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Impact Of Physico- Chemical Characteristics On Planktonic Diversity: A Case Study Of Jhadol Stream In Udaipur District (Rajasthan) India

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ABSTRACT : The physico-chemical parameters are essential and fundamental to know the trophic status of an aquatic ecosystem. Therefore, in the present investigation the limnological parameters and their relationship along with phytoplankton and zooplankton status in Jhadol stream in Udaipur district (Rajasthan) have been studied during the study period 2019-20.

The minimum and maximum water temperature was recorded 17.2°C to 25.3°C respectively. The water remained moderately alkaline (pH 7.7) while electrical conductance (316.2µS/cm), TDS (197.33 mg/l), chloride (0.0387mg/l), hardness (127.33 mg/l) and alkalinity (159.67 mg/l) showed low mean values. Average dissolved oxygen levels were at 7.9mg/l while average nitrate and phosphate levels were 0.154 mg/l and 0.2023 mg/l respectively. A high rate of primary production (average GPP 244.87 mgc/m2/hr and average NPP 133.13 mgc/m2/hr)was recorded. On the basis of water quality parameters in general, Jhadol stream was found to be less polluted. Diversity of phytoplankton (28 forms) and zooplankton (16 forms) were also observed during the study period.

Key Words: Physico-chemical parameters, Planktonic diversity, Jhadol stream

INTRODUCTION

Aquatic ecosystems consist of physico-chemical and biotic components. Physico-chemical parameters directly affect the biodiversity of water bodies. Seasonal study for two annual cycles was under taken to assess different physico-chemical parameters, primary production and zooplanktonic fauna of selected lentic and lotic water bodies of Southern Rajasthan. Biological production in any aquatic body gives direct correlation with its physico-chemical status which can be used as trophic status and fisheries resources

potential (Jhingran *etal*., 1965). Life in aquatic environment is largely governed by physico-chemical characteristics and their stability. These characteristics have enabled biota to develop many adaptations that improve sustained productivity and regulate lake metabolism.

The physico-chemical parameters are essential and fundamental to know the trophic status of an aquatic ecosystem. Therefore, in the present investigation the limnological parameters and their relationship along with phytoplankton and zooplankton status in Jhadol stream in Udaipur district (Rajasthan) have been studied during the study period.

Various studies on limnology of freshwater resources have been made by Sharma and Durve (1985), Chisty (2002), Gaur *et al.* (2014), Surya (2014), Verma (2015), Rajawat and Kumar(2017) Wani (2018) and Saha (2020) .

Johal *et al.* (2000) studied 13 water parameters of 23 hill streams and observed that water temperature, alkalinity, TDS, conductivity, total hardness and pH have direct influence on the fish species richness whereas chlorides, turbidity, altitude, water current have been found to be negatively correlated with the fish species richness.

The life processes depends directly or indirectly upon various physical and chemical factors. Season wise samples were collected in the year 2019-20 from Jhadol stream and the physico-chemical and biological factors which are important from limnological point of view have been studied.

MATERIALS AND METHODS:

(a) Study Area: Jhadol Stream (73°29'15"E and 24°24'15"N) is located 10 Km south east of Jhadol Village in Jhadol Tehsil of Udaipur district. It is situated on a tributary of river Wakal. It has a good catchment area. **(Plate 1)**

(b) ***Physico-chemical Analysis:***

During the study, water samples were collected at seasonal interval during 2019-20, using clean 1L-polyethylene bottle for analysis of water variables in the laboratory from preselected station of the Lake. The water quality parameters such as air and water temperature, pH, depth of visibility, alkalinity (Carbonate and bicarbonate), dissolved oxygen and primary productivity were measured in the field itself. LCD portable digital multistem thermometer of –50°C to 150°C range was used to measure water temperature, digital pH meter HANNA-pHep was used for measuring hydrogen ion concentration (pH), depth of visibility was measured by a standard Secchi disc of 20 cm diameter, Total dissolved solids were estimated by digital (Hold) TDS meter and results are expressed in ppm or mg/l. However, for the electrical conductivity, nitrate nitrogen, orthophosphate, silicates and fluorides samples were brought to laboratory inbottles of 500 ml. capacity and analyzed within 24 hours. These physico-chemical parameters were analyzed following Standard Method (APHA, 2005). Prior to this, the samples were secured in refrigerator. Conductivity was measured by 'Systronics' direct reading conductivity meter (308), ELICO ion analyser LI 126 was used for

determining fluoride ions in the water. Primary productivity was estimated using light and dark bottle method. Methods stated by (Pandey and Sharma, 2003; APHA, 2005) were followed for water analysis.

