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Study of aquatic macrophytes and their significance of Gopal das pond of Sidhi Nagar Palika (M.P.) India

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Abstract
The present paper deals the Study of aquatic macrophytes and their significance of Gopaldas pond of Sidhi Nagarpalik (M.P.) India. The pond is rich in plant diversity showing luxuriant growth of macrophytes. Certain macrophytes in the pond are found useful to man and domestic animals. Since macrophytes are the major contributors of pond productivity, the present investigations have been focused on the same.

Keywords: Macrophytes, frequency, density, importance value index

1. Introduction
Fresh water macrophytes play a very important role in aquatic ecosystems by providing food, shelter and variety of habitats for large number of organisms including economically important fishes (Cook, 1990) [1] Many aquatic plants are also of direct use for man as food (e.g. *Nelumbo nucifera*, *Trapa bispinosa* etc.). They also influence nutrient cycling. Data on phytosociological studies provides information to understand the structure, composition and trophic organisation of the community. Studies concerning the productivity by green plants are of fundamental importance in the management of resources because aquatic plants absorb dissolved minerals and enrich water with oxygen produced during photosynthesis and thereby help in the recovery of polluted water. Floristic composition refers to the kind of species occurring in a community. Study of floristic composition appearing in different seasons in a community is an important parameter of a particular species with the environment and to the other species. The habitat of different species, ecological amplitude of the species, and the present condition and future trends of the aquatic macrophytic community. Since, species diversity influences the stability and function of the community (Unni, 1977) [2]; Chatterjee and Raizuddin (2002) [6]; Borse and Bhave (2000) [7] investigations on species diversity index are quite significant.

Description of study area

Fig 1

The Sidhi District in located in the north eastern part of Madhya Pradesh State having a total geographical area of 10526 sq kms and extend by north latitude 230 45' and 240 45' and east longitudes 810 15' and 830 00' and liesin survey of India Toposheet Nos. 63H&I respectively. Gopal Das pond is located at Gopal das Road in Sidhi.

2. Material and methods
Collection of Water Samples
Monthly collection of stagnant surface water sample for physico-chemical analysis were done in between 06 A.M. to

09 A.M., with the help of a sampler designed by us. The sampler was made up of a thick walled glass bottle of one litre capacity. The rubber stopper was having two holes, one inserted with a long tube, one end of which was almost touching the bottom while the hole was inserted with a shorter tube that ended near the mouth. The neck of the bottle was tied with a nylon thread. The samples were collected by air replacement principle.

3. Results and Discussion

Phytosociological studies of macrophytic vegetation of pond were made for two consecutive years from November to October and the average values have been put in the record.

Gopaldas pond is a shallow lentic water body. Total 13 species were recorded in different seasons & throughout the year. Maximum plant species diversity were recorded in winter while a little less diversity was found in summer & rainy seasons (Table 1.1). *Alternanthera sessilis, Nymphaea stellata, Marsilea quadrifoliata, Nelumbo nucifera, Ipomoea aquatica, Ipomoea fistulosa, Limnophyton obtusifolium, Commelina benghalensis, Astercantha longifoloia, Ceratophyllum demersum* species were not found in summer season. Similarly *Nympheoides indicum, Marsilea minuta, Limnophyton obtusifolium, Astercantha longifolia and Ceratophyllum demersum* species were not found in rainy season. Thus it appeared that quantity of water in the pond does not play significant role in maintaining the diversity but it is the quality of water that decides the growth of plants. Water quantity in the Gopaldas dam remains highest in rainy seasons and a little less in winter but still maximum plant varieties were recorded in winter. In summer, filling of water body with sewage & canal water also does not favour many plant species to flourish although the pond remains almost completely filled in that season. Frequency as introduced by Zutshi and Vass (1973) [3]; APHA (1989) [4]; Bhattacharya and Das (1981) [5]; Chatterjee and Raizuddin (2002) [6]; Borse and Bhave (2000) [7]; Handoo and Kaul (1982) [8] and Kumar (1999) [9] indicates the number of sampling units in which a given species occurred thus express the distribution or dispersion of various species in a community. It is expressed in percentage. In the present studies, the seasonal average value of frequency of each species encountered during study periods are given in table 1.2 A and B. In the winter season (a period of maximum diversity) highest percentage frequency was shown by *Alternanthera sessilis* (75%) followed by some accountable frequency of *Typha angustata* (27.50%), *Nympheoides indicum* (25%), *Ipomoea aquatica* (23.75%) and *Nymphea stellata* (22.50%). Frequencies of other recorded species were comparatively low. Similarly in following summer season maximum frequency recorded was of *Nelumbo nucifera* (35%) followed by *Nymphea stellata* (28.75%), *Alternanthera sessilis* (27.50%), and *Typha angustata* (26.25%). During rainy season only *Alternanthera sessilis* showed the frequency upto 35% while frequency of other recorded species were comparatively very low. In winter 7 species were recorded having more than 20% frequency while in summer only 4 and in rainy season only one species was recorded showing >20% frequency. Thus again it is quite evident that the quality of water decided the diversity degree not the quantity of water of the water body. Out of 7 accountable considered species (with>20% frequency) only *Nymphea stellata & Nelumbo nucifera* showed greater frequency in summer as compared to winter & rainy seasons while frequency of other five species and even other considered species were found highest during winter and lower in summer and rainy season.

