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ASSESSMENT OF FISH-BIODIVERSITY OF KOYA KUJIYA BEEL, ABHAYAPURI, ASSAM IN RELATION TO CERTAIN PHYSICO-CHEMICAL AND ANTHROPOGENIC FACTORS

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ABSTRACT
The present study for the first time examined the fish diversity status of the Koya Kujiya Beel in the Goalpara district of Assam (North-East India). The study investigated the parameters related to the physico-chemical nature of the beel and found that the Koya Kujia Beel has been losing its physical and productive life due to different anthropogenic activities. The study recorded 31 species and 25 genera of zooplankton belonging to four classes namely Protozoa, Rotifera, Copepoda and Cladocera. Phytoplankton diversity in the beel was also found to be very rich. During the study period (summer season) 13,440 number per litre were recorded, of which 50.55% Chlorophyceae, 48.82% Myxiphyceae and only 0.63% were Bacillariophyceae. Altogether 12 different species of phytoplankton recorded during the study period in the beel. In the present investigation a total of 45 species of fishes were identified of which 10 species fall under major group, 13 species fall under intermediate group and 22 species fall under minor group. The present study established that most of the physico-chemical and biological attributes provide congenial environment for fish growth in the beel. The fish catch statistics revealed that the population status of the fish species has been found to be gradually declining.

INTRODUCTION

Wetlands, the threaten landscape are the most productive farmland of aquatic environment (Williams, 1990). Wetlands and their products have been a constant lure to human kind. Wetlands in the past were considered to be wasteland and of no use. However, in recent years, due to explosive growth of knowledge in the perception of wetland uses and values, their hydrological, physical, chemical, biological, socio-economic importance are being acknowledged both in academics and in practice. Wetlands, in the state of Assam (India) are gifted with myriads of riverine and tectonic lakes locally called "Beels". These beels are highly diverse and most productive ecosystems. They create an environment for aquatic food web, which is generally consumed by fish and other animals. The wetlands are sometimes described as "the kidneys of the landscape" for their functions they perform in hydrologic and chemical cycles and as downstream receivers of wastes from both natural and human sources (Mitch and Gosselink, 1986).

Management of wetlands are becoming more important as these ecosystems continue to be drained or encroached upon or has been altered due to changed landuse pattern. The constant population pressure is being associated directly or indirectly on the wetland scenario of the world. Over exploitation of wetland resources, demand for human habitation and permanent change of landscape could be identified as the inheritate problems during the past few decades. So, wetland management, the applied side of wetland science, requires an understanding of scientific aspect of wetlands, balanced with legal, institutional and economic realities to ensure protection of these valuable ecosystems (Mitch and Gosselink, 1986). Fishes make up most of the abundant class of vertebrates, both in terms of number of species and of individuals. They exhibit enormous diversity of size, shape and biology, and in the habitats they occupy. Researchers have arrived at different estimates, most of which range between 17,000 and 30,000 for the numbers of currently recognized fish species. The eventual number of living fish species may be close to 28,000 in the world. Jayaram (1981) listed 742 freshwater species of fishes under 233 genera, 64 families and 16 orders from the Indian region. Talwar and Jhingran (1991) estimated 2546 species of fish belonging to 969 genera, 254 families and 40 orders. The Indian fish population represents 11.72 per cent of species, 23.96 per cent of genera, 57 per cent of families and 80 per cent of the global fishes. As per IRS-TM data, the water spread area of the Koya Kujia Beel was 0.36 km^2 in the January, 1997. The water area of the beel has expanded to 0.42 km^2 in February, 2006. Assam has 1392 beels spread over more than one lakh hectare. This includes 322 on the river Barak in the district of Hailakandi,

Karimganj and Cachar with water spread area of 8000 hectare. Total area of the beels associated with the river Brahmaputra and its tributaries in Assam is estimated at 92,000 hectare. Out of the existing beels, large beels in the range of 200 hectare and above numbering 16 cover an area of about 4600 hectare approximately. Nevertheless, contrary to average annual fish production of 6-7 kg per hectare from Indian reservoirs, the overall fish production from the beels of Assam is more than 100 kg per hectare per year (Dey, 1981).

