Distribution of Macrophytes in River Narmada near Water Intake Point

Vipin Vyas, Salma Yousuf, Shilpa Bharose and Ankit Kumar*

Department of Environmental Sciences and Limnology, Barkatullah University, Bhopal- 462-026, India

*Email: ankit_limno@yahoo.co.in

Abstract:

Rivers have always been the most important fresh water resources. Along the banks of rivers ancient civilizations have flourished and still most of the developmental activities are dependent. Rivers support vast biodiversity of flora and fauna which provide food & shelter to aquatic organisms. Aquatic macrophytes are group of large macroscopic photosynthetic organisms usually growing with their roots in soil or water. Macrophytes provide habitat to aquatic organisms also help in maintaining water quality, nutrient cycling and stabilizing river banks. Present study was carried out on the distribution of macrophytes near water intake point in river Narmada and study depicted about the loss of macrophytic distribution in lower reaches of water intake point in river Narmada in conjunction with some physico-chemical parameters of water quality.

Key Words: River Narmada, Water Intake Point, Aquatic Macrophytes, Water quality.

1. Introduction

River is a natural water course, usually fresh water, flowing towards an ocean, a lake, a sea or another river and play important role in supporting life for all organisms. Aquatic macrophytes refer to large plants visible to the naked eye and having at least their vegetative parts growing in permanently or periodically aquatic habitats. They are the conspicuous plants that dominate wetlands, shallow lakes and streams include aquatic angiosperms (flowering plants), pteridophytes (ferns) and bryophytes (mosses, liverworts, hornworts). Macrophytes often grow more vigorously where nutrient loading is high. Aquatic macrophytes play vital role to make healthy ecosystem and serve as primary producers of oxygen through photosynthesis, provide a substrate for algae, shelter for benthic fauna and breeding ground for fishes. Macrophytes constitute a diverse assemblage of taxonomic groups and can be described as: (i) Floating unattached plants: those plants in which most of the plant is, at or near the surface of water, a root if present hang free in the water and are not anchored to the bottom, (ii) Floating attached plants: plants having leaves which float on surface, but their stems are beneath the surface and their roots anchor the plant in the substrate, (iii) Submerged plants: these are found when entire plant is below the surface of the water, (iv) Emergent plants: those plants whose roots grow under water, but their stems and leaves are found above the water. Present study was directed towards the distribution of macrophytes in conjunction with water quality parameters on the upper reaches, lower reaches and in front of water intake point of river Narmada.

2. Material and Methods

2.1. Study Area:

Narmada is the largest west flowing river of India and one of the 13 prominent rivers of India, originates from a small tank called Narmada kund located at Amarkantak town in Maikal hills ranges from eastern part of Madhya Pradesh forms a traditional boundary between North India and South India over a length of 1,312 Km before draining through the gulf of Cambey (Khambat) into the Arabian Sea.

Present study was carried out in a small reach on the right bank of River Narmada in the central zone from Shahganj village to Jahanpur village in the month of September-November 2011. Between these villages a water intake point has been constructed near the Hirani village to supply drinking water for Bhopal city, the capital of Madhya Pradesh. Aim of the study was to examine the distribution of macrophytes in relation with some water quality parameters on the upper reaches, lower reaches and in front of water intake point (pumping station) (Figure 1).

During the study five sampling stations were chosen for sampling. Station I is located down to Shahganj village and lies on 77° 47.59'E and 22° 50.23'N longitude and latitude. Station II is located on the upstream of water intake point and lies between 77° 47.460'E and 22° 49.939'N longitude and latitude. Station III is located in front of water intake point at Hirani village and lies between 77° 47.439'E and 22° 49.82'N longitude and latitude. Station IV is located at the downstream of water intake point and lies between 77° 47.357'E and 22° 49.782'N longitude and latitude. Station V is situated at Chandni nalla near Jahanpur village and lies between 77° 46.983'E and 22^{o} 49.174'N longitude and latitude. All sampling stations are shown in Figure 2.

