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Seasonal incidence of macrophyte productivity at lower trophic level in two types of aquaculture ponds, Guwahati, Assam

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Abstract
Seasonal prevalence of macrophytic productivity was studied in two perennial aquaculture ponds located at Gauhati University Campus, Guwahati, Assam, India. One of the experimental pond is manually managed (Pond A) with the application of lime and inorganic and organic fertilizer. The other is a naturally maintained pen culture pond (Pond B) recovered from a part of swamp without addition of lime and fertilizer. The reclaimed zone of natural pond is separated from the perennial swamp by bamboo screen. The present study exhibits 17 species of macrophytes belonging to 15 genera under 14 families. Besides *Phragmites karka*, a riparian element is found to dominate the surrounding non-recovered zone outside the pen culture system. The study reveals that 5 species belong to free-floating, 1 floating leaved emergent, 7 rooted emergent and 4 rooted submerged. The Pond A encounters with 11 species whereas Pond B with 12 species dominated by *Eichhornia crassipes* with higher biomass production in comparison to former. The macrophytic productivity of most of the species shows a summer-monsoon peak in both the studied ponds.

Keywords: manually managed pond, natural pen culture pond, macrophytic productivity

1. Introduction
Productivity of an aquatic regime is the capacity to support aquatic living organisms. It depends on several attributes such as climatological parameters, physico-chemical factors and nutrient status to support initially autotrophs along with energy flow for sustenance of the different organism at different trophic level. For an ecosystem to be studied appropriately in terms of productivity and nutrients, it is important to be acquainted with the biotic communities that are present at autotrophic level of an ecosystem. In aquatic ecosystem autotrophic level is occupied by phytoplankton and macrophytes. Macrophytes are higher plants, predominantly angiosperm and play an important role in fixing solar energy, providing food to fish and other aquatic animals in the ecosystem. Besides these, decomposition of the macrophytes results in the cycling of nutrients and formation of organic matter in the ecosystem (Berg & Mc Claugherty, 2002) [1]. These key processes are very important to understand for persistence of an aquaculture system. Macrophytes can be subdivided into four groups on the basis of their water requirements and habitat. Submerged macrophytes are those that are completely underlying in water and having thin and finely divided leaves adapted for exchange of nutrients with water. Floating leaved macrophytes are those that are rooted but have floating leaves while free floating are those that float on the water surface. The last group is the emergent macrophytes, which are rooted plants with their principal photosynthetic surfaces projecting above the water. Emergent macrophytes dominate the shoreline flora while the middle and lower littoral zones supports stands of floating-leaved macrophytes.

2. Materials and Methods
2.1. Site description: The present work deals with the seasonal occurrence of macrophytic productivity in two fresh water aquaculture ponds named as Pond A (treatment pond, manually managed with the application of lime and inorganic and organic fertilizers) and Pond B (natural pen culture pond, recovered from a part of swamp without addition of any fertilizer) located at Gauhati University Campus, Guwahati, Assam, India. The two ponds are located within the latitude of $26^0 09' 26''$ N and longitude of $91^0 40' 21''$ E. During the study period the

natural pond is reclaimed from the part of perennial swamp by bamboo screen. Pond A is triangular in shape with a surface area of 1.4 hac and pond B is rectangular sized pond with a surface area of 0.5 hac (Deka and Goswami, 2011) [3].

2.2. Sampling

2.2.1. Identification of macrophytes: The macrophytes were identified following Biswas and Calder (1984) [2]. The emergent and submerged macrophytes were collected with the help of a barbed iron hawser, while the floating macrophytes were collected with bare hand. Then the aquatic macrophytes were segregated and the herbarium sheets of each species at different stages were prepared and the identification was made at the Plant Taxonomy and Fish and Fishery Biology Laboratory of the Gauhati University.

2.2.2 Estimation of wet biomass of macrophyte: Wet biomass of macrophytes was estimated following Goswami (1997) [6]. The sampled macrophytes were water freed by keeping in pre-weighted cotton bag for 15 minutes. Then wet weight was calculated with the help of a 10 Kg spring balance.

3. Results

The present ponds exhibit 17 species of macrophytes (Table-1) belonging to 15 genera under 14 families. Besides that *Phragmites karka*, a riparian element is found to dominate the surrounding non-recovered zone outside the pen culture system (Pond B), which constitutes the dense reed swamp. Ecologically macrophytes of the studied ponds are categorized into four different groups namely free floating, floating leaved emergent, rooted emergent and rooted submerged. The free-floating group holds 5 species, floating leaved emergent 1 species, rooted emergent 7 species and rooted submerged 4 species (Table-1).