(c) Plankton Analysis:

For Plankton study, samples were collected from surface water, littoral region and bottom mud. For qualitative analysis, the plankton samples were collected by towing Hensen's standard plankton net with uniform speed. The net was made of no. 25 bolting silk. The plankton sample so collected was fixed in 70% ethyl alcohol. For quantitative estimation of the zooplankton, 50 litres of surface water was filtered through a small plankton net made up of the bolting silk number 25. Subsamples of small quantities (10 ml) were taken and counting of zooplankton was done in counting chamber under a C.Z. Inverted microscope. Zooplankton numbers were expressed as individuals per liter. Identification of zooplankton was done as per Edmondson, 1992.

RESULTS AND DISCUSSION :

Results of limnological study are summarized in Table- 1. Air temperature varied between a minimum of 19.2℃ to 34.0℃. The minimum and maximum water temperature was recorded 17.2℃ to 25.3℃ respectively. Water temperature showed maximum and minimum values in summer and winter respectively. The highest oxygen value of 8.3mg/l was observed in winter season whereas, lowest oxygen value of 7.4 mg/l was observed in Monsoon. Temperature showed a significant inverse relationship with dissolved oxygen. Such an inverse relationship has also been observed (Ranu, 2001; Chisty, 2002; Sumitra et al., 2007; Sharma, 2007).

Total alkalinity was found to fluctuate between 115mg/l to 202 mg/l. Chloride concentration varied between 0.01178 mg/l in monsoon to 0.06632 mg/l in Summer. Higher chloride concentration during the summer because high temperature and consequent evaporation. In rainy season, lower concentration of this factor due to dilution. The maximum water current of 121 cm/sec was showed in Monsson. This current slows down (21.2 cm/sec) in Summer. The conductivity was in the range of 268.4 µS/cm to 379 µS/cm. The depth of visibility varied between a minimum of 8.5 cm to a maximum of 39.7 cm. In the present study TDS ranged between 149 mg/l to 242 mg/l with lowest reading in Summer and highest during Monsoon. pH value fluctuated between 7.1 to 8.2. Nitrates concentration varied between 0.054mg/l to 0.3175mg/l. Phosphates concentration varied between a minimum of 0.0578 mg/ l in Monsoon to a maximum of 0.425 mg/l in Summer. Higher values of phosphate during summer months were also reported (Sarang, 2001and Sharma, 2007). Higher phosphate content during summer because of high temperature can evaporate water and increases concentration. In the present investigation the value of silicates ranged between 3.2876 mg/l to 5.2011 mg/l. Total hardness ranged between 94.5 mg/l to 204 mg/l during this investigation. The total hardness was high during summer, which gradually decreased in winter, the minimum values were found during monsoon season.

Trophic status of an ecosystem depends upon rate of energy flow which may be assessed by estimating primary production. Results revealed that, high peaks or maxima were observed in summer (318.9 mgc/m2/hr GPP and 178.7 mgc/m2/hr NPP) and minimum during monsoon (117.5mgc/m2/hr GPP and 49.5 mgc/m2/hr NPP). Naz et al. (2006), Sharma (2007) and Malara (2008) recorded high winter productivity in their studies on tropical freshwater bodies in comparison to summer. In the current study GPP was found to have positive correlationship with dissolved oxygen, total hardness, total alkalinity, chlorides, nitrates phosphates, silicates , NPP and respiration and negative relationship with temperature and TDS. Similar findings were observed by Gaur (2013) and Sharma et al (2011).

Diversity of phytoplankton (28 forms) and zooplankton (16 forms) were also observed during the study period.

The phytoplanktonic community of Jhadol stream was represented by six groups *viz.* Myxophyceae, Chlorophyceae, Xanthophyceae, Bacillariophyceae, Chrysophyceae and Dinophyceae (Table -2). Total 28 forms were identified, out of these 7 belonged to Myxophyceae, 7 to Chlorophyceae, 3 to Xanthophyceae, 7 to Bacillariophyceae, 1 to Chrysophyceae and 3 to Dinophyceae .

Oscillatoria sp., *Phormidium sp*., *Spirulina sp*.,*Merismopedia sp*.,*Microcystis sp*., *Nostoc sp*. and *Anabaena sp*. belonged to Myxophyceae . Chlorophyceae was represented by *Pediastrum sp*., *Scenedesmus sp*., *Panium sp*., *Ulothrix sp*., *Volvox sp*., *Closteriopsis sp*. and *Spirogyra sp*.