MATERIALS AND METHODS

Chemicals

All the chemicals and the glasswares used in the present were purchased from the Nort East Chemicals Ltd, Guwahati, Assam.

The study area

Koya Kujiya Beel is situated in Abhayapuri town under the Tapattary Development Block of the Bongaigaon District of Assam (North-East India) at 26°17´45´NL and 90°39´EL. The beel is bounded by Batabari revenue village in the north and Lalmati village in the south. The eastern boundary is covered by Duramari/Mowamari, Naldoba and Kolbari revenue village. To the west the beel is bordered by National Highway-37and the Singimari hillock. The beel is of oblong shape and occupies a total area of 0.42 km^2. The Koya Kujia Beel is located at a distance of 25 km from the district head quarter, Bongaigaon and 3.5 km from North Salmara, the sub-divisional head quarter. The Koya kujiya is the group of four small beels namely Koya, Folimary, Choutara and Muhuritana beel. The Koya Kujiya Beel is connected with the Kujiya River which finally flows down to the river Brahmaputra through its tributary, Manas. Presently, embankment is constructed on the outlet of this beel to check inflow of flood water and also to resist the outflow of seedlings from the beel.

Experimental procedures

All the laboratory experiments were carried out in the Department of Zoology, Gauhati University. The physico-chemical parameters of water of the beel were derived adopting standard methods.

Collection of Samples

Water samples for the assessment of water quality were collected from the different pre selected points of the beel. Samples were collected in cleaned polythene containers and then tightly closed to avoid air contact or to prevent agitation during transport.

Temperature

Water temperature of the Koya Kujia Beel was measured with the help of mercury glass thermometer graduated from 0°C to 100°C X 1/10°C. The temperature was taken at the morning and evening hours at the depth of 10-15 cm. The range of fluctuation and the calculated average water temperature was recorded.

Water transparency

The water transparency in microhabitat territories was studied using Secchi Disc of 20 cm diameter. The transparency of water has been studied through visual observation by immersing the disc in water until it just disappeared and reappeared and calculated the mean value by following the standard method of APHA, (1995) and Garg *et al*. (2002). The unit of transparency was expressed in cm.

Hydrogen ion concentration (pH)

The pH level of the water in microhabitat territories in the studied beel was recorded fortnightly and calculated the monthly average value from the pulled data for exposed territories and within the burrows separately. The experiments were done with the help of digital pH meter (ELICO-120) with CM-63 combined electrodes.

Dissolved oxygen

Dissolved oxygen (DO) in mg L^{-1} was estimated by following the Alsterberz Azide modification of Winkler method.

Free carbondioxide

Free carbondioxide (FCO_2) was determined titrimetrically with N/44 NaOH solutions after using phenolphthalein as indicator. Free CO_2 reacts with sodium hydroxide to form sodium bicarbonate, when titrated with N/44 sodium hydroxide near to the pH 8.3, it developed pink colour. The burette reading of titrant was recorded and FCO_2 calculated by the following formula:

$$FCO_2 \text{ mg } L^{-1} = \frac{V_2 \times 10}{V_1}$$

Where, V_1 = volume of water sample taken (100 mL)

V_2 = volume (ml) of titrant required (N/44 NaOH)

Total Alkalinity

Total alkalinity (TA) was estimated titrimatrically with 0.02 NH_2SO_4 using phenolphthalein (pH = 8.4) and methyl orange indicator. The titrate value of phenolphthalein alkalinity was added to the titrate value obtained in methyl orange end to get the total alkalinity of the sample. The calculation was done by following the standard method of APHA (1995).

Total Hardness

Total hardness (TH) within the microhabitat territories in the studied beel was estimated by titrimetric method (Chattopadhyay, 1998).

Calcium and magnesium concentration

Calcium concentration was estimated by titrimetric method using EDTA (0.01 N) as titrant and Murexide indicator (commercial calcium hardness tablet) by following the method of APHA (1995) and Chattopadhyay (1998). The magnesium of water within the microhabitat territories was determined as the differences between total hardness and calcium hardness multiplied by a factor 0.244 (Chattopadhyay, 1998; Garg *et al.*, 2002).

