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A COMPARATIVE STUDY OF AQUATIC MACROPHYTES AND ITS PRIMARY PRODUCTIVITY IN THE CLOSED AND OPEN TYPE WETLANDS OF UPPER REACHES OF THE BRAHMAPUTRA RIVER BASIN.

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ABSTRACT

Acomparative studies on a closed and open typed wetlands of upper reaches of the Brahmaputra river system with reference to the occurrence of various macrophytes and their primary productivity has been studied from last 3 years. The aquatic macrophytes of the *closed wetland* (Potiasola Beel) consist of 41 species with 45 families. The dominant macrophytes consist of floating pants *Eichhornia crassipes* (**water hyacinth**) and *Monochoria vaginalis* (Bhat meteka) followed by Chara (submerged). Marginal plants especially *Ipomoea fistulosa* was observed. Other aquatic plants such as *Alternanthera sessilis,Alternanthera phylloxeroides* and *Paspalum scorbiculatum* were absent in the wetland . Aquatic plant of the Open wetland (Nahotia) consists of 45 families including 40 species. *Trapa natans var. bispinosa (cattail)* was absent in the open beel. There are different types of marginal amphibious plants capable of growing on moist soil lands as well as floating on the water surface such as *Ipomoea Crassicaulis, Ipomoea aquatica*(water spinach), *Alternanthera sessilis, Alternanthera philox,Ipomoea carnea,Alternanthera phyllzeroides* and *Paspalum scorbiculatum*. Dominant macrophytes consist of floating plants such as *Eichhornia crassipes*, Monochoria vaginalis (water hyacinth) followed by Chara (submerged) and Ipomoea fistulosa (marginal). IVI (important value index) of macrophytes was 0.00031 – 0.0138, 0.0009 – 0.029 bits/individuals in Potissola beel,(closed wetland) and Nahotia beel (open wetland), respectively. .Macrophytes Coefficient of communities in both the wetlands is almost similar , is about 0.88 . Further present studies showed that the open *wetlands*, harbour less biomass of macrophytes (average 2142.27 g/m2/yr) in comparison to closed *wetlands* (average2655.80g g/m2/yr).

Keywords: Macrophytes, Closed and open type wetland, Brahmaputra river system

No. of References: 37 **No. of Figures: 1** **No. of Tables: 5**

INTRODUCTION

Aquatic macrophytes are aquatic photosynthetic organisms, large enough to see with the naked eye, that actively grow permanently or periodically submerged below, floating on, or growing up through the water surface. Aquatic macrophytes are represented in six plant divisions: Free floating plants, anchored with floating leaves plants, submerged floating plants , rooted submerged plants , rooted emergent plants and marginal plants. Aquatic macrophytes play an important role in the structure and function of aquatic ecosystems and certain macrophyte species (e.g., rice) are cultivated for human consumption from time immemorial. The aquatic macrophytes also play a significant role in the dynamics of physico-chemical and biological characteristics of the Beels. The plants provide energy to herbivores as well as increase the strength of the detritus food chain of the Beel ecosystem which is most important for enhancement of fish production point of view. Many of the threats to fresh waters (e.g., climate change, eutrophication) will result in reduced macrophyte diversity and will, in turn, threaten the faunal diversity of aquatic ecosystems.

There are series of studies on the wetlands of north eastern part of the country covering both the Brahmaputra and Barak river system along with other parts of this regions (1-5,8,12-17,20&23-24) .

