Comparative study on fish and fisheries of a closed and an open type wetland of the Brahmaputra valley

R.Bordoloi

Department of Zoology,D.R College, Golaghat 785621, India

Abstract- The floodplain Wetlands are considered as biologically sensitive areas and provide excellent nursery grounds for several fish species besides a host of other fauna and flora 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.TheWetlands are situated in the North east of Jorhat town, Assam. The Nahotia Beel is of the open type. 18 families including 50 species have been encountered in the open Beel. The Potiasola Beel is closed type Wetland, situated at about 5 k.m. from the Jorhat town in Potiagaon. 17 families including 41 species have been encountered in the closed Wetland, during study period. Status of the Ichthyospecies of the open Beel was 3 species as Vulnerable (VU) **,**3 species as Lower Rick least concern (LR-lc),17 species Near threatened (LRnt) and ,15 species Not assessed (NA) . In case of the closed Wetland 5 species as Endangered, 3 species as Vulnerable (VU), 3 species as Lower Rick least concern (LRlc), 17 species Near threatened (LRnt) and 15 species Not assessed (NA) The rate of fish production from the open Beel has been estimated to be average 1693 kg /yr. on an average which is equivalent to 8546264 $X10^3$kcal whereas in the closed Beel has been estimated to be on average 540kg /yr. which is equivalent to 272592 $X10^4$k cal.

Index Terms- Closed wetland, Open Wetland, Nahotia Beel, Potiasola Beel etc.

I. INTRODUCTION

Fishery, under modern scientific research, signifies the judicious exploitation of natural resources of water. The success of fishery depends on the knowledge of characteristics of water and soil .The floodplain lakes are considered as biologically sensitive areas as they have vital bearing on the recruitment of population in the riverine ecosystem and provide excellent nursery grounds for several fish species besides a host of other fauna and flora. Most of the Beels of Assam are infested with macrophytes, which pose problem in the operation of various fishing gear. These interfere in the productivity of the ecosystem also. At present, the Nahotia and Potiasola Beels are infested with aquatic weeds, there is very low level of fish production i.e., 30 – 40 kg/ha/yr. But there is a potential for at east 1000 – 2000 kg/ha/yr. if managed scientifically. Fishing gears such as Drag nets, Lift nets, Hooks, and Cast net (Locally the net is known as "khewalijal"in this area) were practced in the wetlands. This net is made of nylon threads and having a strong long rope attached to the apex. The net is look like an open umbrella. A number of weights of iron or lead are attached along the Margin of the pockets. The length of the cast net is from 2 to 4 meters. The weight of the net is ranged from 5 -10 kg. Some traditional methods are also practiced in the Beels (Chepa, Tonijal, Jakoi Hhekijal etc.). Dewatering method is carried out during the month of December/January. After dewatering fish are easily caught by hand picking. The major changes observed that the nets were woven and fabricated by synthetic materials instead of natural materials as in the past. The aide of unauthorized mesh size and use of a wide range of non – selective fishing gears such as mosquito nets in these B eels indicates that most fishers does not comply with the existing fishery act and fishing regulations and are not concerned with possible over exploitation of the stocks of commercially important species.

II. MATERIAL & METHODS

Physical, chemical and biological parameters of the Nahotia (Open type) and Potiasola (Closed type) wetlands have been investigated from January 2005 to December 2007. Morphomatic parameters such as Full Storage Level (FSL), Dead storage level (DSL), length, width, and periphery were measured using standard civil engineering method (Punmia, B.C. 1988). Shore development (SD) is calculated by the equation. $SD = S/2 VA_{\pi,}$ Where, S, the length of the shoreline and a, the area of the wetland.The volume development (V_D) is determined by following equation. ,$V_D = 3 (D_m)/ (D_{max})$ where, $D_{m,}$ mean depth of the wetland and $D_{max.}$ Maximum depth of the wetland.

The fish species of the Beels was studied with regard to their taxonomy catch stastics and production. Fish samples were collected at the time of catch of the Beels. Landing site was visited once a week and collected data from the Beels and also enquires from fishermen, Mohalder etc. The individual species was weighed and recorded. Fish yield are estimated by direct observations on catch of individual Beel (Jhingran and Dutta, 1968). The collected samples preserve in 5% formalin and identified after Talwar & Jhingran (1991) and Jayaram (1999).Energy conservation factor of fish tissues is 5048 – 5789cal/g (Javier et al., 2006). 1kg of fish tissues is equal to $5048x10^3$kcal. Fish (5048 – 5789cal/g) are most energy density group, followed by insect (50462 – 5231), crustaceans (3364 - 3994cal/g), oligochaetes (3471) and gastropods (1143cal/g). Monthly water samples of the surface and bottom layers of the two zones of the studied wetlands were collected from randomly from the selected spots following the sampling procedure (APHA, 1989).