Dissolved organic matter (DOM)

The DOM in the water of exposed territories and inside the burrows of microhabitat was estimated following the method used by Chattopadhaya (1998).

RESULTS AND DISCUSSION

Physico-chemical features of water

The results of some of the physico-chemical features of the water samples of Koya Kujiya Beel, viz., temperature, transparency, pH, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, dissolved organic matter, calcium and magnesium concentration which were estimated during the study period and presented in Table 1.

Table 1: Physico-chemical conditions of water in Koya Kujiya Beel

Parameters	Mean value (Range)	Remarks
Water temp (ºC)	26.5 (18.0 - 33.0)	Productive
pH	6.8 (6.0 - 8.9)	Productive
Water transparency (cm)	56.0 (42.0 - 95.0)	Productive
Dissolved oxygen (mg L^{-1})	5.4 (4.2 - 9.0)	Productive
Free carbon dioxide (mg L^{-1})	3.2 (1.0 - 9.4)	Productive
Total alkalinity (mg L^{-1})	37.6 (34.0 - 95.0)	Productive
Total hardness (mg L^{-1})	35.0 (25.0 - 140.0)	Productive
Dissolved organic matter (mg L^{-1})	3.45 (2.26 - 5.68)	Productive
Calcium (mg L^{-1})	15.0 (9.0 - 26.0)	Productive
Magnesium (mg L^{-1})	12.0 (7.0 - 18.0)	Productive

Water temperature

The monthly average value of water temperature of Koya Kujiya Beel has been recorded as 18°C during January and 33°C in the month of August, with an annual mean value of 26.5°C during the study period (Table 1). This range of temperature is generally suitable for fish culture and their growth and development.

Hydrogen ion concentration (pH)

Water pH is the indicator of acidity and alkalinity of water body. The monthly average concentration of pH was recorded from 6.0 to 8.9 with a mean value of 6.8 during the study period.

Water transparency

Water transparency of Koya Kujiya Beel was recorded with a very less fluctuation. The present investigation indicated that the water transparency ranges from 42.0 cm to 95.0 cm with a mean value of 56.0 cm. Minimum values recorded during the month of July-August and maximum value recorded during the month of October-January (Table 1). Such narrow range of water transparency fluctuation indicates the narrow range of fluctuation in physical condition of water like siltation, pollution entrance of other organic substances in the studied beel.

Dissolved oxygen

The dissolved oxygen content of the water of the beel varied widely during the study period. Variations of dissolved oxygen content were recorded from 4.2 mg L^{-1} to 9.0 mg L^{-1} with a mean value of 5.7 mg L^{-1} (Table 1). Thus the present study reveals that the dissolved oxygen concentration of the beel is very much suitable for aquaculture.

Free carbon dioxide

The free carbon dioxide content in water of the studied wetland was recorded from 1.0 mg L^{-1} to 9.4 mg L^{-1} with a mean value of 3.2 mg L^{-1} during the study period (Table 1). This fluctuation

Table 2: Zooplankton density and diversity identified in Koya Kujiya Beel

Group of Zooplankton	Species	Density (Number/litre)	Remarks
1. Protozoa	*Euglena spirogyra*	14	Total number 56 (22.9% of the total zooplankton/litre)
	Chilomonas paramecium	2	
	Euglena acus	8	
	Phacus longicauda	7	
	Phacus pleuronectes	11	
	Chlamydomonas anqulosa	3	
	Vorticella sp.	8	
	Holophyra simplex	3	
2. Rotifera	*Brachionus* sp.	12	Total number 49 (20.8% of the total zooplankton / litre)
	Brachionus forficula	8	
	Keratella tropica	9	
	Lecane sp.	13	
	Asplanchna intermedia	5	
	Rotaria rotatoria	2	
3. Crustacea			
(a) Cladocera	*Artemia salina*	10	Total number 60 (24.6% of the total zooplankton / litre)
	Daphnia pulex	9	
	Daphnia magna	10	
	Moina brachiata	3	
	Moina flagellate	4	
	Macrothrix sp.	5	
	Alona sp.	8	
	Cydorus sp.	9	
(b) Copepoda	*Phylodiaptomus* sp.	11	Total number 77 (31.6% of the total zooplankton / litre)
	Paradiaptomus sp.	12	
	Neodiaptomus sp.	8	
	Megadiaptomus sp.	10	
	Eucyclops agilis	14	
	Macrocyclops sp.	9	
	Mesocyclopes leuckarti	7	
	Tropodiaptomus sp.	6	
		Total 244	