MATERIAL AND METHOD

Aquatic macrophytes were studied in monthly interval from January 2005 to December 2007. Macrophytes were collected randomly in different vegetational zone of the Beels. The species were identified after Chakraborty and Jha (2007&2008); Mishra (1974); Biswas and Cader (1984). To determine dry weight of the macrophytes the samples were collected randomly from different sites of the station using a quadrate (1 meter square). The samples were collected in monthly interval. The collected samples were weighed and dried for 5 to 6 days. Later, the samples were dried in an oven at 105^0c for 24 hrs and reweighed. Similar methods were applied for detritus collection of Macrophytes but materials collected from deeper mud area of the Beel (15-20cm deep). Species dominance is recognized by their density or biomass. Absolute and relative values of density and frequency, abundance importance value index (IVI) etc. were calculated by the following method.

a. Relative dominance = Biomass of species A x 100/Biomass of all species.
b. Relative density = Number of individual species A x 100/Total number of individual of all species.
c. Relative frequency = Frequency of species A x 100/ Sum of frequency values for all species.
d. Important value index (IVI) N; Summarized values of relative dominance, relative density and relative frequency.
e. Simpson's index of dominance = $\sum$ ni(ni-1)/N(N-1)
   Where, N= Total number of individuals of all species
   ni = Number of individuals of species A.

Estimation of primary production: Primary productivity was measured by light and dark

method.Productivity and respiration were measured from oxygen differences by the light-dark bottle technique. Initial and final oxygen concentrations were measured and phytoplankton were incubated for 4 h. Photosynthetic rates were determined by converting oxygen fluxes to carbon equivalents using a photosynthetic quotient of 1.2 and a respiratory quotient of 0.8 (Kochand Madden, 2001).

RESULT

Study area

The Nahotia (Open type) and Potiasola (Closed type) wetlands are located in the geographical ordinates of ($26^0 48^/$-$26^0 49^/$N and $94^0 12^/$-$94^0 13^/$ E, Open Beel) and ($26^0 48^/$-$26^0 49^/$N and $94^0 08^/$-$94^0 10^/$ E, Closed Beel) . Investigation on the wetlands was pursued from January 2005 to December 2007.

Aquatic vegetation of Closed beel consists of 45 families including 40 species are shown in table 1. Free floating plants are represented by 7 families including 15 species , anchored with floating leaves plants by 5 families including 9 species, submerged floating plants by 3 families with 3 species , rooted submerged plants by 2 families including 4 species, rooted emergent plants by 5 families including 6 species and marginal plants by 1 species in the closed Beel (Potiasola). Marginal plants especially *Ipomoea fistulosa* were observed . Other aquatic plants such as *Jussiaea diffusa* ,*Alternanthera phylloxeroides* and *Paspalum scorbiculatum* were absent in the closed Beel. The dominant macrophytes consist of floating pants *Eichhornia crassipes*(Panimeteka)and*Monochoria vaginalis* (bhatmeteka) followed by *Chara* (submerged).

Aquatic macrophytes of the Open Beel (Nahotia) consists of 45 families including 39 species are shown in table 1. Out of these 7 (seven) families and 15 species are grouped into of free floating plants , 5 families and 9 species of anchored with floating leaves group , 3 families and 3 species of submerged floating group, 2 families and 4 species of rooted submerged group , 5 families and 6 species of rooted emergent group and 3 families and 5 species belongs to marginal group.

There are two sources of primary productivity of the studied beels from phytoplankton and another source was the macrophytes.In Beels, it was found that the rate of energy transformation by phytoplankton is comparatively lower than macrophytes. The energy transforms from the primary producer to fish (carnivores) is a complex process. The fish, as a secondary production from the beels represent a fraction of energy trapped by primary producers. Range of Gross primary production (GPP)by the phytoplankton is 1.25 - 2.5 g/m^2 /day with an average value 1.68 in the Closed Beel.In case of Open Beel ,it is 1.5 - 2 g/m^2 /day with an average value 1.82 g/m^2 /day.Net Primary Production (NPP) is 0.625 - 1.2 g/m^2 /day with an average value1 g/m^2 /day in the Open Beel.. Average Net primary production (NPP) by the phytoplankton is 0.83g/m^2 /day in the Closed Beel (Table 2).