III. RESULT

Study area of the Beels : 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). Hydrotopograghic measurement of the closed and open type Wetlands (table 1) and hydro topographical map of the Wetlands are shown figure 4. 18 families including 41 and 50 species have been encountered in the closed and open Beel respectively during 2005-07 (table.2).

Status of fishes according to IUCN are shown in table 2 & fig 1 for both the Wetlands. Annual fish yield was 41.53kg/ha (open Beel) and 25.65 kg/ha (closed Beel) (table 3&4). Average fish production of closed Beel was 500,520 and 600 in the years 2005, 2006 and 2007 respectively. Fish landing in open Beel was 1502, 1531, 2046 in the year 2005, 2006 and 2007 respectively (table 3&4). Fish production by different groups was 316 kg by the carps, catfish (270kg), Feather Back (220kg), Murrel (120kg), *Anabus* (100kg) *C.batrachus*(40kg), *H.pneuses fossilis* (50), and Miscellaneous (577kg) in the open Wetland .Fish production by different group of fishes were as follow 10 kg by carps, *C.batrachus*(40kg), *H.pneuses fossilis* (50), catfish(54kg), Feather Back (40kg), Murrels (30kg), and Miscellaneous (216kg) in the closed Wetland (table 4 &fig.3).

Physicochemical characterstics:

Dissolved oxygen in Open Beels water ranged 6 to 10 ml/l with an average value 8.41 ml/l and in closed Beel ranges from 6.49 to 10.03 ml/l with an average value 8.23 ml/l during 2005 – 07(table 6). In open Beel, free co_2 was 1.9 mg/l and in closed Beel with an average value 1.5mg/l. P^H in open Beel was 6.30 – 7.7. And in Closed Beel fluctuated within 6.5 and 7.2. Hardness of water was higher (35) in open Beel than closed Beel. Minimum and maximum values were 18 and 50 (July and august) in cpen Beel whereas 15 and 35 in case of Closed Beel. Seasonal variation of turbidity have been observed in entire the years. Turbidity was higher (28 NTU) in open Beel than closed Beel (26.8 NTU) during 2005-07. Temperature in open Beel was 17.94 o^C, minimum 7 o^C and maximum 23 o^c. Water temperatures in Closed Beel was 18.18 o^C , minimum 7 o^C and 24.5 o^C maximum. The soil of both the Beels were of the alluvial type. The range of sand in soil was 36.7-40% with an average value of 38.12% and clay ranged from 26.8 - 30 36% with value 25.8 % in Nahatia (open Beel). In closed Beel, it ranged from 29 - 35% (sand) with mean value 32.8% and range of clay from 20 – 23 % with the mean value 21.5.

IV. DISCUSSION

Wetlands are the creation of the river Brahmaputra in the flood plain area. The physiographic and morphometric features of both the Beels are different from each other. The area and water level of the Nahotia Beel is fully dependent upon the water level of the river Brahmaputra. During the summer season, the water level reaches a high level which drops down in the winter season .The area and depth of the Beel increases manifolds at the time of the flood. The area of the Beel expands upto about 80 ha. And the depth reaches up to about 8 meters. In Potiasola Beel the water level and area are dependent upon the rainwater from surrounding paddy fields. During rainy season the area of the Beel increases up to about 20.000ha, due to the surrounding low-lying paddy fields, which become an integral part of the Beel. Depth increases up to about 6 meters during rainy season .

18 families including 41 and 50 species have been encountered in the closed and open Beel respectively during 2005-07 (table.2). In the open wetland,out of 18 family the Cyprinidae family was found to be highest species (19) and followed by Belontidae, Siluridae and Channidae with 4 species each and Bagridae having 3 species each, Chandidae, Mastacembelidae, Nandiadae and Notopteridae with 2 species each. And also family such as Belonidae, Anabatidae, Clariidae, Cobitidae, Clupeidae, Chacidae, Heteropneustidae, Synbranchidae and Tetraodontidae were appering as single species in the open wetland (Nahotia).

