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Diversity and Seasonal Variation of Aquatic Macrophytes in Three Floodplain Wetlands of Kamrup Metro District in Assam

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Abstract The present investigation deals with the documentation of aquatic macrophytes from the wetlands of Kamrup Metro district of Assam, India situated at the global position of 25°43´ N–26°51´ N latitude and 90°36´ E-–92°12´ E longitudes. The study was carried out in three important wetlands of the district viz., Duani *beel*, Jalikhora *beel* and Etila *beel* for a period of one year, from January 2013 to December 2013. Among the three wetlands, Duani *beel* and Etila *beel* are of open type and has connection to the tributary of Brahmaputra river namely Digaru and Kolong. Jalikhora *beel* is of close type that has no connection to any river tributary. All the three wetlands remain covered by water along with its aquatic vegetation almost throughout the year. During the investigation, the wetlands were visited twice in a month for one year and species found there were recorded. A heterogeneous assemblage of 33 species of aquatic macrophytes under 20 families were recorded from the three studied wetlands, which included five free floating, eight rooted floating, two submerged and eighteen emergent species. Four aquatic macrophytes species have been found to occur throughout the year. Among these three wetlands, Etila *beel* is gradually degrading due to discharge of industrial effluent of Paper Industry.

Keywords Wetlands, Aquatic macrophytes, Degradation, Industrial effluent.

Introduction

Wetlands are defined as lands transitional between terrestrial and aquatic eco-systems where the water table is usually at or near the surface, or the land is covered by shallow water. They are one of the most productivity ecosystems in the biosphere and play a significant role in the ecological sustainability of a region. In addition, wetlands are important feeding and breeding areas for wildlife and provide a stopping place and refuge for water fowl. As with any natural habitat, wetlands are important in supporting species diversity and have a complex of wetland values.

Aquatic plants are those whose photosynthetically active parts remain permanently or at least for several months each year submerged in water or floating on water surface [1]. Aquatic macrophytes are primary producers, their diversity and role in understanding the freshwater ecosystem dynamics is very important. Aquatic plants play a significant role in a river and reservoir ecosystems by several means, such as, providing habitats for aquatic organisms, stabiliz-

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ing the sediment by reducing erosion, buffering temperature fluctuation and waves, maintaining dissolved oxygen, utilize nutrients, absorbing heavy metals. According to India's National Biodiversity Action Plan nearly 50% of the aquatic plant species of the world are recorded from Indian sub-continent but only a few have been studied in detail so far, SANDRP [2]. The aquatic macrophytes have greater influence on the ecology and fisheries of floodplain wetlands. Many workers studied the plant communities and their production potential in various lentic ecosystems. Again while Mohanty et al. [3], reported the use of aquatic plants in water quality management.

Kamrup Metro district is amongst the 27 districts of Assam and situated between 25°43´–26°51´ N and 90°36´–92°12´E. The main river tributaries of the district are Kolong and Digaru and these two tributaries are connected to the Brahmaputra river. On the way, several smaller and medium sized wetlands connected to the two tributaties. The Dimoria developmental block of the Kamrup Metro district also has some wetlands which are connected to Kolong and Digaru river.

Several publications came out on aquatic macrophytes of Assam in last two decades, Kar and Borthakur [4], studied on angiosperm flora of Gauhati University including aquatic plants ; Sanil Kumar and John Thomas [5], reported the invasion of Limnocharis flava in the wetlands of Muriyard. Sarkar et al. [6], studied about the medicinally important wetland angiosperms used by the Bodo tribe of Kamrup district ; Sarma and Saikia [7], on utilization of wetland resources by the rural people of Nagaon district ; Nath [8], on aquatic macrophytes of Laokhowa Wildlife Sanctuary, Assam ; Das [9] on diversity of aquatic and wetland angiosperm macrophytes in the Kamrup district; Deka and Sarma [10], on present status of aquatic macrophytes of the wetlands of Nalbari district of Assam, India.