Ranges of Gross Primary Production of Macrophytes (GPP) 1206 - 4371&506 -

4036 g/m2/yr.with an average values of 2655.80g/m2/yr and 2142.27 g/m2/yr in the Closed and Open Beels respectively ,shown in table 3 and figure 1.

DISCUSSION

The aquatic macrophytes play a significant role in the dynamics of physico-chemical and biological characteristics of the Beels. The aquatic macrophytes provide energy to herbivores as well as increase the strength of the detritus food chain of the Beel ecosystem.

In the Closed Beel ,marginal plants especially *Ipomoea fistulosa* were observed . Other aquatic plants such as *Jussiaeadiffusa*, *Alternantheraphylloxeroides* and*Paspalum scorbiculatum* were absent in the closed Beel. The dominant macrophytes consist of floating pants *Eichhornia crassipes* (Panimeteka)and*Monochoria vaginalis* (bhatmeteka) followed by *Chara* (submerged).

Anchored with floating plants such as *Trapa natans var. bispinosa*(cattail) was absent in the open beel. There are different types of marginal amphibious plants capable of growing on moist soil lands as well as floating on the water surface such as *Ipomoea fistulosa*, *Ipomoea aquatica*(waterspinach), *Ipomoea carnea*, *Alternantherasessilis* , *Alternantheraphylloxeroides*, *Jussicadiffusa andPaspalumscorbiculatum* are available in the open beel. Dominant macrophytes such as Monochoria vaginalis (water hyacinth), Eichhornia crassipes followed by *Chara* (submerged) and *Ipomoea fistulosa* (marginal) are found in the Open beel also. Density(D)of *Eichhornia crassipes* ,*Monochoria vaginalis and Chara spp.* is 35,29 and 23 respectively in the Closed and Open Beels(table 4).Frequency(F) of *Azolla pinnata and Lemna Sp.* was observed (80%). In case of *Pistia stratiotes* and *Salvinia cuculata*, density is 5.5 and 5.4, respectively. Frequency(F) of *Azolla pinnata* is 80%.Hydrilla verticillata is 16.75. *Euryale ferex* bears 80 % frequency.Frequency of *Aquatic ipomoea is* 90%(table 5)..

The Beels in Assam are of heavily infested with aquatic weeds. The common forms generally encountered in the Beels are *Eichhornia crassipes* and *Monochoria vaginalis* (water hyacinth), *Chara* (submerged), *Salvina*, *Lemna*, *Wolffia*,*Potamogeton*,*Hydrilla verticillate*, *vallisnereia*, *Ipomoea fistulosa*, *Nymphaea cristata* (water lily) , *Eurylferox* (Makhna) etc. IVI (important value index) of macrophytes was 0.00031 – 0.0138, 0.0009 – 0.029 bits/individuals in Potissola beel and Nahotia Beel, respectively. Macrophytes communities in both the Beels is almost similar (Coefficient of community is about 0.88) .

There are two sources of primary productivity of the studied beels from phytoplankton and another source was the macrophytes.In Beels, it was found that the rate of energy transformation by phytoplankton is comparatively lower than macrophytes. The energy transforms from the primary producer to fish (carnivores) is a complex process. The fish, as a secondary production from the beels represent a

fraction of energy trapped by primary producers.

The energy transforms from the primary producer to fish (carnivores) is a complex process. The fish, as a secondary production from the beels represent a fraction of energy trapped by primary producers. Average Gross primary production (GPP)by the phytoplankton is 1.82 g/m^2 /day in the Open Beel. In case of Closed Beel the value is 1.68 g/m^2 /day. Gross primary production (GPP)by the phytoplankton of Open Beel was higher 0.14 g/m^2 /day than Closed Beel.Net Primary Production (NPP) is 1 g/m^2 /day in the Open Beel but 0.83 g/m^2 /day in the Closed Beel. Differences in Net primary production (NPP) by the phytoplankton is 0.17g/m^2 /day in the Beels.

