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Floristic distribution and growth form analysis of macrophytes in Kongba River, Manipur, India

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Abstract

Floristic composition and growth form of macrophytes in Kongba River, Manipur have been carried out with details of their habitat structure and seasonal changes. The plants were analyzed according to their relationship to the soil substratum, aquatic surface and aerial environment during the study period. recorded 29 macrophytic plant species were further categorized into 10 growth form classes. The finding revealed changes in biological communities because of the various anthropogenic activities affecting the environmental factors, which in turn influence the distribution pattern of different macrophytes.

***Key words*:** Floristic composition, Growth form, Kongba River.

INTRODUCTION

processes those occur in stream habitat. Macrophytes in these systems have a number of important functions including - providing structural complexity and heterogeneity to the habitat (Tokeshi & Pinder 1985), as substrate and cover for other organisms and providing energy to the system through primary production (Westlake 1966). They respond to changes in water quality and have been used as bioindicator of pollution (Tripathi & Shukla 1991).

In aquatic system, vegetation is classified on the basis of physical environment. The structure and dynamics of the vegetation provide indication of the whole environment both physical and biological. Another important aspect of community dynamics is the periodical variation in the composition and structure of vegetation mainly attributed to their interactions with the environmental variables (Tansley 1935). The structural attribute through which plant community is studied are conveniently viewed as analytical (both qualitative and quantitative) and synthetic characters. The qualitative or the subjective analysis includes the floristic composition, life form analysis and growth form classification. Floristic composition of an ecosystem provides major anatomical characters of plant community (Dansereau 1960). Hence floristic survey of a plant community gives information for analyzing diversity, dynamics and structure of the species. The growth forms are plants of comparable structure and similar vegetation to their physical environment. In India, floristic studies of macrophytic vegetation were started by Biswas & Calder (1936). The earlier work on phytosociology of fresh water ecosystem of India was done by Jha (1965), Shah & Abbash (1979), Handoo & Kaul (1982) and others. However, in Manipur studies on ecology of lotic ecosystem is scanty. The investigation on river was initiated by Khangembam & Gupta (2006), followed by Ibechaobi & Gupta (2007).

According to Segal (1966), growth forms are morphological types adapted to their special environment and are considered principally or completely determined by the physical environment and distinguished growth form on the basis of morphological dependences on atmospheric, aquatic or edaphic conditions. Hence the present study was been taken up with a view to study the floristic composition and growth-form analysis of macrophytes in Kongba River, Manipur.

STUDY AREA

Kongba is a freshwater river of Manipur which lies between Latitude 23.80º N to 25.68º N and Longitude 93.03º E to 94.78º E having a catchment area about 120 km^2. It starts at Kongba Meilombi and finally reaches Myanmar and joins Chindwin River. The river, though small in size, is considered as one of the most important rivers for the traditional community Meitei, the major inhabitant of Manipur. The river is subjected to various anthropogenic activities for domestic purposes like bath-

