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Fisheries eco-biology of beel Koshba in Naogaon District

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Abstract: The physical conditions of Beel Koshba consisting of water temperature (25.36±5.12°C/day), water depth (204.96±110.36cm/month) and water transparency (30.91±6.78 cm/day) were recorded. The chemical parameters of total hardness, alkalinity, pH, DO, CO_2 and ammonia were 146.60±13.36 mg/l, 143.30±9.33 mg/l, 7.05±0.75, 6.03±1.08 mg/l, 8.64±0.88 mg/l and 0.73±0.31 mg/l respectively. A total of 54 species of different vegetations 123 species of phytoplankton and 73 species of zooplankton were recorded from the beel. A total of 104 species of fish and Annelids (8), arthropods (12), molluscs (15), amphibian (8), reptiles (21), avis (40) and mammals (12) were identified. Pesticidal toxic effluents contexts were also observed in the beel ecosystem.

Key words: Fisheries, Eco-Biology, Beel Koshba

Introduction

Beel fishery of Bangladesh is being deteriorating day by day due to over fishing, uncontrolled use of chemical fertilizer and insecticide, destruction of natural breeding and feeding grounds, harvesting of wild brood fishes and for many other causes (DoF, 2005). The conservation of freshwater fisheries has been recognized as an important consideration throughout the World. Protected areas as a living resources management tool might play a vital role to restore freshwater biodiversity (Saunders *et al*., 2002). In Bangladesh and other countries in the region, establishment of fish sanctuary is an important recognized tool for conservation, protection and restoration of fish species. A few researches on fish sanctuary have been done in Bangladesh on some particular rather narrow aspects (Ahmed & Ahmed, 2002). No other work has been carried out yet, in the northern region of Bangladesh including beel Koshba. The main objectives of this paper are to assess the eco-biology on the Beel Koshba.

Materials and Methods

Water samples were collected with the help of a glass-stoppard bottle wrapped with black paper. After collection samples were brought to the research laboratory, Institute of Environment Science, University of Rajshahi. Chemical analyses were also done immediately after arrival. Soil samples were collected twice in a year and analyzed from the Soil Research Development Institute (SRDI), Rajshahi.

Water depth was measured monthly. A metal was set at the sinking end of the measuring nylon tape. Sometimes a standard bamboo pole was used for this purpose. A centigrade thermometer with a range of 0°C to 110°C was used to measure the water temperature at the time of sample collection. Transparency was measured by Secchi disc and expressed in cm. The chemical parameters of the beel water *viz*. dissolved oxygen (DO), free carbon dioxide (CO_2), ammonia, total hardness and alkalinity were analysed by HACH Test Kit (Model FF-1A). The pH value of pond water was measured by digital pocket pH meter and titration method.

Fishing was done during daytime using traditional basket traps fabricated from bamboo and funnel bag nets locally know as *sruti jal*. Specimens sampled were immediately chilled in ice on board and later fixed with 10% formalin in the laboratory.

Habit and habitats and detailed ecosystems were studied following Odum (1971). For identifying the hydrophytes consultation are made with Khan & Halim (1987). The phytoplanktons were identified following Fritch (1965) etc. The zooplanktons were identified following Ward & Whipple (1959). Identification and key characters of fish were made with Rahman (1989). The bird identification

was made using Ali & Ripley (1968-72). The wildlife species were identified by Khan (1982). Identification of the molluscan species was made using Jahan *et al*. (2003). The earthworm species were identified by Jahan *et al.* (2005). The toxic metals like copper, zinc, mercury, cadmium, chloride and DDTE (Dichloro Diphenyl Trichloro Ethene) were analyzed from SRDI-Rajshahi, SRDI-Farmgate, Dhaka and Bangladesh Agriculture Research Institute (BARI), Soil Science Division -Joydevpur, Gazipur.

Results and Discussion

Average soil pH was 6.3, organic matter in the high basin was 1.45% and in the low basin was 2.70% and total nitrogen was 0.10%. Calcium and magnesium were 4.8 and 1.1 Meq/100g soil respectively. Potassium was 0.14 and 0.30 Meq/100g soil in the high and low basins of the beel. Phosphorus, copper, zinc and boron were 3.9, 4.5, 2.2 and 6.9 mg/kg of soil, respectively. Sulphur, iron and manganese were 19 and 14, 55 and 85, 4.4 and 17.5 mg/kg soil in the high and low basin respectively in the soil of the beel.

From two years' average data, it was observed that air temperature varied from 17.25°C (January) to 30.13°C (May). The mean value of 24 months was 26.07±4.56°C. It was observed that rainy days varied from 0 day (January) to 23 days (July and August). The mean value of 24 months was 9.54±8.55 days/month. The mean value of 24 months was 113.93±114.01mm/month.