In the closed wetland (Potiasola), out of 17 families the Cyprinidae family was found to be highest species (13). And followed by Belontidae and Channidae with 4 species each and Siluridae and Bagridae having 3 species each, Chandidae, Mastacembelidae and Nandiadae with 2 species each. The remaining family such as Belonidae, Anabatidae, Clariidae, Cobitidae, Clupeidae, Heteropneustidae, Chacidae, Synbranchidae and Tetraodontidae were observed as single species in the wetland. Similar observation was reported by Singh (2009) and Abujam etal (2012). The International Union for Conservation of Nature and Natural Resources (IUCN) has categorized the conservation status of fish species available in the studied Beels. Out of the recorded species in the open *beel*, 5 species as Endangered (facing an extremely high risk of extinction, or dying out in the wild); 5 species as Vulnerable (VU) **(**facing a very high risk of extinction in the wild); 3 species as Lower Rick least concern (LRlc) (facing a high risk of extinction in the wild), 19 species Near threatened (LRnt) ,16 species are still Not assessed (NA) .I n case of the closed Wetland (Table 2 & fig 1), was 5 species as Endangered (facing an extremely high risk of extinction, or dying out in the wild); 3 species as Vulnerable (VU) **(**facing a very high risk of extinction in the wild); 3 species as Lower Rick least concern (LRlc) (facing a high risk of extinction in the wild), 17 species Near threatened (LRnt) and 15 species was Not assessed (NA) . 4% species were recorded as exotic and 96 % species were indigeneous in both the wetlands (fig.2). *T.putitora*,*T.tor Chitola chitola*, *Ompok pabda* (Ham) and *Ompok bimaculatus* are belongs to endangerous species in open beel. But only one species are found in the closed beel (*Ompok pabda* (Ham) which is also avaiable in the open beel. So far 267 fish species belonging to 114 genera under 38 families and 10 orders has been recorded and reported from the region. This is about 33.13% of total Indian fresh water fishes (Sen, 2000). Sarkar and Poonia (2000) evaluated the ornamental value of 172 fish species occurring in North Eastern Region. The status and export potentialities of indigenous ornamental fishes of India were highlighted by some workers (Dey, 1980 & 1982), Sen & Dey (1984), Nath (1986 & 1987) and Tamang (1992).

Annual fish yield was 41.53kg/ha (Open Beel) and 25.65 kg/ha (Closed Beel) (table 3&4). Average fish production of Closed Beel was 540kg which is less than production of open beel (1693 kg 1), (table 3&4). Fish production by different group

of fishes was found catfish (54kg), Mureles (30kg), *Anabus* (100kg) Feather Back (40kg), *H.pneuses fossilis* (50), *C.batrachus* (40kg), 10 kg by the carps and Miscellaneous (216kg) including ornamental fishes the closed Wetland (table 3-4&fig.3).Highest production was from carp (270kg), followed by catfish(270kg), Feather Back (220kg), *Anabus* (100kg) , *H.pneuses fossilis* (50), *C.batrachus*(40kg) and Miscellaneous (577kg) including ornamental fishes in the open Wetland. Both beels dominated by ornamental fishes (577kg in open Beel and 216kg in closed Beel). Carp production (270kg), was higher in open Beel than the closed Beel (10 kg).Similar observation was found (Acharjee et al, 1998), Bordoloi 2010).

Energy production:

The rate of fish production from the open Beel has been estimated to be average 1693 kg /yr. on an average which is equivalent to 8546264 $X10^3$kcal. (1kg of fish is equal to 5048x10^3kcal/kg, table - 5. The contribution of various species in the energy output was as follows *Catla catla* 35336$X10^4$k cal, *L. rohita*, 30288$X10^4$ k cal , *C.migrala*, 636048 $X10^4$ k cal, *L. gonius* 2524 $X10^5$ k cal , feather back 111056 $X10^4$ k cal , Cat fishes, 136296 $X10^4$ k cal (dominated by W.attu), live fishes including *Channa striatus*, 20192 $X10^4$ k cal, *C. puncatus1*, 15144 $X10^4$ k cal ,*Channa muralus* ,2524 $X10^5$ k cal, *C.batrachus1*, 20192 $X10^4$k cal, *H.fossilis* 2524 $X10^5$ k cal ,*Anabus*5048 $X10^4$ kcal and miscellaneous,2912696 $X10^3$ kcal ., Javieretal C. and Miguel P. (2006) reported that Fish (5048 – 5789cal/g) are most energy density group, followed by insect(50462 – 5231),crustaceans(3364 -3994cal/g),oligochaetys (3471) and gastropods (1143cal/g).