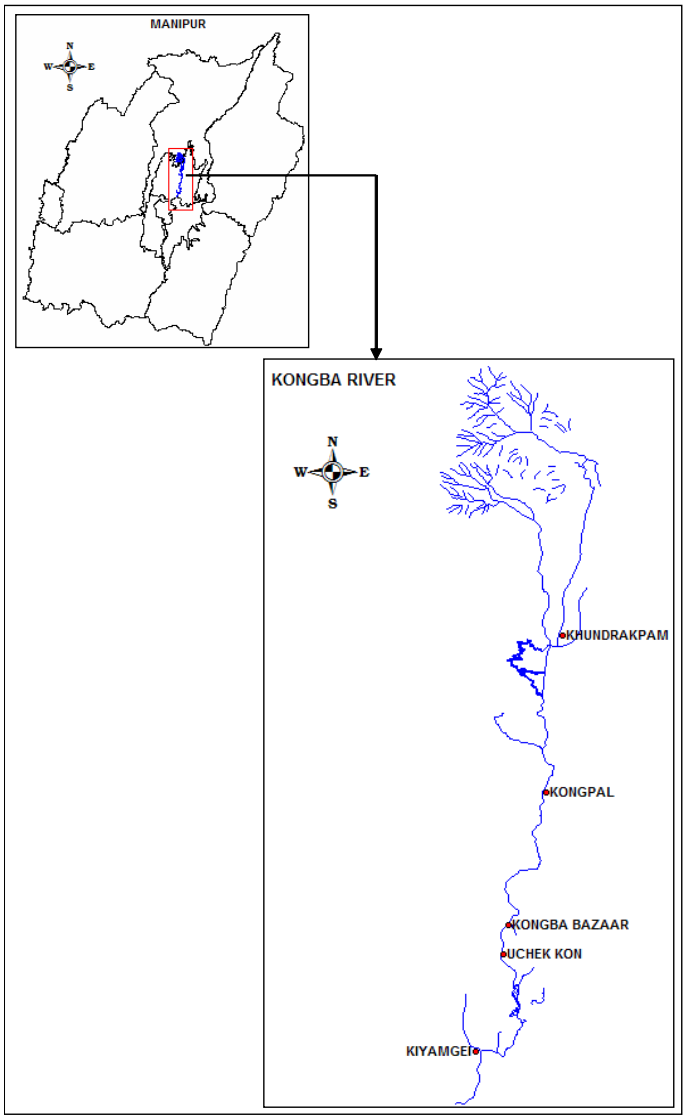

Fig. 1: Location map of the study area

ing (including animals), washing clothes and utensils, dumping of household garbage, fishing etc., which may deteriorate its water quality. The state enjoy moderately cold, sub-tropical monsoonic type of climate with mean maximum temperature ranging from 23.03º C to 30.77º C and mean minimum temperature varied from 4º C to 22.33º C. The maximum rainfall recorded was (256.7 mm). The relative humidity during the study period ranged from 62.80% to 86.67%. Fig.1 shows the ombothermic diagram during the study period.

METHODOLOGY

Regular and periodical survey and sampling of the vegetation was done at monthly intervals during November 2006 to October 2007 at 5 selected sites (Fig. 2). The sites selected were: *Site 1*: Khundrakpam village; *Site II*: Kongpal; *Site III*: Kongba bazaar; *Site IV*: Kongba Ucheckon and *Site V*: Kyamgei (Kongba Meilombi).

The floristic composition of the species as well as changes in the distribution in the different study sites was analyzed. Growth form determination of the vegetation was preceded after detailed floristic studies. The growth form classification was adopted after the method given by Hogweg & Brenkert (1969) who attempted to apply the growth form classification of Hartog & Segal (1964) in the Indian aquatic vegetation with due modifications. Collected specimens were processed into mounted herbarium sheets as suggested by Jain & Rao (1977) and identified using a number of available floras (Kanjilal *et al* 1934, 1936, 1938, 1940; Bor 1940; Deb 1983, 1984). All the voucher specimens were deposited as in the Herbarium of the Department of Life Sciences, Manipur University.

RESULTS

A total of 29 species of macrophytes were recorded growing in the river from the different selected sites. All these plants were categorized into 4 groups *viz*., (1) Free floating, (2) Rooted floating, (3) Submerged and (4) Emergent types. There were 6 free floating (20.68 %), 1 rooted floating (3.44 %), 3 submerged (10.34%) and 19 emergent (65.51%) types of plant (Table 1). The floristic distribution of plants in different study sites has been presented in Table 2.

Out of these, 12 species namely *Azolla pinnata, Ceratophyllum demersum, Colocasia esculenta, Commelina benghalensis, Cyperus rotundus, Hydrilla verticillata, Ipomoea aquatica,*

