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Diversity of Aquatic Macrophytes of Borbila and Silsako Wetland in Assam

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ABSTRACT

A wetland is a land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. There are four major types of wetlands: marsh, swamp, bogs and fen. The aquatic macrophytes are large, predominant angiosperms which are observable by the naked eye and are the important components of the aquatic ecosystem. They may be either emergent, submerged, floating-leaved or free-floating. The main objectives to be achieved during the study of these aquatic macrophytes are: to study and identify the diversity of aquatic macrophytes on the basis of their characters, to classify the aquatic macrophytes on the basis of their habitat and to study the problems and issues of the wetlands. The study has been carried out in some selected wetlands of Guwahati city particularly: Borbila Bill in Chandrapur Tehsil and Silsako Beel in Satgaon which have not yet been studied by anybody else. During the present study, 34 aquatic macrophytes belonging to 17 orders, 19 families and 27 genera have been reported. The names, order, family, habitat, life form of the species found have been noted in the present paper. 5 rare aquatic macrophytes are also recorded in this study. These wetlands and its aquatic macrophytes are degrading at a faster rate due to various anthropogenic activities like habitat destruction, disturbance due to fishing, etc.

***Key words*:** Wetland, Aquatic, Macrophytes, Anthropogenic

Wetlands are defined as 'lands transitional between terrestrial and aquatic ecosystems where the water table is usually at or near the surface or the land is covered by shallow water' [1]. Wetlands are regarded as one of the most valuable ecosystems [2]. Wetlands are often described as "kidneys of the landscape" [3]. Wetlands are considered as ecotone between terrestrial and aquatic ecosystems, as a result of which they are dominated by the influence of water [4]. Wetlands are among the world's most productive environments. They are the cradles and the backbone of biological diversity, providing the water and productivity upon which countless species of plants depend for survival [5]. The wetlands also retain water during dry periods, thus keeping the water table high and relatively stable [6]. Wetland is the collective term for marshes, swamps, bogs and similar areas. Although only 6% of the Earth's surface is covered by the wetlands, however, they provide habitats for about 20% of the total biological diversity of the earth. In Assam, the freshwater, perennial, large and lentic water bodies are popularly known as beel [7].

Aquatic and wetland plants are mostly confined to the marshes and wetland habitats. These waterlogged or wet soils form the diverse habitats for specific aquatic plant communities and they are known as wetlands in broader sense. They are characterized by the presence of water i.e., fresh, brackish, saline or eutrophic [7]. Aquatic macrophytes are those plants that grow in or near water. As aquatic macrophytes are diverse, they have been grouped into three categories: submerged – plants that primarily grow completely below the water surface; emergent – plants that are rooted in the sediments and protrude up at the water surface; floating – plants that can be rooted to the bottom but have leaves floating on the water surface and plant that maybe completely free-floating. Balance within the ecosystem is maintained due to the abundance of native plant communities. In India, most of the aquatic macrophytes are herbs and shrubs. Many species come up during the rainy season while some flourish even in dry season [8].

Submerged plants increase the bed and bank roughness increasing drag and decreasing flow. Floating plants increase water loss through evapotranspiration [9]. Floating or emergent

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plants of the wetlands are considered to be an important tool for reducing increase in temperature and submerged plants are considered to be the generators of oxygen in the aquatic habitats [10]. Free-floating and rooted floating- leaved species are the most dominant and competitive aquatic macrophytic communities for sunlight in wetlands [3].

Wetlands are one of the most threatened habitats of the world as they are increasingly facing several anthropogenic pressures. The rapidly expanding human population, large scale changes in land use/land cover, etc. have caused a substantial decline of wetland resources of the country. Significant losses have resulted from its conversion threats from industrial, agricultural and various urban developments. Unsustainable levels of grazing and fishing activities have also resulted in degradation of wetlands [6]. The current loss rates of wetlands in India can lead to serious consequences, where 74% population is rural. At present in India, only 50% of wetlands remain. They are disappearing at a rate of 2% to 3% every year. Loss of wetland leads to environmental and ecological problems, which have a direct effect on biodiversity. Serious consequences, including increased flooding, species decline, deformity or extinction and decline in water quality could result [11].