The rate of fish production from the Beel has been estimated to be on average of average 540kg /yr. on an average, which is equivalent to 272592 $X10^4$k cal. The contribution of various species in the energy output was *C.batrachus* 20192 x10^4 kcal,*H.fossilis* 2524 x10^5 k cal, *Channa muralus* 5048 x10^4 k cal, *Channa striatus* 42,000k cal, *C. puncatus* 5048 x10^4k cal, Common carps 5048 x10^4 k cal , feather back 20192 x10^4 k cal ,Carp 50480 x10^4 kcal and Cat fishes 272592 x10^3 k cal, table 5.

Comercial production **:**

Annual fish production was higher in (41.53kg/ha) open Beel than (25.65 kg/ha)closed beel . Average fish production of Closed Beel was 540 kg/yr. and in Open Beel was 1693 k/yr. On the basis of inquiries made at the *beel*s sites, the Central Inland Fisheries Research Institute, Barrac pore has estimated yields varying from 14 to 488 kg/ha/year. Average yields of 17 *beel*s in the Brahmaputra valley is 134 kg/ha/year, compared to 285 kg/ha in 6 *beel*s of the Barak valley. The average yield of 23 *beel*s in Assam across the districts is 173 kg/ha (Sugunan and Sinha, 2000). Present production is less due overexploitation fishes, habitat loss and using of unauthorized fishing gears as well as catch of juvenile in the months of July ,August and September .

V. Physicochemical charecterstics of water

Seasonal variation of dissolved oxygen has been observed throughout the entire year during the investigation. Dissolved oxygen in open Beels water ranged from 6 to 10 ml/l with an average value of 8.41 ml/l and in Closed Beel ranges, 6.49 to 10.03 ml/l with an average value of 8.23 ml/l during 2005 – 07. In open Beel, free co_2 was ranged from 0.5 – 3.3 mg/l with an average value 1.9 mg/l and in closed Beel ranged from 0.5 – 3.2 with an average value 1.5mg/l. Free co_2 (r = -.793) is negatively correlated to dissolved oxygen . Hardness of water in the open Beel ranged from 18 – 50 mg/l with an average value of 35 mg/l whereas in closed Beel it ranged from 15 – 35 mg/l with an average value of 23.1mg /l. Turbidity of water in open Beel fluctuated from 18 – 50 (NTU) with an average valueof 28 (NTU) whereas in the closed Beel it ranged from 15 – 35(NTU) with an average value of 26.8(NTU). p^H of water in the open Beel ranged from 6.30 – 7.7 with an average value of 6.9 while in the closed Beel the was from 5.6 – 7.2 with an average value of 6.8 . Surface water temperature of the open Beel ranged from 7 – 23°C with an average value of about 17.9°C. The average water temperature of the Closed Beel fluctuated from 7°C to 24.5°C with an average value of 18.8°C,table. 5. The minimum and maximum temperature of Closed Beel and open Beels were 9.8^0c (January) and 32.3^0c (August). Air temperature of the Beel varied from 9.8 – 33.80^c with an average temperature 23.680^c and in the Closed Beel the range was 9 – 33.5 0^c with an average range 23.68 0^c during 2005 – 07. Air temperature has a significant positive correlation at the level 0.01 with water temperature (r=0.972)and turbidity (r =0.972), Physico – chemical parameters of water and soil have multiple positive correlations (5% level) with fish production , growth of aquatic macrophytes as well as plankton density. Several workers have reported variable dissolved oxygen level in the beels of Assam. For instance Yadava *et al*., (1987) recorded 2.6 to 10.9 mg/l Jhingran and Pathak (1987) 4.27 to 11.2mg/l; Acharjee *et al*. (1999) 5.4 to 8.18mg/l.

VI. Acknowledgement

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Table.1.Hydrotopograghic measurement of the Closed and Open type wetlands (FSL= Full storage level, DSL = Dead storage level.

Parameters	Open Beel	Closed Beel
Area at FSL (ha)	80	20

Area at DSL (ha)	66	13.25
Total volume at FSL m3)	1610448.84	31729.62
Total volume at DSL m3)	88724.42	15864.81
Maximum length at FSL (m)	1500	1000
Maximum width at FSL (m)	600	500
Maximum length at DSL (m)	930	500
Maximum width at DSL (m)	710	210
Maximum depth at FSL (m)	8	6
Minimum depth at FSL (m)	3	0.25
Mean depth (Dm) at FSL (m)	2.5	2.54
Maximum depth at DSL (m)	3	2.10
Minimum depth at DSL (m)	1.25	0.20
Mean depth (Dm) at DSL (m)	1.1	0.25
Volume development (VD) at FSL)	9.6	3.96
Volume development (VD) at DSL	7.2	0.25

Table 2. Status of the Ichthyospecies of the Nahotia (Open Beel) and Potiasola (Closed Beel) wetlands. Critical Endangered (CR), Endangered (EN), Vulnerable (VU), Lower Rick near threatened (LR - nt), Lower Rick least concern (LR lc) and Not assessed (NA) (January 2005 –December 2007).

