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ORIGINAL ARTICLE

# Effect of Macrophytic Community Organisation in a Fresh Water Lentic Body of Durg City in Chhattishgarh

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***ABSTRACT***
*Macrophytic community organisation in terms of floristic composition, relative frequency, relative dominance, importance value index (IVI), index of dominance and indices of species diversity in a typical tropical fresh water lentic body from August 2009 to November 2009 was investigated. The study revealed that the species diversity was minimum in the month of August and was maximum in the month of Novmber. Through relative dominance and IVI were highest for Panicum decanense as compared to other species throughout the study period,the value for index of dominance was associated with different species in different months.*
***Keyword: -*** *Macrophytes, species diversity, fresh water.*

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## INTRODUCTION

India has large diversity of aquatic habitats due to geomorphological, climatic, biotic and cultural diversities. Investigation on community structure and function is an important attribute in the management of aquatic bodies [1]. Recently attention has been given on species diversities as measure of pollution or eutrophication based on the principle that in clean water, community diversity is high, while in polluted water the diversity is low[2,3]. Studies not only on the microphyte diversity ,but on the macrophyte diversity also are useful in evaluating water quality [4]. Several workers [5-11] have studied the structural and functional aspects of macrophytic vegetation in fresh water ponds and lakes of India. However the information related to community organization of macrophytic vegetation of a tropical shallow fresh water habitat in different seasons and to focus its data towards pollution and eutrophication.

The present studies were undertaken in a tropical, lentic water body, the Deepak nagar pond, Durg (21̊10'N lat. 81̊ 15'E long., altitude: 318m above MSL) from August 2009 to November 2009.The pond occupies an area of 3.24 ha with a maximum depth of 3.35m.

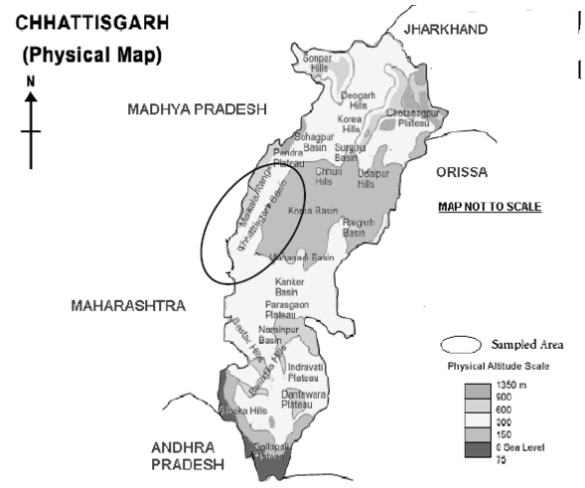



**Fig :- 1. Sampling location of the studied species.**

## MATERIALS AND METHODS

Samples of macrophytes were collected from the pond in first week of every month from August 2009 to November 2009, using a metallic frame quadrate of 1m x 1m size. Phytosociological characters such as relative density, relative frequency, relative dominance and importance value index(IVI) of macrophytes were calculated following Mishra *et.al*(121970). Index of dominance and indices of species diversity such as index of general diversity(H), index of species richness(d) and index of evenness(e) have been calculated using the following formulas:

Shannon-Weavers index of general diversity

$\underline{H} = - \sum (ni/N) \log (ni/N)$ Margalef [27]

Index of species richness (d) = $S/\sqrt{N}$ Menhenick [28]

Index of evenness (e) = $H/\log S$ Pielou [19]

Index of dominance (c) = $\sum (ni/N)^2$ Simpson [29]

Where ni = Number of individuals of each species.

N = Total number of individuals of all species.

S = Number of species.