2.2. Macrophyte Collection and Identification:

Macrophytes constitute a significant component of the aquatic ecosystem and they are of considerable ecological & economic importance. Submerged macrophytes are in contact with water and mud; stems are long and bearing small leaves. Emergent macrophytes grow in shallow waters, are the hydrophilous forms which although require excess of water but their shoots are partly or completely exposed to air. Collection of macrophytes was done with the help of an iron hook on different sampling sites. After collection, samples were washed to get rid of adhering materials and stored properly in poly bags. Collected macrophytes were identified with the help of C.D.K. Cook (1996) and Adoni *et al.,* (1985).

2.3. Water Quality Parameters:

Water samples were collected from all sampling stations and field parameters like Temperature, Transparence, Depth, Water Flow, Conductivity, pH, Turbidity and Total Dissolved Solids (TDS) were determined at sampling sites, where as some other physico-chemical parameters like Chloride, Total hardness, Calcium hardness, Nitrate, Orthophosphate and Total phosphorus were analysed in the laboratory. Methods for the analysis of physico-chemical characteristics of water were followed by APHA (1998) and Adoni *et al.,* (1985).

3. Results

During the study, total 8 (Eight) species of macrophytes were recorded indicating rapid growth of macrophytes with minimum species diversity. These species were catagorised under emergent and submerged macrophytes (Table 1). Emergent macrophytes belong to one class (Mangnoliopsida), three families (Polygonaceae, Onagraceae & Convolulaceae) and three orders (Polygonales, Myrtales & Solonales) while submerged macrophytes belong to one class (Monocotyledons), four families (Potamogetonaceae, Hydrocharitaceae, Najadaceae & Aracaceae) and four orders (Potamogetonales, Butomales, Najadales & Alismatales) shown in Table 2. Results show that submerged species of macrophytes represent 63% and acquires a dominant position in the study area where as emergent species of macrophytes are only 37% (Figure 3).

Among all macrophytes the most common was Polygonum *glabrum*, dominated at all sampling sites followed by Ipomea *fistula*. Najas *sps.* and Hydilla *sps.* were also found in good quantity at sampling site I, II, IV and V. Cryptocoryne *retrospirales* and Jussiaea *repens* were found in very less number. At sampling site III no macrophytes was reported due to construction of pumping station. Some variables like depth, river width, catchment area, water flow influence the growth of macrophytes

Water quality characteristics of aquatic environment arise from multitude of physical, chemical and biological interactions. Physical properties of water in any aquatic system are largely regulated by existing conditions and chemical properties. Chemical properties of water not only change the physical properties of medium but also have a significant influence on the distribution and metabolic activities of the life forms, which in turn, tend to change the chemical quality of water in definite course of time. The results of physico-chemical parameters of sampling sites of river Narmada indicates the range of pH from 7.6 to 8.7 at site V & IV respectively. The depth ranges from 85 cm at site V to 219 cm at site I. Water flow was recorded between 12cm/s at site II to 53cms/s at site IV. Minimum value of conductivity was observed 200 µS at site III, while maximum value was 460 µS at site V. Total Dissolved Solids (TDS) ranged from 80 mg/l to 180 mg/l at sites II, IV & V. Turbidity ranged from 52 mg/l at site V to162 mg/l at site I. Dissolved Oxygen level was within the range of 8.2mg/l at site IV to 8.8 mg/l at site I. Alkalinity ranged from 48.8mg/l at site I to 54.6mg/l at site IV. Nitrate concentration was within the range of 1.6mg/l at site II to 2.8 mg/l at site V. Total Phosphorus was 1.4 mg/l at site V to 0.6 mg/l at site III.

Orthophosphate ranged from 0.09 mg/l at site IV to 0.1 mg/l at site V. Water temperature ranged between 29°C at site III & IV to 32°C at site II, while air temperature ranged between 26°C at site IV 35°C at site I, II & V.

4. Discussion

Fresh water bodies are subjected to variations in the environmental factors such as temperature, dissolved oxygen, light penetration, turbidity, density etc. These factors are responsible for distribution of organisms in different freshwater habitats according to their adaptation, which allow them to survive in that specific habitat. The addition of various kinds of pollutants and nutrients through sewage, industrial effluent etc. into water bodies bring about a series of changes in physico-chemical and biological characteristics of fresh water. These changes have been the subject of various investigations. It is found that there is not a single and most significant factor explaining the spatial patterns and composition of macrophyte communities (Grinberga, 2011).