Family	Species	Occurrence		Status (IUCN)	Economic importance
		Nahotia Wetland (Open)	Potiasola Wetland (Closed)		
1.Anabatidae	1.*Anabus testudineus*(Ham.)	√	√	VU	Edible, Good Medicinal value,Aqurium species
2. Belontidae	1.*Trichogaster fasciata*	√	√	NA	Edible, Aqurium species
	2. *T. labiosa*	√	√	NA	Edible, Aqurium species
	3. *T. lalia*	√	√	NA	Edible, Aqurium species
	4. *T. sota*	√	√	NA	Edible, Aqurium species
3. Beloni dae	1.Xenentodon cancilla (Ham.)	√	√	LR-nt	Edible, Aqurium species
4. Bagr i dae	1.*Mystus cavasius* (Ham.)	√	√	LR-nt	Edible, Aqurium species
	2. *M. tengra* (Ham.)	√	√	NA	Edible, Aqurium species
	3. *Rita Rita* (Ham.)	√	√	LR-nt	Edible

5.Chandi dae	1.*C.handa nama* (Ham.)	√	√	NA	Edible, Aqurium species
	2.*Parambassis ranga* (Ham.)	√	√	NA	Edible, Aqurium species
6.Chacidae	1.*Chaca chaca* (Ham.)	√	√	NA	Edible, Good Aqurium species
7. Clariidae	1.*Clarius batrachus* (Linn.)	√	√	VU	Edible,Good Medicinal value Aqurium species
8. Cobitidae	1. *Botia dario* (Ham.)	√	√	NA	Edible, Aqurium species

Family	Species	Occurrence		Status (IUCN)	Economic importance
		Nahotia Wetland (Open)	Potiasola Wetland		
9. Cyprinidae	1.*Amblypharyngodonmola* (Ham.)	√	√	LR-lc	Edible, Aqurium species
	3.*Chela apter*(ham).	√	√	NA	Edible, Aqurium species
	4.*Cirrhinus mrigala*(ham).	√	√	LR-nt	Edible
	5.*Labeo bata*.	√	√	LR-nt	Edible
	6.*Labeo gonius* (ham).	√	√	LR-nt	Edible
	7.*Puntius chola* (ham.)	√	√	VU	Edible, Aqurium species
	8.*P.sophore* (ham.)	√	√	LR-nt	Edible, Aqurium species
	9. *P.ticto* (ham)	√	√	LR-nt	Edible Aqurium species
	10. P. sarrana.	√	X	VU	Edible
	11.*Rasbora daniconius*(ham.).	√	√	NA	Edible Aqurium species
	12.*Cyprinus carpio carpio* (Lin.)	√	√	Exotic	Edible
	13.*Ctenopharyngodon idella*	√	√	Exotic	Edible
	14. *Catla catla*	√	X	VU	Edible
	15. *L. calbasu*	√	X	LR-nt	Edible
	16. *L. rohita*	√	√	LR-nt	Edible
	17. *T.putitora*	√	X	EN	Edible
	18. *T.tor*	√	X	EN	Edible
	19.*Pangusia pangusia*	√	X	NA	Edible

Family	Species	Occurrence	Status (IUCN)	Economic importance

		Nahotia Wetland (Open)	Potiasola Wetland (Closed)		
10. Channidae	1.*Channa gachua* (Ham.-Bloch.)	√	√	NA	Edible,Good Aqurium species
	2.*C. marulius* (Ham.)	√	√	LR-nt	Edible Aqurium species
	3. *C. punctatus* (Bloch.)	√	√	LR-nt	Edible Aqurium species
	4. *C. striata* (Bloch.)	√	√	LR-lc	Edible Aqurium species
11. Clupeidae	1. *Gudusia chapra* (Ham)	√	√	LR-lc	Edible Aqurium species
12.Heteropneutidae	1.*Heteropneustes fossilis* (Bloch)	√	√	VU	Edible, Good mecinal value, Aqurium species
13.Mastacembellidae	1.*Mastacembelus armatus* (Lacepede).	√	√	LR-nt	Edible Aqurium species
	2.*Macrognathus pancalus* (Ham)	√	√	LR-nt	Edible Aqurium species
14.Nandidae	1.*Nandus nandus* (Ham)	√	√	LT-nt	Edible ,Good Aqurium species
	2.*Badis badis*	√	√	NA	Edible, Good Aqurium species
15.Notopteridae	1..*Notopterus notopterus.*	√	√	LR-nt	Edible Aqurium fish
	2.*Chitala chitala*	√	X	EN	Edible
16.Siluridae	1.*Ompok pabda*(Ham)	√	√	EN	Edible, species Aqurium fish
	2.*Ompok pabo*(Ham)	√	√	NA	Edible species Aqurium fish,
	3.*Ompok bimaculatus*	√	X	EN	Edible, Aqurium fish
	4. *Wallago attu*	√	√	LR -nt	Edible
17.Synbranchidae	1.*Monopterus chuchia* (Ham)	√	√	LR-nt	Edible Good Aquriumspecies
18.Tetradontidae	1.*Tetradon cutcutia* (Ham)	√	X	LR-nt	Edible,Aquriumspecies

