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Hydrobiological Studies of the Chalan *Beel* Wetland in Bangladesh

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Abstract

Hydrobiological studies of the Chalan *beel* Wetland have been made. The limnological profile during the period from 1991 to 2007 has been presented which clearly indicates the change of trophic status of the *beel*. Comparative study with earlier works in our laboratory confirms the declining rate of abundance and species diversity is alarming. A total of 35 taxa had completely been disappeared within ten years.

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Keywords: Hydrobiological studies, Chalan *beel*, Bangladesh

INTRODUCTION

Bangladesh abounds with innumerable natural water bodies known as rivers, *Haor*, *Baor*, *Khals* and *Beels*. Many of these lentic and lotic systems are permanent bodies of water and may have a temporary period of inundation due to influx of water and drainage congestion during the monsoon as flood. The *beels* and *haors* often bloom with their spectacular graceful vegetations and provide sanctuary to aquatic lives. These wetlands with their characteristic ecology represent old and mature ecosystems. The Chalan *beel* wetland is located at $24^0.23^/$-$24^0.35^/$ North latitude and $89^0.05^/$ -$89^0.18^/$ East longitude, about 50 km south east of Rajshahi. The *beel* zone comprises of areas covering Singra and Gurudaspur Thanas of Natore, Chatmohor, Bhangura and Faridpur thanas of Pabna, and Ullahpara, Raiganj and Taras thanas of Sirajgonj district of the Northern Bangladesh. The original area of Chalan *beel* was 107500 ha, but the present area is slightly above 26000 ha. with an altitude of 8-10 meters above the sea level. Spate (1954), Johnson (1957) and Morgan and McIntire (1959) outlined the physiographic sub-region of the Bengal basin. Accordingly Bangladesh was divided into 24 sub-regions with 54 units on the basis of physical features and drainage pattern. One of these sub-regions is known as Bhor (VOR) basin or very deep

depression, the western part of which is conveniently designated as Chalan *beel* depression. The Bhor basin is designated to whole of low land south of the Barind Tract.

The Chalan *beel* is considered as one of the largest wetlands in Bangladesh which serves as a great flowing marsh for the surplus runoff water of the surrounding area of the adjoining districts. It has open connection with a number of rivers i.e. Atrai, Gurnadi, Korotoa, Baral, Mora Boral, Tulsi, Chenchua, Bhadai, Bongonga and Khulbjipur-Telkupi nadi and connected with each other with a mesh of tortuous channels and *khals* which run through the *beel*. The rivers and channels lose their identity during the monsoon due to the influx of flood water and eventually form a large sheet of water. The inundation depth during the flood period varies from 1 to 5 meters depending upon the depression of the basin. The water levels begin to recede from the middle of October and the whole area dries up towards the end of December; heavy rainfall and flash flood do not occur at this time. During the dry period from January to May, the central zone of the Chalan *beel* proper becomes divided into many isolated *beels* of various sizes, some of which may still retain water till the beginning of the next monsoon. The interconnecting channels also dry up with the exception of some large and deep ones which facilitate boat transport and irrigation in a very limited scale.

Considered as the main streams of the wetland drainage, the Atrai, Gurnadi, Korotoa and Baral rivers play the vital role in flooding and discharging of the main bulk of water in and out of the area of the *beel*. Atrai, Gurnadi and Korotoa with their distributaries and interlinked channels release their water into the Baral River at a point known as Hurasagar which in turn, with the entire load of flood water, finally flows in the Jamuna. Siltation and alluviation are the major problems due to the construction of infra-structure for urbanization, flood control dams, embankment and road constructions which lead to the drainage congestion and prolonged flood. Modern agricultural practices also add to the pollution and eutrophication hazard putting stress on the flora and fauna. Knowledge on the aquatic plants in Bangladesh chiefly rests upon the valuable works of Khan and Rahman (1976), Khan and Halim (1978, 1979a, b, c, 1984, 1985 and 1987) and Islam and Paul (1978).

The present communication deals with the floristic composition of angiospermic and other aquatic macroflora occurring in the Chalan *beel* along with its limnological aspects.