The results of the present study revealed that one of the most important factors affecting distribution of macrophyte and other aquatic organisms was abstraction of water. This agrees with the results of other investigations (Benejam *et al.,* 2009, Mitchell, 1993). At sampling sites I and II maximum number of macrophytic species were reported due to alkaline pH and good level of dissolved oxygen. The relationship between macrophytes and water temperature is positively correlated, as the photosynthetic activity is increased by increase in temperature (Uedeme-Naa *et al.,* 2011). The relationship between nutrients (nitrate, phosphorus, orthophosphate) and macrophytes were negatively correlated, as macrophyte growth and distribution is associated with nutrient rich environments particularly nitrate and phosphate which have been noted to favour growth of macrophytes (Frankouich *et al.,* 2006). At sampling site IV and V lesser number of macrophytes was recorded, although dissolved oxygen and pH favours the growth of macrophytes but nutrients (nitrate, phosphorus, orthophosphate) were available in less quantity and thus distribution of macrophytes was also affected. At site III physico-chemical properties of water were favourable for macrophytic growth but no species was present because of construction of water intake point.

5. Conclusion

The study revealed that, at present there is significant decrease in macrophyte diversity in lower reaches due to abstraction of water. Diversity was rich in upper reaches to some extent, at third sampling site i.e. in front of water intake point no species were reported due to construction and in lower reaches lesser number of macrophytes were reported. The quality of water in the study area was found in almost good condition and favorable for macrophytic growth but due to water intake point (pumping station) it ultimately affects the macro invertebrates and other aquatic flora and fauna in the river. In future, increase in water supply from the intake well of river Narmada will decrease the diversity of macrophytes and quality of water and shall subject for future research in environment impact assessment of water intake point on ecology of river.

6. Acknowledgement

Authors are thankful to Prof. Pradeep Shrivastava, Head, Department of Zoology and Applied Aquaculture for giving permission to use GIS softwares for map preaparation. Suggestions given by Mr. Amit Dubey and Mr. Vivek Parashar during the work are gratefully acknowledged. Thanks will be due to Mr. Shyam Panwar, Mr. Mehraj Din Chopan, Mr. Kripal Vishwakarma and Mr. Mansoor Ahmed Sheikh who helped during field visits.

7. References

American Public Health Association (APHA) (1998). Standard methods for examining water 20th edition Washington D.C.

Adoni, A.D., Joshi, G., Ghosh, K., Chourasi, S.K., Vaishya, & A.K. Yadav, H.G. (1985). Workbook on Limnology, Pratibha Publication Sagar 216pp.

Benejam, L., Angermeiz, L., Munne, A. & Berthou, E.J. (2009). Assessing effects of water abstraction on fish assemblages in Mediterranean streams. *Freshwater Biology* **55**, 628–642, DOI:10.1111/j.1365-2427.2009.02299.x

Cook, C. D. K. (1996) Aquatic and wetland plants of India, Oxford University Press, New York, 385 pp.

Grinberga, L. (2011). Macrophyte species composition in streams of Latvia under different flow and substrate conditions. *Estonian journal of ecology* **60**(3), 194-208, DOI: 10. 3176/eco. 2011.3.03

Frankouich, T. A., Gainer, E.E., Zieman, J. C & Wachnick, A. H. (2003). Spatial and temporal variation of epiphytic diatoms growing on Thalassic testudinum Banks ex Konigh. Relationship to water quality. *Hydrology* **340**, 259-271.

Mitchell, C & Associates (1993). Monitoring impacts of water abstraction from the Takahue River. *Conservation Advisory Science Notes No. 52,* Department of Conservation, Wellington. 8pp.

Uedeme-Naa .B., Gabriel, U.U and Akinrotimi, O.A. (2011). The Relationship between aquatic macrophytes and water quality in NTA-WOGBA Stream Nigeria. *Continental J. Fisheries and Aquatic Science* **5**(2), 1-6, http://www.wiloludjournal.com