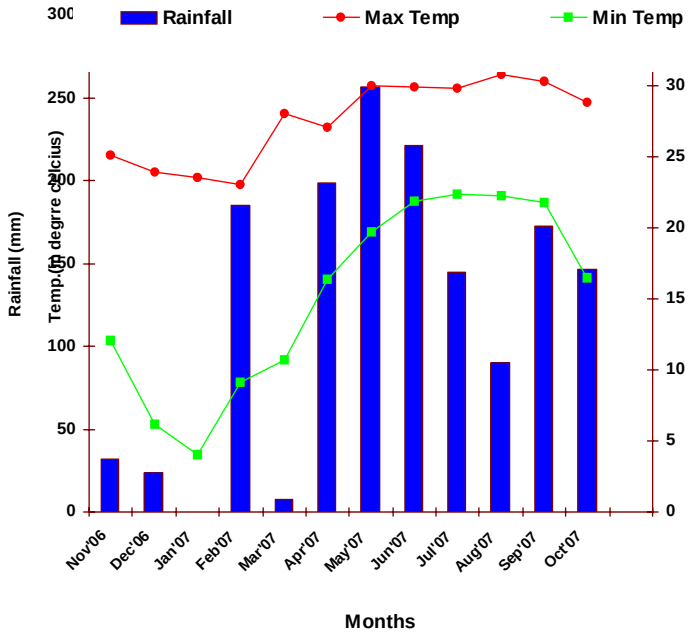

Fig 2: Ombrothermic diagram for the hydrological year 2006-2007

Ludwigia adscendens, Pistia stratiotes, Potamogeton crispus, Persicaria hydropiper and *Persicaria lapathifolia* were found in all the study sites. *Alternanthera sessilis* was present in Site II only. Both *Enydra fluctuans* and *Salvinia cucullata* were present in Site V only, *Persicaria barbata* was found in Site 1 only, whereas the rest of the species were found to be intermixed uniformly in all the 5 sites.

The dominant species recorded form different functional groups revealed variations. Thus from Site I, rooted floating included *Hydrilla verticillata*, submerged group included *Persicaria barbata. Persicaria lapathifolia* and *Ludwigia adscendens*, from Site II, submerged group included *Ceratophyllum demersum* while emergent category included *Alternanthera philoxeroides* and *Monochoria hastata* and *Persicaria hydropiper*. From Site III, free-floating group included *Azolla pinnata*, submerged included *Potamogeton crispus, Ceratophyllum demersum.* Emergent group included *Alternanthera philoxeroides* and *Jussiaea repens.* At Site IV free floating category included *Azolla pinnata* and *Eichhornia crassipes.* Submerged plants included *Ceratophyllum demersum* whereas emergent group included *Alternanthera philoxeroides, Commenlina benghalensis, Ipomoea aquatic, Ludwigia adscendens, Persicaria hydropiper* and *Hygrorhyza aristata.* At Site V the dominant emergent category included *Alternanthera philoxeroides, Commenlina benghalensis, Eclipta prostrata, Hygrohryza aristata, Ludwigia adscendens, Persicaria hydropiper* and *Persicaria lapathifolia.*

The different growth forms of macrophytess in Kongba River are presented in Table 1. Rhizopleustohelophytes comprising of 8 species *(Alternanthera philoxeroides, Alternanthera sessiles, Enydra fluctuans, Hygrorhyza aristata, Ipomoea aquatica, Ludwigia adscendens, Oenanthe javanica,* and *Commenlina benghalensis)* exhibited compact aerial floating vegetation found on water surface followed by Helophytes comprising of 6 species namely *Cyperus rotundus, Echinochloa stagnina, Eclipta prostrata, Persicaria barbata, Persicaria hydropiper* and *Persicaria lapathifolia* represent emergent species found in shallow water. Both the categories of growth forms are rooted. The Ceratophyllids consisting of only one species i.e., *Ceratophyllum demersum* is submerged species whose buoyant stems float in water. The Parvopotamids has two species i.e. *Hydrilla verticillata* and *Potamogeton crispus.* They are undissected narrow leaved plants. Two species i.e., *Azolla pinnata, Lemna perpusilla* belonged to lemnids representing surface-floating species. *Marsilea quadrifoliata* belonged to Marsillids. The Magnolemnids (floating on the surface) included three species viz., *Pistia stratiotes, Salvinia cucullata* and *Salvinia natans.* Pseudohydrophytes comprised of four species viz., *Colocasia esculenta, Monochoria hastata, Rumex nepalensis* and *Sagittaria sagittifolia* and the Vallisnerids comprised of 1 species only i.e. *Vallisneria spiralis* belonging to submerged.

