

Distribution and Composition of Aquatic Macrophytes in Santhapettai Lake of Villupuram District in Tamil Nadu

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ABSTRACT. Macrophytes are important component of the aquatic ecosystem and broad changes in the abundance of individual species and community composition provide valuable information on how and why an ecosystem might be changing. Santhapettai lake is one of the biggest fresh water lake in Villupuram district, Tamil Nadu. The physico-chemical parameters were analysed for one year (October 2012-September 2013). Quadrates were laid randomly and extending from shoreline towards the lake center. The macrophytes falling in each quadrate were sorted species wise, identified and data were recorded. The plants have been identified from fresh materials with the help of different floras. In this present investigation, a total of 33 species belonging to 23 families and 28 genera were identified under algae, pteridophytes, dicotyledons and monocotyledons. Further, the plants were classified in morphological group as floating (7), submerged (1), submerged anchored (13), floating leaved (1) and emergent anchored (11). The coverage/spread of macrophytes along the shorelines was higher compared to the centre of the lakes where the species composition was found reduced. Assessment of biota, continuous monitoring and conservation lake are the important components to safeguard the biological wealth of lentic and lotic freshwater ecosystem.

1. INTRODUCTION

Biodiversity means the assets of life forms found on earth in the form of millions of different plants, animals and microorganisms, which are further diversified with vast potential of future creation of the biodiversity from the ocean of genomic diversity at the effectively functional level with in living biomass, the genes the contain and the intricate system the form. Biological diversity also means the variability among living organisms from all sources and ecological complexes of which they are part and includes diversity within species or between species and of ecosystem. In aquatic habitat, biodiversity of organisms depend on availability and quality of water. As water is an essence and elixir of life on the earth and that water totally dominates the chemical composition, abundance, productivity and physiological conditions especially the indigenous population of aquatic organisms. Therefore the nature and health of any aquatic community is an expression of quality of water.

Indian subcontinent is very rich in fresh water resources. The Indian fresh waters are under considerable threat owing to the fast pace of development. A survey by NEERI shown that 70% of India's fresh waters are polluted by conventional standards. Although rivers and lakes are most important water resource in India for purpose like drinking water supplies, irrigation and fisheries. Fresh water lakes and reservoirs are also very important water resources in this country and in many areas constitute only available water.

The inland fresh water ecosystem, both lentic and lotic contributes a greater fraction towards the available water resource on the planet which, is now being increasingly subjected to

greater stress from various human activities. The physico- chemical and biological characteristics of water depends upon several factors including the location of water body, type of sewage and domestic waste disposal, localized human population in surrounding and their activities. As a result large quantities of organic and inorganic nutrients are added. The enrichment of nutrients also occurs due to disposal of domestic and in industrial effluents from surrounding areas, which supports the growth of a variety of macrophytes and microbes in aquatic system. Some of these organisms in aquatic system assume paramount signification either as biological indicator or as an agent in self- cleaning process.

Aquatic plants (macrophytes) are of important component of lake because they provide food and habitat for invertebrates, fishes and wild life. The aquatic plant community or macrophytes comprises a diverse group of macrophyte organisms including angiosperms, ferns, mosses, liverworts, and some fresh water macro algae that occur in seasonally or permanently wet environment. Aquatic macrophytes can be used as tool in the determination of pollution and nutrient level. Submerged macrophytes play key role in the ecology of shallow, alkaline, clear water, lakes, where they form an extensive and diverse littoral community with numerous associated invertebrates, fish and birds (Jeppesen *et al.*, 1993) while the cover and biomass of submerged macrophytes and their role in lake metabolism are largely predictable from lake area, basic configuration and nutrient loading (Gasithe and Hoyer, 1998).

The present study was carried out in the Santhapettai fresh water lake physico-chemical parameters, to assess the wealth of the macrophytes and to find out the dominance of the macrophytes.

2. MATERIALS AND METHODS

Santhapettai lake (Lat. 11°96 N; Long 79°-20°E) is one of the biggest freshwater lake in Tamil Nadu, South India. It is situated in the western side of Thirukoilur in Villupuram district. The lake is perennial in nature. The mean maximum and minimum temperatures of Villupuram district are 36°C and 21°C respectively with relative average humidity 83%. The average rainfall is around 1157 mm with two - thirds of the annual rainfall received during the monsoon season.