Table .3. Annual fish catch statistics (kg) in Nahotia(NAH) and Potiasola(POT) Wetlands(2005-07)

Years	Closed Wetland (kg)	Open open Wetland (kg)	Mean
2005	500	1502	1001
2006	520	1531	1025.5
2007	600	2046	1323
Average	540	1693	

Table .4. Fish catch statistics (kg) by different groups in Nahotia(NAH) and Potiasola(POT) Wetlands(2005-07)

	Closed Wetland	Open Wetland
Carps	10	316
Cat fishes	54	270
Mureles	30	120
Feather Back	40	220
Miscellaneous	216	577
C.batrachus&	40	40
H.pneuses fossilis	50	50
Anabus	100	100
Total	540	1693

Table 5. Energy Density of individual fish tissues (kcal/g).

Species	Individual fish in Open Wetland (kg)	Enegy Density (kcal)	Individual fish in Closed Wetland(kg)	Energy Density (kcal)
		Energy Consevation factors(5048g/cal)		Energy Consevation Factors (5048 g/cal)
Catla catla	70	$35336X10^4$	0	0
L. rohita	60	$30288X10^4$	0	0
C.migrala	126	$636048 X10^4$	0	0
Common carps&Grass carps(exotic)	10	$5048 X10^4$	10	$5048 X10^4$
L. gonius	50	$2524 X10^5$		
Cat fishes (dominated by W.attu),	270	$136296 X10^4$	54	$272592 X10^3$
Featherback	220	$111056 X10^4$	40	$20192 X10^4$
Channa striatus	40	$20192 X10^4$	10	$5048 X10^4$
C. puncatus1	30	$15144 X10^4$	10	$5048 X10^4$
Channa muralus	50	$2524 X10^5$	10	$5048 X10^4$
H.fossilis	50	$2524 X10^5$	50	$2524 X10^5$
C.batrachus	40	$20192 X10^4$	40	$20192 X10^4$
Anabus	100	$5048 X10^4$	100	$5048 X10^5$
Miscellaneous	577	$2912696 X10^3$	216	$1090368 X10^4$
	1693	$8546264 X10^3$	540	$272592 X10^4$

Table 6. Summary of the physicochemical charecterstics of water of the closed and open Wetlands (January 2005 – December 2007).

Characteristics of water	Wetlands	Range	Mean
DO (mg/l)	Open beel	7.5 - 10	8.41
	Closed Beel	6.49 - 10.03	8.23
pH	Open beel	6.30 - 7.7	6.9
	Closed Beel	5.6 - 7.2	6.8
Hardness (mg/l)	Open beel	18 - 50	35
	Closed Beel	15 - 35	23.1
Free co2	Open beel	0.5 - 2.8	1.5
	Closed Beel	0.5 - 2.7	1.34
Temperature Oc	Open eel	7 - 23	17.9
	Closed eel	7 - 24.5	18.18
Air Temperature Oc	Open beel	9.8 - 33.8	28
	Closed Beel	9 - 33.5	26.8
Turbidity (NTU)	Open beel	18 - 50	28
	Closed Beel	18 - 50	26.8

