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Bacillariophyceae as Ecological Indicators of Water Quality in Manair Dam, Karimnagar, India

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ABSTRACT

The present study has determined Multiple Regression Analysis in between physico-chemical parameters and diatoms in Manair dam, Karimnagar. Such as Temperature, pH, Total Dissolved Solids (TDS), Total Hardness (TH), Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Chloride (Cl^{-}), Sulphates, Carbonates (CO_3^{2-}), Bicarbonates (HCO_3^{-}) Dissolved Oxygen (DO) and organic matter etc., using a statistical method. There is a relationship between variables which shows that one variable actually causes changes in another variable. A regression provides an excellent tool for calculating of various water quality parameters within reasonable degree of accuracy. The results proved to be a useful mean for rapid monitoring of water quality with the help of systematic calculations of correlation coefficient between parameters and regression analysis.

Keywords : Multiple Regression, Bacillariophyceae, Water Quality Parameters and Manair Dam

I. INTRODUCTION

Water is one of the most precious resources necessary for the survival of all living organisms. Water finds application in almost all spheres of life. Modern civilization depends on water bodies like lakes, reservoirs and rivers. The reservoirs are made by constructing dams across the rivers. Physico-chemical analysis is the prime consideration to assess the quality of water for its best usage (Basavarajappa et al., 2010). Life in aquatic environment is largely governed by physico -chemical characteristics and their stability. The chemical and biological factors cannot be separated from each other. Physico-chemical factors are very important to know the pollution strength. Many investigators stressed the importance of temperature in the periodicity of diatoms. Solanki et al., (2007), and several others pointed out that low temperature is favorable to the growth and development of Diatom populations.

Multiple regression analysis is a statistical tool for understanding the relationship between two or more variables. Multiple regression examines the relation between a single dependent variable and a set of independent variables to best represent the relation in the population. The technique is used for both predictive and explanatory purposes within experimental or non experimental designs (Chaudhari and Srivastava, 2008, Purushottam et al., 2010 and Anita Bhatnagar and Pooja Devi, 2012).

II. MATERIAL AND METHODS

The water samples were collected at monthly intervales, for a period of two years at three sampling stations in the dam. Physico-chemical parameters were analysed by following the standards methods (APHA, 2005). One litre of surface water samples were collected from three different stations of the dam and samples were kept in the sedimentation

column after adding 2-3 ml of 4% formaldehyde solution The samples were concentrated to 100 mL. Finally, the concentrated material was used for frequency measurements and identification of species.

Multiple Regression Analysis (MRA) is a statistical approach has been followed in evaluating the relative importance of various physico-chemical variables on the growth and development of algal communities (Tinsley and Brown, 2000, Mahuyaadak Dasgupta and Purohit, 2001). The distribution of algae is a function of various physico-chemical variables in the environment, the number of organisms of a particular group is taken as an independent variable. The percentage of variance brought about algal number is expressed as R^2 value and its statistical significance is tested with F value. The proposed equation contain minimum number of variables, required to explain the variation in algal number to maximum extent in a statistically significant way along with their regression co-efficient for better prediction of algal number in unknown samples. These models for each group of algae in different sites of a lake are incorporated in their respective tables.

III. RESULTS AND DISCUSSION

Diatoms were constituted the dominant group in lower manair dam and were present throughout the period of investigation. They are dominant in winter season. The species of Cymbella, Navicula, Gomphonema, Diploneis, Mastogloea, Amphora, Pinnularia, Rhopalodia, Nitzschia and Synedra were constituted the bulk of the diatom populations. They serve as good ecological indicators of water quality.

Station-I

At this station, all the physico-chemical parameters together account for 87% of algal variance (Table: 1).In the linear Multiple Regression Analysis, all the factors have influenced on diatom growth. Among them pH , temperature, chlorides, DO, BOD, magnesium, total solids, total dissolved solids, and silicates are the minimum factors that could influence the growth of diatoms to the maximum extent of 93.3%.

pH, calcium, and silica exhibited positive influence on the growth of diatoms at 1% level. The significance of pH was also studied by Hosmani and Shankar (2010). According to Verma et al., (2011) calcium is found to be one of the most important factors influencing the distribution of Cymbella species in water bodies.