## RESULT AND DISCUSSIONS

Floristic composition refers to the kind of species occurring in a community and gives clue about(i) the affinity of the species to the environment and to the other species. (ii) habitat of a species, (iii) ecological amplitude of a species and (iv) present condition and future trends of the community. Altogether eleven species of macrophytes were recorded during the period of investigation(Table-1). During rainy season(August and September), seven species- *Alternanthera sessilis, Panicum decanense, Jussiaea repens, Polygonum pulcherum, Nymphaea stellata, Ipomoea aquatic and Marsilea minuta* were observed. whereas during winter winter season (October,November) four species- *Ludwigia parviflora, Spilanthes acmella, Asteracantha longifolia* and *Alternanthera philoxeroides* were found in addition to the list of rainy season plants. Unni[13], Sinha and Naik [14] published floristic list of 126 species and 72 species respectively of macrophytic vegetation found in Raipur(21ĺ 14'N lat. 81ĺ 38'E long) and its vicinity. *Polygonum pulcherum, Spilanthes acmella and Alternanthera philoxeroides* are new to their floristic lists. The rest of the species followed the pattern of seasonal occurrence as given by Unni [13]. The change with increase in the species composition during winter season in comparison to rainy season may be due to silting [7].

The data regarding relative density, relative frequency, relative dominance and IVI of each species of macrophytic community as given in table-1. Maximum relative density and maximum relative frequency was obtained for *Alternanthera sessilis* in the month of October, whereas minimum relative density for *Ipomoea aquatica* in August, and minimum relative frequency for *Ludwigia parviflora* and *Spilanthes acmella* in the month October was found. Relative dominance has been recorded as maximum for *Panicum decanense* throughout the study period *i.e.* the rainy as well as winter seasons, whereas this was minimum for *Nymphaea stellata* during August and for *Ludwigia parviflora* in October.

Fig :1. A View of Urla Pond in Durg city.

IVI, the pooled value of relative density, relative frequency and relative dominance of each species, gives a total picture of ecological importance of a species at a glance. Maximum IVI was observed for *Panicum decanense* throughout the study period while the minimum was for *Ludwigia parviflora* obtained in the month of October (Table-1). From these results it is evident that *Panicum decanense* had better growth than all other species, indicating its a wide range of ecological amplitude with reference to seasonal variations.

The index of dominance for macrophytic community in the study site during the month of August, September, October and November was 0.22, 0.19, 0.20 and 0.12 respectively. These lower dominance index values indicate that the dominance was not concentrated in any one species [15], and this was associated with different species in different months. Index of dominance was more or less similar during the month of August, September and October and showed a fall in the month of November (Table-1). As expected, the indices of species diversity such as index of general diversity, index of species richness and index of evenness was obtained, but the relationship was not statistically significant.