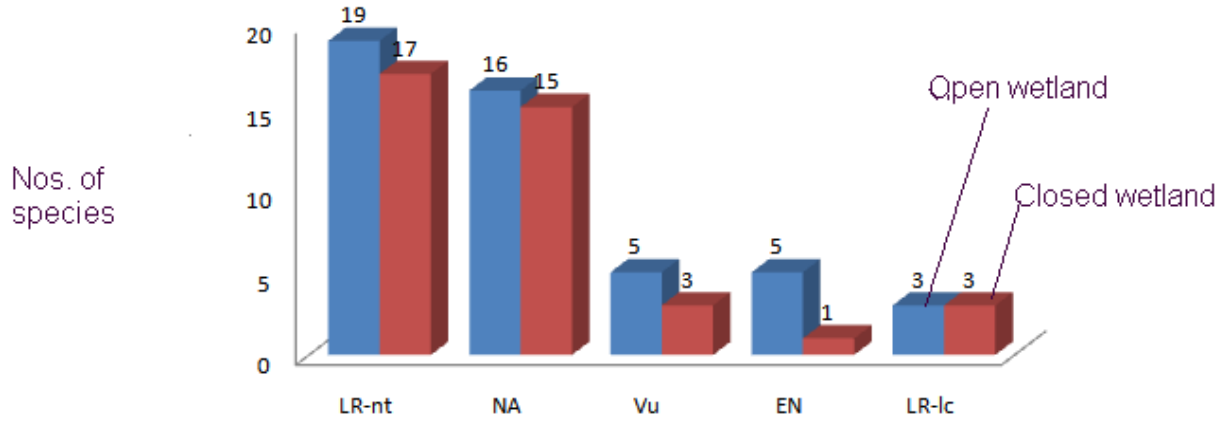

Fig.1. Status of the Ichthyospecies of the Nahotia (Open Beel) and Potiasola (Closed Beel) wetlands. Critical Endangered (CR), Endangered (EN), Vulnerable (VU), Lower Rick near threatened (LR - nt), Lower Rick least concern (LR lc) and Not assessed (NA) (January 2005 –December 2007) .

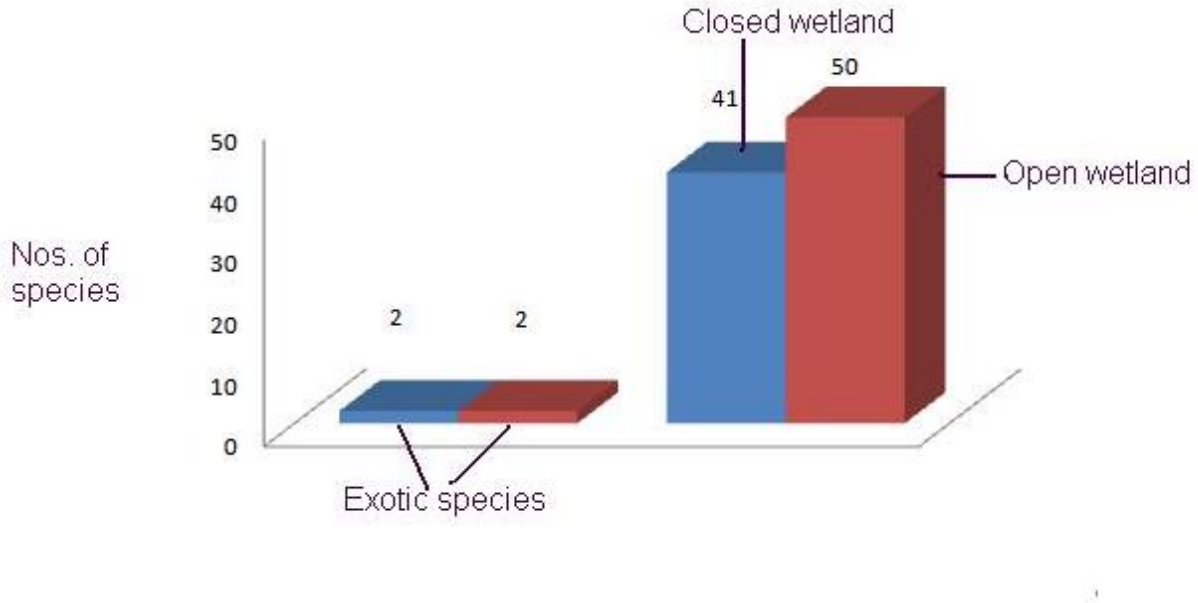

Fig.2.Status of exotic species in closed and open Wetland (2005-07).

