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Seasonal Limnological Variation in Rakh Branch Canal, Samundri Road, Faisalabad

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Abstract: The seasonal variations of Rakh Branch canal were studied. Air and water temperature varied from 17-43 and 15-41°C, respectively. The other variables were varied as light penetration 16-29 cm, pH 7.8-8.5, electrical conductivity 0.15-1.4 dsm^{-1}, dissolved oxygen 1.9-3.4, total alkalinity 237-290, carbonates 46-80, bicarbonates 189-210, total hardness 167-237, calcium 31-44, magnesium 17-37, sodium 14-25, potassium 1.6-5.4, phosphates 0.0-0.103, nitrates 0.43-3.46, total solids 925-1178 and total dissolved solids 796-983 mg l^{-1}. Productivity based on dry weight of planktonic biomass was ranged from 111-229 mg l^{-1}. The total twenty two genera of phytoplankton and zooplankton were recorded which varied significantly during different periods of the study because of season.

Key words: Physico- chemical, biomass, phytoplankton, zooplankton

Introduction

Importance of canals, in maintaining a healthy as well as prosperous nation, a sustainable environment is amply understood from very existence of the civilization on this globe. Freshwater resources are used to meet the day-to-day requirements of human settlement, for production of hydro-power and most important of all, for agricultural, fisheries and industrial needs. Pakistan has one of the most extensive canal systems in the world. It must be recognized that in under developed and densely populated countries, which have the most pollution problems, the importance of healthy freshwater environment has increased. All the aforesaid activities are expected to have a significant impact on the water quality. The Punjab province has an extensive net work of channels which at present are not being adequately utilized or developed so for due to lack of research and other technical inputs. Research studies on the limnological aspects are of great significance in developing resources of a water body. The seasonal variations in Physico-chemical factors have a profound effect on the distribution and population density of both fauna and flora (Mahboob, 1986, 1992; Mahboob *et al.*, 1988a,b, 1992; Latif, 1990; Hassan, 1998; Mahboob and Sheri, 2001).

Singh and Pandey (1990) pointed that the population of planktonic life adversely effected in the polluted lake. They further mentioned that protozoan were unaffected by pollution. The abundance of phytoplankton and zooplankton in the freshwater bodies is greatly regulated by the physico-chemical factors (Muhlhauser *et al.*, 1995; Jersabek and Schabetsberger, 1996). This study has, therefore, been planned in order to achieve the following objectives:

1) To study the annual variations in the water chemistry and planktonic life in the Rakh branch canal in order to find its suitability for fish culture
2) to determine the effect pf various industries situated nearby canal and to know the suitability of water for drinking and agricultural purposes.

Materials and Methods

The study was carried out at Rakh branch canal, situated along the Samundri Road, Faisalabad. It comes from Chenab River and enters in the Faisalabad Division from Salarwala. The total length of Rakh branch canal is 55 miles, while the total length in the Faisalabad Division is 30 miles. Water capacity of branch is 1145 cusec. Average total depth is 6.20 feet and width of 70 feet. The water samples were colleted on monthly basis for a period of one year i.e., from December, 1995 through November, 1996. Water samples were collected from surface, column and bottom of each of the ponds (using Kemmerer). To make the samples representative, six samples were collected from each of the substations A, B, C, D, E and F mixed to have a composite sample. The samples were stored in glass bottles of one-liter capacity, fixed with chloroform and immediately taken to laboratory for analysis. Dissolved gasses, temperature and pH (at the pond site) were determined immediately after collection.

The temperature of the pond water was recorded with the help of electronic thermometer (HI-8564: Hanna) from surface, column and bottom three times a day (6 A.M; 12 and 6.0 P.M) and fortnights average was obtained while air temperature and daily light hours records were obtained from the Department of Agric. Meteorology, University of Agriculture, Faisalabad. The light penetration was determined with the help of Secchi's disc while pH and electrical conductivity of water were determined with a pH meter (Jenco-607) and conductivity meter (MC-1 Mark v) in the laboratory. The chemical factors viz., dissolved oxygen, carbon dioxide, carbonates, bicarbonates, total alkalinity, calcium, magnesium, total hardness, chlorides, orthophosphates, nitrates, ammonia, total nitrogen, total solids and total dissolved solids were estimated by following Boyd (1981). Dry weight of planktonic biomass was measured indirectly from the values of total solids and dissolved solids as described by Mahboob (1986). The data thus obtained were subjected to statistical analysis through computer for the comparison of mean values for various parameters and the significance of interactions were compared by using analysis of variance and Duncan's multiple range tests through two way-classifications. Correlation and regression analysis were also performed to find out relationships among various characteristics. M-stat and Micro-stat packages of the computers were used for the analysis.

