



DIVERSITY OF AQUATIC AND MARSHY ANGIOSPERMS OF FRESHWATER BODIES UNDER BHAGALPUR DISTRICT IN BIHAR, INDIA

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The present study has been carried out to explore the diversity and distribution of the aquatic and marshy angiosperms of the five freshwater bodies under Bhagalpur District of Bihar. A total of 75 aquatic angiosperms were recorded during the study period with 64 genera and 30 families. These plants were categorized into submerged (7 species), floating (11 species), emergent (32 species) and marginal (25 species). Out of 75 angiospermic species, 43 species belonged to dicotyledons and 32 species to monocotyledons.

Key words: Aquatic flora, Bhagalpur District, Freshwater bodies

Freshwater bodies are one of the most productive ecosystems of the world and essential life supporting system, providing a wide array of benefits. Macrophytic communities play a significant role in regulating the structure of a aquatic ecosystem. The aquatic macrophytes contribute significantly to the productivity of water bodies; mobilize mineral elements from the bottom sediments and provide shelter to aquatic invertebrates and fishes. They can serve as the indicators for the possible degree of damage in the ecosystem. Aquatic plants may serve as a good source of food to mankind and animals, thus forming a palatable feed for water birds and a base for aquatic wildlife conservation practices. Little attention has been paid to the systematic study of aquatic and wetland macrophytes of India. An account of hydrophytic plants of India was published by Biswas and Calder (1937), Subramanyam (1962), Deb (1976), Islam (1989) and recently by Cook (1996). Studies on aquatic macrophytes of Bihar are inadequate and fragmentary (Shah and Abbas 1979, Prakash *et al.* 1994, Pandey *et al.* 1995) as still large areas remain unexplored. Present communication includes qualitative aspects of the aquatic and marshy angiosperms of five representative

freshwater bodies of Bhagalpur District.

STUDY AREA

Bhagalpur District is situated in eastern part of Bihar and on southern bank of river Ganga. The climate of Bhagalpur is tropical and it is characterized by hot summer and pleasant winter. The geographical characteristics of Bhagalpur District is presented in Table – 1. The freshwater bodies in this district include marshes, swamps, river flood plains, chauras and littoral areas of ponds and other larger bodies. The aquatic angiosperms were collected from Mukhra pond, Bhairwa pond, Lalbag pond, T. N. B. pond and Burhanath Ghat and designated as Site I, Site II, Site III, Site IV and Site V respectively. All these freshwater bodies selected for present study are perennial in which prime source of water is mainly rain fed and underground seepage.

MATERIALS AND METHODS

Aquatic and marshy angiosperms were collected seasonally during the study period from March, 2007 to February, 2009. Herbarium specimens have been deposited in the Herbarium of University Department of Botany, T. M. Bhagalpur University. Plant species were identified with the help of

available literature of Subramanyam (1962), Singh and Singh (1972), Jain and Rao (1977), Verma (1981), Duthie (1903-1929), Cook (1996), Majid (2000) and Gupta (2001).

RESULTS AND DISCUSSION

A total of 75 angiospermic species belonging to

Typhaceae and Pontederiaceae with 1 species (1.33%). *Achyranthes aspera*, *Alternanthera sessilis*, *Centella asiatica*, *Eclipta prostrata*, *Enydra fluctuans*, *Euphorbia hirta*, *Oxalis corniculata*, *Kyllinga brevifolia*, *Paspalum distichum* and *Eichhornia crassipes* were recorded uniformly from all the five study sites.

Table 1: Geographical characteristics of Bhagalpur District

Latitude	24°30' to 25°30' N
Longitude	86°30' to 87°30' E
Elevation (m)	52.46
Total geographical area (km ²)	2543
Relative Humidity (%)	70.70
Mean maximum annual Temperature (°C)	32.2
Mean minimum annual Temperature (°C)	19.6
Average annual rainfall (mm)	1200

62 genera and 30 families were recorded from the 5 study sites. The collected plant species were grouped under different habitats i.e. marginal (25 species), submerged (7 species), floating (11 species) and emergent (32 species) (Table-2). Dicots were represented by 43 species while monocots were represented by only 32 species. Out of 30 families Cyperaceae turned out as dominant family having 9 species (12.00%) followed by Poaceae with 7 species (9.33%), Asteraceae with 6 species (8.00%), Amaranthaceae with 5 species (6.66%), Lemnaceae and Verbenaceae with 4 species (5.33%), Euphorbiaceae, Hydrocharitaceae and Scrophulariaceae with 3 species (4.00%), Convolvulaceae, Lamiaceae, Nymphaeaceae, Polygonaceae, Solanaceae, Araceae, Ceratophyllaceae, Commelinaceae, and Potamogetonaceae with 2 species (2.66%), Apiaceae, Boraginaceae, Nelumbonaceae, Onagraceae, Oxalidaceae, Ranunculaceae, Rubiaceae, Sapindaceae, Trapaceae,