**Table-1:** Phytosociological characters of macrophytic community in Deepak nagar Pond, Durg

| Month | S.No. | Name of the species | Relative Density (%) | Relative Frequency (%) | Relative Dominance (%) | IVI |
|---|---|---|---|---|---|---|
| August 2009 | 1 | *Alternanthera sessilis* | 25.91 | 24.56 | 07.36 | 57.83 |
| | 2 | *Panicum decanese* | 18.93 | 22.80 | 78.54 | 120.27 |
| | 3 | *Jussiaea repens* | 25.91 | 19.29 | 00.86 | 46.06 |
| | 4 | *Polygonum pulcherum* | 21.51 | 22.80 | 00.43 | 44.82 |
| | 5 | *Nymphea stellata* | 01.32 | 03.50 | 00.01 | 04.83 |
| | 6 | *Ipomoea aquatica* | 00.49 | 01.75 | 00.10 | 02.34 |
| | 7 | *Marsilea minuta* | 05.81 | 05.26 | 12.68 | 23.75 |
| **Index of dominance = 0.22** | | | | | | |
| Sept. 2009 | 01 | *Alternanthera sessilis* | 22.16 | 20.33 | 11.30 | 53.79 |
| | 02 | *Panicum decanese* | 25.86 | 18.64 | 48.33 | 92.83 |
| | 03 | *Jussiaea repens* | 13.54 | 16.94 | 01.56 | 32.04 |
| | 04 | Polygonum pulcherum | 18.96 | 16.94 | 09.11 | 45.01 |
| | 05 | *Nymphea stellata* | 02.21 | 05.08 | 01.51 | 08.80 |
| | 06 | *Ipomoea aquatica* | 03.69 | 06.77 | 22.55 | 33.01 |
| | 07 | *Marsilea minuta* | 13.54 | 15.64 | 05.60 | 34.39 |
| **Index of dominance = 0.19** | | | | | | |
| Oct. 2009 | 01 | *Alternanthera sessilis* | 28.90 | 25.00 | 00.47 | 54.37 |
| | 02 | *Panicum decanese* | 21.09 | 20.83 | 97.35 | 139.27 |
| | 03 | *Jussiaea repens* | 23.40 | 18.05 | 00.90 | 42.35 |
| | 04 | *Polygonum pulcherum* | 03.01 | 04.16 | 00.08 | 07.25 |
| | 05 | *Nymphea stellata* | 00.88 | 02.77 | 00.06 | 03.71 |
| | 06 | *Ipomoea aquatica* | 09.39 | 09.72 | 00.63 | 19.74 |
| | 07 | *Marsilea minuta* | 05.49 | 09.72 | 00.02 | 15.23 |
| | 08 | *Astercantha longifolia* | 01.24 | 02.77 | 00.14 | 04.15 |
| | 09 | *Ludwigia parviflora* | 00.88 | 01.38 | 00.01 | 02.27 |
| | 10 | *Spilanthes acmella* | 02.12 | 01.38 | 00.03 | 03.53 |
| | 11 | *Alternanthera philloxiroides* | 03.54 | 04.16 | 00.24 | 07.94 |
| **Index of dominance = 0.20** | | | | | | |
| Nov. 2009 | 01 | *Alternanthera sessilis* | 14.77 | 11.90 | 00.39 | 27.06 |
| | 02 | *Panicum decanese* | 06.36 | 07.14 | 59.87 | 73.37 |
| | 03 | *Jussiaea repens* | 15.45 | 11.90 | 00.80 | 28.15 |
| | 04 | *Polygonum pulcherum* | 05.22 | 08.33 | 00.11 | 13.66 |
| | 05 | *Nymphea stellata* | 02.72 | 04.76 | 00.09 | 07.57 |
| | 06 | *Ipomoea aquatica* | 08.40 | 09.52 | 00.95 | 18.87 |
| | 07 | *Marsilea minuta* | 13.18 | 14.28 | 36.65 | 64.11 |
| | 08 | *Astercantha longifolia* | 06.31 | 07.14 | 00.62 | 13.89 |
| | 09 | *Ludwigia parviflora* | 03.63 | 04.76 | 00.09 | 08.48 |
| | 10 | *Spilanthes acmella* | 04.77 | 07.14 | 00.14 | 12.04 |
| | 11 | *Alternanthera philloxiroides* | 19.31 | 13.09 | 00.27 | 32.67 |
| **Index of dominance = 0.12** | | | | | | |