Results and Discussion

The seasonal variations in the ecological parameters exert a profound effect on the distribution and population density of both animal and plant species (Odum, 1971). The productivity in terms of planktonic biomass in freshwater bodies is regulated by various physico-chemical factors viz., temperature, transparency, pH, electrical conductivity, total hardness, nitrates, phosphates etc. (Mahboob, 1992; Mahboob and Sheri, 2001).

The overall range of water temperature remained 15-41°C throughout the experimental period. The comparison of means showed significant differences due to months (Table 1). Hassan (1998) noted that water temperature of ponds was 2-5 °C lower than the air temperature. The difference between air and water temperature in this experiment was observed less during the months of September and October, possibly due to increase in humidity which greatly decreased the loss of heat through evaporation. The variation in water temperature at different times were probably due to surface heating during the day and cooling during night, a phenomenon commonly met within tropical water bodies as reported by Mosely (1983). The transparency values as interpreted Secchi's disc ranged from 16.38 to 29.15 cm. According to Boyd (1981) the apparent color of water is caused

Table 1: Comparison of means values for various physico-chemical factors in Rakh Branch canal, Faisalabad.

Months	W.T	L.P	pH	E.C	DO_2	CARB.	BICAR.	T.A.	Ca
December	15.00J	29.15A	7.79E	0.27B	2.07E	62.97D	196.6BC	257DE	38.87BC
January	15.50I	18.00E	7.87E	1.45A	1.87E	47.25EF	191.3BC	238G	38.60BC
February	17.50H	16.38E	8.10C	0.51B	2.05E	47.35EF	189.2C	236.6G	32.30DG
March	20.50G	19.22E	8.06C	0.22B	1.93E	46.23F	193.4BC	239.5G	35.05EF
April	23.50F	21.75DE	8.13C	0.19B	2.47D	63.18D	197.9ABC	261.1CD	38.35BC
May	31.00D	21.80CD	8.22B	0.16B	2.50D	71.35BC	199.5AB	269.2BC	40.77B
June	35.50C	29.05A	8.25B	0.15B	2.77BG	75.25AB	203.1A	277.5B	33.63EFG
July	41.00A	27.12AB	8.50A	0.20B	3.43A	79.58A	210.0AB	289.6A	36.45CDE
August	36.50B	25.87AB	8.22B	0.16B	2.95B	68.38C	198.8ABC	268.4C	31.30G
September	35.50C	24.55BC	8.10C	0.24B	2.68GD	46.82EF	194.6BC	241.5G	34.88DEF
October	26.50E	24.47BC	7.90D	0.24B	2.55CD	51.62E	198.3ABC	249.9EF	37.77BCD
November	20.50G	23.57BC	7.96D	0.22B	2.53ED	49.92EF	191.8BC	241.7FG	43.90A