Table 3: Density and diversity of phytoplankton in Koya Kujiya, Abhayapuri, Assam

Types and species	Density per liter	Remarks
Myxophyceae		Total number 6561
Nostoc linckia	3043	(48.82% of the total phytoplankton / litre)
Anabaena sp.	938	
Microcystis sp.	2580	
Chlorophyceae		Total number 6794
Volvox aureus	4052	(50.55% of the total phytoplankton / litre)
Eudorina elegans	1485	
Spirogyra spiralis	7	
Ulothrix zonata	1150	Total number 85
Bacillariophyceae		(0.63% of the total phytoplankton / litre)
Tabellaria fenestrata	23	
Pinnularia sp.	8	
Diatoma sp.	17	
Asterionella formusa	6	
Melosera	31	
	Total 13,440	

of FCO_2 was resulted by the presence of varieties of aquatic weeds, which were responsible for increase of FCO_2 beel concentration during early morning and night, while depletion resulted during day time.

Total alkalinity

Total alkalinity plays an important role in fresh water ecology. The average value of total alkalinity of the beel water was recorded 37.6 mg L^{-1}. However, the range of TA in the studied beel was recorded from 34.0 mg L^{-1} to 95.0 mg L^{-1} (Table 1).

Total hardness

Total hardness is the indicator of total calcium and magnesium salts present in water. It plays a significant role in the productivity of fresh water habitat. The total hardness in water of the studied beel was recorded from 25.0 mg L^{-1} to140 mg L^{-1} with a mean value of 35.0 mg L^{-1} (Table 1).

Calcium and magnesium concentration

The calcium and magnesium content in freshwater is also an important factor for maintaining productivity of water. Dissolved calcium concentrations in water of the studied beel was recorded from 9.0 mg L^{-1} to 26.0 mg $L^{-1}$with a mean value of 15.0 mg L^{-1}. The present findings indicate that the water of the beel contains available calcium, which maintain the alkalinity of the water body. Similarly, the average value of magnesium concentration was 12.0 mg L^{-1} with a range recorded from 7.0 mg L^{-1} to 18.0 mg L^{-1} (Table 1).

Dissolved organic matter

The dissolved organic matter of water indicates some total of the organic substances dissolve in it in the form of different soluble substances. The dissolved organic matter in water of Koya Kujiya Beel was recorded from minimum of 2.26 mg L^{-1} to maximum of 5.68 mg L^{-1} with a mean value of 3.45 mg L^{-1} (Table 1). The fluctuation of DOM in the studied beel exhibits a very good productive condition of the water body and suitable for aquaculture. High concentration of dissolved organic matter implies presence of high nutritive organic matter for fishes, which supports fast growth of several fish species.

Plankton diversity in the beel

Zooplankton

The diversity and density (number L^{-1}) of zooplankton were recorded during the period from May, 2007 to August, 2007 in different location and depth of the studied beel. Four major groups of zooplankton have been recorded in the beel, which exhibited average density of 244 numbers L^{-1} (Table 2). Thirty one species and twenty five (25) genera of zooplankton belonging to four classes namely Protozoa, Rotifera, Copepoda and Cladocera were identified with varying densities. The order of average density of zooplankton in the beel were recorded as Copepods (31.6 %) > Cladocera (24.7 %) > Protozoa (22.9 %) > Rotifera (20.8 %) (Table 2).

