IMPACT OF POLLUTION LOAD ON PHYTOPLANKTON ABUNDANCE IN SHIVNA RIVER AT MANDSAUR, M.P

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Abstract: The present study highlights on the impact of pollution on phytoplankton abundance and species composition in Shivna River, at Mandsaur, M.P. India. The study was carried out from July 2012 to June 2013 at three different sites (upstream RG, Mid stream PN, and downstream NRO). Various water quality parameters like temperature, PH, Dissolved oxygen (DO), Turbidity, alkalinity, Chloride, Nitrate, Phosphate was carried out in all study points in all seasons. Physico chemical water parameters like temperature, pH, DO, alkalinity and hardness, showed positive correlations with total phytoplankton abundance while TDS, TSS, sulfate phosphate and nitrite showed negative correlations.

Results illustrated distinct seasonal fluctuations in water parameters and plankton diversity. The outcome of this study also indicates a total 33 taxa belonging to 17 genera during the experimental period. We found 16 different taxa from Centralas and 32 variety taxa from Pennales. The large quantity of algae was fluctuated notably between the three study sites. The class Bacillariophyceae (Diatoms) was the dominant group of algae in all the three sites of Shivna River throughout the period of study. The present study also disclosed that the quality of the water was deteriorated due to human interventions at all the selected three sites of downstream in the River.

Keywords: Biodiversity, Diatoms, Shivna River, Water quality

Introduction: The use of biological parameters in categorizing various types of water deprivation is important and complementary to other environmental parameters. The use of algal diversity as biological indicators has recently been included in water quality programmes in some areas of India and other countries. Algae are an ecologically important group and have been an important component of biological monitoring programs. Algae are ideally suited for water quality assessment because they have rapid reproduction rates and very short life cycles, making them valuable indicators of short-term impacts. Algal assemblages are typically species rich, and algal species exhibit wider distributions among ecosystems and geographical regions. As primary producers, algae are most directly affected by physical and chemical factors. Algal assemblages are sensitive to some pollutants and they readily accumulate pollutants, and algal metabolism is also sensitive to the variation of environmental and natural disturbances. The importance of phytoplankton diversity as one of the most and significant biological indicators has been gradually applied (Ariyadej, C et al, 2004, Tiwari, A. and Chauhan, S.V.S., 2006, Hellawell, J.M. ed., 2012, Rodrigues, L.C et al, 2015, Ponnusamy, G et al, 2015, Singh, P., 2015, Sebastian, S., 2016, Sawaiker, R.U. and Rodrigues, B.F., 2016, Sreenisha, K.S. and Paul, P.T., 2016).

Pollution of the aquatic resources in India through discharge of industrial effluents and domestic sewage are the major threat. (Singh et al., 2007). The phytoplankton communities transform with the change in the environment in which they occur. The comparative quantity of loads of the species in a community often provides a good indication of pollution (APHA, 1992). But the research on phytoplanktons in relation to pollution is very less due to practical complications in the analysis and sampling in flowing water. For that reason, we intended to deal with the use of biodiversity of algae in relation to seasonality and pollution load on River Shivna at Mandsaur, M.P.India. We also put forward approaches and further research that may facilitate the use of phytoplankton collections for biological assessment of river health.

Materials and Methods: Study area: Mandsaur district is located on northwest part of Madhya Pradesh state extends between the parallels of latitude 23 46' and 24 45' north and between meridians of longitude 74 44' and 75 54' east. River Shivna is the tributary for river Chambal that flows from south directions. It is seasonal river and highly polluted by both municipal and industrial waste.