MATERIALS AND METHODS

Sampling was done at monthly intervals from 2001 to 2006. The plant materials were collected manually using hand nets, plankton nets from the entire *beel* region. A country boat was also used whenever needed to collect hydrophytes from deeper area. The plant materials were preserved in formalin and herbaria were made with them. Water samples for physico-chemical analysis were collected in 250 ml BOD bottles and large plastic jars. pH and conductivity meter, DO meter and spectrophotometer were used for relevant studies. The physico-chemical and biological factors were analyzed by following standard methods as indicated in APHA (1986), Welch (1948), Mishra *et al.* (1992) and Gautom (1992). The physico-chemical and biological conditions for the years 1991, 2000 and 2007 were depicted in Table1 to show the gradual ecological changes in the degrading wetland.

The aquatic angiosperms and pteridophytes were identified by consulting Arber (1920), Biswas and Calder (1954), Fassett (1957), Heywood (1978), Hooker (1872-1897), Khan and Halim (1987), Prain (1903- Rept 1963), Subramanyum (1962) and Watson and Dallwitz (1992).

Mean data of Zaman 1991(1985 to1988), Hasan 2000(1996-1999) have been compared with the present study.

RESULTS AND DISCUSSION

The physico-chemical and biological conditions show clearly the drastic ecological changes in the Chalan *beel* wetland during the recent years (Table1). Consequently, the rich plant diversity is under threat. A number of hydrophytes belonging to bryophytes, pteridophytes and angiosperms have disappeared from the *beel* due to anthropogenic activities as rice and mustard cultivation has progressed in the dry area (Table 2). A check list of the anchord, submerged, anchord emergent and floating hydrophytes are presented here. A total of 81 taxa were reported during the present study of which 77 species of angiosperms under 23 families were identified. The pteridophytes had 5 species under 3 families. No bryophyte was recorded during present study.

The twenty years of study of hydrophytes of Chalan *beel* reveal that this wetland had been a rich depository of aquatic plants including algae, bryophtes, pteridophytes and angiosperms (Zaman 1991 and Hasan 2000). Hydrophytes of this *beel* are critically threatened as the whole area dries up completely with an exception of few small patches retain water in the central zone. These small

patches of shallow water are now the sanctuaries of the hydrophytes, many of which have already disappeared. Zaman (1991) recorded 108 angiospermic species of which 31 species have disappeared from the *beel* by 2006. Important amongst these plants already disappeared are *Euryale ferox, Nymphaea rubra, Aldrovanda vesiculosa, Neptunia natans, Aeschynomene aspera, Aponogeton natans, Aponogeton echinatus, Sagittaria sagittifolia, Bergia capensis, Myriophyllum tuberculatum, Myriophyllum tetrandrum, Utricularia exoleata, Cyperus cephalatus, Maricus compactus, Paspalidium punctatum, Lasia spinosa, Steudnera virosa, Oryza rufipogon, Panicum paludosum, Pseudographis brunoniana, Glyceria sp.* and *Typha angustata* etc (Table-1).

Table-1. Yearly Average of Physico-Chemical and Biological conditions of Chalan *Beel* wetland in 1991, 2000 and Present Work

Parameters	**Zaman 1991**	**Hasan 2000**	**Present Work**
Air Temperature °C	27.08	28	27
Water Temperature °C	26.33	27	26.41
Average depth (m)	2.25	1.65	0.78
Transparency (cm).	48	28	13.5
T.S.S. mg/l	48	78.6	89
T.D.S. mg/l	463	494	630.4
Electrolytic conductivity µmoh/sec.	280.18	531.34	926.39
pH	8.48	7.87	7.25
Free CO_2 mg/l	12	18.2	12.6
DO mg/ l	8.1	6.4	5.8
% of Saturation of O_2	118	82	85
Total Alkalinity mg/l	127.5	125.7	99.2
BOD_5 mg/ l	2.57	6.37	7.76
COD mg/ l	35.50	40.4	38.95
Total hardness mg/l	80.32	103.52	118.41
Chloride (Cl) mg/l	29.6	51.4	57.3
Silicate (SiO_4) mg/ l	0.0033	0.0021	0.00 22
Phosphate (PO_4) mg/ l	0.06	0.035	0.068
Total Nitrogen mg/ l	0.35	0.68	1.012
Soluble salt mg/ l	0.056	0.117	0.134
Oxidation reduction potential Eh . mv.	0.315	0.392	0.459
Oxidation Reduction Index rH_2	26.42	27.44	28.85
Oil and grease mg/l	0.12	0.46	1.43
Total Phytoplankton Unit/l	64464	48600	275 36
Total zooplankton Unit/l	24746	13369	9893
Total Species of Angiosperms	108	84	77

