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Study on aquatic macrophytic diversity in fish culture ponds at urban Kolkata, West-Bengal, India

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Abstract
In the present study, a total of 5 species of aquatic macrophytes were recorded from three urban ponds (P-1, P-2 and P-3) of Kolkata in West Bengal and were carried out for the months of January 2014 to June 2014. Different types of macrophytes were found in P-2 and P-3 during study period. But there was no macrophyte in the P-1 pond. The average macrophyte weight was the lowest in P-2 (3.925 kg/m^2) and the highest in P-3 (5.792 Kg/m^2) on wet weight basis and 391.66 and 718.95 g/m^2 on dry weight basis, respectively. There were only five species of macrophytes encountered during the study period in different ponds. The major contribution to the total macrophytes spread was from *Nymphoides spp* in P-2 and *Eichornia spp.* in P-3. Other macrophytes contributed to the lesser extent. This study indicates that, aquatic macrophyte species are specific to the environmental quality.

Keywords: Aquatic macrophytes, biomass, respective ponds, environmental quality

1. Introduction
Aquatic macrophytes comprises a diverse group of organisms including angiosperms, ferns, mosses, liverworts and some macroalgae that occur in seasonally or permanently wet environments (Chambers *et al.*,) [1]. It refers to plants visible to the naked eye and having at least their vegetative parts growing in permanently or periodically aquatic habitats (Adesina *et al.*,) [2]. They are the conspicuous plants that dominate wetlands, shallow lakes and streams include aquatic angiosperms (flowering plants), pteridophytes (ferns) and bryophytes (mosses, liverworts, hornworts).They often grow more vigorously where nutrient loading is high. The aquatic macrophytes are important components of freshwater ecosystems that reflect the quality of the ecosystem as a whole. Aquatic macrophytes not only are affected by water quality, but they also affect water quality and provide food and refugia for aquatic invertebrates and fish (Cereghino *et al.*,) [3].They 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 (Vyas *et al.*,) [4].Macrophytes grow abundatly under such current velocity and in sediments where they can be best rooted and withstand the erosive force of the water during periodic scour events (Chambers *et al.*,) [5].Velocity is an important controlling factor of substrate stability and composition of macrophytes. Several authors have argued that flow velocity is the main factor in controlling macrophyte composition and biomass in streams (Riis and Biggs, [6]; Haslam,) [7]. Flow velocity has often been found to affect the distribution of macrophytes in streams (Demars and Harper,) [8].Many authors have already studied about aquatic macrophytes in different aquatic ecosystem (Hrivnak *et al.*, [9]; Chambers *et al.*, [3]; Jimin *et al.*, [10]; Palit and Mukherjee [11]; Bhowmik *et al.*, [12]; Deshmukh *et al.*, [13]; Verma and Khan, [14]).This present work was carried out to study the aquatic macrophytes diversity in different ponds from Kolkata municipal areas to check the pond water quality with different management practices of these urban ponds.

2. Materials and Methods

2.1 Study Area

The present study was carried out for a period of six months from January 2014 to June 2014. The water bodies identified for the present study are situated within the municipal boundary of Kolkata, West Bengal. First pond (P-1), Bibeknagar jheel, is situated near Jadavpur railway station.Second pond (P-2), situated at Panchasayar and the third pond (P-3), namely Baghajatin Park pond is situated near Highland Park.

2.2 Sample collection

Macrophytes from ponds were collected using 1 m^2 quadrate. Subsequently, the macrophytes were identified and their percentage coverage of water surface area was also noted. The wet weight was immediately taken using simple plastic spring balance. Further the dry weight of the collected macrophytes was found out by placing the already weighed macrophytes in the hot air oven at 105˚C for 24 hour.

3. Results and Discussions

The estimated wet weight and the dry weight of macrophytes collected from all sampling ponds are presented in Table 1 and Table 2. There was no macrophyte in the P-1. However, different types of macrophytes were found in P-2 and P-3 during study period. The macrophyte biomass varied from a minimum of 1.427 Kg/m^2 (P-2, January) to a maximum of 10.88 Kg/m^2 (P-3, June) whereas, the respective dry weights were 96.7 and 1726 g/m^2 for the respective ponds. The average macrophyte weight was the lowest in P-2 (3.925 kg/m^2) and the highest in P-3 (5.792 Kg/m^2) on wet weight basis and 391.66 and 718.95 g/m^2 on dry weight basis, respectively. The types of macrophytes with their rate of infestation in percentage are given in Table 3. The major contribution to the total macrophytes spread was from *Nymphoides sp* in P-2 and *Eichornia sp.* in P-3. Other macrophytes contributed to the lesser extent.

