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Study of the Macrophyte Biomass Productivity in the two Wetlands of Upper Brahmaputra region, Assam

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Abstract: Macrophytes are the integral part of any aquatic ecosystem. If present in reasonable quantity they provide elasticity and stability to the wetlands. For sustainable utilization of wetland biodiversity the analysis of macrophytic vegetation is becoming essential in terms of species composition, biomass production and energy conservation. The macrophytes determine the overall ecosystem physiognomy, indicating the degree of pollution & hence they are responsible for the immense role in biogeochemical cycling of nutrients. The Macrophytes Biomass Productivity with some of their medicinal value are studied and assessed from 2011 to 2013 in some wetlands of Dibrugarh District Assam.
Keywords: Macrophytes, wetlands, Biomass Productivity.

Introduction:

The macrophytes determine the overall ecosystem physiogony, indicating the degree of pollution & hence they are responsible for the immense role in biogeochemical cycling of nutrients (Hutchinson 1975; Wetzel, 1975) {page 176 of Arbind kumar}

In the NE region very little information is available till date on the studies pertaining to the freshwater ecosystem especially about the macrophytes. In Manipur, the ecology of macrophyyes of Loktak Lake was investigated by Devi N.B (1993). The ecology of waithou Lake was analyzed by Devi O.I (1993) & The growth form analysis of the macrophytes of utrapat Lake was investigated by Devi K.I & Sharma(1997). The phytosociology of the macrophytes in the freshwater ecosystem of Canchipur was investigated by Devi, ch.U & Sharma (1997) and the phytosociology of macrophytes of the waithou lake was also investigated in recent years by Okram et al (1999). The present paper deals with the two year study of the two wetlands of Dibrugarh district of Assam.

Objectives:
1. To survey the macrophytes of the wetlands.
2. To study the macro invertebrates attached to the macrophytes.

Study area:

1. MAIJAN (OPEN BEEL):

Maijan is an open beel having connection with the river Brahmaputra through a feeding channel. It is situated at 94^0 $58^/$ E longitude and $27^0 32^/$N latitude, breadth of the connecting channel to river Brahmaputra : 600 m, Area: 87.07 hectares. The origin of the beel is dead course of the river Brahma putra.. Its shape is curved. Depth :Minimum: 3.8 m and maximum: 6.4 m.

2. KOTOHA (CLOSED BEEL):

Originally it had a connecting channel with river Buridihing. It is situated at 27^o 15' N latitude and 94^o 55' E longitudes. The length of the beel is: 800m breadth : 200m , area : 1600 sq m i.e 0.16 hectare Its depth (in summer)is 4.8 m and (in winter): 2.7 m Shape of the beel is straight and is about 25 km from Dibrugarh town.

Materials & methods; Plants were collected from three different station at monthly interval. The collected plants carried in plastic bags and immersed in 4% formalin & identified. Identification was done by using published literature (Needham et al. 1972 & patil and Gouder, 1989) Molluscan shall were collected, washed & preserved in 4% formeldehyle. The preserved shall were identified by using pertinent literature (Fernando, 1963: patil and Gouder, 1989) {Arvind kumar vol I page 337}.

Result & Discussion: The macro-invertebrates the insect, nematodes and molluscs were found associated with vallisneria apiralis, potamogeton crispus,chara vulagaris, cera to phyhrum demersum and hydrilla verticillata at al the sites.

Majority of invertebrates species occurred frequently on all the plants & some showed preference to certain plants species only. So there is species specific distribution and an organism could be considered as characteristic of particular macrophytes. The invertebrates on the emergent vegetation like polygonum were always present in low number.

Diptera and oligochaeta were associated with ceratophyllum demersum. The species of chironomides & stylaria lacustris were found associated with cetrophyllum demersum and other hydrophytes, as observed by Dvorak and Best (1982). In the present study the may flies were observed during rainy season. The molluscs were abundant at sites rich in aquatic macrophytes and were found attached to their leaves and roots. Generally molluscs were abundant during summer because of flood and heavy flow. When disturbed they settle at the bottom and the process repeats during different seasons. . The insects, nematodes and molluscs were found associated with vallisneria, potamogaton, ceratophyllum and hydrilla at all sides. Diptera and oligochaeta are associated with ceratophyllum-demersum.

