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Ecological Studies of the River Krishna near Gadwal, Telangana with Reference to Water Quality

Y. Seeta[*1] and P. Manikya Reddy[2]

[1]Department of Environmental Science, Osmania University, Hyderabad-500007. Telangana, INDIA.
[2]Department of Botany, Osmania University, Hyderabad-500007, Telangana, INDIA.

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ABSTRACT

Ecological studies in the river Krishna have been studies for a period of two years (May 2015 to April 2017). Physico-chemical and phycological aspects have been investigated to assess the quality of water. The water was well oxygenated with an alkaline pH, organic matter, chlorides and nutrients were recorded at low concentrations. Diatoms constituted the dominant group of algae. Multiple regression analysis was employed to discover the relative importance of various physico-chemical variables on the abundance and distribution of algae. Mathematical equations were derived involving the physico-chemical variables for better prediction of algal number.

1) INTRODUCTION

Water is undeniably vital for human livelihoods and survival, as well as most forms of economic growth and production. This is an essential resource becoming increasingly scarce in many parts of the world due to the severe impairment of water quality. Human beings are polluting the water resources in many ways. They have modified the quality and quantity of water by over exploitation, misuse and waste. The root cause of water pollution in India is unwise management and over exploitation of the resources. Majority of rivers are made to carry an ever increasing load of sewage and industrial waste effluents as well as urban and agriculture wastes. All these resources can contribute to degradation of water quality. In Telangana a number of rivers have been investigated their studies mainly deal with the assessment of water quality and pollution using chemical and biological characteristics [1, 2, 3]. The present paper deals with the ecological studies of the river Krishna, near Gadwal, Telangana.

2) MATERIALS AND METHODS

River Krishna rises near Mahabaleswar in the Western ghats. Its length is about 1300 km. It flows through the Maharashtra and Telangana states and receives a number of tributaries including the largest one the Tungabhadra.

Four sampling stations were fixed along the river course for the collection of water and algal samples. Water and algal samples were collected at monthly intervals for a period of 2 years from May 2015 to April 2017. Water samples were analyzed by following standard procedures [4]. Benthic algae collection and their quantitative estimation were done by following the procedure Blum [5] and Venkateswarlu [6].

To study the relative importance of various physico-chemical variables on the distribution of algae, multiple regression analysis (MRA) is used the variability in algal number is expressed in terms of coefficient of determination (R^2) and its significance is tested with F value [7, 8].

3) RESULTS AND DISCUSSION

The average values of physico-chemical variables at different sampling stations are incorporated in **Table-1**

The water was alkaline in nature at all the stations dissolved oxygen was always above 7.0 mg/L and organic matter, chlorides, sulphates were in low proportions. Phosphates were observed in very low quantities. Nitrates were recorded in considerable quantities.

In the river Krishna three groups of benthic algae Bacillariophyceae, Cyanophyceae and Chlorophyceae were encountered. Bacillariophyceae were dominant at all the stations followed by Chlorophyceae at station I and II. But at stations III and IV Cyanophyceae occupied second position followed by Chlorophyceae members (**Table-2**).

Bacillariophyceae constitute the highest percentage of algal population in the river Krishna and exhibited variation in species composition. Similar observations have also been made by Manikya Reddy and Venkateswarlu [9] and Sharma and Singh [10]. The diatoms showed maximum development during winter and summer months, this showing a positive and negative relationship with temperature and the rate of water flow. This may be due to the presence of temperature

* Corresponding Author: **M/s. Y. Seeta**
Email address: seetasatyareddy@gmail.com

favored species and some diatoms species with stand fairly wide temperature ranges. This is in agreement with the observations of Sudhakar et al., [3] Manikya Reddy and Venkateswarlu [9]. The blue-green algae recorded more number during December and May at all the stations of the river. The chlorophyceae present their maximum number during summer months at all the stations.

Table: 1 Average value of physico-chemical parameters

Para meters	Station I	Station II	Station III	Station IV	IS 10500:2012
pH	8.4	8.3	8.4	8.4	8.5
CO_3^{2-}	20.4	24.8	23.5	21.2	-
HCO_3^-	148	108.2	140.6	134.8	-
Cl^-	87.6	88.3	89.8	88.8	250
DO	11.1	9.5	9.6	9.7	-
TH	56	56.8	56.6	51.5	200
Ca^{2+}	22.4	19	20.9	19.5	75
Mg^{2+}	13.4	10.4	12.6	13	30
OM	1.5	1.6	1.6	1.4	-
NO_3^-	0.72	0.63	0.6	0.6	45
NO_2^-	0.008	0.007	0.007	0.008	-
PO_4^{3-}	Nil	Nil	Nil	Nil	5
SiO_2	4.2	4.5	4.4	4.5	-
SO_4^{2-}	47	41.9	47.8	47.2	200
Na^+	97.1	95.46	94.3	90.4	-
K^+	7.5	6.7	6.4	6.7	-
TS	436.6	500	522	506	1500