Site I exhibits prolific growth of aquatic angiosperms which results the adverse effect on freshwater fish culture. *Nymphaea nouchali*, *Nelumbo nucifera* and *Pistia stratiotes* were found to form association with maximum number of species at Site I. Most of the floating species like *Lemna gibba*, *Lemna minor*, *Spirodella polyrhiza* and *Wolffia globosa* grew luxuriantly in shallow water zone at Site II and Site III. However, both Site II and Site III were comparatively free from luxuriant growth of aquatic angiosperms. Submerged angiospermic species like *Hydrilla verticillata*, *Ceratophyllum demersum*, *C. muricatum*, *Vallisneria spiralis*, *Potamogeton crispus* and *P. malaianus* covered the whole area of Site IV during all season of the study. This feature of the Site IV substantiates the fact that eutrophication has set in this pond. Site V was almost free from submerged species. The present investigation can be concluded that freshwater bodies in Bhagalpur District are rich

in aquatic angiospermic species and free from heavy anthropogenic pressure.

The author is highly grateful to Prof Sunil K. Choudhary, Department of Botany, T. M.

Bhagalpur University for encouragement and helpful discussion. I am also thankful to my father Prof. Munni Lal Singh, former Head of Sanskrit Department, T. M. Bhagalpur

Table 2: List of aquatic and marshy angiosperms recorded from five freshwater bodies of Bhagalpur District.

Name of plants	Habitat	Site I	Site II	Site III	Site IV	Site V
DICOTYLEDONS						
AMARANTHACEAE						
<i>Achyranthes aspera</i> Linn.	Marginal	+	+	+	+	+
<i>Alternanthera paronychioides</i> A.St. Hill	Emergent	+	-	-	-	+
<i>Alternanthera philoxeroides</i> Mart.	Emergent	+	+	+	-	+
<i>Alternanthera sessilis</i> Linn.	Emergent	+	+	+	+	+
<i>Amaranthus viridis</i> Linn.	Marginal	-	-	-	-	+
APIACEAE						
<i>Centella asiatica</i> Linn.	Emergent	+	+	+	+	+
ASTERACEAE						
<i>Ageratum conyzoides</i> Linn.	Marginal	+	-	-	-	+
<i>Caesulia axillaris</i> Roxb.	Marginal	-	-	+	-	+
<i>Eclipta prostrata</i> (Linn.) Linn.	Emergent	+	+	+	+	+
<i>Enydra fluctuans</i> Loureiro	Marginal	+	+	+	+	+
<i>Parthenium hysterophorus</i> Linn.	Marginal	+	-	-	-	+
<i>Tridax procumbens</i> Linn.	Marginal	-	-	+	+	+
BORAGINACEAE						
<i>Heliotropium indicum</i> Linn.	Marginal	+	-	-	-	+
CANNABINACEAE						
<i>Cannabis sativa</i> Linn.	Marginal	+	-	-	+	+
CONVOLVULACEAE						
<i>Ipomoea aquatica</i> Forssk.	Emergent	+	-	+	+	+
<i>Convolvulus arvensis</i> Linn.	Marginal	+	+	-	-	+
EUPHORBIACEAE						
<i>Acalypha indica</i> Linn.	Marginal	+	-	-	-	+

<i>Euphorbia hirta</i> Linn.	Marginal	+	+	+	+	+
<i>Phyllanthus virgatus</i> G. Forster	Marginal	-	-	-	-	+
LAMIACEAE						
<i>Anisomeles indica</i> (Linn.)	Marginal	-	-	-	-	+
<i>Leucas aspera</i> (Willd.) Spreng.	Marginal	-	-	-	-	+
NELUMBONACEAE						
<i>Nelumbo nucifera</i> Gaertn.	Floating	+	-	-	-	-
NYMPHAEACEAE						
<i>Euryale ferox</i> Salisb.	Floating	+	-	-	-	-
<i>Nymphaea nouchali</i> N.L. Burman.	Floating	+	-	+	-	-
ONAGRACEAE						
<i>Ludwigia adscendens</i> (Linn.) Hara	Floating	+	+	-	-	-
OXALIDACEAE						
<i>Oxalis corniculata</i> Linn.	Marginal	+	+	+	+	+
POLYGONACEAE						
<i>Polygonum plebeium</i> R.Br.	Emergent	+	-	-	-	-
<i>Rumex dentatus</i> Linn.	Emergent	-	+	+	-	-
RANUNCULACEAE						
<i>Ranunculus sceleratus</i> Linn.	Emergent	+	-	-	-	+
RUBIACEAE						
<i>Dentella repens</i> Linn.	Emergent	+	-	-	-	-
SAPINDACEAE						
<i>Cardiospermum halicacabum</i> Linn.	Emergent	+	-	-	-	-
SOLANACEAE						
<i>Datura metel</i> Linn.	Marginal	+	-	+	-	+
<i>Solanum nigrum</i> Linn.	Marginal	+	+	+	-	+
<i>Solanum surattense</i> Burm.f.	Marginal	+	-	-	-	+
SCROPHULARIACEAE						
<i>Bacopa monnieri</i> (Linn.) Penn.	Emergent	+	-	-	-	-
<i>Mecardonia procumbens</i> Miller	Emergent	+	-	+	-	-
<i>Scoparia dulcis</i> Linn.	Emergent	+	-	-	-	-
TRAPACEAE						
<i>Trapa natans</i> Linn.	Floating	+	+	+	+	-