DISCUSSION

Floristic composition provides reliable information about species diversity in a community as each species has its own specific ecological amplitude and the same indicates the ecological nature of the

Table 1: Growth forms of the Macrophytes from Kongba River (After Hogeweg and Brenkert, 1969)

Growth form	Name of species	Relation to (soil) substratum	Relation to Aquatic and Aerial Environment	Habit form	Family
1. Ceratophyllids	*Ceratophyllum demersum*	Free floating	completely submerged	whorls of finely dissected foliage submerged flowering	Ceratophyllaceae
2. Eichhornids	*Eicchornia crassipes*	Free floating, rooting in soft partly organic bottom sediment	leaves emergent (at least the greater part of the leaf and petiole)	stoloniferons rosettes with floating to emergent petiolate leaves.	Pontederiaceae
3. Parvopotamids	*Hydrilla verticillata, Potamogeton crispus*	Rooted during at least a considerable part of life cycle	submerged	Usually developing long stems with undissected narrow leaves.	Hydrocharitaceae Pontederiaceae
4. Helophytes	*Cyperus rotundus, Eicchornia stagnina, Persicaria barbatum, Persicaria hydropiper & Eclipta prostrata, Persicaria lapathifolium*	rooted	emergent	when full grown, vegetative parts and generative parts almost completely emerged at a rule	Cyperaceae, Poaceae Polygonaceae (3sp.) Asteraceae
5. Lemnids	*Azolla pinnata, Lemna perpusilla*	Free floating	floating on the surface	small , not differentiated into leave and stems	Salviniaceae, Lemnaceae
6. Marselids	*Marsilia quadrifoliata*	Rooted	floating leaf and blade	Rhizomatous, stemless sometimes	Marsiliaceae
7. Magnolemnids	*Pistia stratiotes, Salvinia cucullata, Salvinia natans*	Free floating	floating on the surface	stoloniferous or branching rosettes or stem like structure with floating or emergent sessile leaves	Araceae, Salviniaceae
8. Psuedohydrophytes	*Colocasia esculenta, Monochoria hastata, Rumex nepalensis, Sagittaria sagittifolia*	Rooted	emergent	Helophytic with emerged aerial organs.	Araceae, Pontederiaceae Polygonaceae Alismataceae
9. Rhizopleaus tohelophytes	*Alternanthera philoxeroides, Alternanthera sessiles, Enhydra fluctuans, Hygrorhyza aristata Ipomoea aquatic, Jussiaea repens, Oenanthe javanica, Commelina benghalensis*	Rooted	emergent	Stems floating or just below the surface producing aerial leave and shoots. stems floating or just below the surface producing aerial shoot vegetative and generative parts emerged	Amaranthaceae, Asteraceae, Poaceae Convolvulaceae Onagraceae, Apiaceae, Commalinaceae
10. Vallisnerids	*Vallisneria spiralis*	Rooted	submerged	long linear flabby leaves from rosette or in bundle.	Hydrocharitaceae

Table 2: Floristic composition of the Kongba River, showing family and growth habit ('+' denotes presence and '-' denotes absence of a species)