Temperature exhibited negative relationship with diatoms at 5% level and it is influencing to an extent of 27%. Similar behavior was observed by Jyothi and Narasimha Rao (2013). Hosmani and Shankar (2010). also pointed out that the temperature is more important than nutrients in certain situations for the growth and development of diatoms. Singh and Balsingh, (2011) has reported larger number of diatoms during the winter months when the temperature was low. Temperature exhibited negative influence on the growth of Nitzschia at 5% level. Atlaf H.Ganai and Saltanat Praveen (2014) have also recorded multiplication of diatoms during winter months. Present study shows an inverse relationship between temperature and diatom numbers.

Silica exhibited positive correlation with Bacillariophyceaen growth at 1% level and influencing 46% algal variance. The importance of silica in the periodicity of diatoms has been emphasized by Verma et al., (2011). Silica influenced on the growth of Cymbella 1% level. Chlorides, magnesium, sulphates are positively influenced on the algal growth at 5% level. Chlorides have shown 39% algal variance and sulphates have shown 17% algal variance significantly. Phosphates and organic matter has exerted a negative influence on the growth of Pinnularia. Hosmani and Shankar (2010) who reported negative relationship of diatoms and phosphates. Dissolved oxygen showed a positive

relation with diatoms at 1% level and influencing 16% algal variance. Singh and Balsingh, (2011) were also pointed out that the direct relationship between DO and Bacillariophyceae.

Station-II

In the present investigation, MRA reveals that all the physico-chemical factors together explain 84.6% of algal variance out of these, factors, carbonates, chlorides, organic matter, total hardness, calcium, sulphates, silica and total solids explain the variation in the growth to the extent of 92% (Table 2).

Total solids influenced positively on the growth of diatoms at 1% level and influencing 28% algal variance. Total hardness influenced positively on the growth of Cymbella and Gomphonema at 5% level remaining factors has shown negative relationship on the growth of diatoms. This was also in accordance with Atlaf H. Ganai et al., (2010). Water temperature influenced inversely to an extent of 9%. Silica account for 21% of algal variance, it is influencing negatively on the growth of algae as they consume silica in the cell wall synthesis. According to Kumar et al., (2008) silica showed positive relationship with algal growth. Total hardness has shown 36% of algal variance.

Bicarbonates and dissolved oxygen are the minimum factors required for the maximum algal growth, and they are showing positive influence on algae. Generally the carbon source in the form of CO_2 or CO_3^{2-} or HCO_3^- favors diatom growth and at the same time is determined by the range of pH . pH influenced the growth of Navicula positively at 1% level..

Station-III

MRA reveals that all the physico-chemical factors together explain 96.6% of algal variance. Among them carbonates, bicarbonates, DO, BOD, organic matter, COD, calcium magnesium, total solids, sulphates, silica, phosphates, nitrates and nitrites are the minimum factors that could influence the growth of diatoms to the maximum extent of 93.3% (Table:3).

Bicarbonates, total solids, nitrites, and silica has showed positive influence on the growth of diatoms at 1% level and magnesium , total hardness, phosphates, calcium, DO exhibit on the growth of Cymbella and Nitzschia species at 5% level. Ganai et al., (2010) observed positive correlations of phytoplankton and total hardness of freshwater systems.

Phosphates, magnesium and silica contribute each of 4%, 19% and 54% of variance in algal number. Silica exhibit positive influence towards algal growth. The lake with higher silica concentration has denser diatom population and harbored greater number of diatom species. Total hardness contributes 29% of variance towards positive side. Total hardness exhibit positive influence on the growth of Amphora and Pinnularia

Organic matter showed negative relationship with the growth of Navicula, Gomphonema and Diploneis at 1% level. At this station organic matter is the minimum factor effecting maximum growth of Mastogloea and Amphora negatively.COD has shown negative relationship with the algal growth at 1% level. Jyothi and Narasimha Rao (2013) have also observed an inverse relationship between COD and Bacillariophyceae. Whereas total solids exhibit a positive influence on the growth of Cymbella.

