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# FLORISTIC COMPOSITION OF MACROPHYTES IN A FRESH WATER LAKE, THE TAAL RATOI IN EASTERN UTTAR PRADESH

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## ABSTRACT

**The lake *Taal Ratoi* is one of the largest fresh water lake of eastern Uttar Pradesh spread over an area of 1837 hectare. The present work included the floristic composition of macrophytes. In this work a total of 32 species of macrophytes belonging to 21 families were collected and identified with their taxonomical status and distribution. Major submerged macrophytes *Hydrilla verticillata, Potamogeton crispus, Chara, Elodea Canadensis, Najas minor, Vallisnaria americana* and few free floating macrophytse such as *Eichhornia crassipes, Nelumbo nucifera, Potamogeton nodous* were showing high richness value. *Eliocharis palustris, Cyperus spp. Polygonum spp. Ludwigia adscendens* etc. were emergent types which dominated over the East-North basin of the lake. *Oenanthe javanica, Medicago polymorpha, Veronica anagalis, and Gnaphlium uliginosum* were rare species of lake. The largest number of species belongs to the family Hydrocharitaceae. It was dominant over the lake and belonging with four species having frequency value ±19.04. Polygonaceae and Araceae are second largest family of the lake followed by three species having frequency value ±14.28. Asteraceae, Cyperaceae, Fabaceae and Potamogetonaceae have ±9.52 frequency value of species. Amaranthaceae, Commelinaceae, Convolvulaceae, Characeae, Marsileaceae, Nelumbonaceae, Onagraceae, Plantaginaceae, Pontederiaceae, Ranunculaceae, Apiaceae, Ceratophyllaceae, Salviniaceae and Typhaceae were also obtained from lake having species frequency value ±4.7. During study it was observed that the floristic composition of macrophytes greatly affected by environmental condition changes, anthropogenic stresses and physico-chemical properties.**

**KEYWORDS:** Fresh Water Lake, Macrophytes, Physico-Chemical, Taxonomical Status, Submerged, Emergent, Anthropogenic Stress

The fresh water ecosystems are a subset of earth's aquatic systems consist more biodiversity than the terrestrial ecosystems (Dudgeon *et al.* 2006). The macrophytes constitute a large proportion of the aquatic biodiversity. About 2% of vascular plants are considered as aquatic macrophytes in which few angiosperms are fully aquatic (Cook, 1999; Chambers *et al.*, 2008). Macrophytes are the conspicuous plants which are normally found growing in association with stagnant water or near water bodies. Less frequently, they also occur in flowing water (Canada's Aquatic environments). On the basis of their habit of growth they are often categories as emergent, submerged, free floating, rooted with floating leaves, and shoreline (Faizan and Abdullah; 2021). Emergent plants are those whose roots grow underwater, but their stems and leaves are found above the water (Sculthorpe, 1985). Submerged plants are found when the entire plant is below the surface of the water. Rooted with floating leaves have leaves which float on the surface, but their stems are beneath the surface, and their roots anchor the plant in the substrate. Free floating plants are not anchored to the bottom and plants hang free in the water. Shoreline plants are those in which most of the plants are at or near the surface of the water (Vander Valk Arnold; 2006 and Faizan and Abdullah; 2021).

The shallow lakes differ greatly from deeper lakes because they are not thermally stratified in summer and have a large proportion of the littoral zone that can be colonized by aquatic macrophytes (Faizan and Abdullah; 2022). The floristic composition of macrophytes changes as environmental conditions change because lakes are a dynamic system (Capers 2003). The primary productivity of lakes relates to the production of macrophytes (Wetzel 2001), which contributes to the general fitness and nutrient cycling in the aquatic ecosystem (Carpenter and Lodge 1986, Madsen *et al.*, 2001). The alkalinity, pH, chemical oxygen demand and TP are the important physicochemical parameters help in composition of macrophytes (Chengxue Ma ORCID Icon *et al.*, 2018). The composition of macrophytes also related with water, sediments and catchment characteristics of lake (La Toya *et al.*, 2013). Most of the species showed a negative relationship with turbidity and open water surface with the exception of *Potamogeton richardsonii, Stuckenia pectinata* and filamentous algae (La Toya *et al.*, 2013). Seasonal variation also effects the composition of macrophytes. The macrophytes density is high in

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summer, while it is low in winter (Faizan and Abdullah; 2021). The density of blue-green algae was high in winter, minimum during monsoon and moderate in summer (Agale *et al.,* (2013). Except for a few species of submerged plants that are perennial, all other species appear and disappear as the season progresses (Sankaran Unni 1971). In the stratified lakes with high light penetration the maximum depth at which macrophytes occur is often limited by temperature. The plants occur in depth such as *Chara, Isoetes, Utricularia* and *Ceratophyllum* do not require photosynthetic oxygen for their root growth (Dale 1986). The turbulence in shallow lake also effect the composition of submerged macrophytes directly by damaged mature plants or indirectly by altering nutritional status and stability of the bottom sediments inhibiting the establishment of macrophytes ( Spence: 1967). Shallow lake with a large fetches have a deeper wave-mixed zone resulting in sediments induced turbidity which prevent the growth of submerged macrophytes (Kanturd: 1990)