A very rare and globally threatened aquatic carnivorous plant *Aldrovanda vesiculosa* of the family Droseraceae was collected from this wetland in 1987 (Zaman *et al*. 2011) and it has never been seen since then even after a careful search year after year until now. This important plant might have disappeared from this wetland due to loss of undisturbed potential habitat. Another aquatic plant endemic to Chalan *beel* is *Limnophila cana* (Scrophulariaceae) common in deep rice fields has become very rare now. Due to its restricted distribution, there is a threat to the existence of this species as its habitat is being destroyed through expansion of agricultural land for intensive rice cultivation. The pteridophytic plant *Isoetes coromondalina* growing in deep water of the *beel* has not been seen after 1995. *Ricciocarpus natans and Riccia fluitans* (bryophyte) have also disappeared from this wetland. Many elderly men say that *Acorus calamus* of Araceae was commonly found in this *beel* in about 40 years ago. This aromatic medicinal aquatic herb has probably disappeared due indiscriminate harvesting and also due to habitat loss.

Table- 2. List of hydrophytes recorded from Chalan *beel* (Zaman 1991 and Present work)

Type of Plant	Family	**Zaman 1991**	**Present Work**
Bryophyte			
1. *Riccia flutians* L. Fasset(1950)	Ricciaceae	+	-
2. *Ricciocarpus natans*(L) Corda;Fasset(1950)		+	-
Pteridophyte			
1. *Marselia quadrifolia* Lin, Fasset (1950) Prain (1903 Rept. 1963)	Marsiliaceae	+	+
2. *Ceratopteris thalictroides* (L.) Brogn, Prain (1903 Rept 1963)	Parkariaceae	+	+
3. *Azolla pinnata* R.Br, Karim et al. (1995) Prain (1903 Rept. 1963)	Salviniaceae	+	+
4. *Salvinia cuculata* Roxb., Prain (1903 Rept. 1963)		+	-
5. *Salvinia natans* Hoffm., Prain (1903 Rept 1963)		+	+
6. *Isoetes coromondalina*(L) Mig., Khan and Halim(1987)		+	-
Angiosperms			
1. *Sagittaria guayanensis* H.B.R. ssp *lappula* (D.Don) Khan and Halim (1987)	Alismataceae	+	+
2. *Sagittaria sagittifolia* L.Khan et al.(1987)	,,	+	-
3. *Limnophyton obtusfolium* L. Mig. Khan and Halim(1987)	,,	+	-
4. *Aponogeton appendiculatus* Bruggen, Khan and Halim (1987)	Aponogetonaceae	+	+
5. *Aponogeton natans* L. Eng Engl and Kanse, Khan and Halim(1987)	,,	+	-