MATERIALS AND METHODS

Guwahati is the largest city in the Indian State of Assam and also the largest metropolis in North-Eastern India. Guwahati is the administrative headquarter of Kamrup Metropolitan District. It is geographically situated in 26°10´20´´ North latitude and 91°44´45´´ East longitude. The city is situated on the south bank of river Brahmaputra.

The study has been carried out in Borbila Bill and Silsako Beel. Borbila Bill is located in Borbila Village in Chandrapur, a town under Chandrapur Tehsil in Kamrup Metro District of Assam. It is located 42 km towards East of Guwahati. Borbila Bill is geographically situated in 26°19´07´´ North latitude and 91°95´15´´ East longitude. It has an area of about 929.15 hectares. Silsako Beel is located at Satgaon in Kamrup Metro District of Assam. Silsako Beel is geographically situated in 26°9´29´´ North latitude and 91°49´1´´ East longitude and lies in the west of VIP Road and in the north of Narengi. It has an area of about 407 hectares.

Climate, physiography and topography

The principal characteristics of the climate of Borbila Bill and Silsako Beel in Guwahati are: cold and foggy winter, moderately hot spring, temperately hot but very humid summer and pleasant autumn. In summer, the temperature rises upto 38°C, while in winter, it, sometimes, falls to 10°C. The spring season lasts from March-May. In this season, the weather is dry with less humidity and the atmosphere is dusty. In April-May, rain along with thunderstorms occur. The minimum and maximum temperature ranges between 12-31°C. Sufficient rainfall occurs in the months of June-August. The minimum and maximum temperature ranges between 25- 34°C. The autumn season lasts from September-November. The minimum and maximum temperature ranges between 21-31°C. The winter season lasts from December-February. The minimum and maximum temperature ranges between 10-24°C. In this season, mist occurs during the night and morning.

The Guwahati city is a city of hills and marshy land. Hills surround the Eastern, Southern and Western sides. The height of the hills ranges less than 300 metres from the sea level. The hills are Chunsali, Chitrachal, Japorigog, Narakasur, Fatasil, Gotanagar, Nilachal and branches of Khasi and Jaintia hills.

Due to its uneven topography with built-up area, marshy land, the shape of the city looks like a bowl with protrusions like Sarania hills having height less than 200 metres.