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Materials and Methods

Study area

The wetlands selected for the study are located in floodplain region of Dimoria block, which is a tribal development block, and is situated in the Kamrup Metro district of Assam and water of these wetlands remains throughout the year. The principal tributaries of Dimoria are the Kolong and Digaru. There are a large number of so called *beels*. The Dimoria block is situated in the South Eastern corner of Kamrup Metro district and on the south bank of the river Brahmaputra. It is bounded by Meghalaya on the south, Morigaon district on the North East and by greater Guwahati city on the west upto Jorabat, Amerigog region. Dimoria covers an area of 360 sq km and has 162 villages. The wetlands that are selected for the present study are (a) Duani *beel* situated between 26°13´20´´–26°05´30´´ N and 92°05´–92°1´30´´ E and connected to the Digaru river tributary, (b) Jalikhora *beel* situated between 26°09´18´´ – 26°07´ N and 92°4´–92°06´ E and is of closed type, and (c) Etila *beel* situated between 26°10´–26°08´ N and 92°11´–92°08´E and connected to the Kolong river tributary.

Data collection and analysis

During the study period, monthly surveys to record, collect and identify the aquatic macrophytes were carried out from January 2013 to December 2013 in the three wetlands. Adequate field trips were undertaken during the study period to collect and record precisely the macrophytic species. Macrophye species were collected using long handed hooks, nets or by hands. Macrophytes taken out were thoroughly washed, excess water were absorbed on a cloth or filter paper and then were kept in a herbarium sheet for the preparation of herbarium. For submerged aquatic macrophytes drying papers were changed every alternate day. After drying, the dried specimens were then mounted on herbarium sheets by following the usual laboratory techniques. The collected macrophyte species were identified using different available published literatures of Choudhury [11] and Das

Table 1. Species distribution and seasonal variation of aquatic macrophytes found in duani *beel* of dimoria region of Kamrup Metro District, Assam , India ('+' : present, '–' : absent).

Species name	Family	Local name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Free floating														
1. *Azolla pinnata*	Azollaceae	*Guri puni*	+	+	+	+	+	+	+	+	+	+	+	+
2. *Eichhornia crassipes*	Pontederiaceae	*Pani-Meteka*	+	+	+	+	+	+	+	+	+	+	+	+
3. *Lemna perpusilla*	Lemnaceae	*Soru puni*	+	+	+	+	–	–	–	–	–	+	+	+
4. *Ludwigia adscendens*	Onagraceae	*Taljuri*	+	+	+	–	–	–	–	–	–	–	–	+
5. *Pistia stratiotes*	Araceae	*Bor puni*	–	–	–	–	+	+	+	+	+	+	–	–
Rooted floating														
6. *Euryale ferox*	Nymphaeaceae	*Nikori*	–	–	–	+	+	+	–	–	–	+	+	–
7. *Nelumbo nucifera*	Nelumbonaceae	*Padum*	–	–	–	–	–	–	–	–	–	–	–	–
8. *Nymphoides cristatum*	Hydrocharitaceae	*Pan chuli*	–	–	–	–	+	+	+	+	+	–	–	–
9. *Nymphoides indicum*	Hydrocharitaceae	*Bora chuli*	–	–	–	+	+	+	+	+	+	–	–	–
10. *Nymphaea lotus*	Nymphaeaceae	*Boga bhet*	+	+	+	–	–	–	–	–	–	–	+	+
11. *Nymphaea pubescence*	Nymphaeaceae	*Mokua*	–	–	–	+	+	+	–	–	–	+	+	–
12. *Nymphaea rubra*	Nymphaeaceae	*Ronga bhet*	–	–	–	–	–	–	–	–	–	–	–	–
13. *Trapa natans*	Trapaceae	*Dangor-singori*	+	+	+	+	+	+	–	–	–	–	+	+
Submerged														
14. *Hydrilla verticillata*	Hydrocharitaceae	*Patal khar*	+	+	+	+	–	–	–	–	–	–	+	+
15. *Vallisneria natans*	Hydrocharitaceae	*Pata ghah*	+	+	+	–	–	–	–	–	–	+	+	+
Emergent														
16. *Alternanthera sessiles*	Amaranthaceae	*Mati kanduri*	+	+	+	+	–	–	–	–	–	–	+	+
17. *Amaranthus spinosus*	Amaranthaceae	*Hati khutura*	+	+	+	–	–	–	–	–	–	+	+	+
18. *Amaranthus viridis*	Amaranthaceae	*Khutura*	+	+	–	–	–	–	–	–	–	–	+	+

Table 1. Continued.

