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CORRELATION BETWEEN PHYSICO-CHEMICAL PARAMETERS AND PHYTOPLANKTONS OF TIGHRA RESERVOIR, GWALIOR, MADHYA PRADESH

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ABSTRACT
Limnological studies were under taken to understand the correlation between physicochemical parameters and phytoplanktons of the Tighra reservoir, Gwalior, Madhya Pradesh from November 2010 to October 2011.In the present investigation, water temperature ranged from 18.4 ^{o}C to 35.75 ^{o}C, transparency ranged from 152.75 cm to 211.5 cm, conductivity from 272.5 µS/cm to 408.5 µS/cm, turbidity from 5.77 NTU to 12.15 NTU, pH from 6.85 to 7.72, DO ranged from 5.425mg/lit to 8.125 mg/lit, free carbon dioxide from 4.15 mg/lit to 7.57 mg/lit, total alkalinity from 53.75 mg/lit to 145.5 mg/lit, total hardness from 66.25 mg/lit to 137 mg/lit, chlorides from 11.85 mg/lit to 39.5 mg/lit, nitrogen from 0.29 mg/lit to 0.61 mg/lit and phosphates from 0.37 mg/lit to 1.57 mg/lit. All four groups of phytoplanktons, bacillariophyceae, chlorophyceae, myxophyceae and euglenophyceae were recorded throughout the study period. Bacillariophyceae was the most dominant of all the groups of phytoplanktons. The study revealed that phytoplanktons had positive relationship with temperature, pH, chloride, alkalinity, hardness and phosphate.

KEY WORDS: Tighra reservoir, physico-chemical parameters, phytoplanktons

INTRODUCTION

The quality of any water resource is measured in the form of its physico-chemical parameters. The physico-chemical properties of water decide the quality of water and its biological diversity. The changes in the physico-chemical parameters tend to change the living conditions, especially in the number, diversity and distribution of the biota of that ecosystem. Fluctuations in physico-chemical factors adversely affect the organisms, limiting their production and interfering in the physiological processes which reduce their ability to compete with other populations within the environment. The physico-chemical analysis is the prime consideration to assess the quality of water for its best utilization like drinking, irrigation, fisheries and industrial purposes and is helpful in understating the complex processes and interactions between climatic and biological processes in the water. The effect of physical factors such as light and heat are of great significance as they are solely responsible for certain phenomenon such as thermal stratification, chemical stratification, diurnal and seasonal variations in the distribution and quality of planktons and other aquatic organisms. Interaction between physico-chemical factors and biological factors is observed in the water bodies. Investigations have been made to correlate plankton distribution with physico-chemical parameters. Correlation between physico-chemical factors and planktons has been studied by many workers (Chakarabarty *et al.,* 1957, Kaushik *et al.,* 1991b, Adholia and Vyas 1992, Kumar 1995, Joshi *et al.,* 1996, Harsha and Malammanavan, 2004 ; Ayoade *et al*., 2009; Lashkar and Gupta 2009). Aher and Nandan (2005) made an assessment of water quality of Mosam river of Maharashtra with relation to phytoplanktons. Senthikumar and Sivakumar (2008) studied physico-chemical parameters of Veeranamlake in Cuddalore district of Tamil Nadu in relation to phytoplankton diversity. Singh and Laura (2012) made an assessment of physico-chemical properties and phytoplankton density of Tilyar Lake, Rohtak (Haryana). The Tighra reservoir is situated about 20 km west of Gwalior city (Madhya Pradesh) near Tighra village which is in close proximity of SADA Magnet city. It lies on 26^{o}13` N latitude and 78^{o} 30' E longitude at an altitude of 218. 58 m. The reservoir is surrounded by hills from three sides. The hills on the north and western side are 300 m high and those on southern and south east side are about 225m high. Tighra reservoir is the major source of drinking water to Gwalior city. Besides, the water of Tighra reservoir is also used for irrigation and pisciculture. Limnological studies were carried out to investigate correlation between physico-chemical parameters and phytoplanktons.