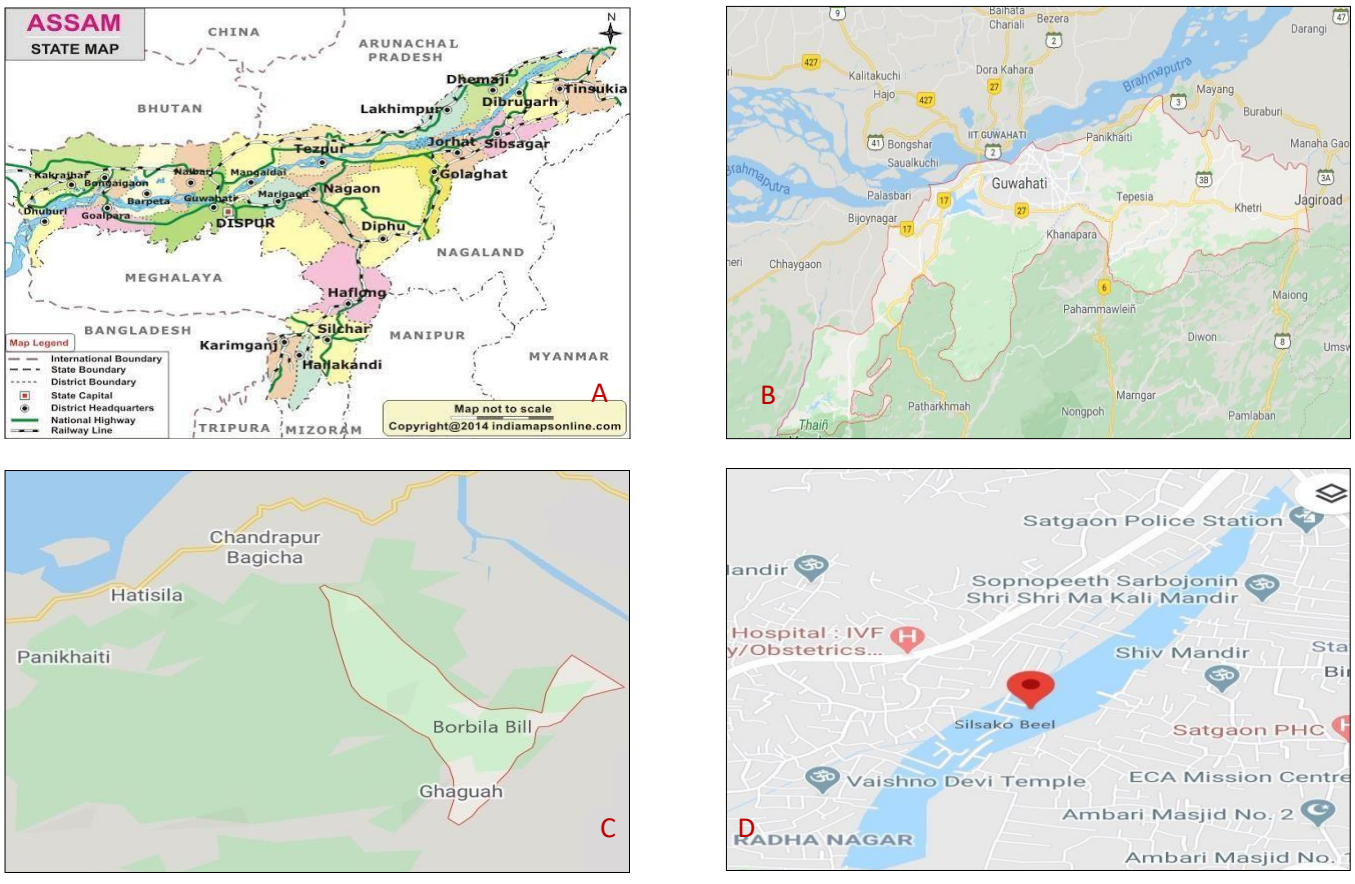

Fig (A) Assam, (B) Guwahati under Kamrup Metro District of Assam, (C) Map showing the study site of Borbila Bill in Guwahati, Assam, India, (D) Map showing the study site of Silsako Beel in Guwahati, Assam, India

Fig 1 Study site of Borbila bill in Guwahati, Assam, India

Fig 2 Study site of Silsako Beel in Guwahati, Assam, India

Equipments used during field study

- Diggers or trowels have been used to obtain specimens with the underground plant parts like rhizomes, corm, bulb, tubers, root systems, etc.
- Pruning knife has been used for the collection and cutting of branches, etc.
- Long stick has been used as safety precaution during the field trip.
- Polythene bags have been used for collection of plants.
- Field notebook is a must and essential tool during the field study. Data's recorded in the field notebook consists of locality name, geographical location, date and time of collection, names of the plants collected, flower colour, etc. A definite number has been given to each specimen and this number has been recorded in the notebook. This number coordinates with the number given on the labels after mounting of the specimens.
- Pen is also an essential tool in field study.
- Photographic equipments such as camera, mobile phone have been used to capture the study area, plants to be collected, etc.

Techniques used for preparation of herbarium

- Plant collection
- Collection of plants in polythene bag
- Hot water treatment
- Pressing of specimens for drying
- Poisoning
- Mounting of plant specimens
- Labelling

Identification of plant specimens

Identification of plant specimens requires a considerable amount of time and effort. The identification of plant material is accomplished with the use of dichotomous keys: published plant descriptions, illustration and photographs and comparison with properly identified herbarium specimens.

