximum value at site IV. The higher conductivity at site IV is due to high nutrient enrichment. Workers (Qadri *et al*., 1981, Bhat and Yousuf, 2004) also related conductively to enrichment.

Chloride content gradually increased from site I to site IV. The increase in chloride concentration downstream is an indication of growing anthropogenic pressure. The stream was found alkaline except at site IV, where often it was found less alkaline. Low pH at site IV may be due to various pollution stresses (Vasisht and Sra, 1970). Bicarbonates were responsible for imparting alkalinity. As per the classification of Moyle (1945), upstream falls under medium water type and downstream falls under hard water type. Carbon dioxide in the stream varied from 2 to 19 mg/l. The high value of free CO_2 content downstream is also indicative of high degree of pollution (Cole, 1977).

The concentration of Ca^{++} and Mg^{++} was higher as compared to other cations and the usual progression was $Ca^{++} > Mg^{++} > Na^{++} > K^{++}$. Ca^{++} and Mg^{++} content showed trends similar to that of total hardness, their concentration increased downstream. It can be related to anthropogenic interference downs-tream and sediment characteristics particularly at site IV, which is located in the neighborhood of the Dal lake mouth. Sodium and potassium, being low in upper reaches and higher in lower reaches, again shows that downstream the increase in human habitation results in the increase in their concentration.

The concentration of nitrogen compounds was in the progression of NO_3 -N >NH_3 -N> NO_2 –N. Bhat (2003) also obtained similar results. The high value of ammonical nitrogen at site IV is attributable to the decomposition which is under temperature control. The higher total phosphorus at site IV may also be related with agricultural practices, using phosphate fertilizers.

Thus, it may be concluded that Dagwan steam is unpolluted upstream while as down stream it is polluted and the main source of pollution is the sewage disposal from the catchment area.

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