MATERIALS AND METHODS

For the present study, Tighra reservoir was divided into four zones. In each zone, one sampling station was selected, as marked in the Figure 1, as S1, S2, S3 and S4. The sampling stations were so selected as to cover the maximum area of the reservoir. For physico-chemical studies, the water samples were collected monthly from four different sampling stations during November 2010 to October 2011 in the morning hours. The samples were collected in 5 litre clean plastic cans. The pH and temperature were estimated on the spot, while other parameters were estimated in the laboratory, employing the methods described by APHA (1989), Trivedy and Goel (1986) and Saxena (1998). For planktonic study, samples

were collected by filtering 50 litre surface water through a plankton net made up of bolting silk cloth no. 20. Extreme care was taken in order to keep water undisturbed at the time of sampling. The collected samples were preserved in lugol's solution for phytoplanktons. The preserved samples were brought to the laboratory for qualitative and quantitative analysis. Phytoplanktons were identified by using the standard methods suggested by Smith (1950) ,Phillipose (1970) and Adoni(1985). Quantitative studies were made by using Sedgwick rafter cell. Sample was properly agitated to distribute the organisms evenly. By using a pipette, one ml of sample was transferred onto the cell. The

Cover slip was placed properly avoiding any air bubble. The planktons were allowed to settle for some time and counting was made under microscope. All the planktons, present in the cell were counted by moving the cell vertically and horizontally, covering the whole area.

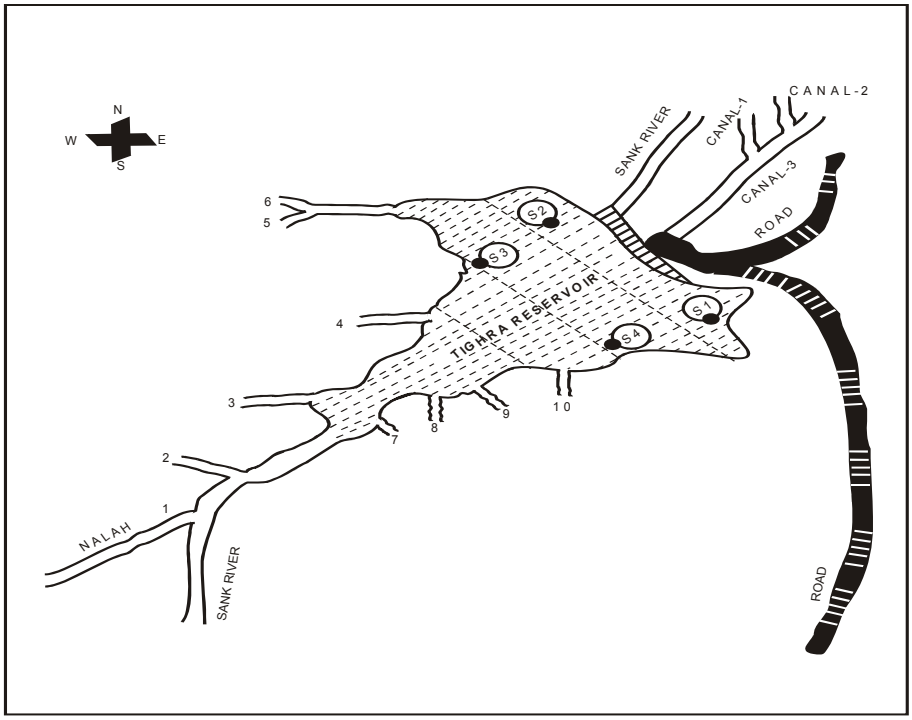

FIGURE 1 : Hydrographic map of Tighra Reservoir, Gwalior showing water sampling stations S1, S2, S3 and S4.

RESULTS AND DISCUSSION

Results are given in table 1-3.The aquatic life in a water body is governed by the physico-chemical conditions and biological conditions of the water body. Davis (1955) pointed out that various physico-chemical and biological circumstances must be simultaneously taken into consideration for understanding fluctuations of plankton population. In Tighra reservoir, all four groups of phytoplanktons, bacillariophyceae, chlorophyceae, myxophyceae and euglenophyceae were recorded throughout the study period. Bacillariophyceae was the most dominant of all the groups of phytoplanktons. Seasonally, maximum numbers of phytoplanktons were observed during summer and lowest number in rainy season. This variation in phytoplanktons number may be due to high temperature. A positive correlation was also observed between temperature and phytoplanktons in Tighra reservoir. Several researchers have proposed temperature as a vital factor responsible for the growth of algae (Ramkrishnaiah and Sarkar, 1982; Verma and Datta Munshi, 1987; Kaushik *et al.,* 1991; Bohra and Kumar, 1999). Wisharad and Mehrotra (1988) reported that proliferation of phytoplanktons from winter to summer could be attributed to progressively increasing water temperature and photoperiod.