The present work is based on the results of Physico-chemical parameters and extensive systematic field studies of the plants of this area for a period of one year (October 2012 to September 2013). Physico-chemical parameters were analyzed, APHA (1998) and Trivedi and Goel (1984) method.

Field trips were made once in a week covering entire lake area with a view to find out the aquatic macrophytes plant species and their ecological features. Quadrates were laid randomly and extending from shoreline towards the lake center. Macrophyte sampling was conducted in June 2013, which forms the peak growth season of the macrophytes. The macrophytes falling in each quadrat were sorted species wise and the number of individuals of each species counted to workout Important Value Index (Frequency, Relative frequency, Density, Relative density, Abundance, Relative abundance)

Angiosperm, pteridophytes and algal macrophytes are observed and collected which include submerged, submerged anchored, floating leaved anchored, emergent anchored and free floating plants. The plants have been identified from fresh materials with the help of different floras (Gamble, Fisher, Flora of presidency of Madras), (Nair, Hendry, Flora of Tamil Nadu, India), (Cook, Aquatic wetland plants of India) and (Subramaniyan, Aquatic angiosperms). The collected specimens were pressed and dried. After drying the plants were mounted on the herbarium sheets and labeled properly for future reference. All the specimens and herbariums were deposited in the laboratory of Botany Department, Arignar Anna Government Arts College, Villupuram.

3. RESULTS AND DISCUSSION

3.1. Physico-chemical parameters

The outcomes on a few physico-chemical parameters viz., Air and water temperature, pH, salinity, electrical conductivity, total dissolved solids, total alkalinity, free carbon-dioxide, dissolved oxygen, biological oxygen demand, total hardness, calcium, magnesium, chloride, sulphate, nitrate, potassium and sodium are given in table 1.

In present study, highest value of air and water temperature (39.5; 37.6 °C), pH (9.3), salinity (2.9 mg/L), electrical conductivity (162 μ S/cm), total dissolved solids (118 mg/L), total alkalinity (96 mg/L), dissolved oxygen (6.1 mg/L), biological oxygen demand (4.1 mg/L), calcium (29.4 mg/L), magnesium (2.34 mg/L), chloride (5.96 mg/L), nitrate (2.03 mg/L), potassium (0.69 mg/L), sodium (6.71 mg/L) were found in summer seasons and free carbon-dioxide (19.24 mg/L), sulphate (1.10 mg/L) was observed in monsoon seasons and total hardness (81 mg/L) was recorded in post monsoon season.

Lowest value of air and water temperature (28.0; 23.5 °C), pH (7.1), salinity (1.1 mg/L), electrical conductivity (95 μ S/cm), total alkalinity (56 mg/L), potassium (0.32 mg/L), sodium (3.67 mg/L) were seen in monsoon seasons and total dissolved solids (76 mg/L), total hardness (42 mg/L), magnesium (1.45 mg/L), nitrate (1.36 mg/L) was found in pre monsoon seasons and dissolved oxygen (3.10 mg/L), biological oxygen demand (1.9 mg/L), calcium (11.2 mg/L), chloride (2.65 mg/L) was recorded in post monsoon seasons and free carbon-dioxide (8.9 mg/L), sulphate (0.59 mg/L) was examined in summer seasons.

Table 1 Physico-chemical parameters of Santhapettai lake water during the month of October 2012 to September 2013

