Macrophytic diversity measurements, A case study of 30 kms stretch of Narmada river in central India.

Dr. Muslim Ahmad Shah and Dr. Vipin Vyas

Dept. Of Environmental Science, ASC Cluster University Srinagar.

Abstract: River plants tend to be associated with particular nutrient concentrations (Holmes and Newbold 1984). In streams where there is an inflow of polluted water from different sources (Natural as well as Anthropogenic) and this polluted water is some time enough intense to destroy the vegetation balance and diversification. Excessive nutrients should be prevented from getting into the water as they will stimulate rapid plant growth which leads to the death of the water body. Besides, aquatic macrophytes are essential to natural water bodies, such as rivers, lakes and ponds, and contribute to the overall health of the water-based ecosystems. Macrophytes are unchangeable biological filters and they carry out purification of the water bodies by accumulating dissolved metals and toxins in their tissues.

The aim of this research was to assess the Macrophytic diversity in selected reaches of River Narmada at Hoshangabad District of Madhya Pradesh.

Key Words: River Narmada, Aquatic, Macrophyte, Water quality, Anthropogenic, vegetation, Ecosystem.

Introduction: Rivers are complex flowing water systems of draining specific land surfaces which are defined as river basins or watersheds. The characteristics of the river, or rivers, within the total basin system are related to a number of features. These features include the size, form and geological characteristics of the basin and the climatic conditions which determine the quantities of water to be drained by the river network. Rivers have always been the most important fresh water resources. While as macrophyte is an aquatic plant that grows in or near water and is either emergent submergent, or floating. Plants have adapted to thrive in diverse habitats. They are most obvious in the terrestrial environment, but they also can inhabit many types of aquatic environments. Aquatic plants are a natural part of the aquatic ecosystem, used by many different animals either as food or as a hiding place. Many people find aquatic plants interesting and attractive. However, as with any naturally occurring organisms, they may interfere with people's activities either by their over-abundance or by their mere presence. When this occurs the plants are considered "weeds" and some control is desired. Keeping this in mind, comparative study on macrophytic diversity was done during 2012-13. Diversity is commonly used to describe the number, variety and variability of living organisms.

Material and Methods:

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 hill 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. The tributaries of River Narmada are of great importance in Central India as they provide an important source of water, irrigation and other resource based activities. When river Narmada emerges from the Marble Rocks it enters into its first fertile basin. This basin extends about 320 km with an average width of 35 km in the south. The northern part of the valley is the Barna-Bareli plain, where the Barna River flows.

The aim of this research was to assess the distribution of macrophytes in selected reaches of River Narmada at Hoshangabad District of Madhya Pradesh. During the present study fourteen sampling stations were chosen for sampling in the central zone of M.P. which starts from Shahganj village to Bandra village.

Shahganj- The water at Shahganj site is of run condition. The range between the banks was measured 350mts. The river bank at this stretch shows some agricultural practices.

Hirani Ghat- The stretch at this site is of pool condition with a range of 434mts between the banks. The station is dominated by only one species of aquatic macrophyte. Agricultural practices were seen on the upper side of the bank.

Jahanpur- The site shows maximum range of 500mts between the left and right bank. The station is also dominated by only one species of macrophyte which is in abundance on the right bank.

Bahndraban Ghat (Right bank) - This site is situated at right bank of the river. The section shows range of 455mts between the banks. This section of the river is followed by some religious practices.

Bhandraban Ghat (Left bank) - This site is situated on left bank of the river. This stretch forms the confluence point for Tawa River. The range between the banks measures up to 343mts.

Ramnagar- This site is also located on the right bank of the river. The range between the banks measured 295mts. The stretch is dominated by two macrophyte species.

Zarrahpur- This site is located on the left bank of the river just opposite to the Jamuniya Qila. The range between the adjacent banks measures up to 450mtrs. This stretch shows some macrophytic diversity.

Landia- This site is located on the left bank of the river. This stretch has been the sink for domestic sewage. The stretch shows the range of 230mts between the adjacent banks.

Opposite Gadariya Nalla- This site is also on the left bank of the river just opposite to the confluence of Gadarya nala. This stretch also shows some macrophytic diversity.

Budhni Ghat- This site is located on the right bank of the river. The stretch is in a pool condition with a maximum range of 245.5mts. The stretch is dominated by maximum number of macrophyte species.

Dongarwara- This site is located on the right bank of the river. The water is in a run condition with a maximum range of 148mts. The stretch is dominated by two macrophyte species.

Mou-Kalan- This site is also located on the right bank of the river. The adjacent banks show a range of 350 meters. The water is in a run condition.