The present study revealed that the submerged plants with finely dissect or small and densely packed leaves offer better shelter and more generous food source like periphyton etc.
Kutikova (1971) and Dvorak and Best (1982) also made similar observations.

Macrophytes;

The shallow lakes have been the ideal habitat for greater colonization of macrophytes with substantial to thick strands throughout the globe. The extensive growth of floating, submerged, emergent and marginal macrophytes was the common sights in both the wetlands under study. However the floating and submerged macrophytes were significant being the most dominant during the period under study.

Table: 1. **Macrophytes**; The following macrophytes are observed in both the wetlands.

Sl.no.	**MACROPHYTES**	Maijan beel	Kotoha borbeel
	Submerged Weeds		
1	*Ceratophyllum demersum*	+ +	+ +
2	*Hydrilla verticillata*	+ +	+ +
3	*Valisneria*	+ + +	+ + +
4	*Najas minor*	+ +	+
5	*Nymphaea nouchali*	+ +	-
	Emergent Weeds		
6	*Nymphoides indica*	+	+ +
	Marginal Weeds		
7	*Ipomoea aquatica*	+ +	+ +
8	*Ludwigia adscendens*	+	+
9	*Chara zerylanica*	+	+
10	*Limnophila indica*	+ +	+ +
11	*Polygonum glabrum*	+	-
12	*Bacopa moneiri*	+ +	+ +
13	*Colocasia esculenta*	+	+ + +
14	*Hydrocotyle sibthorpioides*	+	+ +
15	*Marsilea minuta*	+	+
	Floating Weeds		
16	*Utricullaria stellaris*	+ +	+
17	*Pistia statiotes*	+	+ + +
18	*Trapa natans var. bispinossa*	+ + +	+ +
19	*Azolla pinnata*	+ +	+ + +
20	*Eichhornia crassipes*	+ + +	+
21	*S.cucullata*	+ +	+ +

Diversity of Macrophytes: Table 1 contains the various types of macrophytes that present in the two wetlands studied. Among them are *Eichhornia crassipes* (Free-floating) was the most dominant species in both the wetlands. Among the total 21 species recorded from both the wetlands, Maijan harboured all 21 species whereas Kotoha recorded 19 species.

In Maijan water hyacinth *(Eichhornia crassipes)* was followed by *Ceratophyllum demersum, Hydrilla verticillata, Valisneria, Najas minor, Nymphaea nouchali, Trapa natans, Azolla pinnata* in the order of abundance. Others like *Ipomoea aquatic, Polygonum glabrum, Chara zerylanic, Pistia statiote, S.cucullata* etc. remained sporadic and localized in distribution.

In Kotoha also, water hyacinth *(Eichhornia crassipes)* was the dominant macrophytes followed by *Ceratophyllum demersum, Hydrilla verticillata, Valisneria, Najas minor, Pistia statiotes, Salvinia cucullata, Colocasia esculenta* and *Azolla pinnata. Nymphaea nouchali* and *Polygonum glabrum* were not found in Kotoha. Others *Utricullaria stellari, Hydrocotyle sibthorpioides, Ludwigia adscendens, Ipomoea aquatica* etc. were of restricted distribution in this wetland.