The study of correlation between biotic and abiotic factors is useful in gaining basic knowledge of trophic status of a water body. The distribution of certain species is correlated with temperature, pH, dissolved oxygen, hardness, alkalinity and inorganic nutrients. In addition to C, H and O_2, phytoplanktons require some other essential nutrients to grow well. According to Cabecadas and Brogueira (1987), the growth and photosynthesis of algae are influenced by the pH and alkalinity of water. Positive correlation was observed between phytoplanktons and pH and alkalinity, in the present study. Agarwal *et al.* (1990) developed a relationship between nutrients and algal growth. Pandy *et al.* (1995) showed a positive correlation between pH, dissolved oxygen, bicarbonate, phosphate and transparency. They reported a positive correlation between pH, dissolved oxygen and transparency and chlorophyceae. Bhat and Pandit (2005) found a close relationship between physico-chemical characters of water and growth and abundance of phytoplanktons. They observed high growth of phytoplanktons during summer and a very low growth during winter. In the present study also high growth was observed during summer months and it was low during winter. According to Bhat and Pandit (2005), higher transparency and temperature associated with low water levels seem to be conducive factors of maximum phytoplankton density.

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TABLE 1: Monthly variations in physico-chemical parameters (average value of four stations) of water of Tighra reservoir, Gwalior from November 2010 to October 2011

MONTHS	Temp (^{O}C)	pH	Trans (Cm)	Turb (NTU)	Cond (µS/Cm)	DO (mg/l)	Alk (mg/l)	Hardness (mg/l)	Free CO2(mg/l)	Cl (mg/l)	N_2 (mg/l)	P (mg/l)
NOV 10	26.65	6.85	208.75	6.05	282	8.05	53.75	69.75	4.15	18.15	0.612	1.175
DEC 10	20.13	7.1	211.5	5.78	272.5	8.13	89.25	66.25	5.25	15.16	0.587	1.5
JAN 11	18.4	6.98	207.5	6.68	291.75	8.05	93.5	69.25	4.65	23.6	0.422	1.35
FEB 11	20.33	7.43	205.75	6.35	296.5	7.68	92	90.5	4.15	28.65	0.292	1.35
MAR 11	22.13	7.68	190	7.1	300.25	7.08	127.5	88	4.95	31.38	0.432	1.575
APR 11	25.7	7.48	181.75	8.18	304.5	6.55	111.75	106.75	4.58	38.05	0.63	1.575
MAY 11	32.35	7.48	161.25	9.18	299	5.63	145.5	135	6.88	38.33	0.382	1.575
JUN 11	35.75	7.73	153	10.25	311.5	5.43	109.5	137	7.55	39.5	0.36	1.375
JUL 11	32.1	7.5	156.25	11.13	367.75	6.38	84.75	109.5	7.58	35.15	0.55	1.075
AUG 11	27	7.45	153.75	12.15	408.5	7	57.75	95.5	6.23	13.98	0.405	0.375
SEP 11	25.1	7.23	152.75	10.6	344.25	7.2	67.5	90.5	7.1	11.85	0.415	0.85
OCT 11	23.75	7.25	182.5	5.93	321.5	7.6	64	87.75	5.33	15.87	0.532	0.625
Minimum	18.4	6.85	152.75	5.78	272.5	5.43	53.75	66.25	4.15	11.85	0.292	0.375
Maximum	35.75	7.73	211.5	12.15	408.5	8.13	145.5	137	7.58	39.5	0.63	1.575

TABLE 2: Monthly variations in phytoplanktons (no./lit) (average value of four stations) of water of Tighra reservoir, Gwalior from November 2010 to October 2011

Phytoplankton	Nov.10	Dec 10	Jan 11	Feb 11	Mar 11	Apr 11	May 11	Jun 11	Jul 11	Aug 11	Sept 11	Oct 11
Chlorophyceae	168.25	201.75	389.25	296.25	293.75	383.75	287.5	298.75	361.25	235	216.25	223.75
Myxophyceae	330.75	336.75	356.25	369.25	412.25	558.25	532	435.5	419.25	349.75	322.75	315.75
Bacillorophyceae	422.5	332.5	298	471.25	591.25	976	833	756.25	634.25	439.5	358.75	344
Euglenophyceae	140.5	122.5	167.5	195	188.25	265.5	105	148.75	94.5	80	83.75	81.25
Total	1062	1013	1224	1356.75	1480.75	2183.5	1807.5	1639.25	1509.25	1104.25	981.5	964.75

TABLE 3: Correlation matrix of physico-chemical parameters and phytoplantons of Tighra reservoir from November 2010 to October 2011