Kaliyadeh Nalla confluence- This site is located at the confluence of Kaliyadeh Nalla. The water is also in a run condition. The stretch shows a range of 370mts between the banks.

Holipora Ghat- This site is on the right bank of the river. The stretch shows some agricultural practices. The station shows maximum macrophytic diversity with a maximum range of 356mts.

Macrophyte Collection and Identification:

Macrophytes are considered to be most important component of the aquatic ecosystem having ecological as well as economic importance. Macrophytes contact with water and mud are termed as Submerged their stems are long and are bearing small leaves. Macrophytes which grow in shallow waters are Emergent, they are hydrophilous forms and require water in excess, however, their shoots are partly or completely exposed to the atmosphere. During the process of collection, macrophyte species were collected with the help of iron hook at different sampling sites and a boat was hired in order to collect the macrophytes farther than iron hook. The samples collected were immediately washed out to get rid from all adhering materials and were stored properly in polythene bags. Soon after collection all macrophyte species were identified with the help of identification keys given by C.D.K. Cook (1996) and A.D. Adoni (1985).

Results:

Macrophytic diversity in Narmada River:

During the present study, a total 12 species of aquatic macrophytes were recorded. These macrophytic species were categorized as Free Floating macrophytes, Submerged macrophytes and Emergent macrophytes.(Table 2). Free floating macrophytes recorded during the study period were Vallisneria spiralis, Spirogyra sps., Eichhornia crassipes, Azolla pinnata. The Submerged macrophytes constitutes Najas graminea, Hydrilla verticillata, Potamogeton crispus and Potamogeton nodosus. Whereas, Emergent macrophytes recorded in this study were Polygonum glabrum, Sagittaria sps., Cyperus amabilis and Typha domingensis. Among all macrophytes the most common species recorded were Najas graminea which was dominated almost at all sampling stations followed by Vallisneria *spiralis*, Hydrilla *verticillata*, Potamogeton *crispus*, Polygonum *glabrum*, Cyperus *amabilis* and Typha *domingensis.* Potamogeton *nodosus* was found at sampling site IV and IX. Azolla *pinnata* was also found in only two sampling sites i, e. Sampling site IX and XIV respectivily. Spirogyra and Sagittaria species were found in very less number. Eichhornia *crassipes* was found at sampling site (VIII) only, were river water is highly contaminated by domestic sewage. However, the Classification of macrophytes, recorded during the present study is shown in (Table-1).

Table 1: classification of macrophytes recorded during study:

Kingdom	Class	Order	Family	Genus	Species
Plantae	Monocotyledons	Alismatales	Hydrocharitaceae	Vallisnera	spiralis
		Alismatales	Hydrocharitaceae	Hydrilla	verticillata
		Alismatales	Hydrocharitaceae	Najas	graminea
		Alismatales	Potamogetonaceae	Potamogeton	crispus
		Alismatales	Potamogetonaceae	Potamogeton	nodosus
		Commelinales	Pontederiaceae	Eichhornia	crassipes
		Alismatales	Alismataceae	Sagittaria	sps.
		Poales	Typhaceae	Typha	domingensis
	Dicotyledons	Polygonales	Polygonaceae	Polygonum	glabrum
	Polypodiopsida	Salviniales	Azollaceae	Azolla	pinnata
	Lilopsida	Poales	Cyperaceae	Cyperus	amabilis
Protista	Zygnematophyceae	Zygnematales	Zygnemataceae	Spirogyra	sps.

Table 2: Categorization of identified macrophytes during the study:

S. No.	Type	Name of species
1	Free Floating	Azolla pinnata
		Eichhornia crassipes
		Vallisneria spiralis
		Spirogyra sps.
2	Submerged	Potamogeton crispus
		Hydrilla verticillata
		Potamogeton nodosus
		Najas graminea
3	Emergent	Polygonum glabrum
		Typha domingensis
		Cyperus amabilis
		Sagittaria sps.

Table 3: Diversity of macrophytes at all the selected sites:

Name of species	Site-1	**Site-2**	**Site-3**	**Site-4**	**Site-5**	**Site-6**	**Site-7**	**Site-8**	**Site-9**	**Site-10**	**Site-11**	**Site-12**	**Site-13**	**Site-14**
Vallisneria *spiralis*	+	-	-	-	-	-	+	-	-	+	-	+	-	-
Hydrilla *verticillata*	+	-	-	-	-	+	+	-	-	+	-	-	-	-
Najas *graminea*	+	-	-	-	-	+	+	-	-	+	-	+	-	-
Potamogeton *crispus*	-	-	-	-	+	-	-	-	+	+	-	+	-	-
Potamogeton *nodosus*	-	-	-	-	-	-	-	-	+	+	-	-	-	-
Spirogyra *sps*.	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Eichhornia *crassipes*	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Azolla *pinnata*	-	-	-	-	-	-	-	-	+	-	-	-	-	+
Polygonum *glabrum*	-	+	+	-	-	-	-	-	-	-	-	-	+	+
Sagittaria *sps.*	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Cyperus *amabilis*	-	-	-	+	-	-	-	+	-	-	-	-	+	+
Typha *domingensis*	-	-	-	-	+	-	+	-	-	-	+	-	-	+
Total	**3**	**1**	**1**	**1**	**2**	**2**	**4**	**2**	**3**	**5**	**2**	**3**	**2**	**5**

Discussion:

Assessment of macrophytic species diversity, abundance and distribution of established populations, provides indicative information of environmental impacts upon aquatic ecosystems. Macrophytes are especially good bioindicators in continuous and long period monitoring. They do not have strong mechanisms regulating the uptake of nutrients and heavy metals. Some species have expressive ability of bioconcentration and therefore, increased accumulation, of nutrients and heavy metals, (STANKOVIC et al., 2000). Macrophytes play an important role in developing future management strategies for aquatic systems. The main factors and processes involved in controlling the status of macrophytes in temperate rivers are typically velocity, light, substrate, competition, nutrient status and river management practices (Franklin *et al*., 2006).

During the present study, only twelve species of aquatic macrophytes were identified in Narmada River. Among all these species of aquatic macrophytes, seven species were widely distributed these are Najas *graminea* followed by Vallisneria *spiralis,* Hydrilla *verticillata,* Potamogeton *crispus,* Polygonum *glabrum,* Cyperus *amabilis and* Typha *domingensis*. All the recorded macrophyte species are catagorized as Free Floating, Submerged and Emergent macrophytes. The results of the present study revealed that the submerged macrophyte Potamogeton *crispus* was found at maximum sampling sites which are mostly shallow reaches. These submerged macrophytes acts as semi-permeable dams retarding flow velocities and increasing river depth. They likely increase the sedimentation, potential for nutrient processing and increased primary production, both by macrophytes and attached epiphyton (Champion and Tanner, 2000). Eichhornia *crassipes* was found at only one station (sampling station VIII) which was recognized as highly polluted area of the river and acts as a sink for domestic sewage. Eichhornia *crassipes* could be regarded as a pollution tolerant aquatic macrophyte and might be used as a biological indicator for water pollution (Kshirsagar and Gunale, 2013). The macrophytes diversity is directly affected by the water flow. During the study maximum numbers of macrophytes were reported from low flow areas whereas macrophytic diversity was almost absent at high water flow areas. Majority of the plant species collected during the survey are indicators of eutrophic conditions. Some collected species such as Ceratophyllum *demersum,* Potamogeton *crispus* and Eichhornia *crassipes* commonly serve as indicators of a significant nutrient load. Based on the broad distribution of these species within the longitudinal extent of the River, a conclusion can be drawn about significant nutrient inputs and sources. In general, submerged macrophyte species prefer low light conditions and low water temperatures than free floating or even emergent species.. The final dominance of the three submerged macrophyte species Najas *graminea,* Hydrilla *verticillata* and Potamogeton *crispus* is decided upon the factor of light availability which in its turn is determined by the transparency of the river water. Submerged species prefer high transparency values as habitat conditions.

Conclusion:

The main motto behind this piece of research work was to assess the diversity of aquatic macrophytes in selected reaches of river Narmada. A systematic survey was done throughout the stretch on both the banks. Diversity of macrophytes was found high in the areas where water flows slowly and low in the areas where water flows fast. On the basis of the study results we may conclude that some aquatic macrophyte species were sensitive to water pollution in some stretches of river Narmada similarly here at sampling station VIII (Landia) it shows high degree of organic pollution which results the dominance of Eichhornia *crassipes*, this specie is considered to be the indicators of organic pollution. The results also suggested that the impact on aquatic macrophytes of river Narmada is due to the discharge excessive nutrients which should be strictly prevented from getting into the water it is because they stimulate rapid plant growth. Common sources of nutrients discharged in to the river are runoff from livestock holding areas, septic tank drainage, and heavily fertilized fields.The submerged macrophytic diversity was mostly observed in shallow reaches, where they deposit sediments resulting in the primary production both by macrophytes and epiphytons.