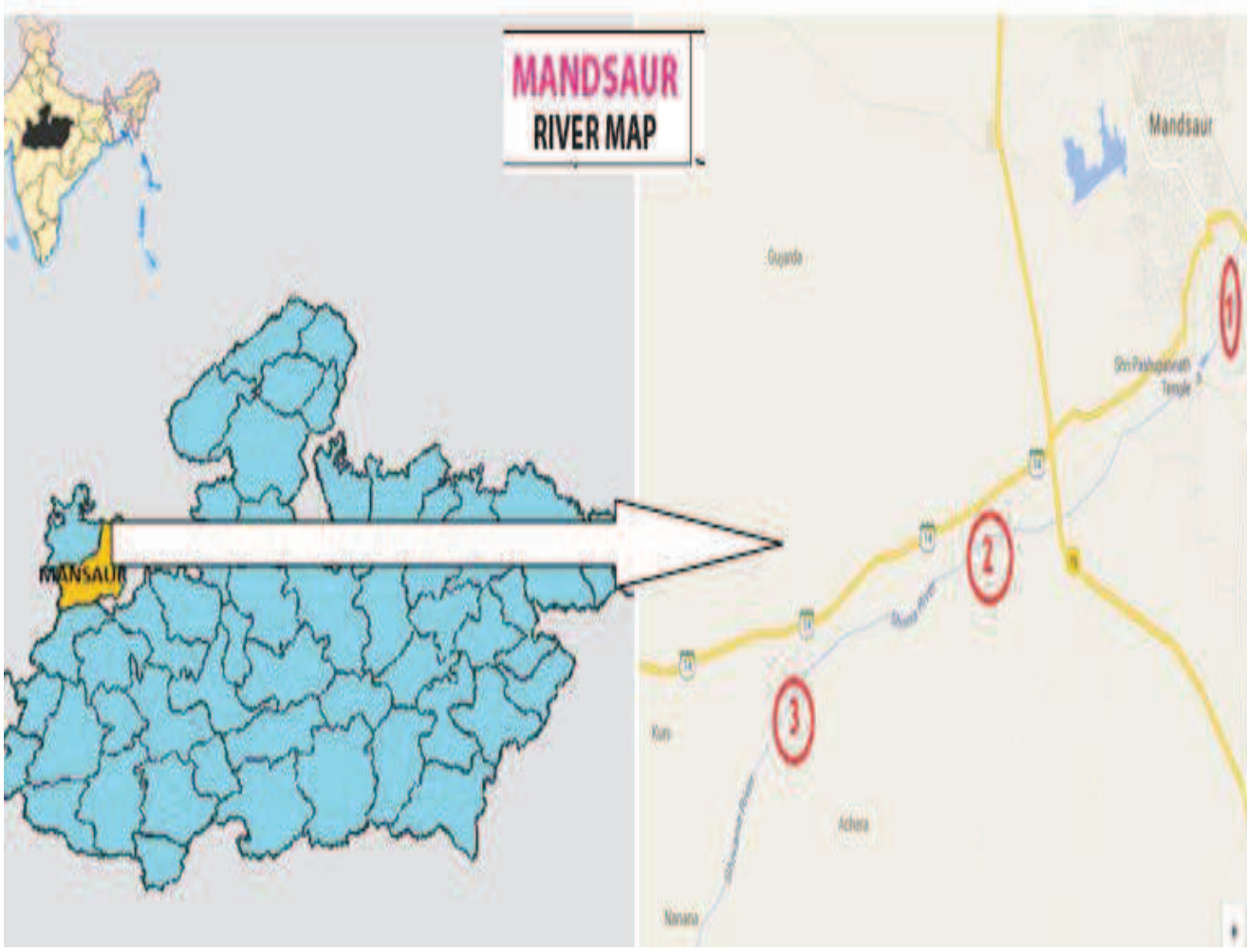

Fig.1. **Map showing the study locations of Shivna River at Mandsaur, India**

Three different stations of the river of both upstream and downstream were selected for the present investigation and named as Station I, II and III (I Upstream –Ramghat II. Middle stream-Pashupatinath temple and Downstream –Near Railway over Bridge).

Water sampling: Periodical water samples were collected from all three study sites in different seasons of the year for12 months from August 2012 to July 2013. Hygienic and sterilized plastic and glass bottles were used for sample collection. Sampling bottles were washed and rinsed thoroughly with river water earlier to sampling. The temperature and pH of water samples were noted by standard methods on the spot at the time of collection. Various water quality parameters like temperature, PH, Dissolved oxygen (DO), Turbidity, alkalinity, Chloride, Nitrate, Phosphate was carried out according to standard methods (APHA,2012).