All parameters are expressed in mg/L except pH

Table: 2 Percentages of Algae

Algae group	Station I	Station II	Station III	Station IV
Bacillariophyceae	92.6	90.5	87.8	85.7
Chlorophyceae	5.1	6.1	4.8	4.9
Cyanophyceae	2.2	3.3	7.3	9.3

Bacillariophyceae: At station-I MRA reveals that temperature, pH, carbonates, bicarbonates, dissolved oxygen, organic matter, nitrates, silica, total hardness, calcium, magnesium. Sulphates and total solids explain 87% of variations in algal number. Among them DO, nitrates and silica account for 74% variations. The derived equation involving these factors is as follows.

Algal number = 1181.3 + 307.6 DO – 1712.2 NO_3^- – 773.7 NO_2^- + 101.5 SiO_2

(R^2 = 0.74; df = 19; n = 24).

Of the four variables nitrates, silica and dissolved oxygen could account for 67% variance and exhibit a positive influence on the growth of algae. A unit change in DO concentration is sufficient to bring variation of 491 units in the number of organisms.

Dissolved oxygen is an important factor to influence the growth and development of diatoms [9]. DO is associative with other factors could influence the diatom number to the extent of 55%. Silica is another important factor for the growth of diatoms and could influence the diatom number to the extent of 6% nitrates alone explained the variation in algal number to the extent of 12% nitrates are found to be more important influencing the diatoms to the positive side. A unit change in nitrate concentration is sufficient to bring variation of 639 units in the number of organisms. Sulphates appear to be less significant for the growth of diatoms.

At station -III MRA reveals that all the factors collectively explain 82% of variation in algal number is a statistically significant manner. Among them a total of three factors nitrates, sodium and total solids influenced 72% of variation. But individually sodium is less significant. Remaining factors have not showed much influence as the diatom growth.

Algal number = 1203.7 – 5178.6 NO_3 + 2.6 Na – 1.4 total solids.

(R^2 = 0.72, df = 17.6, n = 24).

At Station-IV to explain the variation in algal number to the extent of 93% a minimum of seventeen factors. MRA reveals that the relatively less important factors are eliminated in the stepwise regression analysis. The remaining six factors temperature, NO_3^-, SiO_2, Ca^{2+}, Na^+ and total solids collectively influencing 88% variation in algal number.

The factors pH, CO_3^{2-}, HCO_3^-, DO, Na^+, K^+ shows positive influence and temperature, total hardness, calcium and sulphates shows negative influence on the growth of the diatoms [10, 11]. pH is found to be more important influencing the diatoms to the positive side. A unit changes is pH concentration is sufficient to bring variation of 290 units in the number of organisms. The derived model is as follows.

Algal number = 3044.1 – 32.1Temp – 8001.8 NO_3 – 74.8 SiO_2 – 29.8 Ca^{2+} + 4.32 Na^+ – 1.4 total solids.

(R^2 = 0.88; df = 6.17; n = 24)

From the data it is clear that different species of factors distinct set of environmental conditions.

Chlorophyceae: MRA reveals that a group of seventeen factors are found to influence the growth of green algae to the extent of 78% variation. Out of 17 factors, only four factors collectively influenced 57% variation in algal number. Total solids, dissolved oxygen and sodium explain the variation to maximum extent, whereas temperature showed less significant variation. DO is found to be more important influencing the green algae to the positive side. A unit change is DO concentration is sufficient to bring variation of 190 units in the number of organisms. High concentrations of DO are favorable for the development of Chlorococcales [12].

Algal number = 7.41 – 3.5 Temp + 4.0 DO + 0.28 Na^{2-} + 0.07 Total solids.

(R^2 = 0.57; df = 4.19; n = 24)

At station- IV a group of 17 factors are found to influence the growth of green algae to the extent of 82%. Among them only three factors collectively influenced 53% of variations in algal number. NO_3^- and DO influenced maximum extent in algal number where as HCO_3^- have less significant variation in algal number. pH is formed to be more important influencing the green algae to the positive side. A unit change in pH concentration is significant to bring variation of 12 units in the number of organisms. Nitrates represent are of the nutrient factors that is responsible for the multiplication of green algae [13, 14]. In the present study the positive relationship between these two could be attributed a state of equilibrium between utilization and recycling of 'N'.