The study also revealed that at sampling stations I (Shahganj) and sampling station XIV (Holipora) some agricultural practices were observed on the banks of the river followed by the use of nutrient rich fertilizers for crop production, the aquatic macrophyte diversity was observed in abundance at both the stations that might be due to the nutrient load from the adjacent crop fields. The study further revealed that macrophytes represent the best indicators of water pollution in Narmada River. In future, decrease in the domestic sewage discharge and substitution of chemical fertilizers with organic fertilizers in agricultural practices near the banks of river Narmada in order to decrease the diversity of weeds and promote the growth of healthy macrophytes for the aquatic life and pollution indication.

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References:

Ali. M.M., Mageed., A. A and Heikal. M. (2006). Importance of aquatic macrophyte for invertebrate diversity in large subtropical reservoir. Limnological. 37: 155-169.

Baatrup-Pedersen. A and Riis. T. (1999). Macrophyte diversity and composition in releation to substratum characteristics in regulated and unregulated Danish Streams. Freshwater Biology. 42: 375-385.

Camargo. A. F.M. and Florentino. E.R. (1999). Population dynamics and net primary production of the aquatic macrophytes, Nymphaea rudgeana C.F Mey in a lotic environment of the Hanhaem river basin (SP Brazil). Rev. Brasil. Biol. 60(1): 83-92.

Champion. P. D and Tanner. C. C. (2000). Seasonality of macrophytes and intereaction with flow in a New Zealand lowland stream. Hydrobiologia. 441: 1-12.

Chapman. D. (1998). Water quality assessments- A guide to the use of biota, sediments and water in Environmental monitoring, Taylor and francis, an imprint of Rouledge 2, Park Square, Milton Park, New York 10016.

Cronin. G., Jr. Lewis. W. M and Schiehser. M. A. (2006). Influence of freshwater macrophytes on the littoral ecosystem of a young Colorado Reservoir. Aquatic Botany. 85: 37-43.

Dwivedi. H.S., Pradeep. S.,Bhawna. M and Dwivedi. P. (2014). Macrophytic diversity as an indicator of Eutrophication; A case study of Rudra Sagar, Ujjain, M.P, India. IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT). Vol. 8: 34-37.

Franklin. P., Dunbar.M and Whitehead. P. (2008). Flow controls on lowland river macrophytes; A review. Science of the total environment. 369-378.

Gecheva.G., Yurukova. L and Cheshmedjiev.S. (2012). Patterns of aquatic macrophyte species composition and distribution in Bulgarian Rivers. Tourkish Journal of Botany. 37: 99-110.

Germ. M., Urbance-Bercic.O., Gaberscik.A and Janauer.G.A. (2004). Distribution and abundance of macrophytes in the River Krka. Internat. Assoc. Danube Res. 35: 433-440.

Grinberga. L. (2011). Macrophyte species composition in streams of Latvia under different flow and substrate conditions. Estonian journal of Ecology. 60: 194-208.

Hrivnak. R.,Otahelova.H and Jarolimek. I. (2006). Diversity of aquatic macrophytes in releation to environmental factors in the Slatina River (Slovakia). Biologia, Bratislava. 61/4: 413-419.

Joshi. P. P. (2012). Study on diversity, taxonomy and impact of macrophytes on the fresh water resources (Minor project-Dam) of Yavatmal District, Maharstra, India. International Journal of Environmental Sciences. Vol. 1(5): 1-5.

Kshirsagar.AD and Gunale.VR. (2013). Diversity of aquatic macrophytes from River Mula Pune city, MS, India. Science Research Reporter. 3(1): 09-14.

Melzer .A. (1999). Aquatic macrophytes as tools for lake management. Hydrobiologia. 395/396: 181-190.

Meybeck.M., Frendrich.G., Thomas.R and Chapman.D. (1996). Water quality assessments- A guide to use of biota, sediments and water in Environmental monitoring, UESSO/WHO/UNEP. IInd Edition.

Riis. T and Biggs. B. J. F. (2003). Hydrologic and Hydraulic control of macrophyte establishment and performance in streams. Limnol. Ocenogr. 48(4): 1488-1497.

STANKOVIĆ, Ž., PAJEVIĆ, S., VUČKOVIĆ, M., STOJANOVIĆ, S. (2000): Concentration of trace metals in dominant aquatic plants of Lake Provala (Vojvodina, Yugoslavia). – Biologia Plant.43: 583-585.

Thomaz. S. M and Cunha. E. R. da. (2010).The role of macrophytes in habitat structuring in aquatic ecosystems: methods of measurement, causes and consequences on animal assemblages, composition and biodiversity. Acta Limnologica Bresliensia. 22: 218-236.

Vyas.V., Yousuf. S., Bharose. S and Kumar. A. (2012). Distribution of Macrophytes in River Narmada near water intake point. Journal of Natural Sciences Research. 2: 23-29.