Species name	Family	Local name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Emergent														
19. *Centella asiatica*	Apiaceae	*Bor manimuni*	+	+	+	+	–	–	–	–	–	+	+	+
20. *Cynodon dactylon*	Poaceae	*Dubori-bon*	+	+	+	+	+	–	–	–	+	+	+	+
21. *Cyperus corymbosus*	Cyperaceae	*Uria bon*	+	+	+	–	–	–	–	–	–	–	+	+
22. *Cyperus pilosus*	Cyperaceae	*Sereka bon*	+	+	+	+	+	–	–	–	–	+	+	+
23. *Elephantopus scaber*	Asteraceae	*Hati bon*	+	+	+	–	–	–	–	–	–	+	+	+
24. *Enhydra fluctuans*	Asteraceae	*Helachisak*	+	+	+	–	–	–	–	–	–	–	+	+
25. *Eupatorium odoratum*	Euphorbiaceae	*Germanibon*	+	+	–	–	–	–	–	–	–	–	+	+
26. *Hydrocotyle sibthorpioides*	Araliaceae	*Soru manimuni*	+	+	+	–	–	–	–	–	–	–	+	+
27. *Hygroryza aristata*	Poaceae	*Petuli-dol*	–	–	–	–	+	+	+	+	+	+	–	–
28. *Ipomoea aquatica*	Convolvulaceae	*Kolmousak*	–	–	–	–	+	+	+	+	+	+	–	–
29. *Mimosa pudica*	Mimosaceae	*Lajokibon*	+	+	+	+	+	–	–	–	+	+	+	+
30. *Phragnitis karka*	Poaceae	*Khagori*	–	–	–	–	+	+	+	+	+	+	–	–
31. *Polygonum orientales*	Polygonaceae	*Bihlongoni*	–	–	–	–	–	–	–	–	–	–	–	–
32. *Sagittaris trifolia*	Alismataceae	*Panikochu*	+	+	+	+	–	–	–	–	–	+	+	+
33. *Vetiveria zizanoides*	Poaceae	*Birina*	–	–	–	–	+	+	+	+	+	+	–	–

[9].

Enumeration

The wetland wise records of aquatic macrophytes have been enumerated in Table 1, Table 2 and Table 3 with families and their local names in Assamese.

Results and Discussion

A heterogeneous assemblage of 33 species of aquatic macrophytes fewer than 20 families were recorded from the three studied wetlands. Of these, *Azolla pinnata* and *Eichhornia crassipes* were found to occur throughout the year in Duani *beel*. *Eichhornia crassipes* and *Cynodon dactylon* were found to occur throughout the year in Jalikhora *beel*. *Eichhornia crassipes*, *Trapa natans* and *Cynodon dactylon* were found to occur throughout the year in the Etila *beel*. In Duani *beel*, during monsoon (June–August), floating varieties of aquatic macrophytes viz., *Azolla pinnata*, *Eichhornia crassipes*, *Nymphoides cristatum*, *Nymphoides indicum* and *Pistia stratiotes* flourished and dominated the aqua-regime at a greater depth of the wetland water. Among the emergent varieties viz., *Hygroryza aristata*, *Ipomoea aquatic*

Table 2. Species distribution and seasonal variation of aquatic macrophytes found in the Jalikhora *beel* of dimoria region , Kamrup Metro District, Assam , India ('+' : present, '–' : absent).