The monthly observed macrophyte productivity is estimated (kg/m^2) during the study period commencing from Nov, 2007 to October, 2009 (Table 2 & 3). The study reveals that the gross annual macrophyte productivity is higher in Pond B (21.37 kg/m^2 in 2007-2008 and 19.05 kg/m^2 in 2008-2009) than Pond A (11.78 kg/m^2 in 2007-2008 and 13.92 kg/m^2 in 2008-2009). Moreover, the non-recovered zone around Pond B covering about 2.5 ha area is dominated by *Phragmites karka* where gross annual wet biomass production is found to be 7.3 kg/m^2.

It is clearly observed that *Eichhornia crassipes* dominate the Pond B contributing to the highest biomass; but found to be totally absent in Pond A. However, no single species of macrophytes is observed to be dominant in Pond A; but their composition more or less uniform in distribution. However, *Alternanthera sessilis* and *Enhydra fluctuans* contribute remarkably to the macrophytic production of Pond A, which are absent in Pond B. The highest biomass contributed by *Eichhornia crassipes* is recorded during monsoon. It is also noticed that total biomass production by all macrophytes is found to be the highest in monsoon and the lowest in winter.

It is observed that *Azolla pinnata*, *Sagittaria sinensis*, *Polygonum tomentosum*, *Lemna minor*, *Salvinia natans* have little contribution to their biomass production over other macrophytes (Table 2 & 3). However, these macrophytes show seasonal incidence with their highest biomass during summer and monsoon. Barring *Azolla pinnata*, all other seasonal macrophytes are found to be absent during winter throughout the observation periods. Other emergent macrophytes form a bed of the miscellaneous species in littoral zone in both the ponds.

Table 1: List of macrophytes of the studied ponds (+ = Present, - = Absent)

Category	Scientific Name	Family	Occurrence	
			Pond A	Pond B
Free floating	1. *Eichhornia crassipes*	Pontederiaceae	-	+
	2. *Azolla pinnata*	Salviniaceae	+	-
	3. *Salvinia cucullata*	Salviniaceae	+	+
	4. *Salvinia natans*	Salviniaceae	-	+
	5. *Lemna minor*	Lemnaceae	-	+
Floating leaved emergent	6. *Nymphoides indica*	Gentianaceae	+	-
Rooted Emergent	7. *Cyperus iria*	Cyperaceae	+	+
	8. *Ipomoea aquatica*	Convolvulaceae	-	+
	9. *Ipomoea cornea*	Convolvulaceae	+	-
	10. *Monochoria hastifolia*	Pontederiaceae	-	+
	11. *Sagittaria sinensis*	Alismataceae	-	+
	12. *Polygonum tomentosum*	Polygonaceae	+	+
	13. *Colocasia antiquorum*	Araceae	+	+
Rooted submerged	14. *Hydrilla verticillata*	Hydrochloride	+	+
	15. *Utricularia stellaris*	Lentibulariaceae	+	+
	16. *Alternanthera sessilis*	Amaranthaceae	+	-
	17. *Enhydra fluctuans*	Compositae	+	-

Table 2: Estimation of macrophyte productivity in kg/m^2 in the studied pond (Nov, 2007 to Oct, 2008)

Name of the macrophytes	Pond	Nov, 2007	Dec	Jan, 2008	Feb	Mar	April	May	June	July	Aug	Sept	Oct
Eichhornia crassipes	A	0	0	0	0	0	0	0	0	0	0	0	0
	B	1.41	0.95	0.72	0.95	2.75	3.34	4.52	5.41	4.74	4.21	3.42	1.21
Azolla pinnata	A	0.13	0.15	0.21	0.34	0.24	0.21	0.14	0.12	0.17	0.08	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0
Salvinia cucullata	A	0.13	0.14	0.41	0.24	0.11	0.32	0.24	0.22	0.25	0.34	0.39	0.28
	B	0.21	0.22	0.31	0.18	0.17	0.26	0.41	0.66	0.51	0.52	0.44	0.39