Trobonema sp., *Chlorobotrys sp*.and *Botryococcus sp*. represented Xanthophyceae. Bacillariophyceae was represented by *Melosira sp*., *Pinnularia sp*., *Fragillaria sp*., *Bacillaria sp*., *Nitzschia sp*., *Ophephora sp*. and *Cymbella sp*., Chrysophyceae represented by *Chromulina sp*. and Dinophyceae by *Glenidium sp*., *Ceratium sp*. and *Gymnodium sp*.

The most prominent phytoplankton during the study were *Microcystis sp*., *Anabaena sp*. *Nostoc sp*. *Spirulina sp*. and *Phormidium sp*. from group Cyanophyceae. While *Volvox sp*. *Spirogyra sp*. *Chlorella sp*. *Ulothrix sp*. and *Pediastrum sp*. from group Chlorophyceae. As evident from the study, Chlorophyceae dominated over Cyanophyceae. Baghela (2006) observed the dominance of Chlorophyceae in oligotrophic lake Jawai Dam. Sharma *et al.* (2011) also observed dominance of Chlorophyceae over Cyanophyceae in Lake Pichhola. On the contrary, Sharma (1980), Solomon (1994) and Shekhawat (1997) observed dominance of blue green algae in Udaipur waters.

During present study,Total 16 forms of zooplankton comprising of four groups, namely Protozoa , Rotifera , Cladocera and Copepoda were identified. Out of these 3 belonged to Protozoa, 3 belonged to Rotifera, 6 to Cladocera and to 4 Copepoda.

A list of zooplankton with their occurrence is given in the form of Table 3 . Zooplankton *Arcella sp.*, *Euglena sp.*, *Difflugia sp*.belonging to phylum Protozoa. Rotifera was represented by *Lepadella sp.*, *Tricocerca sp*. and *Monostyla sp.*

Among Cladocera the represented forms were *Daphnia sp., Moina sp., Bosmina sp., Pleurocus sp., Alona sp.* and *Macrothrix sp*. Copepodes included *Cyclops sp., Rhinodiaptomus sp., Heliodiaptomus sp., Eucyclops sp*.

During present study Rotifers showed dominance over Cladocerans followed by Protozoans and Copepods. These findings are supported by Sharma *et al.(*2011) in Lake Pichhola.

Anthropogenic factors like discharge of industrial, domestic and agricultural wastes are adversely affecting diversity and density of these zooplanktonic groups. The relationship between biodiversity and ecosystem functioning has recently emerged as a focused area of ecological research (Sharma *et al.* 2000).

Table-1 Season-wise Physico-chemical parameters of Jhadol Stream

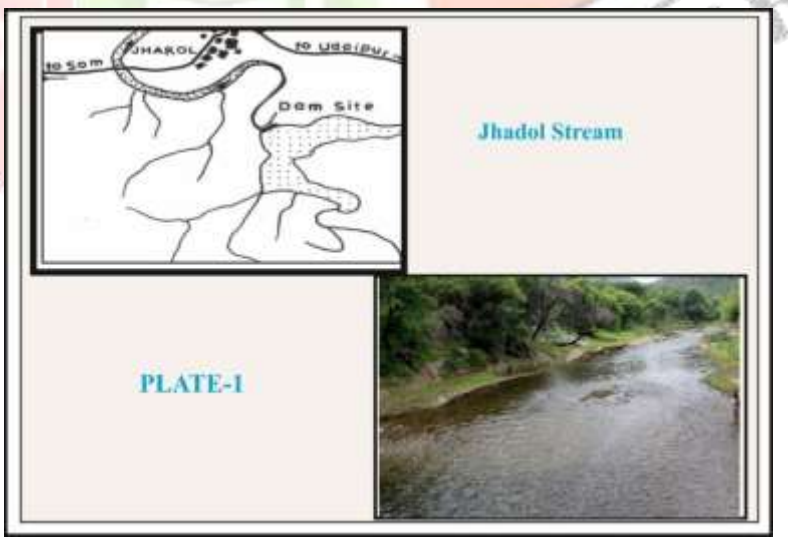
S. N.	Parameters	2019-20			
		Monsoon	Winter	Summer	Average
1	Air Temperature (°C)	31.4	19.2	34	28.2
2	Water Temp. (°C)	21.9	17.2	25.3	21.467
3	pH	7.1	7.8	8.2	7.7
4	Conductivity (µS/cm)	379	301.2	268.4	316.2
5	Depth of Visibility (cm)	39.7	15	8.5	21.067
6	Total Dissolved Solids (mg/l)	242	201	149	197.33
7	Water Current (cm/sec)	121	65.8	21.2	69.333
8	Total Alkalinity (mg/l)	115	162	202	159.67
9	Total Hardness (mg/l)	90	121	171	127.33
10	Dissolved Oxygen (mg/l)	7.4	8.3	8	7.9
11	Chlorides (mg/l)	0.01178	0.03785	0.06632	0.0387
12	Nitrates (mg/l)	0.054	0.0906	0.3175	0.154
13	Phosphates (mg/l)	0.0578	0.124	0.425	0.2023
14	Silicates (mg/l)	3.7128	3.2876	5.2011	4.0672
15	GPP (mgc/m^2/hr)qQ	117.5	298.2	318.9	244.87
16	NPP (mgc/m^2/hr)	49.5	171.2	178.7	133.13
17	Respiration (mgc/m^2/hr)	41.5	107.5	148.5	99.167