Table 1 : Contuined

Months	Mg	T.H	Na	K	Phos.	Nit.	TS	TDS	Bio.
December	17.38F	166.9H	15.53CDE	1.75F	0.089AB	1.30H	925.5G	796.3E	125.8EF
January	20.63E	179.1G	19.13BCD	2.79DE	0.072ABC	2.29FG	1043.0BCD	846.3DE	197.0B
February	27.18A	229.7B	24.92A	3.38BCD	0.075ABC	2.38FG	1012.0CDE	869.5CD	142.2DEF
March	24.12D	184.4G	14.49E	1.95F	0.000D	2.97CD	1007.0CDE	825.3DE	181.8BC
April	24.30D	193.1F	13.61E	1.62F	0.037BCD	3.12BC	1010.0CDE	839.2DE	160.7CD
May	25.58CD	204.6DE	14.26E	3.25BCDE	0.040BCD	3.36AB	990.5DEF	824.7DE	182.5BC
June	31.77B	211.3D	15.10DE	4.87A	0.059ABCD	2.76DE	1095.0B	983.3A	111.5F
July	36.52A	237.4A	14.11E	2.92CDE	0.083ABC	3.46A	1058.0BC	916.0BC	142.0DEF
August	31.80B	206.0DE	19.67BC	3.90B	0.031BCD	2.14G	1178.0A	948.3AB	229.2A
September	26.90C	194.9F	16.98CDE	5.40A	0.103A	0.43I	1005.0CDE	820.5DE	184.2BC
October	27.08C	203.0E	22.23AB	3.77BC	0.031BCD	2.16G	949.0FG	802.3E	147.2DE
November	27.72C	220.8C	15.22CDE	2.47EF	0.026CD	2.52EF	983.7EF	799.5E	184.2BC

Month means with the same letter are statistically similar at $P < 0.05$

Table 2: Correlation coefficients of different physico-chemical parameters in Rakh Branch canal, Samundri Road, Faisalabad

	W.T	S.D	pH	E.C	D.O	CO_3	HCO_3	T.A	Ca	Mg	T.H	Na	K	P	Nit	T.S	T.D.S	Bio.
W.T		0.527	0.826	-0.508	0.904	0.604	0.770	0.716	-0.353	0.559	0.490	-0.239	0.627	0.118	0.120	0.562	0.604	0.529
S.D			0.238	-0.536	0.620	0.643	0.688	0.668	0.003	0.002	0.001	-0.392	0.251	0.237	-0.199	0.188	0.314	-0.568
PH				-0.511	0.779	0.661	0.701	0.723	0.38	0.743	0.689	-0.290	0.305	0.027	0.486	0.550	0.654	-0.068
E.C					-0.531	-0.432	-0.459	-0.450	0.087	-0.287	-0.294	0.352	-0.115	0.262	-0.103	0.013	-0.109	-0.218
D.O						0.694	0.817	0.771	-0.153	0.595	0.619	-0.248	0.415	0.128	0.187	0.467	0.533	-0.636
CO_3							0.886	0.985	-0.083	0.294	0.302	-0.460	0.067	0.094	0.462	0.408	0.616	-0.286
HCO3								0.949	-0.102	0.329	0.334	-0.452	0.161	0.116	0.391	0.310	0.524	-0.329
T.A									-0.113	0.337	0.339	-0.455	0.109	0.093	0.455	0.418	0.621	-0.285
Ca										-0.514	-0.154	-0.428	-0.477	0.158	-0.169	-0.616	-0.658	0.014
Mg											0.926	0.322	0.444	0.072	0.299	0.508	0.630	-0.128
T.H												0.184	0.302	0.010	0.420	0.317	0.437	-0.138
Na													0.314	0.133	-0.322	0.048	-0.018	0.060
K														0.349	-0.406	0.384	0.437	0.014
P															-0.524	-0.090	0.079	-0.511
Nit																0.201	0.287	0.688
T.S																	0.873	0.585
T.D.S																		0.183
Bio.																		

E.C = Electrical conductivity, D.O = Dissore oxygen, TA = Total alkalinity, T.S = Total solids, T.D.S = Total dissolved solids Nit = Nitrates T.H = Total hardness

by suspended matter which interferes with light penetration. He further explained that the turbidity and color of water may result from colloidal clay particles, colloidal organic matter originating from the decay of vegetation or from abundance of plankton. The transparency values in April to August remained statistically similar (Table 1). Overall these low values of transparency were possibly due to more turbidity of water which was further confirmed from the higher values of suspended matters. These results were in line with the findings of Mahboob (1992). The overall pH values showed non-significant differences among all the six stations. The pH values of 8.0 and above were observed during the period from February to September indicated that the photosynthesis activity during these months were greater than the respiratory activity. During December-January and October-November the pH was below 7.8 indicating reduced photosynthetic activity. There is a considerable difference of opinion regarding the effect of pH on phytoplankton abundance. Brezonik *et al.* (1984) mentioned that high pH values promote the growth of phytoplankton and result in blooms. On the other hand Mahboob *et al.* (1988a) argued that high pH values of ph during blooming period were the result and not the cause of phytoplankton. The latter explanation seems to be more convincing in this study.

