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A review on aquatic macrophytes as bio indicators of Water Quality of Lakes

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ABSTRACT

The present study is a review on the assessment of macrophyte as bioindicators. As macrophytes are good in responding to the different water quality parameters therefore they are chosen as an indicator. A total of fifteen species of macrophytes with their occurrence in different physcio chemical characteristics of water such as pH, electrical conductivity were noted down after reviewing scientific papers dealing with the bio indicator. Submerged aquatic vegetation like *Ceratophyllum demesrum* is found in oligotrophic environmental condition whereas floating species such as *Ludwigia stolonifera* occurs in mesotrophic condition. *Eichhornia crassipes* occurs in the eutrophic conditions of lake.

Key words: *Bioindicator, Macrophytes, Physcio chemical characteristics, Ceratophyllum demesrum, Ludwigia stolonifera, Eichhornia crassipes*

Introduction

Assessing the health of species, populations, communities, and ecosystems is an important part for the sustainable development. This has led to the development of assessment tools and bio monitoring plants aimed at determining the overall health of ecosystems and their component parts. This has led to the concept of biomonitoring.

Bio indicator" was defined by ARNDT *et al.* (1996): " Organisms or communities of organisms, which react to environmental influences alternation of their life functions and/or by their chemical composition. Thereby it is possible to draw conclusions concerning their environmental conditions."

The concept of using living organisms to identify, monitor and assess pollution is well established and many bodies responsible for the monitoring of water quality regularly employ methods utilizing invertebrates, algae and plants

The occurrence of aquatic macrophytes is unambiguously related to water chemistry and using plant species or communities as indicators or bio monitors is an objective for surveying water quality (Robach *et al.,* 1996). Aquatic plants are used in water quality studies to monitor heavy metals and other pollutants of water and submerged soils. Their selective absorption of certain ions combined with their sedentary nature is a reason for using Macrophytes as biological monitors (Sawidis *et al.,* 1995). For example Seagrasses meadows are profoundly seen in saline water then in the fresh water (Bhatta and Patra, 2018).

Aquatic plants are used in water quality studies to monitor heavy metals and other pollutants of water and submerged soils. Their selective absorption of certain ions combined with their sedentary nature is a reason for using hydrophytes as biological monitors (Sawidis *et al.*, 1995)

Macrophytes are organisms with low mobility and cannot avoid any combination of flow, nutrient availability and other physical and chemical characteristics that influence their survival in aquatic systems. Thus, an assembly of such organisms in a river or lake can be an effective indicator of the integrated combination of the pressure and stress disorders that affect their habitat (Murphy, 2000).

There are several advantages to using macrophytes as the basis for bioindication or biomonitoring schemes: macrophytes are stationary so absence is easily ascertained; they are by definition visible to the naked eye; there are relatively few species within any one region; many are rooted and thus reflect both water and sediment quality; they are relatively long-living and therefore can integrate seasonal or disturbance factors (Carbiener *et al.*, 1990); monitoring is rapid and requires little or no subsequent laboratory identification; and tissue samples can be easily dried and stored for future reference. They are recognized as valuable indicators for ecological status of rivers under the Water Framework Directive of the European Union (European Commission, 2000).

Occurrence of Macrophytes in different water quality parameters of lake

The overall protocol was to examine the abstracts, keywords, and text for all papers in four journals: Ecotoxicology and Environmental Safety, Environmental Pollution, Environmental Science and Technology, Science of the Total Environment and Ecology, Environment and Consrevation to search for papers that claimed to be about indicators or bioindicators.

Water quality parameters includes pH, Electrical Conductivity (EC), Nitrate (NO_3), Dissolved Oxygen (DO) and Phosphate (PO_4). Different quality parameters influences the growth and distribution of macrophytes so also the changes in the quantitative and qualitative composition of the macrophytes are the indicator for the different water quality parameters.

Macrophytes are stationary so absence is easily ascertained; they are by definition visible to the naked eye. They are relatively long-living and therefore can integrate seasonal or disturbance factors. Therefore aquatic macrophytes are used as bioindicators or biomonitors of trophic status in rivers. Different workers have already suggested the growth of macrophytes depending upon the water quality parameters.