Ranges of Gross Primary Production (GPP) 1206 – 4371 g/m2/yr. and 506 g/m2/yr. with an average values of 2655.80g/m2/yr and 2142.27 g/m2/yr in the Closed and Open Beels respectively . Lowest Gross Primary Productive (GPP) was observed in the month of December (1456g/m2/yr.) in the Open Beel and 2160.33g/m2 /yr.in the Closed Beel. Maximum average value was observed in the months of November(3174.33g/m2/yr) and 2641 g/m2/yr in Closed Beel respectively. GPP decrease during winter season and gradually increase summer season (fig.1) Yadava, (1987a) reported Macrophytes contributed 66.65 x 10^5 cal/m^2/yr of . Gross primary production of Brahmaputra river in different centres was ranged from 11.5 to 46.9(mgC/m3/day) from 1973 – 1980. Net primary production ranged from 12.6 to 46.9(mgC/m3/day) during 1973 -1980.

Eichhorniacrassipes and Monochoria vaginalis (water hyacinth) generally abundant throughout the years if water is available in the wetlands. Their growth is influenced by rainfall, high and high temperature humidity. Dominant phase was observed during monsoon to post monsoon. Some weeds such as Hydrilla verticillata, Vallisneria spiralis, Potamageton octundrus ,renew their seasonal cycle despite drying up some patches of the wetland beds.The macrophytes under decomposition during the winter season. Seasonal variation of biomass is dependent on availability of water in the bed of wetlands.

Enegy fixed by producer such as Phytoplankton,(1.82 g/$m^{2)}$ and Macrophytes,(506- 4036 g/m2/yr)but out of these total energy only 0.16%and 0.20% were converted into fish energy in Closed and Open Beel respectively. Energy through fish production was 5048x10^3X10^3kcal in the open Beel and 272592 X10^4k cal in Closed Beel. Though potential of the Beels is so high but only less than 1% energy used by fishes and remaining energy transforms in to detritus food chain in the bottom of the beels. It indicates that values of primary productivity of the Beels so higher than the productivity of any other fresh water reservoirs due to two types of productivity sources.

Most of these macrophytes are not grazed directly by herbivores and the unused material is deposited at the bottom after their

death. When decay occurs, dead macrophytes contribute to the organic detritus pool that is very important in aquatic food webs . In other words, the energy fixed by macrophytes is not much utilized in the system and gets deposited at the bottom as detritus energy which is generally so high in both the Beels. In the Open Beel , detritus ranged between 0.91 to 4.56 kg/m^2/yr/ m^2, with an average 2.55kg /m^2/yr. In Closed Beel the detritus ranged from 2.05 – 4.75 kg/m^2/yr. with an average value 2.75kgm^2/yr.During winter season value of detritus was higher (4.45kg/m2/yr.) than the summar season (1.3kg/m2/yr.) inboth theBeels. A unique feature of the floodplain wetlands of the Brahmaputra is the rich growth of marginal and submerged vegetation due to heavy nutrient loading from both allochthonous and autochthonous sources. These macrophytes often tend to replace the plankton community and this progressive replacement of plankton community with macrophytes as the main primary producer hastens the pace of eutrophication. This also leads to higher rate of evapo-transpiration and swampification of the lakes. However, this process can be reversed through effective management. Open *Beel*s, which generally harbour less macrophytes (Average 2142.27 g/m2/yr) are favourably disposed for energy transformation through phytoplankton. Closed *Beel*s (Average2655.80g/m2/yr) of Assam are mostly choked with floating (water hyacinth) submerged (*Najas, Vallisnaria, Hydrilla* and *Chara*) and marginal (*Typha*) vegetation affecting productivity. This leads to the low rate of net productivity in the Closed Beel (0.83 g/m2/day) and in Open Beel (1gc/m2/day).Low rate of net productivity (0 to 281 mg C/m^3/ha) is also recorded in Dikhow Mornai and Ramnagar, *Beel*s in the districts of Sibsagar and Cachar districts respectively (Sugunan and Bhattacharjya,2000).