## MATERIALS AND METHODS

One of the largest fresh water lentic body the "Taal Ratoi" is situated near Fatehpur village in Mau District of Eastern Uttar Pradesh, India. It is located at North-East Coast (26°09'46.6"N-83°44'16.8"E) of India and connected with river Ghaghara (Faizan and Abdullah 2021). The study covers 10 sites of lake which are selected for monitoring of macrophytes. The south and east basins are deeper while north and west basins are comparatively shallow. An overview of lake is given bellow.The observation was made on the all sites of the selected lake during the main growing season. The aquatic macrophytes were collected by hand or by using a rake. Small semi-aquatic macrophytes are carefully uprooted and for longer plants the only representative part such as flowers and fruiting twigs or both were collected in minimum three specimens. All the specimens were identified through flora and monograph such as Naskar 1990, Bor 1960, Subramanyam 1962, Hooker 1872-1897, Duthie 1960 and from the book Biodiversity of aquatic and semi-aquatic plants of Uttarpradesh.

## RESULTS AND DISCUSSION

During study 32 species of macrophytes were collected from all different sites of lake which belonging to twenty one families. 8- Species in SI, 10- species in SII, 11- species in SIII, 8- species in SIV, 7- species in SV, 7- species in SVI, 6- species in SVII, 9- species in SVIII, 5- species in SIX and 4- species in SX (Table-1). It was found that *Hydrilla verticillata*, *Potamogeton crispus* and *Ipomea aquatica* were practically dominated over all sites in lake. The species of *Hydrilla, Potamogeton, Elodea* and *Najas minor* made a bed on the water surface of lake which prevent the movement of other aquatic organism as well as provide shelter to the zooplankton. Similarly *Lemna minor, Elodea canadensis, Polygonum spp., Eleocharis, Vallisnaria spiralis, Medicago* were commonly found in all sites of lake while *Nelumbo nucifera, Persicaria minor, Potamogeton nodosus, Eichhornia crassipes, Marsilea quadrfolia* were rarely occur in lake. *Gnaphalium uliginosum, Ludwigia adscendens, Oenanthe javanica, Rannunculus sceleratus, Rumex pulcher, Veronica anagallis, Cyperus spp., Xanthium strumarium* were found at the shore of lake. (Table 1)

The family Hydrocharitaceae was dominant over the lake and consisting four species having a frequency value ±19.04. Polygonaceae and Araceae are second largest family of lake followed by three species having ±14.28 mean value. Asteraceae, Cyperaceae and Potamogetonaceae have ±9.52 frequency value of species. Amaranthaceae, Commelinaceae, Convolvulaceae, Marsileaceae, Nelumbonaceae, Onagraceae, Plantiginaceae, Pentideriaceae, Ranunculaceae, Apiaceae, Ceratophyllaceae, Characeae, Salviniaceae and Typhaceae were also obtained from lake having frequency value ±4.7 (Table 3). The south, east and north basins have more divers' macrophytes population in compare to west basin of lake. The name, family, common name and type of macrophytes are given in Table 2.

The floristic composition of macrophytes changes as environmental conditions change (Capers 2003). The important parameters such as light availability, alkalinity, turbidity, DIC (dissolve inorganic carbon), pH, COD (chemical oxygen demand), DO (dissolve Oxygen), nitrogen and phosphorous play a vital role in the composition of macrophytes (Chengxue Ma Orcid Icon *et al.*, 2018). The composition of macrophytes also related with water, sediments and catchment characteristics of lake (La Toya *et al.,* 2013). The macrophytes density is high in summer, while it is low in winter (Faizan and Abdullah; 2021).

**Table 1: Frequency of occurrence of macrophyte species in a particular site of lake**

| Sites Name | Site Code | NOS* | Frequency (%) |
|---|---|---|---|
| MACHARIYAHWAN | SI | 8 | 25 |
| UTRAI | SII | 10 | 31 |
| MARYADPUR | SIII | 11 | 34 |
| BAIRIYADIH | SIV | 8 | 25 |
| NEWADA GOPALPUR | SV | 7 | 21 |
| DOOBARI | SVI | 7 | 21 |
| RAMAUPUR | SVII | 6 | 18 |
| GANGAUPUR | SVIII | 9 | 28 |
| KAKRADIH | SIX | 5 | 15 |
| FATEHPUR | SX | 4 | 12 |