Density

Average seasonal density analysis of different species showed that density of all considered species corresponds to their frequency pattern. Density of *Alternanthera sessilis* (5.51), *Marsilea quadrifoliata* (1.45), *Ipomoea aquatica* (0.38), *Typha angustata* (0.42), and *Nympheoides indicum* (0.42) were found highest in winter and lowest in rainy season. Only *Nymphea stellata* showed maximum density of 1.27 in rainy whereas maximum density of *Nelumbo nucifera* (0.47) was recorded in summer season. Density of both *Nymphea stellata* & *Nelumbo nucifera* was minimum during winter (Table - 1.3 A & B).

Importance Value Index (IVI)

Importance value index of various plant species in Gopaldas pond in all seasons was found highly variable during rainy season. *Alternanthera sessilis* totally dominated over the other species whereas during summer *Alternanthera sessilis* was accompanied by *Nymphea stellata, Typha angustata, & Nympheoides indicum* exhibiting IVI value >50. During winter only *Alternanthera sessilis* and *Typha angustata* dominated other unconsidered species were found highest during winter and lower in summer and rainy season.

Table 1.1: Floristic Composition Data of Gopaldas pond.

S. No.	Occurred plant species	Seasons		
		Winter	Summer	Rainy
1.	*Alternanthera sessilis*	+	+	+
2.	*Nymphea stellata*	+	+	+
3.	*Marsilea quadrifoliata*	+	+	+
4.	*Nelumbo nucifera*	+	+	+
5.	*Ipomoea aquatic*	+	-	+
6.	*Typha angustata*	+	+	+
7.	*Nympheoides indicum*	+	+	-
8.	*Marsilea minuta*	+	-	-
9.	*Ipomoea fistulosa*	+	+	+
10.	*Limnophyton obtusifolium*	+	-	-
11.	*Commelina benghalensis*	+	-	+
12.	*Astercantha longifolia*	+	+	-
13.	*Ceratophyllum demersum*	+	-	-

Table 1.2A: Seasonal Frequency Data of Gopaldas pond.

S. No.	Occurred plant species	Seasons		
		Winter	Summer	Rainy
1.	*Alternanthera sessilis*	75.05	27.52	35.04
2.	*Nymphea stellata*	22.50	28.75	16.26
3.	*Marsilea quadrifoliata*	21.75	12.50	17.50
4.	*Nelumbo nucifera*	21.25	35.00	13.75
5.	*Ipomoea aquatic*	23.75	-	15.00
6.	*Typha angustata*	27.50	26.25	8.75
7.	*Nympheoides indicum*	25.00	17.50	-

Table 1.2B: Seasonal Density data of Gopaldas pond.

S. No.	Occurred plant species	Seasons		
		Winter	Summer	Rainy
1.	*Alternanthera sessilis*	5.51	2.22	3.55
2.	*Nymphea stellata*	0.42	0.47	1.27
3.	*Marsilea quadrifoliata*	1.45	1.27	0.41
4.	*Nelumbo nucifera*	0.23	0.47	0.26
5.	*Ipomoea aquatic*	0.38	-	0.23
6.	*Typha angustata*	0.42	0.38	0.12
7.	*Nympheoides indicum*	0.42	0.28	0.05

Table 1.3A: Seasonal IVI Data of Gopaldas pond.