Type of Plant		Family	Zaman 1991	Present Work
6.	*Aponogeton echinatus* Roxb., Khan and Halim(1987)	,,	+	-
7.	*Colocasia esculanta* (L.) Schott., Prain (1903 Rept 1963)	Araceae	+	+
8.	*Lasia spinosa* (L.) Thwait., Khan and Halim (1987)	,,	+	-
9.	*Steudnera virosa*, Prain (1903 Rept 1963)	,,	+	+
10.	*Pistia stratiotes* Linn., Khan and Halim (1987)	,,	+	+
11.	*Typhonium trilobatum* (L.) Schott Prain (1903),Rept. 1963	,,	+	+
12.	*Amorphophallus campanulatus* Decne.(1834)	,,	+	+
13.	*Arisaema leschenaultii* Blume	,,	+	+
14.	*Xanthosoma sagittifolium*(L.) Schott. & Endl.(1832)	,,	+	+
15.	*Cyperus corymbosus* Roxb., Khar and Halim (1987)	Cyperaceae	+	-
16.	*Cyperus tegetiformis* Roxb., Khar and Halim (1987)	,,	+	+
17.	*Cyperus cephalotes* Vahl., Khan and Halim (1987)	,,	+	-
18.	*Maricus compactus* (Retz.) Bold., Khan and Halim (1987)	,,	+	-
19.	*Eleocharis diandra* R.B. Fassett (1957)	,,	+	-
20.	*Eleocharis dulcis* (Buran. f) Trin Trinn, Khan and Halim (1987)	,,	+	-
21.	*Fimbristylis miliacea* (L.S Vahl. Prain (1903 Rept 1963)	,,	+	+
22.	*Fimbristylis acquimifnata* (L.S Vahl. Prain (1903 Rept 1963)	,,	+	+
23.	*Scirpus articulatus* (L.) Palle Khan, et al. (1987)	,,	+	+
24.	*Scirpus erectus* Poir, Prain (1903 Rept 1963)	,,	+	-
25.	*Scirpus grossus* Lft Paka, Khan and Halim (1987)25.	,,	+	+
26.	*Scirpus deblis* Pursh Fassell, 1957 Rept 1960.	,,	+	+
27.	*Scirpus mucronatus* Linn.Prain(1903 Rept 1963)	,,	+	+
28.	*Eriocaulon truncatum* Hatrn, Khan and Halim (1987).	Eriocaulaceae	+	-
29.	*Coix aquatica* Roxb., Khan and Halim (1987)	Graminae	+	+
30.	*Coix lacryma* Prain (1903 Rept 1963)	,,	+	+
31.	*Echinochloa crusgalli* (L.) P.B. Ernst-Haflinga Hildemur	,,	+	+
32.	*Eleusine indica* Gearth, Prain (1903 Rept 1963)	,,	+	+
33.	*Eragrostis cynosuroides* P.Beauv. Prain (1903 Rept 1963)	,,	+	-
34.	*Eragrostis gangetica*(Roxb.) Steud. Prain (1903 Rept 1963)	,,	+	+
35.	*Eragrotis tenella* (L.)Beauv.*ex* Roem. & Schult. Prain (1903 Rept. 1963)	,,	+	+
36.	*Leersia hexandra* Swarts., Khan and Halim (1987)	,,	+	+
37.	*Leptochloa chinensis* (L.) Nees, Prain (1903 Rept 1963)	,,	+	+
38.	*Leptochloa panacea*(Retz.)Dhur. Karim *et al*.(1987)	,,	+	+
39.	*Oryza rufipogon Griff* Khan and Halim (1987)	,,	+	-
40.	*Panicum paludosum* Roxb., Khan and Halim (1987)	,,	+	-
41.	*Paspalidium punctatum* Burmja. Cammuns., Khan and Halim(1987)	,,	+	-
42.	*Pseudographis brunoniana* Griff., Khan and Halim (1987)		+	-
43.	*Phragmites karka* Trin, Prain (1903 Rept 1963)	,,	+	+
44.	*Phragmites karka var. karka* Prain (1903 Rept 1963)	,,	+	-
45.	*Glyceria sp.*		+	+
46.	*Blyxa auberti* Rich., Subramanyum (1962)	Hydrocharitaceae	+	+
47.	*Hydrilla verticillata* (L.F) Royle, Khan and Halim (1987)	,,	+	+
48.	*Nechamandra alternifolia* Roxb., Subramanyam (1962)	,,	+	+
49.	*Ottelia alismoides* (L.) Pers., Subramanyam (1962)	,,	+	+
50.	*Vallisneria spiralis* Lenn Subramanyam (1962)	,,	+	+
51.	*Hydrocharis dubia* (BI) Backer., Khan and Halim (1987)		+	+
52.	*Lemna perpusilla* Tor., Hooker (1993) Khan and Halim (1987)	Lemnaceae	+	+
53.	*Spirodela polyrhiza* (L.) Schield, Hooker (1893)	,,	+	+
54.	*Wolffia arrhiza* L.Horkel ex Wimmer Khan and Halim (1987)	,,	+	+
55.	*Najas graminea* Del. Hooker (1993), Khan and Halim (1987)	Najadaceae	+	+
56.	*Potamogeton crispus* L. Khan and Halim (1987)		+	+
57.	*Potamogeton nodosus* Porr., Khar and Halim (1987)	,,	+	-
58.	*Potamogeton mucronatus* Presl., Khan and Halim (1987)		+	+
59.	*Potamogeton nodosus* Poir., Khar and Halim (1987)		+	+
60.	*Potamogeton octandrus* Poir., Khan and Halim (1987)		+	+
61.	*Eichhornia crassipes* Poir., (Mart Solms, Khan and Halim (1987)	Pontederiaceae	+	+
62.	*Monochoria hastata* (L.) Solms Subramanyam (1962)	,,	+	+
63.	*Monochoria vaginalis* (Burm.f.,)Presl. Khan and Halim (1987)	,,	+	-
64.	*Typha angustata* Bory & Chaub., Subramanyam (1962)	,,	+	-
65.	*Alternanthera philoxeroides* (Mart.) Griseb	,,	+	+
66.	*Ceratophyllum demersum* L., Khan and Halim (1987)	Ceratophylllaceae	+	+
67.	*Ceratophyllum submersum* L.,Khan and Halim (1987)	,,	+	+