RESULTS AND DISCUSSION

A total of 34 aquatic macrophytes were found, belonging to 17 orders, 19 families and 27 genera. They have been recorded from the two selected wetlands of Guwahati i.e., Borbila Bill and Silsako Beel [12-14]. 14 aquatic macrophytes have been recorded from Borbila Bill (Table 1). 23 aquatic macrophytes have been recorded from Silsako Beel (Table 2). 3 aquatic macrophytes were common in both the wetlands (Table 3).

Of the 17 orders, Alismatales was found in 6 species; Nymphaeales in 4 species; Polygonales in 4 species; Arales, Cyperales, Commelinales, Solanales, Myrtales, Hydrocharitales in 2 species each and Caryophyllales, Asterales, Asparagales, Apiales, Najadales, Ranunculales, Typhales, Scrophulariales in 1 species each. Of the 19 families, Nymphaeaceae and Polygonaceae consisted of 4 species each; followed by Araceae and Hydrocharitaceae of 3 species each; Poaceae, Pontederiaceae, Convolvulaceae, Lemnaceae and Alismataceae of 2 species each; Amaranthaceae, Asteraceae, Iridaceae, Onagraceae, Apiaceae, Potamogetonaceae, Ranunculaceae, Trapaceae, Typhaceae and Lentibulariaceae of 1 species each. 33 species found belonged to herbs and 1 species belonged to shrub. 22 plants species were perennial and 12 plant species were annual in their habitat. Among their life forms, 18 emergent plant species were found, followed by 8 rooted with floating leaves, 5 free-floating, 2 submerged and 1 submerged floating plant species (Table 4). 5 species of macrophytes are found in this study which are listed in IUCN Red List (Table 5).

Table 1 List of aquatic macrophytes found in Borbila Bill with their scientific names, common names, orders and families

S. No.	Scientific name	Common Name	Order	Family
1	*Eichhornia crassipes*	Water hyacinth	Commelinales	Pontederiaceae
2	*Euryale ferox*	Fox nut	Nymphaeales	Nymphaeaceae
3	*Hydrocharis dubia*	Frogbit	Alismatales	Hydrocharitaceae
4	*Hygroryza aristata*	Asian watergrass	Cyperales	Poaceae
5	*Nymphaea odorata*	Firecrest water lily	Nymphaeales	Nymphaeaceae
6	*Nymphaea pubescens*	Pink water lily	Nymphaeales	Nymphaeaceae
7	*Nymphaea rubra*	Red Indian water lily	Nymphaeales	Nymphaeaceae
8	*Potamogeton natans*	Floating pondweed	Najadales	Potamogetonaceae
9	*Sagittaria trifolia*	Three-leaf arrowhead	Alismatales	Alismataceae
10	*Sagittaria sagittifolia*	Arrowhead	Alismatales	Alismataceae
11	*Trapa natans*	Water chestnut	Myrtales	Trapaceae
12	*Typha latifolia*	Common cattail	Typhales	Typhaceae
13	*Utricularia aurea*	Golden bladderwort	Scrophulariales	Lentibulariaceae
14	*Vallisneria spiralis*	Eel grass	Hydrocharitales	Hydrocharitaceae

Table 2 List of aquatic macrophytes found in Silsako Beel with their scientific names, common names, orders and families