Species name	Family	Local name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Free floating														
1. *Azolla pinnata*	Azollaceae	*Guri puni*	+	+	+	+	+	–	–	–	–	+	+	+
2. *Eichhornia crassipes*	Pontederiaceae	*Pani-Meteka*	+	+	+	+	+	+	+	+	+	+	+	+
3. *Lemna perpusilla*	Lemnaceae	*Soru puni*	–	–	–	+	+	+	+	+	+	–	–	–
4. *Ludwigia adscendens*	Onagraceae	*Taljuri*	–	–	–	–	–	–	–	–	–	–	–	–
5. *Pistia stratiotes*	Araceae	*Bor puni*	–	–	–	+	+	+	+	+	+	–	–	–
Rooted floating														
6. *Euryale ferox*	Nymphaeaceae	*Nikori*	–	–	–	–	–	–	–	–	–	–	–	–
7. *Nelumbo nucifera*	Nelumbonaceae	*Padum*	–	–	–	–	–	–	–	–	–	–	–	–
8. *Nymphoides cristatum*	Hydrocharitaceae	*Pan chuli*	–	–	–	+	+	+	+	+	+	–	–	–
9. *Nymphoides indicum*	Hydrocharitaceae	*Bora chuli*	–	–	–	–	–	–	–	–	–	–	–	–
10. *Nymphaea lotus*	Nymphaeaceae	*Boga bhet*	–	–	–	–	–	–	–	–	–	–	–	–
11. *Nymphaea pubescence*	Nymphaeaceae	*Mokua*	–	–	–	–	+	+	+	+	+	–	–	–
12. *Nymphaea rubra*	Nymphaeaceae	*Ronga bhet*	+	+	+	+	+	–	–	–	–	–	+	+
13. *Trapa natans*	Trapaceae	*Dangor-singori*	+	+	+	+	–	–	–	–	–	–	+	+
Submerged														
14. *Hydrilla verticillata*	Hydrocharitaceae	*Patal khar*	+	+	+	–	–	–	–	–	–	+	+	+
15. *Vallisneria natans*	Hydrocharitaceae	*Pata ghah*	+	+	+	–	–	–	–	+	+	+	+	+
Emergent														
16. *Alternanthera sessiles*	Amaranthaceae	*Mati kanduri*	+	+	+	–	–	+	+	+	–	–	+	+
17. *Amaranthus spinosus*	Amaranthaceae	*Hati khutura*	–	–	–	–	–	–	–	–	–	–	–	–
18. *Amaranthus viridis*	Amaranthaceae	*Khutura*	+	+	+	+	+	–	–	–	–	–	+	+

Table 2. Continued.

Species name	Family	Local name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Emergent														
19. *Centella asiatica*	Apiaceae	*Bor manimuni*	+	+	+	+	–	–	–	–	–	+	+	+
20. *Cynodon dactylon*	Poaceae	*Dubori-bon*	+	+	+	+	+	+	+	+	+	+	+	+
21. *Cyperus corymbosus*	Cyperaceae	*Uria bon*	+	+	+	+	–	–	–	–	–	+	+	+
22. *Cyperus pilosus*	Cyperaceae	*Sereka bon*	+	+	+	–	–	–	–	–	–	–	+	+
23. *Elephantopus scaber*	Asteraceae	*Hati bon*	+	+	+	–	–	–	–	–	–	+	+	+
24. *Enhydra fluctuans*	Asteraceae	*Helachisak*	–	–	–	–	–	–	–	–	–	–	–	–
25. *Eupatorium odoratum*	Euphorbiaceae	*Germanibon*	+	+	+	+	+	–	–	–	–	+	+	+
26. *Hydrocotyle sibthorpioides*	Araliaceae	*Soru manimuni*	+	+	+	–	–	–	–	–	+	+	+	+
27. *Hygroryza aristata*	Poaceae	*Petuli-dol*	–	–	–	–	+	+	+	+	+	–	–	–
28. *Ipomoea aquatica*	Convolvulaceae	*Kolmousak*	–	–	–	+	+	+	+	+	+	–	–	–
29. *Mimosa pudica*	Mimosaceae	*Lajokibon*	–	–	–	–	–	–	–	–	–	–	–	–
30. *Phragnitis karka*	Poaceae	*Khagori*	–	–	–	–	+	+	+	+	+	–	–	–
31. *Polygonum orientales*	Polygonaceae	*Bihlongoni*	+	+	+	–	–	–	–	–	–	–	+	+
32. *Sagittaris trifolia*	Alismataceae	*Panikochu*	+	+	+	–	–	–	–	–	–	+	+	+
33. *Vetiveria zizanoides*	Poaceae	*Birina*	–	–	–	–	+	+	+	+	+	+	–	–