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Table 1: *Diversity of the Macrophytes in the Closed and Open Beel.*

Types	Family	Species	Occurrence	
			Open Beel	Closed Beel
Free floating	1.Araceae	1. Pistiastratiotes (water lettuce)	✓	✓
	2.Salviniaceae:	2. Salviniacuculata (floatingmoss)	✓	✓
		3.Azolla pinnata (water velvet)	✓	✓
		4. S .natanus (floating moss)	✓	✓
	3.Lemnaceae	5. Lemna minor (lesser duck weed)	✓	✓
		6. Wolffaarrhiza (water meal)	✓	✓
		7. Spirodelapolyrhiza.(greater duck weed)	✓	✓
	4.Nyphaeaceae	8. Nymphoidescristata (water lily)	✓	✓
	5.Najadaceae	9. Potamogetonpectinatus (pond weed)	✓	✓
		10. Potamogetonnodusu (pond weed)	✓	✓
	6.Pontederiaceae	11. Eichhorniacrassipes (Panimeteka))	✓	✓
		12. Monochoriavaginalis (Bhatmeteka)	✓	✓
	7.Ceratophyllaceae	13. Ceratophylum (Horn wort)	✓	✓
Anchored with floating leaves	1. Trapaceae	14.Trapanatansvasr. bispinosa . (cattail)	X	✓
	2.Nymphaeaceae	15. Nymphoidescristata	✓	✓
		16. Nelumbonucifera (water lily/podum)	✓	✓
		17. Nymphaeastettata (vate)	✓	✓
		18. Euryale ferex (prickly makhna)	✓	✓
	3.Ceratophyllaceae	19. Ceratophylumdemorsum	✓	✓
	4.Najadaceae	20. Potamogetonpectinatus	✓	✓
		21. Potamogetonnodusus	✓	✓
	5.Marsileaceae	22. Marsileaminuta (pepper wort)	✓	✓

Submerged floting (root less)	1.Ceratophylaceae	23. Ceratophylum	✓	✓
	2. Najadaceae	24. Najas minor	✓	✓
	3.Characeae	25. Chara spp.	✓	✓
Rooted submerged	1.Hydrocharitaceae	26. Hydrillaverticillata (hydrilla)	✓	✓
		27. Vallisneriaspiralis (trapy grass or wild calery)	✓	✓
	2.Najaclaceae	28.Potamogeton pectinatus	✓	✓
		29. Potamogetonnodusus	✓	✓
Rooted Emergent	1.Alismaceae	30. Sagittariasagittifolia (Duck potato)	✓	✓
	2.Ranunculaceae	31. Ranunculus	✓	✓
	3.Poceae	32. Orizastativa	✓	✓
	4. Cyperaceae	33.Eleocharisdulcis(spike rush)	✓	✓
	5.Polygonaceae	34.Cyperustegetum (madurkati)	✓	✓
		35. Polygonumorientale (buck wheat)	✓	✓
Marginal	a.Canvolvulaceae	. Ipomoea fistulosa	✓	✓
		36. Ipomoea aquatica (water spinach)	✓	X
		37.Ipomoea carnea	✓	X
	b.Amaranthaceae	38. Aernantherasessilis	✓	X
		39. Alternantheraphylloxerides	✓	X
	c.Poaceae	40. Paspalumscorbiculatum	✓	X

Table 2: *Gross Primary Production of Phytoplankton(GPP)*

GPP		Open wetland		Closed wetland	
	Years	M	SD	M	SD
GPP(gmC/m^2 /day)	2005	1.85	0.007	1.62	0.021
NPP(gmC/m^2 /day)	2005	1	0.011	0.72	0.042
GPP(gmC/m^2 /day)	2006	1.82	0.028	1.82	0.014
NPP(gmC/m^2 /day)	2006	1	0.012	0.95	0.042
GPP(gmC/m^2 /day)	2007	1.81	0.014	1.62	0.011
NPP(gmC/m^2 /day)	2007	1	0.001	0.82	0.049