Sl. No.	Parameters	Monsoon			Post Monsoon			Summer			Pre Monsoon		
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
01	Air Temperature (°C)	30.0	28.5	28.0	29.0	31.0	31.5	37.4	38.2	39.5	37.9	36.2	31.1
02	Water temperature (°C)	26.5	24.0	23.5	24.0	28.5	29.0	35.8	36.4	37.6	35.2	34.6	29.4
03	pH	7.5	7.1	7.3	7.8	7.6	7.9	8.8	9.1	9.3	8.5	8.3	7.7
04	Salinity (mg/L)	1.4	1.2	1.1	2.5	1.8	2.3	2.7	2.9	2.6	1.8	1.5	1.7
05	Electrical conductivity (μ S/cm)	124	118	95	120	130	115	136	162	148	125	112	101
06	Total dissolved solids (mg/L)	89.5	83.2	78.6	91.5	92.1	90.0	106	118	102	90	81	76
07	Total alkalinity (mg/L)	56	63	61	75	72	73	89	96	80	72	85	59
08	Free CO ₂ (mg/L)	16.08	19.24	18.92	16.42	12.13	13.94	11.2	10.5	8.9	12.5	14.2	17.2
09	Dissolved oxygen (mg/L)	4.40	4.70	5.15	4.85	3.10	3.80	5.75	6.10	5.90	4.25	3.90	4.15
10	Biological oxygen demand (mg/L)	2.8	2.2	2.7	1.9	2.5	2.3	2.9	3.4	4.1	3.6	2.7	3.4
11	Total hardness (mg/L)	57	61	61	81	66	59	62	54	67	42	49	51
12	Calcium (mg/L)	18.3	17.5	17.3	11.2	11.9	12.4	21.3	25.8	29.4	22.1	26.9	27.7
13	Magnesium (mg/L)	1.46	1.97	1.90	1.66	1.78	1.84	1.91	2.34	2.01	1.86	1.63	1.45
14	Chloride (mg/L)	3.20	3.22	3.25	2.65	2.80	3.16	4.8	5.96	5.63	4.91	4.84	3.62
15	Sulphate (mg/L)	0.89	0.96	1.10	0.76	0.82	0.85	0.59	0.65	0.71	0.69	0.78	0.81
16	Nitrate (mg/L)	1.88	1.94	1.87	1.72	1.61	1.56	1.93	1.81	2.03	1.84	1.73	1.36
17	Potassium (mg/L)	0.45	0.32	0.43	0.14	0.29	0.36	0.48	0.69	0.61	0.65	0.51	0.46
18	Sodium (mg/L)	3.95	3.84	3.67	4.61	4.90	4.82	5.92	6.5	6.71	6.6	6.1	5.8

3.2. Biological parameters

In this present investigation, a total of 33 species belonging to 23 families and 28 genera were identified under four classes. Seven species of seven genera and seven families under the class dicotyledons, nine species of eight genera and nine families under the class monocotyledons, six species of six genera and six families under the class pteridophytes, eight species of five genera and three families under the class algae are recorded. Further the aquatic macrophytes classified in morphological group. Among five morpho-ecologic groups, submerged anchored with 13 species dominated the lake followed by emergent anchored (11), floating (7), floating leaved anchored and submerged with one species each. The most dominant families were Hydrocharitaceae and Najadaceae with three species followed by Salviniaceae, Ceratophyllaceae, Characeae, Cyperaceae and Lemnaceae with two species each. Only one species each was recorded for Aponogetonaceae, Commelinaceae, Poaceae, Pontederiaceae, Convolvulaceae, Isoetaceae, Onagraceae, Verbenaceae, Marseliaceae, Araceae, Potamogetonaceae, Polygonaceae, Traphaceae, Typhaceae, and Haloragaceae. The morpho-ecological group of aquatic macrophytes is given in table-2. The plants were photographed and given in figure 1. Aquatic macrophytes in the lake occur as submerged anchored (40%) dominated the lake followed by emergent anchored (33%), floating (21%), floating leaved anchored and submerged with 3% each (figure 2). Important value index (IVI) of the aquatic macrophytes is given in figure 3.

Presence of *Eichornia*, *Pistia* and *Ipomoea* indicated a clear sign of invasion of alien species in the lake. Narayana and Somashekar (2002) have been conducted that the physico-chemical characters influence the growth of species, distribution, indicator group and Pollution tolerant species. The influence of water chemistry in aquatic plant richness was analysed in several studies. Nicolas *et al.*, (2000) formed that the vegetation response to environmental factors are not always linear. Rørslet (1991) and Murphy (2002) found that the higher macrophytes diversity was observed in mesotrophic to slightly eutrophic lakes.

Table 2 Morpho-ecological group of aquatic macrophytes recorded in Santhapettai lake October 2012 to September 2013