Among the eight different species of Protozoan, Euglena and Phacus were recorded as dominant, while the Chilomonus and Chlamidomonas showed very low density. Among the Rotifers, Brachionus and Lecane sp. were recorded as dominant and Rotaria and Asplanchna sp. were in low density in the beel. Similarly, Daphnia and Artemia sp. belonging to Cladocera and Eucyclopes and Phylodiaptomus belonging to Copepodes were found as dominant zooplankton in the studied beel. On the other hand, the genus Macrothrix, Moina and Alona of Cadocera and the genus Tropodiaptomus and Neodiaptomus belonging to Copepodes were recorded with low density in the beel during the study period.

Phytoplankton

Phytoplankton diversity in the beel was also very rich. During the study period (summer season) there were 13,440 number per litre phytoplankton was recorded, of which 50.55% Chlorophyceae, 48.82% Myxiphyceae and only 0.63% Bacillariophyceae. Altogether 12 different species of phytoplankton were recorded during the study period in the beel (Table 3). Chlorophyceae and Myxophyceae was the major constituent of phytoplankton which indicated suitability of the water body of the beel for aquaculture.

Fish resources of Koya Kujiya Beel

Fish diversity of Koya Kujiya Beel has been recorded after the physical verification and interview with the local fishermen of the beel. Fish specimens are collected from the fishermen and the lessee of the beel and were identified on spot and in laboratory by following standard methodologies (Talwar and Jhingran, 1991; Vishwanath, 2002). There were 45 species of fishes recorded in the beel during the study period. All together 45 fish species were known to occur in the beel and their status was determined after field study and interviewing the fishermen and the lessee of the studied beel area. The Table 4 shows the fish resources of the beel. Among the species identified in the present study, 10 species under major group, 13 species under intermediate group and 22 species were under minor group on the basis of their size at matured stage.

Major group

There were 10 fish species recorded in the beel during the study period which were included as major group (Table 4). Among these fishes *Catla catla*, *Labeo rohita*, *Labeo gonius*, *Cirrhinus mrigala* were found as major constituent, but their quantities were in decreasing in order. The fish species like *Labeo calbasu*, *Channa striatus*, *Aorichthys seenghala* had

Table 4: Fish resources reported from Koya Kujiya Abhayapuri, Assam

Fish group	Availability in the beel	Population Status	Utility
Major Group			
Catla catla	Available	Decreased	FF
Labeo rohita	Available	Decreased	FF
Labeo calbasu	Medium	Decreased	FF
Labeo gonius	Available	Same	FF
Cirrhinus mrigala	Available	Same	FF
Aorichthys seenghala	Medium	Decreased	FF
Aorichthys aor	Low	Decreased	FF
Wallago attu	Low	Decreased	Ff
Channa striatus	Medium	Decreased	FF
Channa marulius	Low	Decreased	FF
Intermediate group			
Labeo bata	Available	Decreased	FF
Cirrhinus reba	Medium	Decreased	FF
Eutropichthys vacha	Available	Same	FF
Clupisoma garua	Medium	Decreased	FF, OF
Ompok bimaculatus	Low	Decreased	FF, OF
Heteropneustes fossilis	Available	Same	FF
Clarias batrachus	Available	Same	FF
Channa punctatus	Medium	Same	FF, OF
Channa gasua	Available	Decreased	FF, OF
Mastacembelus armatus	Available	Decreased	FF, OF
Macrognathus aculeatus	Low	Decreased	FF, OF
Notopterus notopterus	Medium	Decreased	FF, OF
Anabas testudineus	Medium	Decreased	FF
Minor group			
Puntius sophore	Low	Decreased	FF, OF
P. phutonio	Available	Same	FF, OF
P. ticto	Available	Decreased	FF, OF
P. gelius	Low	Decreased	FF, OF
Mystus tengra	Low	Decreased	FF, OF
M. vitatus	Medium	Decreased	FF
M. cavasius	Medium	Decreased	FF
M. bleekeri	Medium	Same	FF
Clupisoma atherionoides	Available	Same	FF, OF
Gadusia chapra	Medium	Same	FF, OF
Danio davario	Low	Decreased	FF, OF
Rasbora rasbora	Available	Decreased	FF, OF
R. daniconius	Medium	Same	FF, OF
R. elanga	Available	Decreased	FF, OF
Salmostoma bacaila	Available	Same	FF, OF
Amblypharyngodon mola	Medium	Same	FF, OF
Batasio batasio	Low	Decreased	FF, OF
Chanda nama	Medium	Decreased	FF, OF
Chanda ranga	Medium	Same	FF, OF
Badis badis	Low	Decreased	FF, OF
Tetradon cutcutea	Low	Same	OF
Chacca chacca	Medium	Decreased	OF