	TEMP	PH	DO	CL	ALKALINITY	HARDNESS	CO2	NITRATE	PHOSPHATE	TRANS	TURB	COND	PHYTO
TEMP		0.48802	-0.8683	0.52038	0.20882	0.84832	0.76144	-0.0666	-0.0521	-0.7647	0.66641	0.35171	0.673
PH			-0.7749	0.64813	0.57292	0.75819	0.47734	-0.4238	0.14438	-0.5978	0.50466	0.33473	0.633
DO				-0.7392	-0.5778	-0.9804	-0.7219	0.27899	-0.1743	0.78266	-0.6605	-0.2862	-0.87
CL					0.79335	0.73302	0.21232	-0.1513	0.64994	-0.2227	0.16496	-0.1852	0.92
ALK						0.55655	0.12269	-0.2738	0.7885	-0.074	-0.0222	-0.391	0.774
HARDNESS							0.67919	-0.3558	0.14833	-0.7495	0.60259	0.25503	0.845
CO_2								-0.2495	-0.2402	-0.8857	0.80735	0.55022	0.393
NITRATE									0.03913	0.27134	-0.2752	-0.1632	-0.04
PHOSPHATE										0.3985	-0.4031	-0.7733	0.538
TRANS											-0.9157	-0.7393	-0.42
TURB												0.82901	0.308
COND													-0.09

Kumar and Bohra (2005) showed a significant positive correlation between phytoplanktons and pH in Raja Dighi pond, Jhark and Khare (2005) found a marked and significant correlation among plankton density and temperature, DO, phosphate and nitrate. In Tighra water, too, phytoplanktons showed a positive relationship with temperature and phosphate but no significant relationship was observed with dissolved oxygen. Hulyal and Kaliwal (2008) showed a significant relation between biotic and abiotic factors. They revealed a positive relationship between cyanophyceae with dissolved oxygen, nitrate, phosphate and negative correlation with pH, chloride, rainfall and humidity. Similarly, an inverse correlation was found between bacillariophyceae and rainfall, humidity and phosphate. Lashkar and Gupta (2009) observed a highly significant positive correlation between phytoplankton density and transparency ($p<0.01$) and significant positive correlation with total hardness. In the present investigation, on Tighra reservoir, phytoplanktons showed positive correlation with pH, chloride, alkalinity, hardness and phosphate.

Synudeen Sahib (2011) observed a close relationship between turbidity and velocity and plankton biomass. A rise in turbidity, during summer and rainfall, leads to silting, disturbances of normal O_2 and CO_2 exchange, consequently an inhibition of photosynthesis of the phytoplanktons. During winter DO reaches the peak and free CO_2 remains less while a reverse situation occurred in the rainy season. The results indicate that fall in DO and rise in free CO_2 during rainy season could be ascribed to retarded photosynthetic activity of the phytoplanktons or decreased concentration of O_2 being consumed by the organic matter in turbid state of water during low phytoplankton density. In the present study no significant correlation was found between turbidity and phytoplankton.

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REFERENCES

Adholia, U.N. and Vyas, A. (1992) Correlation between copepods and limnochemistry of Mansarovar reservoir, Bhopal. *J. Env. Biol*.**13 (4):** 281-290

Adoni, A.D. (1985) Work Book on Limnology. Pritibha Publication, Sagar (MP) India.

Agarwa,l N.C., Bais, V.S. and Shukla, S.N. (1990) Effect of nitrates & phosphate enrichment on primary productivity in the Sagar Lake, Sagar. *Poll. Res.* **9:**29-32.

Aher, N. H. and Nandan, S. N. (2005) Limnological studies of Mosam River in Maharashtra with relation to phytoplanktons. In : Ecology of Planktons. Ed. Arvind Kumar Daya Publishing House, Delhi pp.273-378.

APHA (1989) Standard Methods for the Examination of water and waste water 17th edition. American Public Health Association, Washington D.C.

Ayoade, A.A., Agarwal, N.K. and Solanki, A. Chandela (2009) Changes in physico-chemical features and plankton of two regulated high altitude rivers Garwal Himalaya, India. *Euro. J. of Sci. Res.***27(1):**77-92.

BhatSamin, A. and Pandit, Ashok K. (2005) Phytoplankton Dynamics in Anchar Lake, Kashmir. In : Ecology of Planktons. Ed. Arvind Kumar Daya Publishing House, Delhi pp.190-208.

Bohra, C. and Kumar, A. (1999) Comparative studies of phytoplankton in two ecologically different lentic freshwater ecosystems. Modern trends in environmental pollution and ecoplanning (Ed. A. Kumar) ABP Publishers, Jaipur pp.220-242.

Cabecadas, G. and Brogueira, M. J. (1987) Primary production and pigments in three low alkalinity connected reservoirs receiving mine wastes. *Hydrobiol.***144:**173-182.