*NOS= Number of species

**Table 2: Different types of macrophytes**

| S.N. | Macrophytes | Family | | Comman name | Types |
|---|---|---|---|---|---|
| 1 | *Alternanthra sessilis* | Amranthaceae | | Girni | Emergent |
| 2 | Azolla pinnata | Salviniaceae | | Mosquito fern | Free floating |
| 3 | Ceratophyllaum demersum | Ceratophyllaceae | | Horn wort | Submerged |
| 4 | Chara brounii | Characeae | | Stone wort | Submerged |
| 5 | *Commelina diffusa* | Commelinaceae | | Kanshura, | Wetland herb |
| *6* | *Cyperus halpan* | Cyperacaea | | Dwarf Papyrus | Emergent |
| *7* | *Eichhornia crassipes* | Pentideriaceae | | Jalkumbhi | Free floating |
| *8* | *Eliocharis palustris* | Cyperacaea | | Marsh spike rush | Emergent |
| *9* | *Elodea Canadensis* | Hydracharataceae | | Waterweeds | Submerged |
| *10* | *Gnaphallium uliginosum* | Asteraceae | | Marsh cudweed | Wetland herb |
| *11* | *Hydrilla verticillata* | Hydracharataceae | | *Sewar* | Submerged |
| *12* | *Ipomea aquatic* | Convolvlaceae | | Karemua | Rooted floating |
| *13* | *Lemna minor* | Araceae | | Duck weed | Free floating |
| *14* | *Ludwigia adscendens* | Onagraceae | | Water primerose | Free floating |
| *15* | *Marsilea quadrifolia* | Marsileaceae | | Susnari | Rooted floating |
| *16* | *Medicago polymorpha* | Fabaceae | | Toothed medick | Wetland legume |
| *17* | *Najas minor* | Hydracharataceae | | Brittle water nymph | Submerged |
| *18* | *Nelumbo nucifera* | Nelumbonaceae | | Kamalgatta | Rooted floating |
| *19* | *Oenanthe javanica* | Apiaceae | | Water drop wart | Wetland herb |
| *20* | *Persicaria minor* | Polygonaceae | | Depresa | Emergent |
| 21 | Pistia spp. | Araceae | | Water cabbage | Free floating |
| *22* | *Polygonum lapathifolium* | Polygonaceae | | Curlytop knotweed | Emergent |
| *23* | *Potamogeton crispus* | Potamogetonaceae | | *Curly leaf pond weed* | Submerged |
| *24* | *Potamogeton nodosus* | Potamogetonaceae | | Long leaf pond weed | Free floating |
| *25* | *Ranunculus sceleratus* | Rannunculaceae | | Jaldhania | Wetland herb |
| *26* | *Rumex dentatus* | Polygonaceae | | *Jungali Palak* | Emergent |
| 27 | Typha angustifolla | Typhaceae | | Elephant grass | Emergent |
| *28* | *Vallisnaria americana* | Hydracharataceae | | Tap grasses | Submerged |
| *29* | *Veronica angalis* | Plantiginaceae | | Water speedwel | Wetland herb |
| *30* | *Vicia sativa* | Fabaceae | | Ankari | Wetland legume |
| 31 | Wolffia | Araceae | | Water meal | Free floating |
| *32* | *Xanthium strumium* | Asteraceae | | Lapetua | Wetland herb |

**Table 3: Family frequency of macrophytes**

| S.N. | Family | NOS | F % |
|---|---|---|---|
| 1 | Amranthaceae | 1 | 4.7 |
| 2 | Apiaceae | 1 | 4.7 |
| 3 | Araceae | 3 | 14.28 |
| 4 | Asteraceae | 2 | 9.52 |
| 5 | Ceratophyllaceae | 1 | 4.7 |
| 6 | Characeae | 1 | 4.7 |
| 7 | Commelinaceae | 1 | 4.7 |
| 8 | Convolvulaceae | 1 | 4.7 |
| 9 | Cyperaceae | 2 | 9.52 |
| 10 | Fabaceae | 2 | 0.52 |
| 11 | Hydrocharataceae | 4 | 19.04 |
| 12 | Marsileaceae | 1 | 4.7 |
| 13 | Nelumbonaceaea | 1 | 4.7 |
| 14 | Onagraceae | 1 | 4.7 |
| 15 | Pentideriaceae | 1 | 4.7 |
| 16 | Plantiginaceae | 1 | 4.7 |
| 17 | Polygonaceae | 3 | 14.28 |
| 18 | Potamogetonaceae | 2 | 9.52 |
| 19 | Rannuculaceae | 1 | 4.7 |
| 20 | Salviniaceae | 1 | 4.7 |
| 21 | Typhaceae | 1 | 4.7 |
| | Total | 32 | - |

## CONCLUSION

In the present study it has been observed that a great floristic composition of macrophytes occur in the lake. There are various species of macrophytes have comparatively high frequency value. The emergent and submerged species indicate a relative growth having high frequency of occurrence. Similarly the shore line species have a significant richness value. There are thirty two macrophytes species were obtained during present study belonging to twenty one families in which Hydrocharitaceae was dominant (Table 3). *Hydrilla verticillata* and *Potamogeton crispus* were abundantly grown throughout the year in the selected lake. Presence of *Eichhornia* (water hyacinth), *Potamogeton, Marsilea, Lemna* and *Cyperus* species confirmed that the lake is grossly polluted and has high anthropogenic stress. It is evident from the study the lake status is eutrophic. So regulation and prevention in anthropogenic activities are needed and the highest priority must be given to removal of macrophytes especially water hyacinth for sustainable management and conservation of lake.

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