Sl. No.	Name of the plants	Family	Morpho-ecological group
01	<i>Aponogeton natans</i> (L.) Engl K. Krause	Aponogetonaceae	Floating leaved Anchored
02	<i>Azolla caroliniana</i> (L.)	Salviniaceae	Floating
03	<i>Ceratophyllum desmersum</i> (L.)	Ceratophyllaceae	Submerged Anchored
04	<i>Ceratophyllum</i> sp. (L.)	Ceratophyllaceae	Submerged Anchored
05	<i>Chloris barbata</i> (L.)	Poaceae	Emergent Anchored
06	<i>Chara vulgaris</i> (L.)	Characeae	Submerged
07	<i>Commelina bengalensis</i> (L.)	Commelinaceae	Emergent Anchored
08	<i>Cyperus articulatus</i> (L.)	Cyperaceae	Emergent Anchored
09	<i>Cyperus rotundus</i> (L.)	Cyperaceae	Emergent Anchored
10	<i>Eichhornia crassipes</i> (Mart) Solms	Pontederiaceae	Floating
11	<i>Hydrilla verticillata</i> (L.F) Royle	Hydrocharitaceae	Submerged Anchored
12	<i>Hydrilla</i> sp. (L.)	Hydrocharitaceae	Submerged Anchored
13	<i>Ipomoea carnea</i> (Jacq.)	Convolvulaceae	Emergent Anchored
14	<i>Isoetes</i> Sp. (L.)	Isoetaceae	Submerged Anchored
15	<i>Jussiaea repens</i> (L.)	Onagraceae	Emergent Anchored
16	<i>Lemna gibba</i> (L.)	Lemnaceae	Floating
17	<i>Lippia nudiflora</i> (L.)	Verbenaceae	Emergent Anchored
18	<i>Marsilea quadrifolia</i> (L.)	Marsilaceae	Emergent Anchored
19	<i>Myriophyllum aquaticum</i> (L.)	Haloragaceae	Submerged Anchored
20	<i>Najas gramineae</i> Delile	Najadaceae	Submerged Anchored
21	<i>Najas minor</i> All	Najadaceae	Submerged Anchored
22	<i>Najas</i> sp. (L.)	Najadaceae	Submerged Anchored
23	<i>Nitella hyalina</i> (L.)	Characeae	Submerged Anchored
24	<i>Nelumbo nucifera</i> (Gaerth Fruct)	Nymphaeaceae	Submerged Anchored
25	<i>Nymphaea pubescens</i> (L.)	Nymphaeaceae	Submerged Anchored
26	<i>Pistia stratiotes</i> (L.)	Araceae	Floting
27	<i>Potamogeton nodosus</i> (L.)	Potamogetonaceae	Emergent Anchored
28	<i>Polygonum glabrum</i> (Willd)	Polygonaceae	Emergent Anchored
29	<i>Salvinia natans</i> (L.)	Salviniaceae	Floting
30	<i>Spirodela polyhize</i> (L.)	Lemnaceae	Floting
31	<i>Trapa natans</i> (L.)	Traphaceae	Floting
32	<i>Typha angustifolia</i> (L.)	Typhaceae	Emergent Anchored
33	<i>Vallisneria natans</i> (L.)	Hydrocharidaceae	Submerged Anchored

In the present study the monocots predominant over dicots with respects to species, genera and family. Anand and Sharma (1993) also reported that in lotic water bodies monocot dominated the dicot. Such a dominance of monocots over the dicots in aquatic habitates has already been emphasized by a number of works (Muencher, 1994 and Hutchinson, 1975). Predominance of monocots in an aquatic ecosystems is due to the high degree of polyploidisation, consequently increased the seed size, tendency to reproduce vegetatively and resistance to herbivores (Kautsky, 1989). Growth of emergents becomes very dense with eutrophication (Moss, 1979) and with the increase in the alkalinity of lakes, the floating leaf species get replaced by emergent macrophyte (Makela *et al.*, 2004). The studied lakes are shallow lakes, which provide suitable habitat for the growth of emergent vegetations (Pandit, 2010).



Azolla caroliniana (L.)



Ceratophyllum demersum (L.)



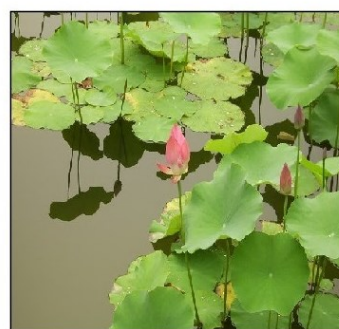
Eichhornia crassipes (Mart) Solms.



Isoetes sp., (L.)