**Table-2 :** Indices of macrophyte species diversity in Deepaknagar Pond, Durg From August 2009 to November 2009.

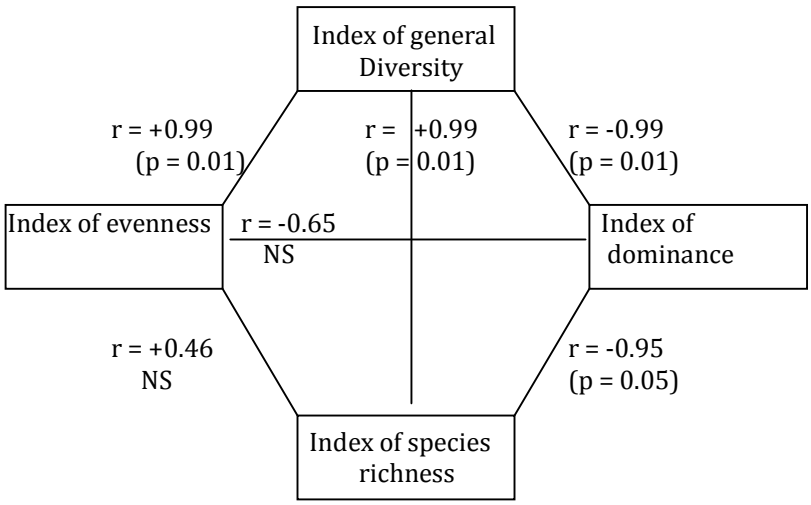
| Indices of Species diversity | Year 2009 | | | |
|---|---|---|---|---|
| | August | September | October | November |
| Index of general diversity (H) | 0.69 | 0.76 | 0.78 | 0.95 |
| Index of species richness (d) | 1.28 | 1.53 | 2.07 | 3.39 |
| Index of evenness (e) | 0.81 | 0.89 | 0.75 | 0.91 |
| Average rainfall (mm) at Bhilai (2005-08)* | 332.18 | 154.46 | 76.62 | 5.56 |
| | | | | |

* Courtesy from Production, Planning and Control (PPC) department Bhilai Steel Plant, Bhilai

There was a continuous increase in the index of general diversity and in the index of species richness from the month August to the month November (Table-2). As expected, there was a strong positive correlation (p=0.01) between the variables general diversity index and species richness index (Fig-1) Archibald [16] also found such relationship between index of general diversity and index of species richness. As species diversity decreased with the eutrophication, low species diversity in the month August indicated that the studied habitat may be an eutrophicated one during peak rainy month (Table-2).

Diversity is of theoretical interest because it can be related to stability, maturity, productivity, evolutionarytime, predation pressure and spatial heterogeneity [17]. It is also of vital importance for conservation ofnatural communities which are increasingly threatenedby industrial and urban expansions and forest clearing [18].

Figure 2 : Correlation coefficient (r) among the variables – index of species richness (d), index of general diversity H, index of evenness (e) and index of dominance (c).




NS = Not Significant

Monthly changes in the index of general diversity and evenness index were almost similar as these indices were increased countinuosly from the month August to the month November (Table-2). However, the evenness index was not increased in the month of October where there was a little increase in the index of general diversity. The values for index of general diversity in the month September and October were nearly equal, but there was a considerable increase in the value of species richness index in the of October, as compared to that of previous months (Table-2). As calculations for index for evenness(e) is dependent on the index of general diversity(H), the evenness index values are species number dependent [19]. Thus, the increased value for species richness index was responsible for decreased value of evenness index in the month October (Table-2).

Each diversity index demonstrates a specific aspect of the diversity of a plant community. The examined species richness is the simplest form of diversity index, and shows high diversity in communities with higher species number. High species diversity indicates a high complexity of organization, which is often associated with high stability, although this may not always be the case. In some cases there are species-poor, but ecologically stable ecosystems such as moors, heathlands, etc. [20]. Shannon, the second examined diversity index, is a measure of the probability of finding a species in a community [21].

In aquatic vegetation monodominant stands or belts were observed relatively frequently [22-25], and this is a reason the same pattern was observed for the species richness and Shannon diversity index in the study area. High diversity can be the result of human influence, as is the case with some managed forest types [26]. For this reason the absolute species number does not mean much for the quality of an ecosystem and it should be seen in relation to the specific development stage, the intensity of the human influence, the site conditions, and so on. In general, the occurrence of macrophyte vegetation improves the quality of water entering a lentic body.

The main threat to aquatic ecosystems arises from the cultivation of surrounding land in addition to the lack of knowledge regarding the importance of aquatic ecosystems among the local population. Detailed knowledge concerning the floristic composition, ecology and environmental factors that influence vegetation types, provide a strong basis to research and helps in the improvement of conservation and management practices in relation to the vegetation and biodiversity of aquatic ecosystems.

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