Table 5: Fish catch composition of Koya Kujiya Beel, Abhayapuri, Assam during the year 2000 and 2006

S. No.	Fish group	Year 2000	Year 2006
1	Total catch	55 MT.	38 MT.
2	Major group	54%	26%
3	Intermediate group	21%	18%
4	Minor group	25%	66%

been recorded in medium quantities. Similarly other species like *Aorichthys aor*, *Wallago attu*, *Channa marulius* had been recorded with low quantities and decreasing population.

Intermediate group

In intermediate fish group13 species of fishes were recorded (Table 4). This group of fish includes the species like *Labeo bata*, *Cirrhinus reba*, *Eutropichthys vacha*, *Clupisoma garua*, *Ompok bimaculatus*, *Heteropneustes fossilis*, *Clarias batrachus*, *Channa punctatus*, *Channa gasua*, *Mastacembelus armatus*, *Macrognathus aculeatus*, and *Notopterus notopterus*. However, among these fish species most of them are found in decreasing order in population. Amongst the fishes of intermediate group recorded in the present study, 9 species have ornamental value.

Minor group

This group includes all trash fishes. The study recorded 22 fish species from the beel belong to minor group of which 13 species were found in decreasing order (Table 4). The fish species like *Puntius sophore*, *Salmostoma bacaila*, *Puntius*

gelius, *Mystus cavasius*, *Mystus bleekeri*, *Tetradon cutcutea* and *Chacca chacca* were occurred in very low quantities and their population status was also found to be in decreasing order (Table 4). Among the fishes of minor group about 19 species were of ornamental value. Unfortunately, these fishes having high ornamental value were found to be brought to the market as ordinary food fish with a minimum market price.

Fish catch statistics

The fish catch statistics during the study period clearly indicated that the fishes belonging to the major group were gradually decreasing from 54% in the year 2000 to 26% recorded in the year 2006 (Table 5). Similarly the fishes belonging to intermediate group decreased from 21% in 2000 to 18% in 2006. However, the fishes of minor group comprised of 25% of the total catch during the year 2000 while during the year 2006 it was recorded as 66% of the total catch. The statistical analysis clearly indicated that the fishes belonging to the major and intermediate groups were in decreasing order. On the other hand, the total catch of fish during the year 2000 was recorded as 55 metric ton (MT) and this value decreased to 38 MT during the year 2006 (Table 5).

The Natural wetlands provide the habitat for diversified air breathing as well as other indigenous ichthyo-species. Several workers notably Welch (1952), Hora and Pillay (1962), Dehadrai and Tripathi (1976) have studied the characteristics of swamps, marshes and wetlands from different environment, which were identified as the natural habitat of different fish species. Similarly, the present investigation was conducted in Koya Kujia Beel of Bongaigaon district of Assam and the physico-chemical conditions of water along with the plankton composition and the ichthyo-faunal diversity in the beel was been critically analyzed. Temperature is one of the most significant parameter among the physical and chemical attributes of the water environment, which directly and indirectly influence on almost all the living processes of the aquatic organisms. Being the poikilothermic animal, fish has the ability to adapt and live at very different temperature gradients but it affects on the general metabolism of fishes. The present finding reveals that the water temperature of Koya Kujia Beel is in the suitable range for growth and development of fish.