S. No.	Occurred plant species	Seasons		
		Winter	Summer	Rainy
1.	*Alternanthera sessilis*	66.31	76.79	126.62
2.	*Nymphea stellata*	35.44	53.88	32.79
3.	*Marsilea quadrifoliata*	32.63	29.13	8.56
4.	*Nelumbo nucifera*	22.92	47.06	25.94
5.	*Ipomoea aquatic*	16.54	-	24.59
6.	*Typha angustata*	48.15	62.08	-
7.	*Nympheoides indicum*	20.07	64.58	4.93

Table 1.3B: Seasonal water quality of Gopaldas pond.

S. No.	Occurred plant species	Seasons		
		Winter	Summer	Rainy
1.	Chloride	113.14	346.98	131.13
2.	Nitrate	0.80	0.84	1.21
3.	Phosphate	4.28	5.41	5.66
4.	Total alkalinity	242.26	322.02	270.10

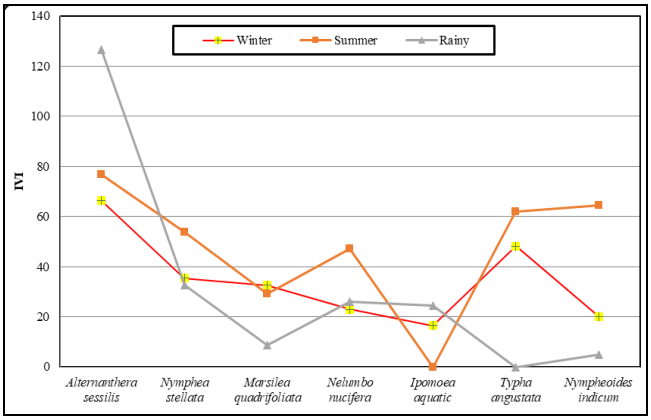

Fig 2: Graphics analysis of Seasonal IVI Data of Gopaldas pond

5. Conclusion

Physico-chemical analysis studies in Gopaldas pond revealed that there was a drastic change in Cl^- concentration in the water with seasonal changes. It was highest during summer - 346.98 mg/l while the concentration depleted up to approximately 66% during winter and rainy seasons when the concentration recorded were 113.14 and 131.13 mg/l respectively. Similarly substantial variation in total alkalinity was also recorded. Total alkalinity was found to be 322.02 mg/l during summer while it got reduced up to 33% during winter and rainy season with the total alkalinity values of 242.26 and 270.10 mg/l. No significant variations were found in respect to other factors like NO_3^-, PO_4^{--} etc. When these variations were correlated with vegetation studies it was found that *Typha angustata, Nympheoides indicum, Nelumbo nucifera, and Nymphea stellata* greatly flourished during summer with IVI values of 62.08, 64.58, 47.06 and 53.88 whereas their IVI values got enormously decreased upto 50 to 100% during winter and rainy seasons. Similarly growth of *Ipomoea aquatic* got suppressed during summer and flourished during winter and rainy seasons. Thus it may be concluded that total alkalinity and Cl- concentration might be playing some important role in controlling growth of aforesaid plant species. Both these factors tend to suppress the growth of *Ipomoea aquatica* while boosting the growth of *Typha angustata, Nympheoides indicum, Nelumbo nucifera* and *Nymphea stellata.* It also appeared that *Nympheoides indicum, Typha angustata* & *Ipomoea aquatica* are highly sensitive to Cl- concentration and total alkalinity.

NO_3^- Conc. of pond water was found to increase by 33% during rainy season. *Marsilea quadrifoliata, Nympheoides indicum* and *Typha angustata* were found to show some sensitivity towards increase in NO_3^- concentration. It was found that overall growth of these three species got suppressed with increase in NO_3^- concentration while on the other hand *Alternenthera sessilis* exhibited approximate 43% increase in overall growth with increase in NO_3^- concentration.

Data on phytosociological studies provides information to understand the structure, composition and trophic organisation of the community.

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