Salvinia natans	A	0	0	0	0	0	0	0	0	0	0	0	0
	B	0.01	0	0	0.05	0.08	0.08	0.09	0.12	0.24	0.26	0.10	0.09
Lemna minor	A	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0.05	0.06	0.08	0.11	0.10	0.11	0.03
Nymphoides indica	A	0	0	0	0	0	0	0.04	0.05	0.08	0.12	0.08	0.02
	B	0	0	0	0	0	0	0	0	0	0	0	0
Other Emergent	A	2.56	3.21	3.1	2.98	3.54	3.45	3.21	2.89	2.56	3.54	2.45	2.75
	B	2.54	4.85	3.21	4.67	3.65	2.24	2.36	4.68	3.86	3.45	3.78	3.11
Monochoria hastifolia	A	0	0	0	0	0	0	0	0	0	0	0	0
	B	0.45	0.54	1.54	1.98	1.45	3.14	3.87	3.12	3.82	3.02	2.65	0.91
Sagittaria sinensis	A	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0.3	1.45	2.11	2.16	2.08	3.24	1.24	0	0
Polygonum tomentosum	A	0	0	0	0.54	1.24	2.47	2.54	2.31	2.04	1.21	0.05	0
	B	0	0	0	0.34	1.45	2.75	3.21	3.54	2.45	1.74	0.09	0
Hydrilla verticillata	A	1.41	1.44	1.23	1.11	2.01	2.04	1.23	1.12	1.32	1.29	1.58	1.49
	B	1.04	1.03	0.08	0.05	0.06	0.06	0.07	0.04	0.03	0.04	0.07	0.04
Utricularia stellaris	A	1.12	1.54	0.91	0.85	1.24	1.05	1.16	1.27	1.47	1.19	1.11	1.08
	B	1.45	1.33	0.81	0.54	1.02	1.09	1.41	1.31	1.42	1.94	2.54	2.21
Alternanthera sessilis	A	2.21	1.44	0.51	0.61	0.44	1.21	2.65	3.44	3.78	2.54	2.44	2.84
	B	0	0	0	0	0	0	0	0	0	0	0	0
Enhydra fluctuans	A	1.12	0.87	0.75	0.42	0.32	1.45	1.87	1.97	2.14	2.44	2.75	1.01
	B	0	0	0	0	0	0	0	0	0	0	0	0

Table 3: Estimation of wet macrophyte productivity in kg/m^2 in the studied ponds (Nov, 2008 to Oct, 2009)

Name of the macrophytes	Pond	Nov, 2008	Dec	Jan, 2009	Feb	Mar	April	May	June	July	Aug	Sept	Oct
Eichhornia crassipes	A	0	0	0	0	0	0	0	0	0	0	0	0
	B	1.56	1.45	2.12	1.95	2.18	2.87	3.84	4.79	4.95	4.71	3.49	1.49
Azolla pinnata	A	0.17	0.19	0.31	0.32	0.34	0.29	0.12	0.10	0.24	0.07	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0
Salvinia cucullata	A	0.16	0.11	0.21	0.34	0.27	0.34	0.25	0.27	0.26	0.39	0.43	0.31
	B	0.15	0.21	0.33	0.19	0.27	0.29	0.29	0.31	0.38	0.32	0.44	0.31
Salvinia natans	A	0	0	0	0	0	0	0	0	0	0	0	0
	B	0.03	0	0	0.06	0.07	0.04	0.13	0.11	0.21	0.23	0.14	0.14
Lemna minor	A	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0.04	0.04	0.06	0.09	0.11	0.10	0.04
Nymphoides indica	A	0	0	0	0	0	0	0.03	0.05	0.06	0.08	0.07	0.02
	B	0	0	0	0	0	0	0	0	0	0	0	0
Other Emergent	A	2.57	4.21	3.87	3.98	2.59	3.66	4.45	3.89	2.61	2.51	2.61	3.04
	B	3.11	3.24	4.33	3.12	3.29	3.24	2.14	3.76	3.82	4.01	3.98	3.98
Monochoria hastifolia	A	0	0	0	0	0	0	0	0	0	0	0	0
	B	0.40	0.41	1.32	1.48	1.25	2.17	2.89	3.05	2.95	3.08	1.98	0.58
Sagittaria sinensis	A	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0.29	0.45	1.45	1.86	2.11	3.12	1.4	0.09	0
Polygonum tomentosum	A	0	0	0	0.32	1.42	2.58	2.61	2.4	2.09	0.21	0.05	0
	B	0	0	0	0.41	1.14	2.21	3.48	3.47	2.98	0.54	0.09	0
Hydrilla verticillata	A	1.78	1.21	1.21	2.1	2.09	1.14	1.29	0.92	0.98	1.19	1.17	1.25
	B	1.45	1.19	0.19	0.18	0.15	0.26	0.26	0.05	0.03	0.07	0.19	0.45
Utricularia stellaris	A	1.15	1.44	0.94	0.75	1.29	1.45	1.14	1.17	1.34	1.43	1.89	2.08
	B	1.49	0.84	0.81	0.57	1.07	1.24	1.47	1.37	1.75	2.51	2.58	1.73
Alternanthera sessilis	A	1.45	1.07	0.58	0.74	0.65	1.45	3.12	4.79	5.12	3.42	2.98	2.45
	B	0	0	0	0	0	0	0	0	0	0	0	0
Enhydra fluctuans	A	1.75	0.98	0.71	0.45	0.42	0.67	1.08	1.21	1.45	1.98	1.77	1.45
	B	0	0	0	0	0	0	0	0	0	0	0	0