The water transparency is another important physical attribute, which acts as a productivity indicator of the water body. It is directly related with the quantity of suspended particles and biotic community present in water (Jhingran, 1985). Banerjee (1967) has reported that the water transparency less than 30 cm and more than 70 cm is generally less productive and affect the growth and productivity of fish. In the present findings the water transparency of the beel is found within highly productive range (42.0-95.0 cm). Similarly all the chemical parameters like dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, calcium and magnesium concentration of the studied water body have been recorded within the suitable range for growth and development of fish and other aquatic organisms (Table 1). Hydrogen ion concentration (pH) is an indicator of various attributes of water body. It has direct and indirect effects on the growth and development of aquatic organisms including fishes. The pH of any water body generally undergoes diurnal as well as seasonal variation. However, the optimum pH level of water for fish culture ranges from 6.5 to 8.5 (Banerjee, 1967; Jhingran, 1985). In the present investigation the pH range of the beel water has been recorded from 6.0 to 8.9 (Table 1). This corroborates the findings of several workers in different wetlands of Assam (Dey, 1981; Lahon, 1983; Goswami, 1985; Agarwal, 1996).

Dissolved organic matter concentration depends on the rate of decomposition of organic matters and the nature of soil. Higher value of DOM is the characteristic of swamp, which is due to decomposition of organic matters (Munshi and Hughes, 1991). In the present investigation higher value of DOM concentration was found in the beel water (3.45 mg L^{-1}) (Table 1). This higher DOM was resulted due to prolonged stagnation of water and decomposition of detritus in the burrows. Higher DOM is an indicator of nutrient rich water (Munshi and Hughes, 1991), which also gives support to nutrient flow into the burrows from the overlying swamps. This result of the present study coincides with the findings in different wetlands of Assam (Dey, 1981; Lahon, 1983; Goswami, 1985; Dey and Kar, 1987; Yadav, 1987; Agarwal, 1996; Thakuria and Sarma, 2005; Kalita and Goswami, 2006). Plankton is of immense value as food, indicator of various physico-chemical and biological properties of natural water body. Several authors contributed their works on the importance of plankton on the productivity of water body and role in aquaculture in different aspects (Pennak, 1953; Edmondson, 1959; Goswami, 1985). Present study reveals that the studied beel was rich with 31 different species of zooplankton (Table 2) and 12 species of phytoplankton (Table 3), which exhibits a congenial environment for fish growth in the beel.

In the present investigation it has been observed that most of the physico-chemical and biological attributes provide congenial environment of the beel for fish growth. However, the study of fish catch statistics reveals that the population status of different fish species was gradually declining (Table 5). The local fishermen and the lessee of the beel also confirmed the same phenomena. Majorty of the Indian major carps and some commercially important fishes like *Channa striatus*, *C. marulius*, *Aorichthys seenghala*, *Aorichthys aor*, *Wallago attu* had been recorded as critically declining species in the beel. Moreover, a variety of ornamental fish species were recorded and found declining drastically (Table 4). The fish catch statistics of the beel also supported that the population status of most of the fishes are in declining trend. Moreover, the water area of the Koya Kujiya Beel expanded from 0.36 km^2 in January, 1997 to 0.42 km^2 in February, 2006. This is because of the clearance of the unusual growth of vegetation of the beel under the National Rural Employment Guarantee Programme (NREGP) from August, 2006. On the other hand, the other waterbodies, which had occupied 0.40 km^2 in 1997, has shrunk to 0.34 km^2 in the year 2006. The shrinking of the beel caused by the deposits carried down from the adjoining areas, which indicates over exploitation and encroachment around the beel. It was found that the villagers were using chemical fertilizers in their agricultural field. During rainy season the run off water along with eroded materials carry some amount of dissolved chemical substances from its surrounding agricultural fields to its low lying areas. As such

there was a continuous addition of chemical substances and eroded materials in the present studied beel that effected the growth and development of fish by affecting the chemical content, pH, turbidity and temperature conditions of water of the beel. In our investigation the fish catch statistics also revealed that there was a decline in fish population of the beel (Table 5), which confirmed the impact of anthropogenic influences on fish bio-diversity of the studied Koya Kujiya Beel.

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