S. No.	Scientific name	Common Name	Order	Family
1	*Alternanthera philoxeroides*	Alligator weed	Caryophyllales	Amaranthaceae
2	*Colocasia esculenta*	Taro	Arales	Araceae
3	*Colocasia fontanesii*	Black taro	Arales	Araceae
4	*Echinochloa crus-galli*	Cockspur grass	Cyperales	Poaceae
5	*Eichhornia crassipes*	Water hyacinth	Commelinales	Pontederiaceae
6	*Enhydra fluctuans*	Water cress	Asterales	Asteraceae
7	*Ipomoea carnea*	Bush morning glory	Solanales	Convolvulaceae
8	*Ipomoea reptans*	Water spinach	Solanales	Convolvulaceae
9	*Iris pseudacorus*	Water flag	Asparagales	Iridaceae
10	*Jussiaea repens*	Creeping water primrose	Myrtales	Onagraceae
11	*Lemna minor*	Common duckweed	Alismatales	Lemnaceae
12	*Monochoria vaginalis*	False pickerelweed	Commelinales	Pontederiaceae
13	*Oenanthe javanica*	Water dropwort	Apiales	Apiaceae
14	*Ottelia ulvifolia*	-	Hydrocharitales	Hydrocharitaceae
15	*Persicaria lapathifolia*	Pale smartweed	Polygonales	Polygonaceae
16	*Persicaria maculosa*	Pink smartweed	Polygonales	Polygonaceae
17	*Persicaria orientalis*	Tall persicaria	Polygonales	Polygonaceae
18	*Pistia stratiotes*	Water lettuce	Alismatales	Araceae
19	*Ranunculus sceleratus*	Celery-leaved buttercup	Ranunculales	Ranunculaceae
20	*Rumex crispus*	Curly dock	Polygonales	Polygonaceae
21	*Sagittaria trifolia*	Three-leaf arrowhead	Alismatales	Alismataceae
22	*Sagittaria sagittifolia*	Arrowhead	Alismatales	Alismataceae
23	*Spirodela polyrhiza*	Greater duckweed	Alismatales	Lemnaceae

Table 3 List of aquatic macrophytes found in both wetlands with their scientific names, common names, orders and families

S. No.	Scientific name	Common Name	Order	Family
1	*Eichhornia crassipes*	Water hyacinth	Commelinales	Pontederiaceae
2	*Sagittaria trifolia*	Three-leaf arrowhead	Alismatales	Alismataceae
3	*Sagittaria sagittifolia*	Arrowhead	Alismatales	Alismataceae

Table 4 List of aquatic macrophytes found with their scientific names, habit, habitat and life forms

S. No.	Scientific name	Common name	Order	Family
1	*Alternanthera philoxeroides*	Herb	Perennial	Emergent
2	*Colocasia esculenta*	Herb	Perennial	Emergent
3	*Colocasia fontanesii*	Herb	Perennial	Emergent
4	*Echinochloa crus-galli*	Herb	Annual	Emergent
5	*Eichhornia crassipes*	Herb	Perennial	Free-floating
6	*Enhydra fluctuans*	Herb	Annual	Emergent
7	*Euryale ferox*	Herb	Perennial	Rooted with floating leaves
8	*Hydrocharis dubia*	Herb	Perennial	Free-floating
9	*Hygroryza aristata*	Herb	Perennial	Rooted with floating leaves
10	*Ipomoea carnea*	Shrub	Perennial	Emergent
11	*Ipomoea reptans*	Herb	Annual	Rooted with floating leaves
12	*Iris pseudacorus*	Herb	Perennial	Emergent
13	*Jussiaea repens*	Herb	Perennial	Emergent
14	*Lemna minor*	Herb	Annual	Free-floating
15	*Monochoria vaginalis*	Herb	Perennial	Emergent
16	*Nymphaea odorata*	Herb	Perennial	Rooted with floating leaves
17	*Nymphaea pubescens*	Herb	Perennial	Rooted with floating leaves
18	*Nymphaea rubra*	Herb	Perennial	Rooted with floating leaves
19	*Oenanthe javanica*	Herb	Perennial	Emergent
20	*Ottelia ulvifolia*	Herb	Annual	Submerged
21	*Persicaria lapathifolia*	Herb	Annual	Emergent
22	*Persicaria maculosa*	Herb	Annual	Emergent
23	*Persicaria orientalis*	Herb	Annual	Emergent
24	*Pistia stratiotes*	Herb	Annual	Free-floating
25	*Potamogeton natans*	Herb	Perennial	Rooted with floating leaves
26	*Ranunculus sceleratus*	Herb	Perennial	Emergent
27	*Rumex crispus*	Herb	Perennial	Emergent
28	*Sagittaria trifolia*	Herb	Perennial	Emergent
29	*Sagittaria sagittifolia*	Herb	Perennial	Emergent
30	*Spirodela polyrhiza*	Herb	Annual	Free-floating
31	*Trapa natans*	Herb	Annual	Rooted with floating leaves
32	*Typha latifolia*	Herb	Perennial	Emergent