Name of plants	Family	Type	Sites				
			I	II	III	IV	V
Alternanthera philoxeroides Griseb	Amaranthaceae	Emergent	-	+	+	+	+
Alternanthera sessiles (L.) R.Br.	Amaranthaceae	Emergent	-	-	-	+	-
Azolla pinnata R.Br.	Salviniaceae	Free floating	+	+	+	+	+
Ceratophyllum demersum L.	Ceratophyllaceae	Submerged	+	+	+	+	+
Colocasia esculenta (L.) Schott	Araceae	Emergent	+	+	+	+	+
Commelina benghalensis L.	Commelinaceae	Emergent	+	+	+	+	+
Cyperus rotundus L.	Cyperaceae	Emergent	+	+	+	+	+
Echinochloa stagnina (Retz.) P. Beauv.	Poaceae	Emergent	-	+	+	+	+
Eclipta prostrata L.	Asteraceae	Emergent	-	+	-	-	+
Eichhornia crassipes (Mart) Solms	Pontederiaceae	Free floating	-	+	+	+	+
Enhydra fluctuans Lour	Asteraceae	Emergent	-	-	-	-	+
Hydrilla verticillata (L.f.) Royle	Hydrocharitaceae	Rooted floating	+	+	+	+	+
Hygrorhyza aristata (Retz.) Nees. ex. Wight & Arn	Poaceae	Emergent	-	-	+	+	+
Ipomoea aquatica Forskal	Convolvulaceae	Emergent	+	+	+	+	+
Jussiaea repens L.	Onagraceae	Emergent	+	+	+	+	+
Lemna perpusilla Torr	Lemnaceae	Free Floating	-	+	+	+	+
Marsilea quadrifoliata L.	Marsiliaceae	Emergent	+	+	+	-	+
Monochoria hastata (L.) Solms	Pontederiaceae	Emergent	+	+	+	-	+
Oenanthe javanica D.C	Apiaceae	Emergent	-	-	-	+	+
Pistia stratiotes L.	Araceae	Free Floating	+	+	+	+	+
Potamogeton crispus L.	Potamogetonaceae	Submerged	+	+	+	+	+
Persicaria barbata L.	Polygonaceae	Emergent	+	-	-	-	-
Persicaria hydropiper L.	Polygonaceae	Emergent	+	+	+	+	+
Persicaria lapathifolia L.	Polygonaceae	Emergent	+	+	+	+	+
Rumex nepalensis Sprengel	Polygonaceae	Emergent	+	-	+	+	+
Sagittaria sagittifolia L.	Alismataceae	Emergent	-	-	+	+	-
Salvinia cucullata Roxburgh	Salvinaceae	Free floating	-	-	-	-	+
Salvinia natans Hoffm	Salvinaceae	Free floating	-	+	+	+	+
Vallisneria spiralis L.	Hydrocharitaceae	Submerged	+	-	-	+	+
Total			18	20	22	23	26

habitat. It is one of the major anatomatical characters of the plant community (Dansereau 1960).In the present study a total of 29 macrophytic species belonging to 4 groups viz., free floating, rooted, submerged and emergent were obtained out of which emergent groups are found to be dominant.

The present findings are in conformity with the works of Shah & Abbash (1979) who reported 28 macrophytic species in Ganga River at Bhagalpur, out of which 22 species were emergent, 4 submerged and 2 species were free floating.

Growth forms are the morphological types adapted to spatial environment. According to Segal (1966) the growth forms are considered principally or completely determined by the physical environment and distinguished growth forms on the basis of morphological dependence on the atmospheric, aquatic or edaphic conditions. In an aquatic habitat a few physical factors like level, wave and currents, consistency of sub-soil and dimension of water body like depth and surface are

significant. In the present study, the 29 macrophytes belonged to 10 growth form classes out of the 23 growth forms recognized by Hogweg & Brenkert (1969).

It was observed that free floating, rooted with floating-leaved, submerged and emergent communities were found intermixed. However, it was observed that the water depth determined the occurrence of various macrophytic groups for example shallow regions occupied by submerged vegetation is replaced by floating leaved plants on change of water level. Similarly floating leaved plants in open water was invaded by emergent vegetation because the anthropogenic changes leading to shift in habitat conditions like enhanced sedimentation due to organic debris accumulation causing replacement of vegetation and succession.

Neiff *et al*. (2000) predicted colonization by macrophytes in the Yacireta Reservoir of the Parana river (Argentina and Paraguay), the estimated potential area for geophytes was 99 km^2 whereas it was 131 km^2 for rooted floating leaved plants and 120 km^2 for submerged plants, at 76 m above mean sea level. At 82 m above sea level, the geophytes could reach 271 km^2.

CONCLUSION

The various factors like land use in the river catchment, sediment types in the river, flow velocity and anthropogenic activities affects the habitat structure and influence the distribution pattern of macrophytes. Light availability, substrate characteristic and morphology (Duarte *et al.* 1986) and water column nutrient concentration (Soseak 2002) have all been identified as important determinants of the distribution. In Kongba River our results revealed change in biological communities which reflected in downstream flow reduction in the river because of riparian land use and other anthropogenic interferences. The reduced water velocity affects the biological community structure which increases richness, abundance and diversity of emergent species. The rich growth of emergent species indicates the enhancement of eutrophication indicating various anthropogenic activities. It is high time to check the enhanced eutrophicationn of river water taking proper remedial measures.

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