and *Vetiveria zizanoides* were found to occur during the monsoon period. During winter (December–February), floating varieties of aquatic macrophytes viz., *Lemna perpusilla* and *Ludwigia adscendens* were found to occur in Duani *beel*. Submerged varieties of *Hydrilla verticillata* and *Vallisneria natans* were found to occur in the winter season in Duani *beel*. Among the emergent varieties viz., *Alternanthera sessile*, *Amaranthus spinosus*, *Amaranthus viridis*, *Centella asiatica*, *Cynodon dactylon*, *Cyperus corymbosus*, *Cyperus pilosus*, *Elephantopus scaber*, *Enhydra fluctuans*, *Eupatorium odoratum*, *Hydrocotyle sibthorpioides*, *Mimosa pudica*, Sagittaris trifolia were found to occur during winter in Duani *beel*. In Jalikhora *beel*, during monsoon, floating varieties of aquatic macrophytes viz., *Eichhornia crassipes*, *Lemna perpusilla*, *Pistia stratiotes*, *Nymphoides cristatum*, *Nymphaea pubescence*, *Trapa natans* were found to occur. Among the emergent varieties viz., *Alternanthera sessile*, *Cynodon dactylon*, *Hygroryza aristata*, *Ipomoea aquatica*, *Phragnitis karka*, *Vetiveria zizanoides* were found to occur in monsoon season. During winter, floating varieties of aquatic macrophytes viz., *Azolla pinnata*, *Eichhornia crassipes*, *Nymphaea rubra*, *Trapa natans* were found to occur in Jalikhora *beel*. Among submerged, *Hydrilla verticillata* and *Vallisneria* natans were found to occur during winter in Jalikhora

Table 3. Species distribution and seasonal variation of aquatic macrophytes found in the Etila *beel* of dimoria region, Kamrup Metro District, Assam , India ('+' : present, '–' : absent).

Species name	Family	Local name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Free floating														
1. *Azolla pinnata*	Azollaceae	*Guri puni*	+	+	–	–	–	–	–	–	–	+	+	+
2. *Eichhornia crassipes*	Pontederiaceae	*Pani-Meteka*	+	+	+	+	+	+	+	+	+	+	+	+
3. *Lemna perpusilla*	Lemnaceae	*Soru puni*	–	–	–	–	–	+	+	+	+	–	–	–
4. *Ludwigia adscendens*	Onagraceae	*Taljuri*	–	–	–	–	–	–	–	–	–	–	–	–
5. *Pistia stratiotes*	Araceae	*Bor puni*	–	–	–	–	–	–	–	–	–	–	–	–
Rooted floating														
6. *Euryale ferox*	Nymphaeaceae	*Nikori*	–	–	–	–	–	–	–	–	–	–	–	–
7. *Nelumbo nucifera*	Nelumbonaceae	*Padum*	–	–	–	–	–	–	–	–	–	–	–	–
8. *Nymphoides cristatum*	Hydrocharitaceae	*Pan chuli*	–	–	–	–	+	+	+	+	–	–	–	–
9. *Nymphoides indicum*	Hydrocharitaceae	*Bora chuli*	–	–	–	–	–	–	–	–	–	–	–	–
10. *Nymphaea lotus*	Nymphaeaceae	*Boga bhet*	–	–	–	–	–	–	–	–	–	–	–	–
11. *Nymphaea pubescence*	Nymphaeaceae	*Mokua*	–	–	–	–	+	+	+	+	+	–	–	–
12. *Nymphaea rubra*	Nymphaeaceae	*Ronga bhet*	+	+	+	+	+	–	–	–	–	–	+	+
13. *Trapa natans*	Trapaceae	*Dangor-singori*	+	+	+	+	+	+	+	+	+	+	+	+
Submerged														
14. *Hydrilla verticillata*	Hydrocharitaceae	*Patal khar*	+	+	+	+	–	–	–	–	–	–	+	+
15. *Vallisneria natans*	Hydrocharitaceae	*Pata ghah*	+	+	+	–	–	–	–	–	–	+	+	+
Emergent														
16. *Alternanthera sessiles*	Amaranthaceae	*Mati kanduri*	+	+	+	–	–	–	–	–	–	+	+	+
17. *Amaranthus spinosus*	Amaranthaceae	*Hati khutura*	–	–	–	–	–	–	–	–	–	–	–	–
18. *Amaranthus viridis*	Amaranthaceae	*Khutura*	–	–	–	+	+	–	–	–	–	–	–	–