Algal number = -15.6 + 0.07 HCO_3^- + 4.5 DO – 52.0 NO_3^-

(R^2 = 0.53; DF = 3.20; n = 24)

Cyanophyceae: MRA reveals that temperature, pH, carbonates, bicarbonates, chlorides, dissolved oxygen, organic matter, nitrates, silica, total hardness, calcium,

magnesium, sodium, potassium, sulphates and total solids explain 89% of variation in algal number in a statistically significant manner. Among them a total of 5 factors temperature, HCO_3^-, total hardness, magnesium and sodium are the minimum factors essential to account for maximum variation significantly 75%. The relatively less important factors are eliminated in the stepwise regression analysis accompanied by negligible drop in R^2 value. pH is found to be more important influencing the blue-green algae to the positive side. A unit change in pH concentration on is sufficient to bring variation of 14 units in the number of organisms. Manikya Reddy and Venkateswarlu [2], Sudhakar et al., [3] emphasized the role of temperature on the growth of blue-greens. Moderate temperature favours the growth of cyanophyceae [9]. Total hardness of water has a positive influence on the growth of blue-greens. Individually it accounts for 61% variance. The influence of calcium and magnesium on cyanophyceae is more effective in the presence of hardness. This is in agreement with findings of Jyothi et al., (1992).

Algal number = 44.6 – 2.13 Temp + 0.06 HCO_3^- + 0.11 Total hardness – 0.23Mg^{2+} + 0.03 Na^{2+}

(R^2 = 0.75; df = 5.18; n = 24)

It is clear that different species of blue-greens respond to different independent variables in a quite distinct way and the response also depends on several other factors. Temperature, bicarbonates, total hardness and magnesium were showed significant variation.

4) CONCLUSION

pH, calcium, and DO exhibited positive influence on the growth of diatoms. Silica exhibited positive correlation with Bacillariophyceae growth. Phosphates and organic matter has exerted a negative influence on the growth of diatoms. Bicarbonates and dissolved oxygen are the minimum factors required for the maximum algal growth, and they are showing positive influence on algae. Dissolved oxygen, Chlorides, phosphate, nitrate and pH are the most significant parameters for the growth of Chlorophyceae in the present investigation. Organic matter and magnesium has exerted a positive influence of Cyanophyceae growth. High concentration of dissolved oxygen, carbonates and low concentration of chlorides, bicarbonates, total hardness and organic matter were recorded throughout the period of investigation. In the river all the physico-chemical parameters were well below the permissible limits. It can be concluded that the water is fresh and unpolluted.

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REFERENCES

1) Venkateswarlu, V. 1993. Ecological studies on the rivers of Andhra Pradesh with special reference to water quality and pollution. Proceeding of Indian Academy of Science (Plant Science). 96, 495-508.
2) Manikya Reddy, P. and Venkateswarlu, V. 1992. The impact of paper mill effluents on the algal flora of the river Tungabhadra. J. Indian. Bot. Soc. 71, 109- 114.
3) Sudhakar, G. Jyothi, B. and Venkateswarlu, V. 1994. Role of diatoms as indicators of pollution gradients. Environ Mon Assess. 33, 85 - 99.
4) APHA, 2005. Standard Methods for the Examination of Water and Wastewater. 21st Edn. APHA, AWWA, WPCF, Washington DC, USA.
5) Blum, J L. 1957, An ecological study of the algae of the Saline River Michigan. Hydrobiologia, 9, 361-408.
6) Venkateswarlu, V. 1969. An ecological study of algae of river Moosi, Hyderabad (India) with special reference water pollution III. The Algal periodicity Hydrobiol. 34(3-4), 533-560.
7) Hosmani, S. P. 2013. Freshwater Algae as Indicators of Water Quality. UJERT. 3(4), 473- 482.
8) Suresh B. 2015. Multiplicity of phytoplankton diversity in Tungabhadra River near Harihar, Karnataka (India). International Journal of Current Microbiology and Applied Sciences. 4 (2), 1077-1085.
9) Manikya Reddy, P. and Venketeswarlu, V. 1986. Ecology of algae in the paper mills effluents and their impact on river Tungabhadra. J.Environ. Biol. 7, 215-223.
10) Sharma, D. K. and Singh, R.P. 2013. Correlation between physico-chemical parameters and phytoplanktons of Tighra reservoir, Gwalior, Madhya Pradesh. International Journal of Security and Networks. 4(1), 90-95.
11) Ananthaiah, 2010. Ecological studies on temple tanks of Ananthagiri and sarpanpally project with reference to water quality. Ph.D. Thesis, Osmania University, Hyderabad.
12) Jyothi, H. Sudhakar G. and Venkateswarlu, V. 1992. Chlorophycean Blooms and their Ecological Aspects. International Journal of Environmental Studies. 4D, 151-164.
13) Manikya Reddy, P. and Venkateswarlu, V. 1987. Assessment of water quality and pollution in the river Tungabhadra near Kurnool, Andhra Pradesh. Jr. Environ.Biol. 8(2), 109-119.
14) Mishra, K.N. Siyaram and Singa, D.P. 2007. The seasonal variation in phytoplankton composition of Dhesura tal Lawain in Jaunpur district, U.P. J Indian Bot Soc. 86(34), 151 - 155.