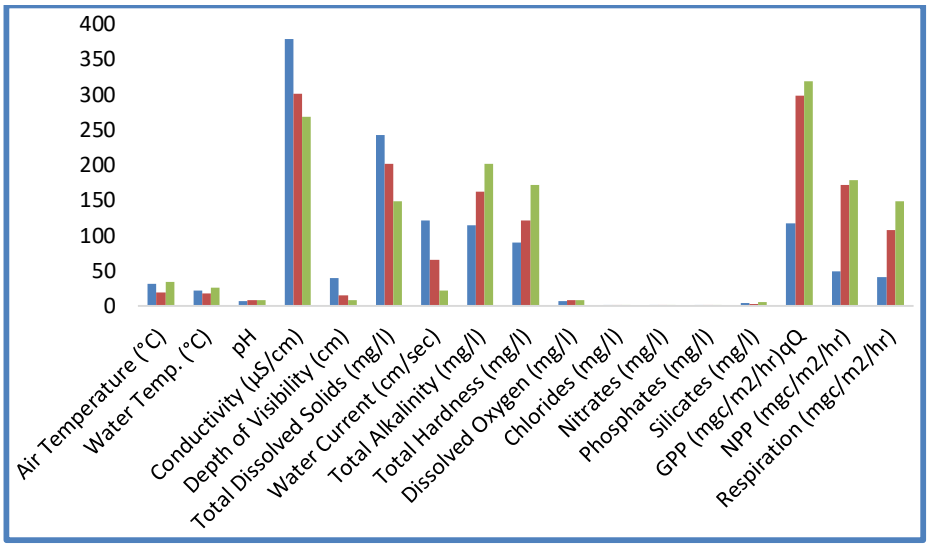
Table 2 : List of Phytoplankton inhabiting the Jhadol Stream

Myxophyceae		**Bacillariophyceae**		**Xanthophyceae**	
1	*Oscillatoria sp.*	1	*Melosira sp.*	1	*Trobonema sp.*
2	*Phormidium sp.*	2	*Pinnularia sp.*	2	*Chlorobotrys sp.*
3	*Spirulina sp.*	3	*Fragillaria sp.*	3	*Botryococcus sp.*
4	*Merismopedia sp.*	4	*Bacillaria sp.*	**Chlorophyceae**	
5	*Microcystis sp.*	5	*Nitzschia sp.*	1	*Pediastrum sp.*
6	*Nostoc sp.*	6	*Ophephora sp.*	2	*Scenedesmus sp.*
7	*Anabaena sp.*	7	*Cymbella sp.*	3	*Panium sp.*
Dinophyceae		**Chrysophyceae**		4	*Ulothrix sp.*
1	*Glenidium sp.*	1	*Chromulina sp.*	5	*Volvox sp.*
2	*Ceratium sp.*			6	*Closteriopsis sp.*
3	*Gymnodium sp.*			7	*Spirogyra sp.*

Table 3 : List of Zooplankton inhabiting the Jhadol Stream

Protozoa			**Cladocera**			**Copepoda**	
1	*Arcella sp.*		1	*Daphnia sp.*	1	*Cyclops sp.*	
2	*Euglena sp.*		2	*Moina sp.*	2	*Rhinodiaptomus sp.*	
3	*Difflugia sp.*		3	*Bosmina sp.*	3	*Heliodiaptomus sp.*	
Rotifera			4	*Pleurocus sp.*	4	*Eucyclops sp.*	
1	*Lepadella sp.*		5	*Alona sp.*			
2	*Tricocerca sp.*		6	*Macrothrix sp.*			
3	*Monostyla sp.*						





Season-wise Physico-chemical parameters of Jhadol Stream

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