IV. CONCLUSION

The correlation and regression study of physico-chemical parameters and diatoms of Manair dam reveals that all the parameters are more or less correlated with each other. Low temperature, high dissolved oxygen and silica favored the growth of diatoms The statistical regression analysis has been found to be a highly useful technique. Multiple regression analysis has been employed to find out the

relative importance of physico-chemical parameters on the growth of algae. The diatoms showed significant relation with water temperature, DO, silica, organic matter and chlorides. The temperature is significantly and negatively correlated with Bacillariophyceae. Bacillariophyceae was positively correlated with DO and chloride and negatively correlated with water temperature, organic matter and phosphates. The statistical data reveals that the diatoms serve as good ecological indicators of water quality in Manair dam.

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VI. REFERENCES

[1]. Altaf H.Ganai and Saltanat Praveen. 2014. Effect of physic-chemical conditions on the structure and composition of the phytoplankton community in Wular lake at Lankrishiora, Kashmir. International Journal of Biodiversity and Conservation. 6(1): 71-84.

[2]. Anita Bhatnagar and Pooja Devi, 2012. Applications of correlation and regression analysis in assessing lentic water quality: a case study at Brahmsarovar Kurukshetra, India, International Journal of Environmental Sciences, Volume 3, No 2, Department of Zoology, Kurukshetra University, Kurukshetra, India.

[3]. APHA 2005. Standard Methods for the Examination of Water and Wastewater. 21st Edn. APHA, AWWA,WPCF, Washington DC, USA.

[4]. Basavarajappa, S. H., Raju, N. S., Hosmani, S. P. and Niranjana, S. R. 2010. Algal diversity and physico-chemical parameters in Hadinaru Lake,Mysore, Karnataka. The Bioscan, 5(3): 377-382.

[5]. Hosmani, Shankar, P., 2010. Phytoplankton diversity in Lake of Mysore district, Karnataka state, India. The Ecoscan, 4, 53-57.

[6]. Jyothi K and Narasimha Rao G M.(2013) Seasonal distribution of phytoplankton in Riwada reservoir,Visakhapatnam, Andhra Pradesh, India. Not Sci Biol, 2013, 5(3): pp. 290-295.

[7]. Kumar, Anil, Sharma L L and Aery N C., 2008. Physicochemical Characteristics and Diatoms as Indicators of Trophic Status of Kishore Sagar, Rajasthan. In. Proceedings of Taal 2007: 12th World Lake Conference:1804-1809

[8]. Purushottam J. Puri, M.K.N. Yenkie, D. G. Battalwar, Nilesh V. Gandhare and Dewanand B. Dhanorkar (2010). Study and Interpretation of Physico-Chemical Characteristic of Lake Water Quality in Nagpur City (India). Department of Chemistry, L.I.T., RTM, Nagpur University, Nagpur, India.

[9]. Solanki VR, Murthy S, Samba S, Kaur A and Raya SS, 2007. Variation in dissolved oxygen and biochemical oxygen demand in two freshwaters lakes of Bodhan, A.P., India. Nature Environment and Pollution Technology 4(2) 299-302.

[10]. Singh, R.P. and Balasingh, G.S.R, 2011. Limnological studies of Kodaikanal Lake (Dindugal District), inspecial reference to phytoplankton diversity. Indian J. Fund. Appl. Life Sci., 1 (3): 112-118.

[11]. Sharma, L.L and Sarang, S. 2004. Physico-chemical limnology and productivity of Jaisamand Lake, Udaipur (Rajasthan), poll.Res, 23(1): 87-92.

[12]. Tinsley EAH, Brown SD (2000). Handbook of applied multivariate statistics and mathematical modeling. Academic, San Diego.

[13]. Mahuyaadak Dasgupta and K. M. Purohit, (2001).Status of Surface and Groundwater Quality of Mandikudar-Part-III, Correlation Coefficient and Regression, Poll. Res., 20(2), 227-232.

[14]. Verma PU, Chandawat DK and Solanki, 2011. Seasonal variations in physico-chemical and phytoplankton analysis of Kankaria Lake. Life Sciences Leaflets 19 842-854.

[15]. Chaudhari G. R. and V. S. Srivastava (2008). Srivastava, Modeling of the Industrial Waste Water Quality Parameters: A Correlation-Regression Study AJCER, 1, 49-53.