Table: 2 Species composition of Benthic Macro-invertebrates

S.No.	Macro-invertebrate fauna	Maijan beel	Kotoha Borbeel
	Phylum : Annelida Family: Tubicidae		
1	*Tubifex sp.*	+	+ +
2	*Limnodrilus hoffmeisteri* (Claparede,1862)	+	+
	Family: Hirudinaria (Leech)		
3	*Helobdella sp.*	+ + +	+ + +
4	*Hirudo sp.*	+ + +	+ + +
	Family : Lumbricidae (Earthworm)		
5	*Pheretima postuma*	+ + +	+ + +
6	*Pristina aequiseta Bourne,1891*	+ +	+ +
	Phylum: Arthropoda Order: Insecta		
7	Ephemeroptera (May fly)	+ + +	+ + +
8	Odonata (Dragon fly nymph)	+ + +	+ + +
	Diptera		
9	Chironomids (larvae) (*Chironomus circumdatus*)(Keiffer)	+	+
 10 11	Mosquito larvae- *Anopheles sp.* *Culex sp.*	 + +	 + + +
 15	Order: Decapoda Crab (*Carcinus* / Cancer)	+	+
16 17	Prawn (*Machrobracium rosenbergii* *M.malcomsonii)*	+ + +	+ + +
	Phylum: Mollusca Class: Gastropoda		
12	*Pila globosa*	+ + +	+ + +
13	*Lymnaea acuminate*	+ +	+ +
14	*Parryyesia flavidens assamensis* (Bivalves)	+ + +	+ + +

Table 2 consists of benthic organisms which form an important component of the aquatic ecosystem. These animals are confined to a micro-habitat continuously receiving materials produced in or flushed into the aquatic body. The benthic community structure may be regarded as an integral part of the aquatic ecosystem. Many of these benthic animals are detritivores and play key role in mineral re-cycling and many benthic insect larvae and oligochaeta are the major food sources for small and big benthovorous fishes. These benthic communities depend to a large extent on organic autochthonous and allochthonous detritus for food.

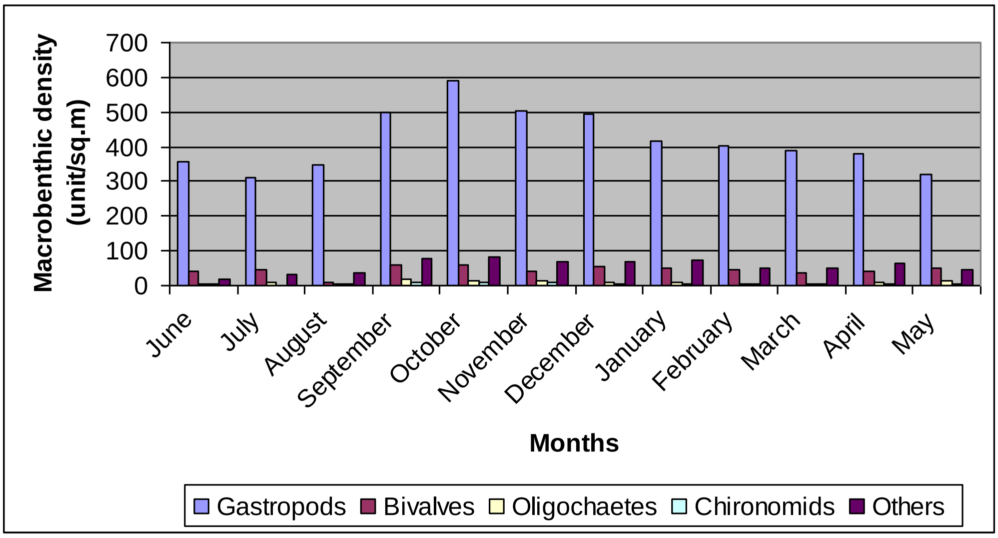
The species composition of the benthic community of a given aquatic ecosystem often reflects the environmental conditions. Because of the adverseness of the environmental conditions these sensitive species may have to be eliminated from the system. Such changes in the species composition persist for some time and thereby help in monitoring the imprints of the preceding adverse and environmental conditions. So this property of benthic macro-invertebrates is more informative than the water quality assessment by physico-chemical properties (Gaufin, 1958; Hellawell 1986). After Hellawell (1986) benthic macro-invertebrates were recognized as useful indicator organisms in pollution studies.

The aquatic oligocheates increases in densities with the increase in eutrophication of the water body (Brinkhunst, 1974; Hellawell 1984). Larvae of species belonging to chironomidae represent one of the numerically most important families of fresh-water insects and are widely distributed in all types of aquatic environments where they occur in different types of habitats and occupy a great variety of niches. These characters provide good information about classification of lotic systems and their water quality assessment in particular. The chironomids tend to be more common on sediments with high allochthonous content (Horn and Goldman, 1994).