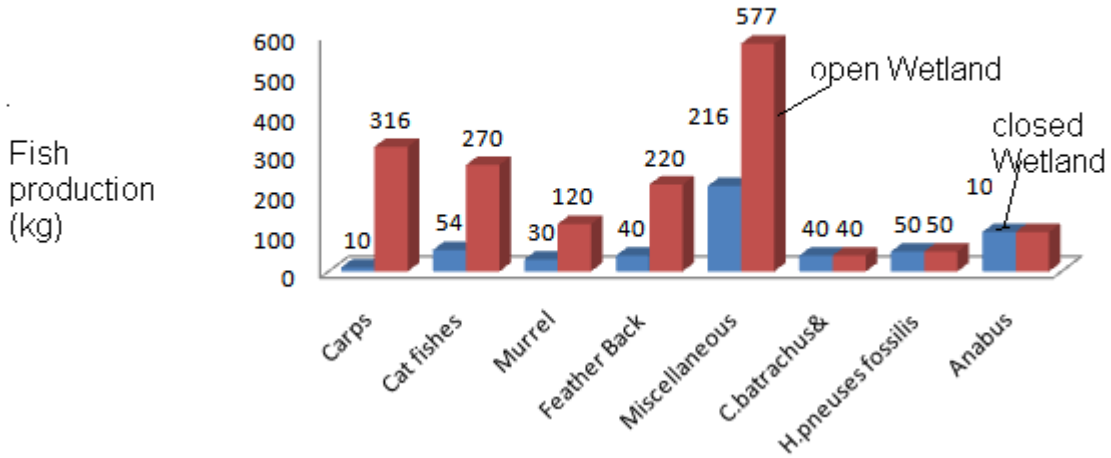

Fig.3. Fish composition in closed and open beel (2005-07).

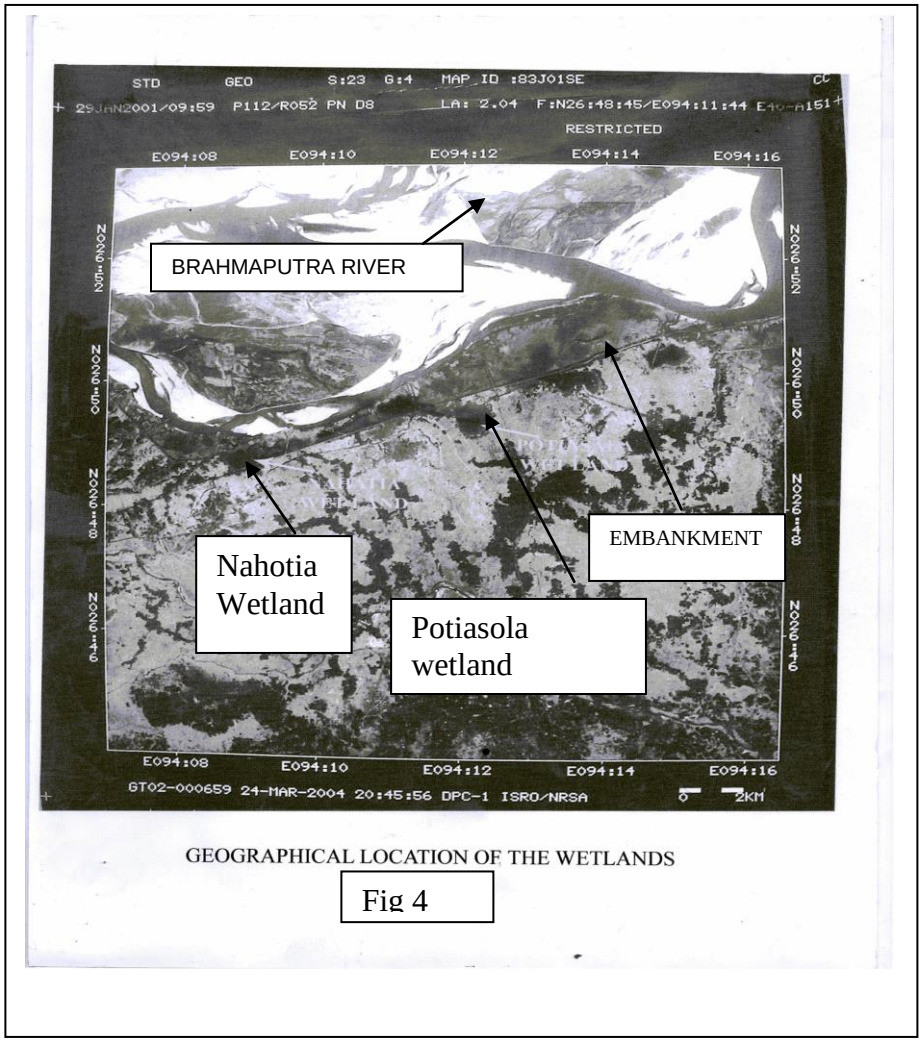

Fig.4 : Location of the wetlands.

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AUTHORS

First Author – R.Bordoloi, Department of Zoology,D.R College, Golaghat 785621, India

Correspondence Author – Rimen Bordoloi, Email address: rimen11@gmail.com / rimenbordoloi@yahoo.com; M; 9435463123