Slow and restricted flows of stagnation favour the concentration of dissolved salts were to increase the conductance (Prather *et al.*, 1982). The conductivity values confirm the above explained phenomenon (Table 1). Dissolved oxygen of the canal showed that there were significant differences due to months (Table 1). During the period from April through August the higher dissolved oxygen contents were probably due to the effect of rain and physical aeration and high blooms of phytoplankton as reported by Mahboob *et al.* (1988b). Low dissolved oxygen contents during December to March were seemed to be the result of combined effect of high salinity of water and of decreased photosynthetic activity. Carbon dioxide remained absent through the experimental period which could be due to its higher solubility in water. Carbonates and bicarbonates were strongly correlated with each other as these showed a gradual decrease from April to July which ultimately resulted in the increase of total alkalinity. These findings were in line with the results of Ghandour *et al.* (1985).The water of this canal like most of the other freshwater bodies were

alkaline throughout the year. In this study the total alkalinity and total hardness showed the similar trend of variations with the highest values during the period from April to July. The calcium followed by magnesium, was dominant cations and bicarbonates were the dominant anions (Table 1). The concentration of calcium ranged between 31.30 to 43.90 mg l^{-1}. The comparison of means for sodium that march to July, November and December were statically similar (Table 1). These results were in line with the findings of Fouzia (1986). The concentration of potassium in this canal water varied between 1.62 to 5.39 mg l^{-1}. Analysis of variance showed that there were non-significant differences among the six stations for potassium. Sodium and potassium followed the similar trend of variations in this study. Boyd (1984) demonstrated that potassium ions not absorbed by the plants either remain in solution or participate in ion exchange reactions with sediment. The result of this experiment was in line with the findings of above worker.

A significant amount of orthophosphates was almost present throughout the experimental period. DMR test revealed that there were significant differences due to months (Table 1). The level of orthophosphates varied from time to time and it was interesting to note that these fluctuations, to significant degrees, do not seem to affect the distribution of phytoplankton species. The maximum amount of nitrates was recorded in July (Table 1) which was blooming period of phytoplankton species, especially *Microcystis* (Nazneen, 1980). It shows that, in spite of nitrate being continuously used by the algae there was still in excess amount left in water. This may be due to regeneration of nitrate in water by bacterial species and by nitrogen fixing cynophyta. These results were in accord with the findings of Mahboob *et al.* (1988b). They mentioned significant contribution of nitrates and total nitrogen towards the increase in planktonic biomass. Total solids (TS) and total dissolved solids (TDS) showed similar patterns of seasonal variations. The TS additionally contain also some suspended matters. Both TS and TDS were extremely variable throughout the period of study (Table 1).

Productivity in water is measured in many ways. Estimation of this by the dry weight of planktonic biomass has also been popular as reported by Watson and Carpenter (1974) and Mahboob *et al.* (1988b). The dry weight of planktonic biomass including the phytoplankton and zooplankton gave a vivid picture of fluctuations in productivity. The dry weight of planktonic biomass ranged from 111.5 to 229.2 mg l^{-1}. The minimum (111.5 mg l^{-1}) amount of planktonic was recoded in June immediately after a spell of heavy rain. This was perhaps due to the fact that rains generally disturbed the fauna and flora of freshwater bodies.

Correlation coefficients of physico-chemical parameters with dry weight of planktonic biomass: The dry weight of planktonic biomass was positively and significantly correlated with water temperature, dissolved oxygen and nitrates (Table 2). However, Secchi's disc penetration showed negative and significant correlation with biomass. The pH, electrical conductivity showed negative and non-significant relationship. As regards the other chemical variables like carbonates, bicarbonates, total alkalinity, calcium, magnesium, total hardness, sodium, potassium and orthophosphates with dry weight of planktonic biomass remained non-significant. While the total solids and total dissolved solids showed positive and significant relationship with biomass. The findings of this study showed that water of the Rakh canal branch found to be suitable for drinking and freshwater fish culture purposes.

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