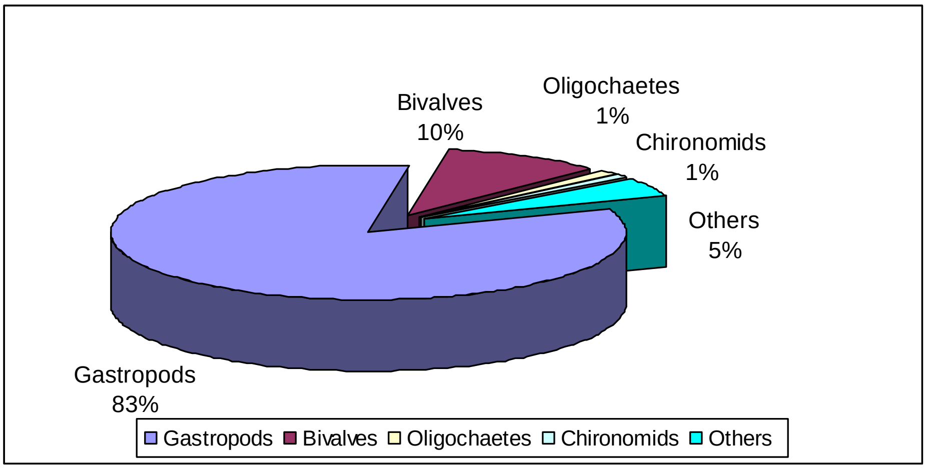
During the monsoon period the population density of benthos was seen decreasing mainly because of water in-flow and flushing of the soft bottom sediments along with the animals of the upper layers. After the ceasation of the water flow, the suspended materials and the organic matter settle down to form the bottom sediment. This condition favours the re-colonisation of benthic community during the post monsoon period (Synudeen, 1992). The substratum act as an important abiotic factor in the benthic environment by its more physical condition (Muss, 1967).

The total benthos depicted a direct correlation with organic carbon, bottom total hardness and bottom water dissolved oxygen are found to be significant at 5 % level of significance .Graph 1. Shows the monthly variation of Macrobenthic communities in Maijan beel and Diagram 2 represents the percentage composition in the studied wetlands.

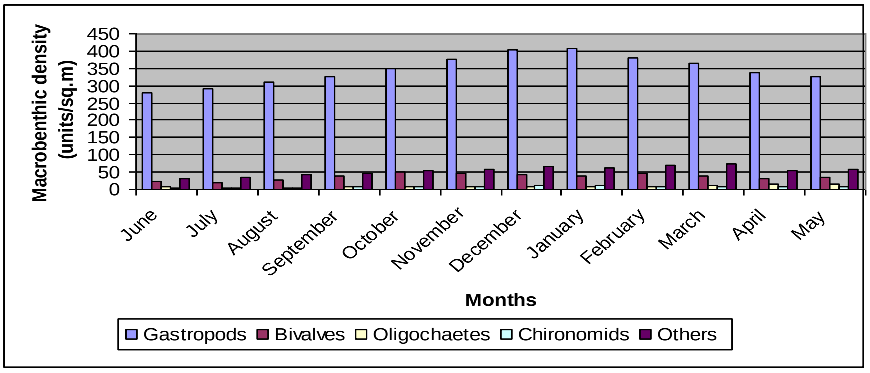
Graph 1: **Monthly variation of Macrobenthic communities in Maijan beel**



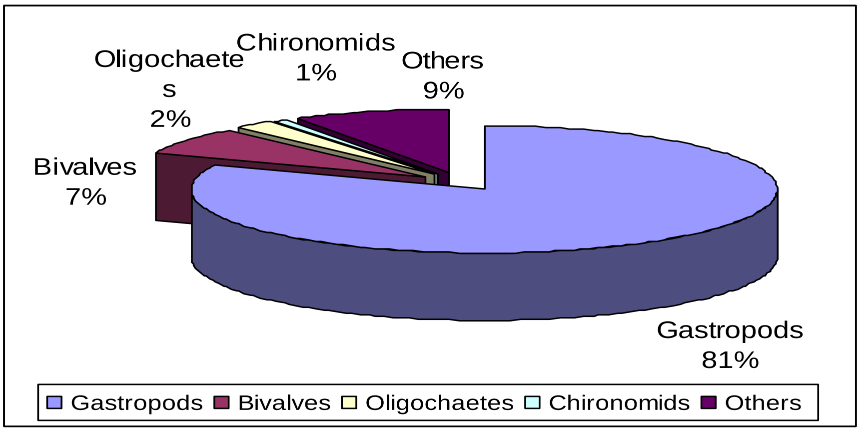
Diagram; 1 Percentage composition of of Macrobenthic communities in Maijan beel