Ranges of Gross Primary Production of Macrophytes (GPP) 1206 - 4371&506 - 4036 g/m2/yr. with an average values of 2655.80g/m2/yr and 2142.27 g/m2/yr in the Closed and Open Beelsrespectively ,shown in table 3 and figure 1

Table 3: *Gross Primary Production (GPP) of Macrophytes(g/yr.)*

Months	Closed wetland 2005		Open wetland 2005		Closed wetland 2006		Open wetland 2006		Closed wetland 2007		Open wetland 2007	
	M	SD	M	SD	M	SD	6	SD	M	SD	M	SD
Dec	1350	70.71	850	70.71	1271	70.7	471	70.71	2082	70.71	542	14.14
Jan	1412	16.26	673	70.71	1217	21.2	657	35.36	1382	70.71	617	21.21
Feb	1434	14.14	694	70.71	1382	70.7	637	7.071	1206	7.071	506	7.071
Mar	2016	21.21	650	70.71	1915	70.7	660	7.071	1853	14.14	823	28.28
Apr	2181	70.71	881	70.71	2062	70.7	1562	70.71	1972	21.21	1972	21.21
May	2304	70.71	1304	70.71	2715	70.7	2415	70.71	2963	49.5	2558	56.57
Jun	2906	70.71	2756	0	2845	28.3	2775	14.14	3136	21.21	3016	7.071
Jul	2815	70.71	2715	70.71	3005	7.07	2800	141.4	3254	14.14	3139	7.071
Aug	3482	70.71	3082	70.71	3213	3.54	2960	70.71	3426	7.071	3211	14.14
Sep	4371	70.71	4036	21.21	3729	35.4	3064	14.14	3547	7.071	3052	14.14
Oct	3915	70.71	3665	141.4	4113	141	4113	141.4	4331	14.14	4011	14.14
Nov	2593	70.71	2493	70.71	4000	145	3765	132	4211	20.5	3997	15.1

Table 4:*Monthly variation of Detritus in Closed &Open wetlands (kg/yr.) during 2005 -07.*