Najas graminea (Delile)



Nelumbo nucifera (Gaerth.Fruct)

Figure 1 Photograph of Aquatic macrophytes in Santhapettai lake

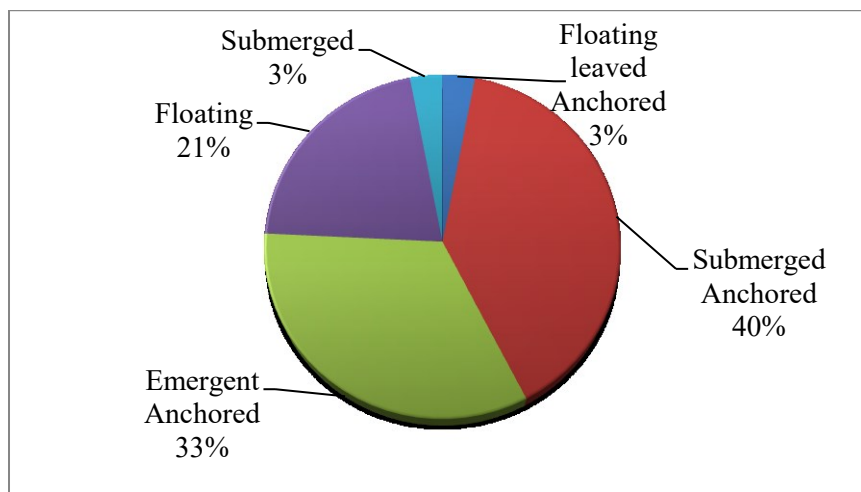


Figure 2 Percentage (%) of Aquatic macrophytes distribution in Santhapettai lake

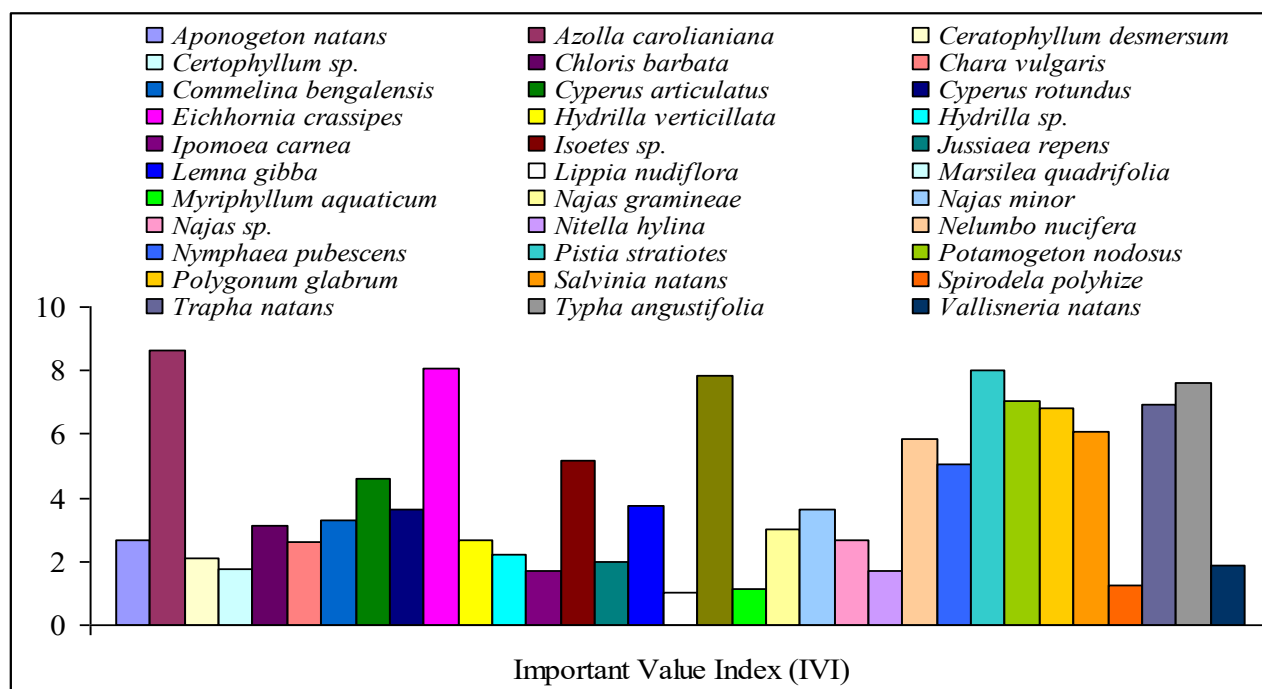


Figure 3 Important value index (IVI) of Aquatic macrophytes in Santhapettai lake

4. CONCLUSION

Inhabitants around the lake are unaware about the importance of flora and fauna. Qualitative and quantitative floristic survey, constant monitoring and protection of lentic and lotic ecosystems are the need of the hour in order to save the native biota, to maintain the quality of drinking water, and disqualify the efforts of alien species to invade.

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