Type of Plant		Family	Zaman 1991	Present Work
68.	*Ipomoea aquatica* Forsk. Khan and Halim (1987)	Convolvulaceae	+	+
69.	*Ipomoea fistulosa* Mast ex Choisy, Khan and Halim (1987)	,,	+	+
70.	*Aldrovanda vesiculosa* L.	Droseraceae	+	-
71.	*Bergia capensis* L. Khan and Halim (1987)	Elatinaceae	+	-
72.	*Elatine triandra* Schuler	,,	+	+
73.	*Myriophyllum tuberculatum* Roxb.	Halograceae	+	-
74.	*Myriophyllum tetrandrum* Roxb.	,,	+	-
75.	*Utricularia aurea* Lour	Lentibulariaceae	+	+
76.	*Utricularia stellaris* L.F	,,	+	+
77.	*Utricularia inflexa* Forsk	,,	+	+
78.	*Utricularia exoleata*R.Br.	,,	+	-
79.	*Rotala wallichii* (Hook.f.) Koehne	Lythraceae	+	+
80.	*Hypericum sp.*	Hypericaceae	+	+
81.	*Nymphoides cristatum* (Roxb.) O. Kuntze.,	Menyanthaceae	+	+
82.	*Nymphoides indicum* (L.) O. Kuntze	,,	+	+
83.	*Nelumbo nucifera* Gaertn , *(Nelumlium speciosum* Wild)	Nymphaeaceae	+	+
84.	*Nymphaea nouchali* Burm.	,,	+	+
85.	*Nymphaea stellata* Wild.	,,	+	+
86.	*Nymphaea rubra* Roxb.	,,	+	-
87.	*Eurayle ferox* Salisb. Khan and Halim (1987)	,,	+	-
88.	*Neptunia natans*(L.f.)Druce Khan and Halim (1987)		+	+
89.	*Aeschynomene aspera* L. Khan and Halim (1987)	Papilionaceae.	+	-
90.	*Sesbania roxburghii* Merr. Khan and Halim (1987)	,,	+	+
91.	*Ludwigia adsendens* (L.) Hara. Khan and Halim (1987)	Onagraceae	+	+
92.	*Ludwigia repens*		+	+
93.	*Polygonum glabrum* Willd Khan and Halim (1987)	Polygonaceae	+	+
94.	*Polygonum tomentosum* Willd	,,	+	+
95.	*Limnophila aquatica* R.Br	Scrophulariaceae	+	+
96.	*Limnophila cana* Griff	,,	+	+
97.	*Limnophila heterophylla* (Roxb) Benth	,,	+	+
98.	*Limnophila indica* (Linn) Druce	,,	+	+
99.	*Limnophila sessiliflora* Blum	,,	+	+
100.	*Trapa bispinosa* Roxb	Trapaceae	+	+
101.	*Enhydra fluctuans* Lour	Asteraceae	+	+
102.	*Ethulia conyzoides* L.	,,	+	+

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