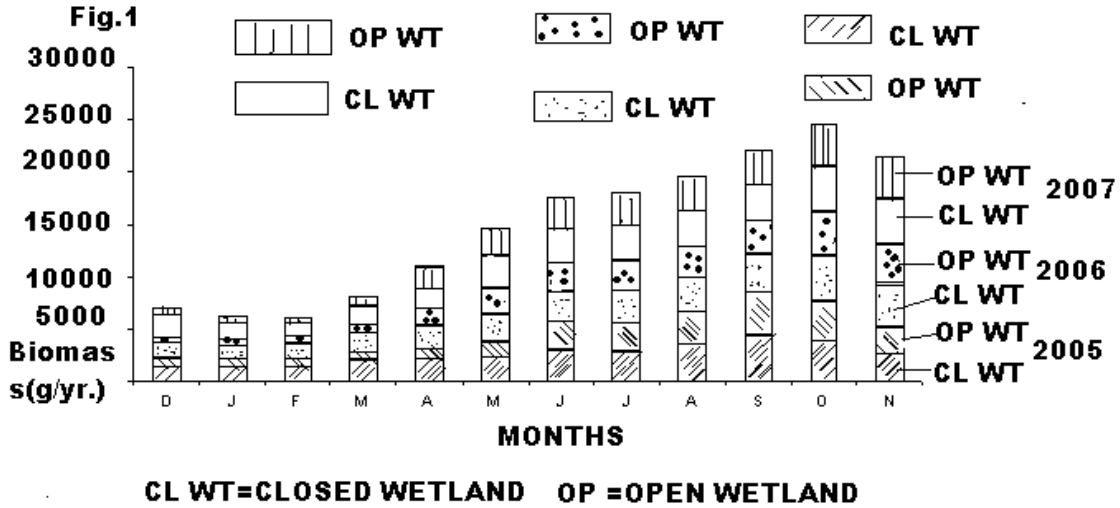
Months	Open wetland 2005		Closed wetland 2005		Open Wetland 2006		Closed wetland 2006		Open wetland 2007		Closed wetland 2007	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Jan	4	0	4.04	0.05	4.2	0.02	4.15	0.01	4.1	0.071	4.1	0.07
Feb	3.04	0.354	4.05	0.05	3.08	0.07	3.85	0	3	0.071	3	0.07
Mar	3.1	0.707	3.04	0.14	3.05	0.07	1.55	0.07	2.5	0.78	2.5	0.07
Apr	0.9	0.141	3.08	0.14	2.95	0.07	1.95	0.07	2.1	0.071	1.1	0.01
May	1.3	0.071	2.05	0.14	0.91	0.9	0.91	0.01	1.3	0.071	1.3	0.01
Jun	1.15	0.071	1.35	0.07	1.11	0.9	1.11	0.01	1.06	0.071	1.06	0.07
Jul	2.25	0.071	2.25	0.07	2.25	0.0	2.05	0.07	2.1	0.071	2.1	0.07
Aug	2.22	0.007	3.09	0.02	2.08	0.05	3.84	0.01	2.1	0.071	2.1	0.07
Sep	2.05	0.071	2.45	0.5	2.05	0.05	3.04	0.07	2	0.007	2	0.07
Oct	2.03	0.071	3.05	0.07	3.09	0.01	3.19	0.01	2	0.007	2	0.05
Nov	3.18	0.071	3.35	0.01	3.25	0.07	3.45	0.07	3.12	0.007	3.02	0.14
Dec	4.22	0.071	4.75	0.01	4.56	0.01	4.85	0.01	4.34	0.007	4.54	0.21

Table 5:*Abundance(A),Frequency(F) and Density(D) of Macrophytes in the Open &Closed wetlands. M=Mean, SD= Standard Deviation, CL= Closed wetland and OP=Open wetland.*

SPECIES	CL (2005)		OP (2005)		CL (2006)		OP (2006)		CL (2007)		OP (2007)	
	(F)		(F)		(A)		(A)		(D)		(D)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Eichhorniacrassipes	100	0	100	0	35.2	0.7	35.5	0.7	35.2	0.7	35.2	0.7
Monochoriavaginalis	100	0	100	0	29	0.7	30	1.4	29	0.7	29	0.7
Chara spp.	100	0	100	0	23	0	22.5	0.7	23.5	0.7	23.5	0.7
Ipomoea fistulosa	80	0	80	0	28.9	0.7	29	0	24	0.7	23.55	0
Ipomoea carnea	72.5	3.5	73.5	4.95	21	0	16	0	15.7	1.41	11.75	0
Alternantheraphylloxerides	74	5.6	63	4.243	16	0.71	21.5	0.7	12.3	2.12	12.8	0
Paspalumscorbiculatum	60	0	62.5	3.536	21.3	0.71	25	0	14.8	2.8	14.2	0
Ipomoea fistulosa	64	5.7	44	50.91	25.8	0.7	21.5	0.7	16.7	2.1	16.75	0
Azollapinnata	80	0	80	2.828	21.5	0.7	29	0	16.8	0	22.3	0
S .natanus	84.5	6.4	75	0	29.4	0.7	22.5	0.7	25.8	4.9	27.5	0
Wolffaarrhiza	48	0	49.5	0.707	22.8	0.7	33.5	0.7	26	0.7	16.75	0
Lemna minor	80.5	5	79.5	0.707	33.4	0	21.5	0.7	17.2	0.7	18.75	0.2
Ipomoea aquatica	90	0	90.5	0.707	21.5	0.7	10.5	0.7	19.4	0.701	7.45	0.2
Orizastativa	75	7	55	7.071	11	0.7	8..3	0	6.8	0.7	5	0
Pistiastratiotes	55	7	45	7.071	8.38	0.07	14.5	0.7	5.5	0	5..5	0.7
Salviniacuculata	52.5	3.5	62.5	3.54	15.9	0.7	8.3	0	7.2	0.7	5.4	0
Spirodelapolyrhiza	63	4.2	55	7.07	8.43	0.14	8.35	0.5	5.5	0.7	2.85	0
Nymphoidescristata	63.5	4.9	50	0	9.16	0.7	5.8	0	5.7	0.7	8.3	0.1