4. Discussion

In Assam, the diversity of wetlands aquatic macrophytes was extensively studied by Goswami (1985, 1987) [4, 5], Goswami (1997) [6], Goswami and Goswami (2004-2005) [7]. Goswami (1985) [4] recorded 72 species of aquatic macrophytes in Chandubi, a tectonic lake of Assam of which 50 species belonging to emergent, 12 submerged, 5 floating leaved and 5 free floating while Goswami and Goswami (2004-2005) [7] described 42 species of macrophytes carried out in six different wetlands of Assam. Recently Kalita (2007) [9] has reported 30 species of macrophytes from Deepar beel, a Ramsar site which is situated at a distance of 4 km away from the present study area. The recorded 17 species in the present investigation was already described by Goswami (1985) [4] and Goswami and Goswami (2004-2005) [7].

In the present investigation it is found that the Pond B is encountered with 12 species of macrophytes while in Pond A with 11 species. The higher macrophytic assemblage in Pond B is contributed by its shallow depth supplemented by surrounding swamp dominated by *Phragmites karka*. Thick stands in patches of the free floating species *Eichhornia crassipes* in Pond B dominates over all other macrophytes throughout the study period while Pond A being deeper and more open, no single species of macrophyte is found to be dominant**.** Out of 7 species of rooted emergent recorded in the present investigation, are marginal in their habitat of which 6

species inhabit in Pond B while 4 species in Pond A. The higher incidence of the marginal plants in Pond B may also be due to the interference of surrounding swamp and the comparatively shallow depth (Hazarika, 2009) [8]. Only 4 species of submerged macrophytes are encountered in the study, of which *Hydrilla verticillata* and *Utricularia stellaris* are the common species recorded in both the ponds throughout the year. *Alternanthera sessilis* and *Enhydra fluctuans* are recorded only in Pond A with moderate biomass production (Table-2 and 3).

The macrophytic productivity of most of the species shows a summer-monsoon peak in the studied ponds (Table-2 and 3), associated with vegetative growth period, which is ultimately influenced by high rainfall and temperature (Kalita, 2007) [9] in summer and monsoon season. However, prominent decomposition period during autumn and winter resulting lower biomass production of most of the species of macrophytes is noticed.

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6. References

1. Berge B. Claugherty MC. Plant litter decomposition humus. Springer-verlag, New York, 2002.
2. Biswas K. Calder. Hand Book of common water and marsh plants of India and Burma. Bishen Singh Mahendra pal Singh, Dehra Dun, India, 1984, 216.
3. Deka P, Goswami MM. A comparative study of the seasonal trend of Physicochemical Parameters in two types of fresh water aquaculture ponds of Guwahati, Assam. J Aquacult. 2011; 12(2):167-175.
4. Goswami MM. Limnological Investigations of a tectonic lake of Assam, India and their bearing on fish production. Unpublished Ph.D. Thesis, Gauhati University, Assam. 1985, 395.
5. Goswami MM. Aquatic macrophytes in Assam beels: An analysis. *Compendium*, Workshop on development of beel fishery in Assam, A.A.U., 1987; 95-106.
6. Goswami N. Studies on productivity indicators in three different types of wetlandsof Assam, India. Ph. D. Thesis, Gauhati University, Guwahati, Assam, India. 1997, 217.
7. Goswami N. Goswami MM. Macrophytic diversity of Assam floodplain wetlands: some case studies. J. Tropical Zoology, 2004-2005; 1(2).
8. Hazarika, R. Studies on Aquatic insect of fish pond ecosystem with special reference to hemiptera Ph.D. Thesis, Gauhati University, 2009, 181.
9. Kalita G. Ecology and distribution of macro-invertebrate enmeshed fauna in Deepar wetland of Assam, India. Ph.D. Thesis, Gauhati University, 2007, 207.