Graph 2: **Monthly variation of Macrobenthic communities in Kotoha Borbeel:**



Diagram; 2 Percentage composition of of Macrobenthic communities in Kotoha Borbeel



Aquatic plants may serve as a good source of food to mankind and animals, thus forming a palatable feed for the water birds and a base for aquatic wildlife conservation practices. Aquatic weeds similar to terrestrial plants are capable of trapping solar radiation and thus serve as potential source of energy. They may also serve as good source of fertilizers. Some of the aquatic weeds are being cultivated for their diversity of medicinal and aesthetic values (Bardach, 1968). Graph 2. Shows the monthly variation of Macrobenthic communities in Kotoha borbeel. And Diagram 2 represents the percentage composition **in the studied wetlands**.

Macrophyte Biomass:

Maijan beel:

The wet weight of aquatic macrophytes varied from 266 g/m^2 to 600 g/m^2 (first year), 446 g/m^2 to 1240 g/m^2 (second year) The monthly variation of dry weight of macrophytes biomass fluctuated in the range of 44.4 g/m^2 to 100.2 g/m^2 (first year), 74.4 g/m^2 to 207 g/m^2 (second year).

Kotoha borbeel:

The wet weight of aquatic macrophytes ranged from 199 g/m^2 to 440 g/m^2 (first year), 289 g/m^2 to 615 g/m^2 (second year) and 750 g/m^2 to 5500 g/m^2 (third year). The corresponding dry weight ranged from 33.2g/m^2 to 73.4 g/m^2 (first year), 48.2 g/m^2 to 102.7 g/m^2 (second year)

Macrophyte Biomass Productivity:

Maijan beel:

The productivity of aquatic macrophytic biomass has been calculated by drying the collected samples of macrophytes in different months. The range of variation was recorded as 176.86 10^{6}Cal/m^2 (July) to 399.11 10^{6}Cal/m^2 (January) with an average of 252.05 10^{6}Cal/m^2 during the first year observation. During the second year of observation, it fluctuated between 296.63 10^{6}Cal/m^2 (January) to 824.85 10^{6}Cal/m^2 (October) with an average of 556.72 10^{6}Cal/m^2.

The seasonal variation in macrophytes productivity showed a distinct bimodal pattern of variation. The maximum was recorded during winter and minimum in monsoon season **Kotoha borbeel:**

The range of variation was recorded as 132 10^6Cal/m^2 (April) to 266.07 10^6Cal/m^2 (November) with an average of 192.85 10^6Cal/m^2 during the first observation. During the second of observation, it fluctuated between 192.18 10^6Cal/m^2 (October) to 409.03 10^6Cal/m^2 (June) with an average of 304.29 10^6Cal/m^2.

The seasonal variation showed a distinct bimodal pattern of variation. The maximum was recorded during Post-monsoon and minimum in Pre-monsoon season

Conclusion

The study of the vegetation occurring in a particular ecosystem is the pre -requisite for understanding of the ecological aspects of a ecosystem. One of the important aspects of community dynamics is the periodical variation in the vegetation composition and structure which are mainly attributed to their interactions with other environmental variables.

Aquatic macrophytes have often been considered as weeds and eradication of weeds was thought to be the only solution for the better management of wetland ecosystem. But with the increasing interest in the concept of biodiversity conservation and sustainable use of natural resources and the practice of alternative use of wetland becoming more essential today. For the exploitation of the wetland resource with minimum damage to the biodiversity, the analysis of the macrophyte vegetation in terms of species composition, biomass production and energetic is very much necessary.

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