Chakarabarty, R .D., Roy, P. and Singh, S.B. (1957) A qualitative study of the plankton and physico-chemical conditions of the river Jamuna at Allahabad in 1954-55. *Indian J. Fish* **6(1) :** 186-203

Davis, G.L. (1955) The marine and fresh water plankton in Michigan state .University Press, East Lansing.

Harsha, T.S. and Malammanver, S.G. (2004) Assessment of phytoplankton density in relation to environmental variables on Gopalaswamy pond at Chitradurga, Karnataka. *J. Environ. Biol.* **25(1):**113-116.

Hulyal, S.B. and Kaliwal, B.B. (2008) Dynamics of phytoplankton on relation to physico-chemical factors of Almathi reservoir of Bijapur District, Karnataka state. *Environ. Monit. Assess.* **153 (1-4):**45-59.

Joshi, B.D., Bisht, R.C.S. and Joshi, Namita (1996) Planktonic population in relation to certain physico-chemical factors of Ganga Canal at Jwalapur (Haridwar) Him. *J. Env. Zool.***10:**75-77

Kaushik, K.S., Agarkar, M.S. and Saksena, D.N. (1991) Water quality and periodicity of phytoplantonic algae in Chambal Tal, Gwalior, Madhya Pradesh. *Bionature,* **11(2):** 87-94

Kaushik, S., Saksena, M. N. and Saksena, D.N. (1991 b) Phytoplankton population dynamics in relation to environmental parameters in MatsyaSarovar at Gwalior (MP) *Acta. Botanica*. **19:**113-119.

Khare, P. K. (2005) Physico-chemical characteristics in relation to Abundance of plankton of JagatSagar Pond, Chattapur, India. Advances in Limnology Ed. S.R. Mishra, Daya Publishing House, New Delhi pp.162-174.

Kumar, A. and Bohra, C. (2005) Dynamics of phytoplankton productivity of certain Lentic Ecosystem of Jharkhand, India. Ecology of plankton (Ed. Arvind Kumar) Daya Publishing House, Delhi pp. 1-14.

Kumar Arvind (1995) Periodicity and abundance of plankton in relation to physico-chemical characteristics of a tropical wetland of South Bihar. *Eco. Env. & Cons.* **1(1-4):**47-51.

Lashkar, H. S. and Gupta, S. (2009) Phytoplankton diversity and dynamics of Chatla flood plain Lake, Borak Valley, Assam, North East India- a seasonal study. *J. Environ. Biol.***30 (6):**1007-1012.

Pandey, B.N., Mishra, A.K. , Das, P.K.L. andJha, A.K. (1995) Studies on hydrological conditions of river Saura in relation to its impact on Biological health. In: Recent Research in aquatic environment. Ed. V.B. AshutoshGoutam and N.K.Aggarwal..Daya Publishing House, Delhi pp. 57-65

Philipose, M.T. (1970) Freshwater plankton of Inland fisheries. Pro. Sympo. Algae. ICAR, New Delhi. pp. 272-291.

Ramkrishnaiah, M. and Sarkar, S. K. (1982) Plankton productivity in relation to certain hydrological factors in Konar reservoir (Bihar) *J. Inland Fish. Soc. India* **14**:58-68.

Saxena, M.M. (1998) Environmental analysis. Water, soil and air. Agro Botanica, Bikaner, India.

Senthikumar, R. and Sivakumar, K. (2008) Studies on phytoplankton diversity in response to abiotic factors in Veeranam Lake in the Cuddalore District of Tamil Nadu. *J. Environ. Biol*. **29(5):**747-752.

Singh, Ajit and Laura, J.S. (2012) An assessment of physico-chemical properties and phytoplankton density of Tilyar lake, Rohtak (Haryana).*Int. Jr.of Current Research.,* **4(05):**047-051

Smith, G.M. (1950) The freshwater algae of united states, McGraw Hill Book Co. N.Y.

Synudeen Sahib, S. (2011) Physico-chemical parameters and phytoplankton in the Parappar Reservoir, Kerala. *J. Eco. Biol*. **28(2):**187-190.

Trivedy, R.K. and Goel, P.K. (1986) Chemical and Biological Methods for water pollution studies. Environmental Publications, Karad (MS).

Verma, P.K. and Dutta Munshi, J.S. (1987) Plankton community structure of Bandra reservoir, Bhagalpur. *Tropic Ecol.***28** : 200-207

Wisharad ,S.K. and Mehrotra, S.N. (1988) Periodicity and abundance of plankton in Gulasia reservoir in relation to certain physico-chemical conditions*. J. Ind. And Fish Soc.,* India. **20**:42-49.