Study of Phytoplankton: Samples were collected in 2012-13 on monthly basis from all the three study sites. Planktonic net, hand picking and squeezing of aquatic plant and brushing stones with a toothbrush etc were used for the sample collection. The collected sample was preserved in 4% formaldehyde in small plastic bottles. The species identifications, taxonomical characters and counts were made by standard methods described by Afnor (2007) using the Krammer and Lange-Bertalot (1998) floras and other particular bibliographical data. 'T' test was applied to verify the significant differences between the various biological traits in the organic pollution and trophic level classes.

Results and Discussion: The results of seasonal physico chemical analysis of surface water were summarized in Table.1. Results show that surface water samples were colorless and neutral at of Mandsaur sites. This investigation also clearly shows that, the status of the water of the downstream was eutrophic and it is unsuitable for the human uses. We also noted that the pollution load was relatively high during summer season when compared to other seasons. The value of the physico-chemical parameters were compared with desirable/permissible limit of ICMR/BIS of drinking water specification (BIS, 2003, ICMR, 1975).

Table.1: Seasonal variations of the physicochemical parameters of the surface water of Shivna River at Mandsaur

Sr.No.	Parameters	Rainy season			Winter Season			Summer season		
	Study Stations	S1	S2	S3	S1	S2	S3	S1	S2	S3
1.	pH	6.8	6.9	7.0	7.8	8.1	8.4	8.2	8.7	8.6
2.	Electrical Conductivity	380	290	302	395	389	395	401	412	426
3.	Total Dissolved Solids	575	587	581	356	452	462	390	587	535
4.	Total alkalinity	58	62	70	75	81	85	51	69	73
5.	Chlorides	24.74	25.22	26.51	24.14	27.21	23.51	26.72	24.11	28.17
6.	Nitrate	0.201	0.191	0.166	0.31	0.21	0.186	0.231	0.21	0.26
7.	Dissolved oxygen	6.9	7.1	7.4	8.3	8.6	8.8	7	8.7	8.6
8.	EC,umho/cm	85.73	321.2	321.2	85.73	321.2	321.2	85.73	321.2	321.2
	Water Quality Index	96.00			101.7			106.3		

During the present study a total of 191 algal taxa belonging to 87 genera have been gathered and identified in different seasons and in different study sites of the River. The number of various member of class Chlorophyceae (124 taxa), Euglenophyceae (12 taxa), Bacillariophyceae (33 taxa) and Cyanophyceae (22 taxa) are as publicized in Table 2 and Fig.a&3.

Table.2 Group wise distribution of phytoplankton at different stations of the Shivna River at Mandsaur.M.P.

	Total Genera	Total Taxa	Site-I		Site-II`		Site III	
			Genera	Taxa	Genera	Taxa	Genera	Taxa
Chlorophyceae	56	124	56	119	47	69	38	61
Bacillariophyceae	17	33	12	23	13	19	12	20
1.Centralas	1	1	1	1	1	1	1	1
2.Pennales	16	32	11	22	11	18	11	19
Cyanophyceae	11	22	11	22	11	18	11	19
Euglenophyceae	03	12	03	12	02	08	01	05
Total	**87**	**191**	**82**	**176**	**73**	**114**	**62**	**105**

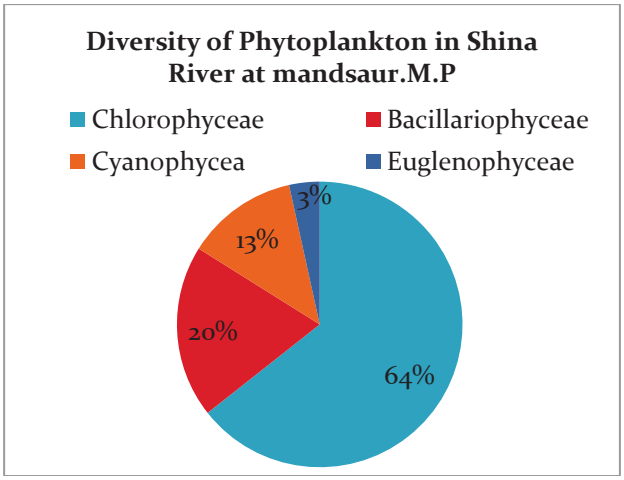

Fig.2. Distribution of phytoplankton at different stations of the Shivna River at Mandsaur.M.P

The physicochemical parameters of water affected the diversity and distribution of algae in different seasons. The less diversity during Monsoon may be due to high water currents of the River. The trends of various assemblages of phytoplankton in river Shivna showed that the lowest populations were observed during rains, more in winters and maximum during summer. We also noticed that the abundance of phytoplankton were very less in number at all sites during February/March. However in May the abundance of phytoplankton was high and the highest number of Bacillariophyceae was obtained at the site 2.