Table 1. Multiple Regression Analysis of Physico chemical factors on Bacillariophyceae

Station-I

Model Summary[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.933[b]	.870	.403	59.65

a. station = station I

NO_3^-, TDS, DO, CO_3^{2-}, BOD, Ca^{2+}, pH

ANOVA[a,b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	119284.656	18	6626.93	1.86	.254[c]
	Residual	17789.302	5	3557.86		
	Total	137073.958	23			

a. station = station I

b. Dependent Variable: Bacillariophyceae

c. Predictors: (Constant), NO2-, Temp, OM, Cl^-, SO_4^{2-} , SiO_2, PO_4^{3-}, Mg^{2+}, COD, HCO_3^-, TS, NO_3^-, TDS, DO, CO_3^{2-}, BOD, Ca^{2+}, pH

b. Predictors: (Constant), NO_2^-, Temp, OM, Cl^-, $SO4^{2-}$, SiO_2, PO_4^{3-}, Mg^{2+}, COD, HCO_3^- , TS,

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
11	(Constant)	799.642	407.524		1.96	0.07
	Temp	28.742	13.628	0.27	2.11	0.05
	Cl^-	-2.236	.692	-0.43	-3.23	0.01
	DO	40.775	11.257	0.74	3.62	0.00
	BOD	2.922	1.221	0.49	2.39	0.03
	Mg^{2+}	3.460	1.572	0.27	2.20	0.04
	TS	-1.870	.455	-0.58	-4.11	0.00
	TDS	-1.441	.573	-0.33	-2.52	0.02
	$SO4^{2-}$	-2.609	1.136	-0.31	-2.30	0.04

a. station = station I

b. Dependent Variable: Bacillariophyceae

Table 2. Multiple Regression Analysis of Physico chemical factors on Bacillariophyceae

Station-II

Model Summary[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.920[b]	.846	.116	62.61

a. station = station II

b. Predictors: (Constant), NO2-, NO3-, Ca2+, SO42- , HCO3-, BOD, Temp, CO32-, Mg2+, SiO2, PO43-, Cl-, TSS, OM, TDS, DO, pH, COD, TS

ANOVA[a,b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	86278.262	19	4540.96	1.16	.496[c]
	Residual	15680.363	4	3920.09		
	Total	101958.625	23			

a. station = station II

b. Dependent Variable: Bacillariophyceae

c. Predictors: (Constant), NO2-, NO3-, Ca2+, SO42- , HCO3-, BOD, Temp, CO32-, Mg2+, SiO2, PO43-, Cl-, TSS, OM, TDS, DO, pH, COD, TS

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-158.810	170.827		-0.93	0.36
	TS	.981	.329	0.54	2.98	0.01

a. station = station II

b. Dependent Variable: Bacillariophyceae

Table 3. Multiple Regression Analysis of Physico chemical factors on Bacillariophyceae

Station-III

Model Summary[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.983[b]	.966	.739	23.54

a. station = station III

b. Predictors: (Constant), NO2-, DO, PO43-, TSS, OM, Cl-, SiO2, TH, TDS, CO32-, Ca2+, COD, HCO3-, SO42- , Temp, TS, NO3-, pH, BOD, Mg2+

ANOVA[a,b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	47105.866	20	2355.29	4.25	.129[c]
	Residual	1661.968	3	553.99		
	Total	48767.833	23			

a. station = station III

b. Dependent Variable: Bacillariophyceae

c. Predictors: (Constant), NO2-, DO, PO43-, TSS, OM, Cl-, SiO2, TH, TDS, CO32-, Ca2+, COD, HCO3-, SO42- , Temp, TS, NO3-, pH, BOD, Mg2+

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	388.748	225.409		1.72	0.12
	CO32-	1.944	.406	0.57	4.79	0.00
	HCO3-	1.666	.565	0.38	2.95	0.01
	DO	14.703	7.688	0.42	1.91	0.08
	BOD	3.229	.791	1.16	4.08	0.00
	OM	112.204	16.046	0.82	6.99	0.00
	COD	-3.362	.843	-0.57	-3.99	0.00
	Ca2+	-6.424	1.453	-0.69	-4.42	0.00
	Mg2+	9.909	1.168	1.02	8.48	0.00
	TS	-.959	.299	-0.44	-3.20	0.01
	SO42-	-5.205	.938	-0.75	-5.55	0.00
	PO43-	137.549	31.997	0.53	4.30	0.00
	NO3-	-247.632	49.632	-0.57	-4.99	0.00
	NO2-	1611.413	465.734	0.40	3.46	0.01

a. station = station III

b. Dependent Variable: Bacillariophyceae