Table 1: Wet weight (Kg/m^2) of Macrophytes in three ponds under study

Ponds	Jan	Feb	Mar	Apr	May	June	Average weight (Kg/m^2)
P-1	Nil	Nil	Nil	Nil	Nil	Nil	Nil
P-2	1.427	1.798	3.22	6.24	5.34	5.525	3.925
P-3	3.67	3.4	3.77	4.62	8.414	10.88	5.792

Table 2: Dry weight (g/m^2) of Macrophytes in three sampling ponds

Ponds	Jan	Feb	Mar	Apr	May	June	Averageweight (g/m^2)
P-1	Nil	Nil	Nil	Nil	Nil	Nil	Nil
P-2	96.7	135.4	310.2	668.2	571.2	568.2	391.66
P-3	312.5	286	339.2	430	1220	1726	718.95

Table 3: Infestation rate (%) and types of macrophytes in three water bodies

Ponds	Rate of infestation of Macrophytes (%)	Types of Macrophytes
P-1	Nil	No
P-2	25-30	*Nymphoides sp.*
P-3	40-45	*Eichornia sp and Ipomeas sp.*

Macrophyte constitute a bulk of the biomass produced in both pond and wetland ecosystems. Their dominance is reflected in the multifarious role they play in the aquatic productivity process. These macrophytes have profound influence on the ecology and fisheries of the ponds and wetlands. During present study P-1 did not show any type of macrophyte throughout the study period. P-2 had 25-30% of the waterspread area covered with three species of macrophytic communities and P-3 40-45% of the waterspread area covered with two species of macrophytic communities. The *Eichornia spp* was the dominant species in P-3 and the *Nymphoides spp* in P-2. Pattet [15] reported that Eichornia had the capacity to appear very aggressively on account of vegetative proliferation and also due to its capacity to propagate by seeds. Moreover the seeds of Eichornia are also known to dormant and viable for several years (Parija) [16].Phillipose *et. al.*, [17] observed that floating and marginal weeds adversely affect the productivity of submerged weeds. Accordingly during the present investigation profused growth of *Eichornia sp, Ipomea sp, Nymphoides sp* adversely effected the growth of submerged macrophytes. The highest average wet weight of macrophytes was found in P-3 (5.79kg/m^2) followed by P-2 (3.92kg/m^2). Sinha and Jha [18] recorded the average wet weight between 4 and 25 kg/m^2 for the different oxbow lakes of Bihar. The highest dry weight was also found in P-3 (718.9 g/m^2) followed by P-2 (391.6 g/m^2). Sugunan and Das [19] encountered a dry weight varying between 18.44 g/m^2 to 726.67 g/m^2 in some of the beels of West Bengal. During this study, there were only five species of macrophytes encountered in different ponds.Similarly several author also reported various macrophyte diversity in different area in India.Ambasht, [20] recorded 25 species of macrophytes from Gujrat Tal, Jaunpur townshio North India. Kiran *et al.*, [21] recorded 15 species of macrophytes belonging to 13 families and grouped them under submerged (2 species), rooted floating (2 species), free floating (2 species), emergent (7 species) and marshy amphibious (2 species) from fish culture ponds of Karnataka. Game and Salaskar, [22] recorded the macrophytes on Malchmali lakes, Thane, Maharashtra. Saltanat Malik and Atul Namdeo, [23] recorded the 21 species of macrophytes in a polluted pond of Shahjanpur, U.P., Palit and Mukharjee, [24] recorded 25 species of macrophytes in wetlands of Bankara district, West Bengal and Harney *et al.*, [25] reported 19 species of macrophytes in three water bodies of Bhadrawati of Chandrapur District. Sitre, [26] recorded 17 macrophytes species in the Ghotnimbala reservoir of Bhadrawati tehsil in Chandrapur district.Several environmental factors such as temperature, dissolved oxygen, light penetration, turbidity, density *etc.* are responsible for distribution of organisms in different freshwater habitats. Not only environmental factors but also 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. By this study it is found that there is not a single and most significant factor explaining the spatial patterns and composition of macrophyte communities.So, from the overall study, it can be concluded that the health status of P-3 is significantly inferior. After studying these it can be concluded that the ecological condition of P-1 is better than P-2.

4. Conclusion

The study revealed that, at present there is no macrophyte diversity in pond (P-1). The average macrophyte weight was the lowest in P-2 (3.925 kg/m^2) and the highest in P-3 (5.792 Kg/m^2) on wet weight basis and 391.66 and 718.95 g/m^2 on dry weight basis, respectively.The quality of water in these ponds was found in almost good condition and favorable for macrophytic growth but due to anthropogenic activities it ultimately affects the macro invertebrates and other aquatic flora and fauna.

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