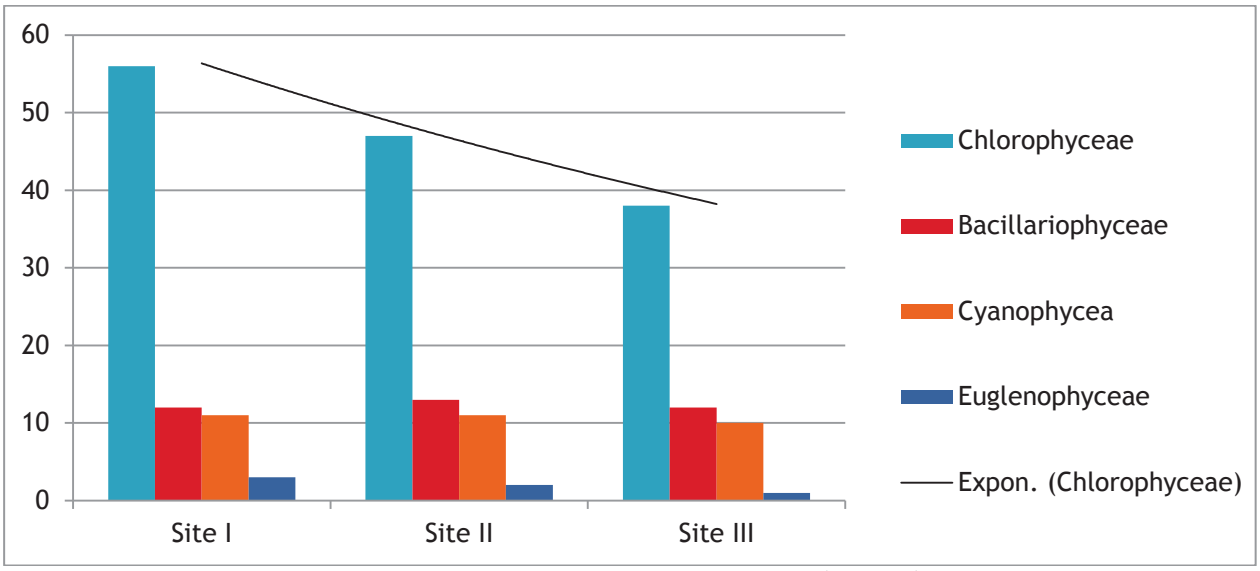

Fig.3.Group wise distribution of phytoplankton (genera) at different stations of the Shivna River at Mandsaur.M.P

During the present study species diversity of Bacillariophyceae was 17 genera and 33 species distributed across all three sites. The Species composition percentage was higher at Site-I and III. Diatoms as a whole were fairly dominant though out the study except during monsoon. The diatoms were found as regular inhabitants of the river water under all seasonal fluctuations. Peak of diatom population in January at low temperature and high D.O. has been also reported by Tiwari *et al.* (2001). The seasonal periodicity and species richness designate Site-I to be oligotrophic, whereas in polluted Site-II and III exhibited algal characters. The present study clearly exhibits the seasonal changes in algal dynamics in relation to the water quality status of river Shivna. The high density of diatoms have been reported to be associated with addition of sewage and starch factory effluent at Site-II and Site-III respectively, which results in a fall of species diversity. Impact of water quality difference is reflected in higher diatom diversity at Site-I but more assemblage was found in downstream.

Conclusions: The assessment of the phytoplankton diversity in various study points of Shivna River at Mandsaur leads to the conclusion that the river is contaminated with organic pollutants. It is suggested that constant probing of the River should be encouraged to reduce the possible risks brought about by pollutants of this River.

The present study discloses that the study sites II and III in the Shivna River at Mandsaur were polluted especially in summer months due to human interferences. The distribution and abundance phytoplankton varied in different sites and in different seasons. Therefore, phytoplankton can be used as a promising tool for assessing the intensity of different water bodies.

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