Table 3. Continued.

Species name	Family	Local name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Emergent														
19. *Centella asiatica*	Apiaceae	*Bor manimuni*	+	+	+	+	–	–	–	–	–	+	+	+
20. *Cynodon dactylon*	Poaceae	*Dubori-bon*	+	+	+	+	+	+	+	+	+	+	+	+
21. *Cyperus corymbosus*	Cyperaceae	*Uria bon*	–	–	–	–	–	–	–	–	–	–	–	–
22. *Cyperus pilosus*	Cyperaceae	*Sereka bon*	–	–	–	–	–	–	–	–	–	–	–	–
23. *Elephantopus scaber*	Asteraceae	*Hati bon*	+	+	+	–	–	–	–	–	–	–	+	+
24. *Enhydra fluctuans*	Asteraceae	*Helachisak*	–	–	–	–	–	–	–	–	–	–	–	–
25. *Eupatorium odoratum*	Euphorbiaceae	*Germanibon*	+	+	+	–	–	–	–	–	–	+	+	+
26. *Hydrocotyle sibthorpioides*	Araliaceae	*Soru manimuni*	–	–	–	–	–	–	–	–	–	–	–	–
27. *Hygroryza aristata*	Poaceae	*Petuli-dol*	–	–	–	–	–	–	–	–	–	–	–	–
28. *Ipomoea aquatica*	Convolvulaceae	*Kolmousak*	–	–	–	–	–	–	–	–	–	–	–	–
29. *Mimosa pudica*	Mimosaceae	*Lajokibon*	+	+	+	+	–	–	–	–	–	+	+	+
30. *Phragnitis karka*	Poaceae	*Khagori*	+	+	+	+	+	+	+	+	+	+	+	+
31. *Polygonum orientales*	Polygonaceae	*Bihlongoni*	–	–	–	–	–	–	–	–	–	–	–	–
32. *Sagittaris trifolia*	Alismataceae	*Panikochu*	+	+	+	–	–	–	–	–	–	+	+	+
33. *Vetiveria zizanoides*	Poaceae	*Birina*	–	–	–	–	–	–	–	–	–	–	–	–

beel. Among the emergent varieties viz., *Alternanthera sessile*, *Amaranthus viridis*, *Centella asiatica*, *Cynodon dactylon*, *Cyperus corymbosus*, *Cyperus pilosus*, *Elephantopus scaber*, *Eupatorium odoratum*, *Hydrocotyle sibthorpioides*, *Polygonum orientales*, *Sagittaris trifolia* were found to occur during winter in Jalikhora *beel*. In Etila *beel*, during monsoon, floating varieties of aquatic macrophytes viz., *Eichhornia crassipes*, *Lemna perpusilla*, *Nymphoides cristatum*, *Trapa natans* were found to occur. Among the emergent varieties *Cynodon dactylon* was found to occur during monsoon season. During winter, floating varieties of aquatic macrophytes viz., *Azolla pinnata*, *Eichhornia crassipes* and *Trapa natans* were found to occur in *Etila beel*. Among submerged, *Hydrilla verticillata* and *Vallisneria natans* were found to occur during winter season in Etila *beel*. Emergent varieties viz., *Alternanthera sessile*, *Centella asiatica*, *Cynodon dactylon*, *Eupatorium odoratum*, *Mimosa pudica* and *Sagittaris trifolia* were found to occur in Etila *beel* during winter season.

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