Figure 1: Map of the Study Area

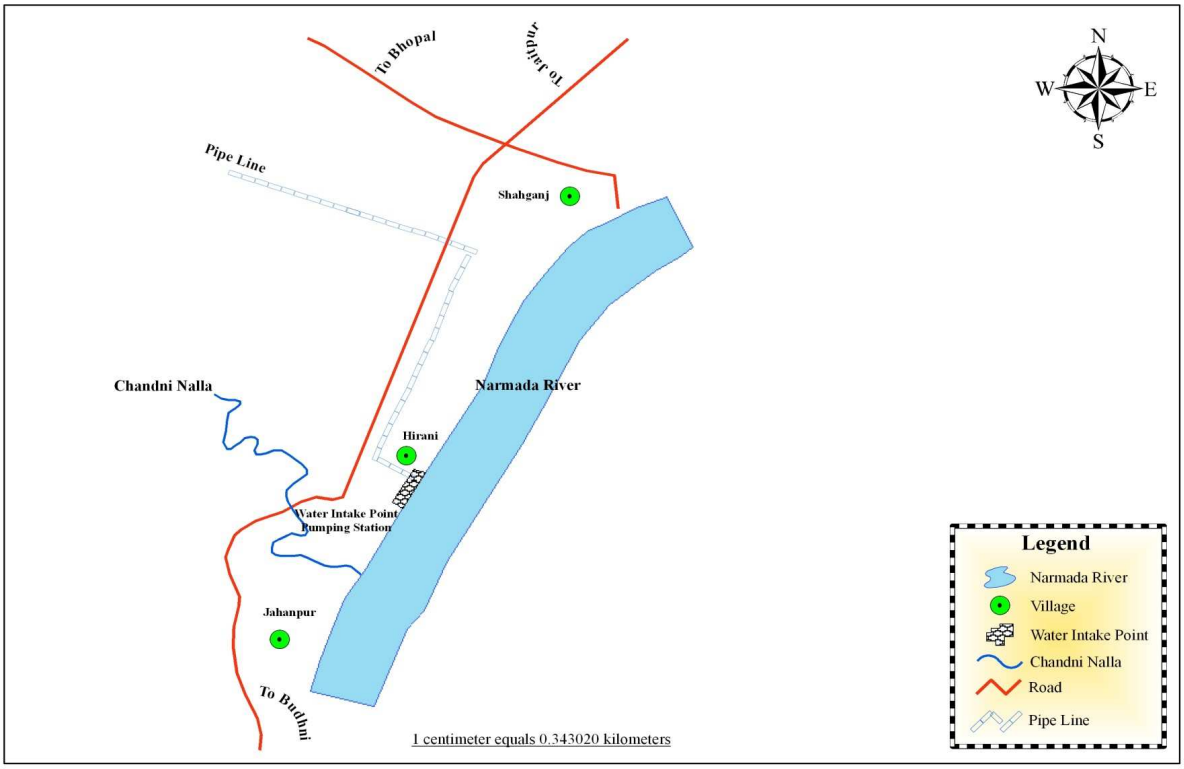

Figure 2: Sampling Sites of the Study Area

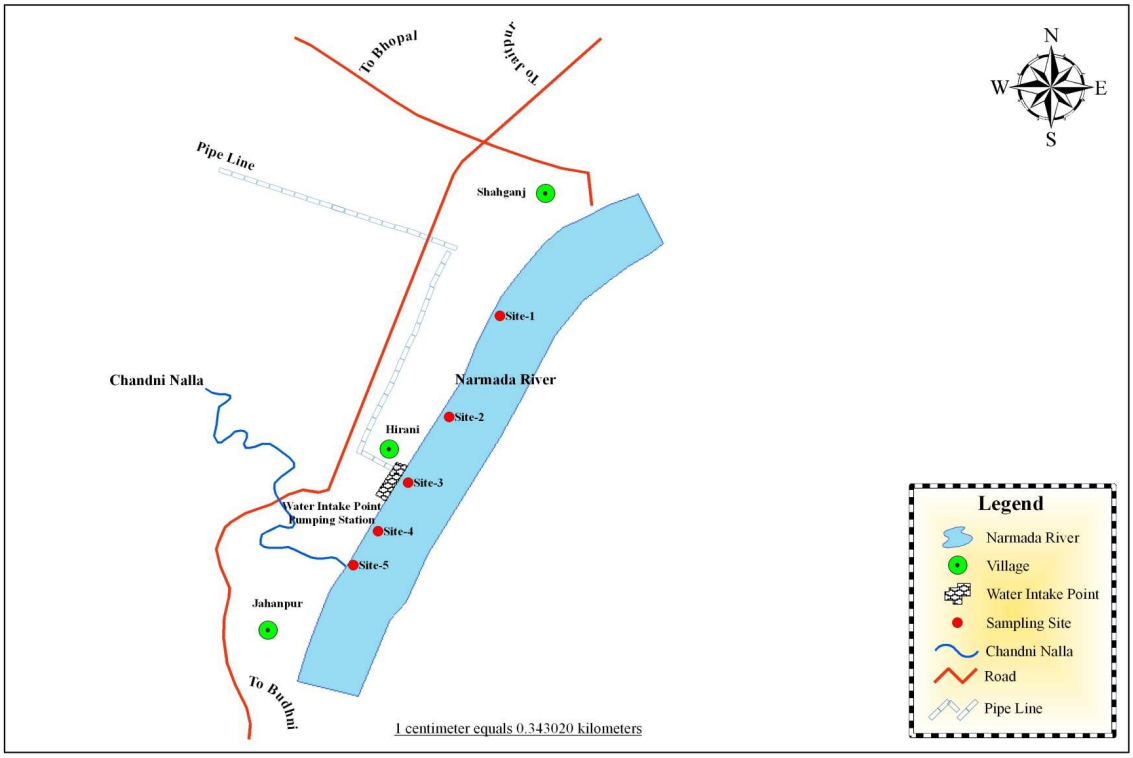

Figure 3: Percent Composition of Macrophytes in the Study Area

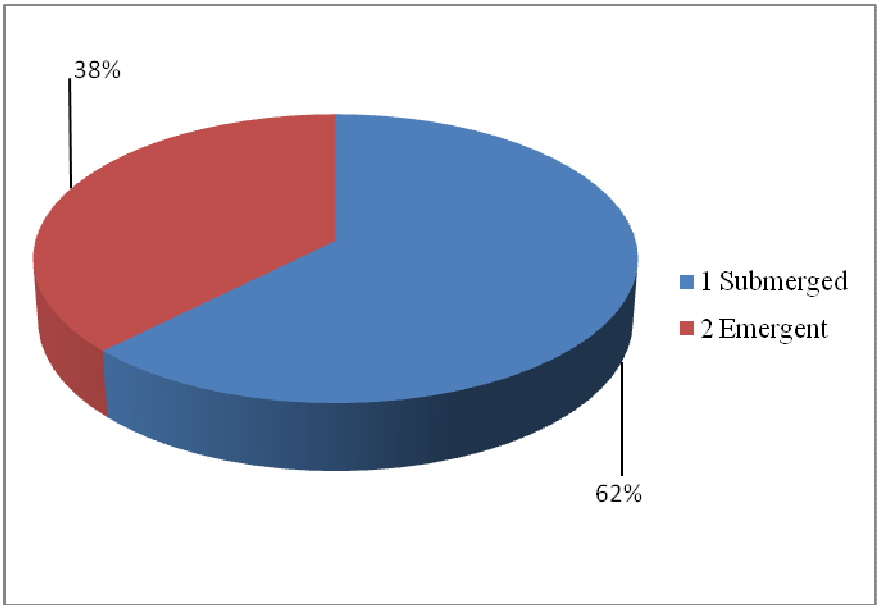

Table 1: Categorisation of macrophyte found in the study area

S.No.	Type	Name of the species
1	**Submerged**	Najas *minor*
2		Najas *graminea*
3		Potamogeton *pectinatus*
4		Hydrilla sps.
5		Cryptocoryne *retrospirales*
6	**Emergent**	Polygonum *glabrum*
7		Ipomea *fistula*
8		Jussiaea *repens*

Table 2: List of Macrophytes recorded during study

Kingdom	Class	Order	Family	Genus	Species
Plantae	Monocotyledons	Potamogetonales	Potamogetonaceae	Potamogrton	*Pectinatus*
		Butomales	Hydrocharitaceae	Hydrilla	*sps.*
		Najadales	Najadaceae	Najas	*Minor*
					Graminea
	Mangnoliopsida	Polygonales	Polygonaceae	Polygonum	*Glabrum*
		Alismatales	Aracacea	Cryptocoryne	*Retrospirales*
		Myrtales	Onagraceae	Jussiaea	*Repens*
		Solonales	Convolvulaceae	Ipomea	*Fistilosa*