33	*Utricularia aurea*	Herb	Annual	Submerged floating
34	*Vallisneria spiralis*	Herb	Perennial	Submerged

Table 5 List of rare aquatic macrophytes found in both wetlands (included under IUCN Red List)

S. No.	Scientific name
1	*Colocasia fontanesii*
2	*Hydrocharis dubia*
3	*Iris pseudacorus*
4	*Nymphaea odorata*
5	*Ottelia ulvifolia*

Problems and issues of the wetlands

Wetlands and its aquatic macrophytes are degrading at a faster rate due to various anthropogenic activities. These anthropogenic activities include habitat destruction, encroachment through drainage and landfill for colonization, construction purposes, over- exploitation of fish, discharge of waste water, runoff from agricultural fields, climate change, etc., [15-16].

Habitat loss or habitat destruction: Large number of wetlands are converted into cultivable land which results in the destruction of habitats or habitat loss.

Agricultural conversion: Rice culture in the Indian subcontinent has resulted in the degradation of wetlands. Rice farming is a wetland dependent activity and as a result of this, water is deprived to the downstream natural wetlands.

Exploitation of birds through hunting: Hunting of water birds such as ducks, storks, etc. has also caused degradation of wetlands.

Degradation of water quality: Water quality is degrading in the wetlands as a result of sewage run, industrial pollution, agricultural runoff, etc. which may contain pesticides, fertilizers, etc.

Disturbance due to fishing: Fishing has resulted in the loss of aquatic macrophytes in wetlands. It has also led to the turbidity of the wetlands. During my first visit to Borbila Bill I saw a destructive fishing conducted by a large number of local people.

Fig Destructive fishing at Borbila Bill

Encroachment: Encroachment of wetland for colonization, construction purposes, etc. has also caused degradation of the wetlands.

Eutrophication: Eutrophication as a result of excessive plant and algal growth due to the increased availability of limiting growth factors needed for photosynthesis such as sunlight, carbon dioxide, etc. also led to the loss of wetlands.

Nymphaea odorata

Euryale ferox

Eichhornia crassipes

Typha latifolia

Nymphaea rubra

Potamogeton natans

Vallisneria spiralis

Sagittaria trifolia

CONCLUSION

A wetland is an ecosystem that arises when inundation by water produces soils dominated by anaerobic processes, which, in turn, forces the biota, particularly rooted plants, to adapt to floo- ding. The aquatic macrophytes are large, predominant angiosperms and they may be either emergent, submerged, floating-leaved or free-floating. 34 aquatic macrophytes were found, belonging to 17 orders, 19 families and 27 genera from the two selected wetlands of Guwahati city particularly Borbila Bill and Silsako Beel. 14 aquatic macrophytes have been recorded from Borbila Bill, 23 aquatic macrophytes have been recorded from Silsako Beel and 3 aquatic macrophytes were common in both the wetlands. 33 species found belonged to herbs and 1 species belonged to shrub. 22 plants species were perennial and 12 plant species were annual in their habitat. Among their life forms, 18 emergent plant species were found, followed by 8 rooted with

floating leaves, 5 free-floating, 2 submerged and 1 submerged floating plant species. 10 families were found belonging to dicotyledons and 9 families to monocotyledons. Amaranthaceae, Asteraceae, Nymphaeaceae, Convolvulaceae, Onagraceae, Apiaceae, Polygonaceae, Ranunculaceae, Trapaceae and Lentibulariaceae were the families found belonging to dicotyledons. Araceae, Poaceae, Pontederiaceae, Hydrocharitaceae, Lemnaceae, Alismataceae, Iridaceae, Typhaceae and Potamogetonaceae were the families found belonging to monocotyledons. Wetlands and its aquatic macrophytes are degrading at a faster rate due to various anthropogenic activities. Climate change is also another factor which is responsible for the degradation of wetlands.

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Conflict of interest

The authors declare that there is no conflict of interest.

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