Results and Discussion

The environment with oligotrophic characteristics (low concentrations of nutrients) did not provide a favorable environmental condition for the growth of floating species like *Eichhornia crassipess.* However, this condition is very much suitable for the growth of submerged aquatic vegetation, example

Sl No	Aquatic macrophyes	pH	EC	NO_3	PO_4	References
1.	*Carex riparia*	alkaline	high	rich	rich	Jenackovic *et al., 2016*
2	*Eleocharis palusteris*	indifferent	indifferent	poor	poor	Umetsu *et al.*, 2018
3.	*Lemna minor*	Slightly alkaline	moderate	rich	moderate	Heather Joy Gray, 2009
4.	*Pharagmites australis*	indifferent	high	rich	moderate	Ganjali *et al.*, (2014).
5.	*Potamogeton lucens*	acid	indifferent	poor	indifferent	Matache *et al.*, 2013
6.	*Scripus lacustris*	alkaline	high	rich	poor	*Mandal et al.*, 2014
7.	*Typha angustifolia*	acid	low	moderate	moderate	Fariasa *et al.*, 2018
8.	*Typha latifolia*	acid	low	indifferent	indifferent	Srivastava *et al.*, 2008
9.	*Myriophyllum spicatum*	alkaline	high	high	high	Onaindia *et al.*, 2005
10.	*Ceratophyllum.demesrum*	alkaline	moderate	poor	poor	Galal *et al.*, 2008
11.	*Potamegoton. nodosus*	alkaline	moderate	rich	poor	Paolo Zuccarini and Sasa Kampus, 2011
12	*Eichhornia crassipes*	alkaline	moderate	rich	moderate	Ondiba *et al.*, 2018
13.	*Ludwigia stolonifera*	alkaline	moderate		moderate	Saleh *et al.*, 2019
14	*Cyperus alopecuroides*	alkaline	high	rich	moderate	Yasser *et al.*, 2015
15	*Polygonum tomentosum*	alkaline	low	low	moderate	Haroon.A.M.and Hussian, 2017

Ceratophyllum demesrum. Like wise in the eutrophic conditions growth of emergent species like *Cyperus alopecuroides* occurs (Pereira *et al.*, 2012). While in mesotrophic ecosystem of the river floating macrophytes like *Ludwigia stolonifera* was observed. Rooted hydrophytes with floating leaves are affected by nutrients where as submerged and emergent species are affected by both nutrient enrichement and sediment (Schneider *et al.*, 2015).

Water chemistry variables such as pH, alkanity, nitrogen and phosphorous strongly influences the distribution of macrophytes. Their distribution varies according to the water quaity parameters. Emergent macrophytes, such as *Typha angustifolia,* and *Typha latifolia* were observed in acidic waters. Where as *Pharagmites australis* was observed in water of indifferent pH and *Cyperus alopecuroides* was observed in the alkaline water.

Mostly the emergent species like *Carex riparia, Scripus lacustris* and *Pharagmites australis* were observed in rich NO_3 and PO_4 concentrations. *Where as Ludwigia stolonifera* occurred in moderate nitrate and phosphate conditions.

Floating macrophytes like *Eichhornia crassipes Lemna minor* and *Ludwigia stolonifera* were found in alkaline, rich NO_3 and moderate PO_4 concentrations.

Submerged species like *Ceratophyllum.demesrum* and *Potamegoton. nodosus* in alkaline water. *Potamegoton. nodosus* was found in nitrate ($NO_{3)}$ rich water where as *Ceratophyllum demesrum* was found in poor NO_3 condition.

Conclusion

Alterations in different components of water quality parameters will affect the aquatic vegetation. The responses to variation in water quality parameters will vary among different plant groups The impact will be evident as alterations in physiology, growth, reproduction of macrophytes and other plant forms. Significant alteration in production of macrophytes will have a great impact on the ecosystems. It can be concluded that simultaneous monitoring of species and habitat several times during the growing seasons can provide precise information about the environmental preference of a perennial species It increase the usefulness and validity of a species as a bioindicator. The data on the response of species to the water quality parameters can be an appropriate basis for designing new local or regional indicator system.

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