TYPHACEAE

<i>Typha domingensis</i> Persoon.	Emergent	+	-	-	-	+
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VERBENACEAE

<i>Clerodendrum viscosum</i> Vent.	Marginal	+	-	-	-	+
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<i>Lantana camara</i> Linn.	Marginal	+	-	+	+	+
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<i>Lippia alba</i> Mill.	Marginal	+	+	-	+	+
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<i>Phyla nodiflora</i> (Linn.) Greene	Emergent	+	-	-	-	+
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MONOCOTYLEDONS

ARACEAE

<i>Colocasia esculenta</i> Linn.	Marginal	+	+	+	-	+
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<i>Pistia stratiotes</i> Linn.	Floating	+	+	+	+	-
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CERATOPHYLLACEAE

<i>Ceratophyllum demersum</i> Linn.	Submerged	+	-	-	+	-
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<i>Ceratophyllum muricatum</i> Chamisso	Submerged	+	-	-	+	-
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COMMELINACEAE

<i>Commelina benghalensis</i> Linn.	Emergent	+	-	+	-	-
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<i>Commelina diffusa</i> N.L. Burman	Emergent	+	-	+	-	-
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CYPERACEAE

<i>Cyperus amabilis</i> Vahl	Emergent	+	+	-	+	+
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<i>Cyperus difformis</i> Linn.	Emergent	+	-	-	+	+
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<i>Cyperus iria</i> Linn.	Emergent	-	-	-	-	+
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<i>Eleocharis dulcis</i> N. L. Burman	Emergent	+	-	-	-	+
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<i>Fimbristylis argentea</i> (Rott) Vahl	Emergent	+	-	-	-	+
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<i>Fimbristylis aestivalis</i> (Retz.) Vahl	Emergent	+	+	-	-	+
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<i>Kyllinga brevifolia</i> Rott boll.	Emergent	+	+	+	+	+
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<i>Pycerus pumilus</i> (Linn.) Nees ex Clarke	Emergent	+	-	-	+	+
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<i>Scirpus articulatus</i> Linn.	Emergent	+	-	-	+	+
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HYDROCHARITACEAE

<i>Hydrilla verticillata</i> (Linn.f.) Royle	Submerged	+	-	-	+	-
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<i>Nechamandra alternifolia</i> (Roxb.) Thwaites	Submerged	+	-	-	-	-
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<i>Vallisneria spiralis</i> Linn.	Submerged	+	-	-	+	-
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LEMNACEAE

<i>Lemna gibba</i> Linn.	Floating	+	+	+	+	-
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<i>Lemna minor</i> Linn.	Floating	+	+	+	+	-
<i>Spirodela polyrhiza</i> (Linn.) Schliden	Floating	+	+	+	-	-
<i>Wolffia globosa</i> (Roxb.) Hartog a van der Plas	Floating	-	+	+	-	-
POACEAE						
<i>Brachiaria ramosa</i> (Linn.) Stapf	Marginal	+	-	-	-	+
<i>Oryza sativa</i> Linn.	Emergent	+	+	-	-	+
<i>Panicum paludosum</i> Roxb.	Emergent	+	-	+	-	+
<i>Paspalum distichum</i> Linn.	Emergent	+	+	+	+	+
<i>Paspalum scrobiculatum</i> Linn.	Emergent	+	+	-	-	+
<i>Paspalidium geminatum</i> Forssk.	Emergent	+	-	-	-	-
<i>Saccharum spontaneum</i> Linn.	Marginal	+	-	-	+	+
PONTEDERIACEAE						
<i>Eichhornia crassipes</i> (Martius) Solms-Lanb.	Floating	+	+	+	+	+
POTAMOGETONACEAE						
<i>Potamogeton crispus</i> Linn.	Submerged	+	-	-	+	-
<i>Potamogeton malaiianus</i> Miquel	Submerged	+	-	-	+	-

University for help during aquatic plant species collection.

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