Potamogetonpectinatus	53	4.2	75	7.07	6.3	0.71	10	0	3.9	1.41	9.75	0.1
Potamogetonnodusu	82.5	3.5	65	7.07	10.75	0.7	15.5	0.7	8.7	0.7	5.7	0.1
Ceratophylum	62	2.8	60	0	15	0.7	9.65	0.5	9.2	0.7	7.6	0
Trapanatansvasr. bispinosa	62	2.8	45	7.07	10.33	1.41	13.5	0.7	6.1	0.7	14.7	0.1
Nymphoidescristata	51.5	2.1	50	0	13.5	0.7	29.5	0.7	6.5	0	2.5	0
ssNelumbonucifera	21.5	2.1	13	4.24	29.9	0.7	25.5	0.7	8	0	3.65	0.1
Nymphaeastettata	10.5	0.7	20.5	0.71	26	1.41	19.5	0.7	3	0.7	3.65	0.2
Spirodelapolyrhiza	20.5	0.7	50.5	0.71	17.5	1.41	42.8	50	4.2	0.7	3.25	0.1
Nymphoidescristata	52	2.8	50.5	0.71	7.6	0	6.8	0.3	4.3	0.7	1.2	0
Potamogetonpectinatus	51.5	2.1	40.5	0.71	6.6	0	3.5	0.7	3.3	0	8	0
Potamogetonnodusu	41.5	2.1	70.5	0.71	3	0	12	1.4	1.7	0.7	11.5	0.7
Euryale ferex	71.5	2.1	80.5	0.71	13.4	2.82	17.5	0.7	8.5	0.7	8.5	0
Ceratophylumdemorsum	82	2.8	70.5	0.71	13.4	2.82	13	1.4	12.5	0.7	1.6	0
Potamogetonpectinatus	75	7	70.5	0.71	17.6	0.7	3.2	1.1	9	0.7	2.85	0
Potamogetonnodususus	65	7	35	7.07	12.6	0.71	7.3	0	1.6	0.14	5.85	0.1
Marsileaminuta	45	7	65	7.07	2.92	0.7	48.7	57	2.9	0	4.75	0.1
Ceratophylum	71.5	2.1	68	2.83	7.75	0.7	7.95	1.5	5.85	0.07	11.5	0
Najas minor	68	2.8	68.5	2.12	8.92	0.71	14.5	0.7	4.75	0.07	1.75	0.1
Hydrillaverticillata	60	14.1	39.5	0.71	8.35	2.12	4.65	0.5	10.55	0.07	3	0
Vallisneriaspiralis	40	0	70.5	0.71	16.5	2.12	5.35	0.5	1.65	0.07	3.45	0.1
Potamogetonpectinatus	75	7.08	41.5	2.12	4.75	0.71	7	1.4	23.5	27.57	4.75	0.4
Ceratophylumdemorsum	45	7	40	2	7.21	2.12	6	1	2.5	0.14	4	.3

Fig 1: *Gross Primary Productivity of Macrophytes (2005-07) -(C) Monthly variation of the Macrophytes (Biomass) in Closed and Open Wetlands (2005-07)*



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