From two years' average data, it was observed that humidity varied from 63.00% (March) to 87.00% (July, August and October), averaging 79.33±7.94%. It was observed that water temperature value varied from 15.79°C (January) to 31.06°C (May), averaging 25.36±5.12°C. It was lowest (69.50 cm) in the month of April and the highest (408.50cm) in August. The water level began to rise rapidly from the mid May till it reached a maximum in August to mid October. Water transparency varied from 15.88cm (April) to 41.28cm (November) (Table 1) with a mean of value 30.91±6.78cm. Hardness in a water body depends on the physico-chemical conditions of basin soil, watershed, climate, liming, fertilization *etc* (Das *et al.* 1997). In the present study, hardness value varied from 115.80mg/l (January) to 163.13mg/l (September) were observed (Table 1). The mean value of 24 months was 146.60±13.96mg/l. Alkalinity of the beel was varied from 123.23mg/l (January) to 153.52 mg/l (August), averaging 143.30±9.32mg/l. All chemical and biological reactions are directly depending upon the pH values (Das *et al.,* 1997). In this study, it was observed that pH value varied from 6.11 (January) to 8.40 (April) (Table 1), with a mean value of 7.05±0.75. Monthly average values of DO content varied from 4.20mg/l in June to 7.83mg/l in September, averaging 6.03±1.08mg/l. Free CO_2 showed considerable variations throughout the study period. It varied from 7.14mg/l (January) to 10.05mg/l (July). The mean value of 24 months was 8.64±0.88mg/l. Ammonia (NH_3) reacts with water and forms NH_4OH. Ammonia value varied from 0.35mg/l (July) to 1.25mg/l (January) (Table 1), averaging 0.73±0.31mg/l for two years.

A total of 58 species of different vegetations were observed. Ten species of submerged plants, 10 species of floating plants, 19 species of rooted plants with floating leaves and 19 species of amphibian vegetation were identified in the study area (Table 2). A total of 123 phytoplankton species comparing 45 Chlorophyceae, 30 Cyanophyceae, 25 Bacillariophyceae, 18 Euglenophyceae and 5 Dinophyceae were identified (Table 3). A total of 73 zooplankton species consisting of 30 Rotifera, 22 Cladocera, 15 Copepoda, six Ostracoda (Table 4) and two Crustacea larvae (Nauplia and Metanauplias) were recorded. A total of 103 fish species were found in the beel Koshba. During the investigation period, eight species of annelids, 12 species of arthropods, 15 species of molluscs, eight species of amphibians, 21 species of reptiles, 40 species of birds and 12 species of mammals were identified (Table 5 & 6).

In the dry season when most of the beel area dried up then the areas went under crop production. In the beel area mostly boro rice (dry season rice: December-May) is cultivated. For this, huge amount of irrigation water is needed for better production. In addition, huge amount of fertilizers are used in the area. In most cases over dose of fertilizers are

applied non-judiciously for more production. The most commonly used fertilizers were urea, TSP, MP, zinc sulfate and manganese sulfate. All of the nutrients applied to the field are not taken up by the crops. The residue of the chemicals come out with water and pollute the beel. The fate of most of the pollutants in the aquatic ecosystem is determined by their degree of degradability in water in that context, highly toxic effluents contain metals like copper, zinc, mercury, cadmium and chloride which are toxic and could kill fishes even at 0.1-0.22ppm in freshwater (Ragothaman & Trivedy, 2002). In the study area, it was found that the pesticides *viz*. Propiconazol, Hexaconazol, Mencozer and Metarixcil, weedicides *viz*. Butachlor, Oxadiazon, Propilachlor and 2-4-D amine, insecticides *viz*. Carbofuran, Carbamgte, Diazinon, Cypermethrin, Chloropyriphos and Quinalphos are used non-judiciously. In this observation, average toxic metals like copper, zinc, mercury, cadmium, chloride and DDTE were 0.11-0.23, 0.12-0.21, 0.12-0.22, 0.13-0.24, 0.11-0.22 and 0.14-0.25ppm, respectively in the beel ecosystem.

Water body is an ecosystem with a complicated network of various physico-chemical parameters and its biota. Aquaculture depends almost completely on the qualities of water which depend on the environment of that geographical region. The recorded values of physical and chemical parameters have been employed to determine the ecological conditions of the beel. Again a factor is not always independent. There are close relationships among the factors. A little variation in one of the factors may influence the other. Similar type of interaction was observed in this study where average pH of soil was 6.3, organic matter in the high basin 1.45% and in the low basin 2.70% and the total nitrogen was 0.10%. It reveals from this study that the annual air temperature cycle maintained a close parallel relationship with the annual cycle of water temperature. Water temperature usually declined from November and reached the minimum in January and after that increased steadily, reaching the maximum during April to September. The differences between air and water temperature were higher during summer and lower in winter, the occurrence of the temperature curves of air and water coincided each other during monsoon due to sudden fall of air temperature due to heavy rainfall. On the other hand, both the curve differed before and after monsoon period due to the absence of cooling effect of rainfall and the presence of windless hot days which prevail in the areas. The temperature tolerance of the live fishes varies between 31°C – 40°C (Das *et al.* 1997). The average temperature of beel water varied from 15.79°C (January) to 31.06°C (May). Fluctuation of atmospheric humidity was found to be in conformity with the extent of rainfall. The highest humidity was 87.00% (July, August and October) and the lowest 63.00% (March). Rainfall is governed by the monsoon like other hydrological feature (Das *et al.* 1997). The rainfall is also an important ecological factor in the aquatic environment. During the study period the range of rainfall varied from 0 mm (January) to 311.30 mm (July). Heavy rainfall above 200 mm was in June to September. With a peak in July, rainfall acts as the causative factor for rising of water level, increasing of some chemical factors like nitrate and phosphate and coolness of water. The minimum and maximum rainy days varied from 0 day (January) to 23 days (July and August). The pH values were the highest 8.10 in April and the lowest 6.21 in January (Table 1). Swingle (1967) reported that low pH to be the cause of reduction of fish growth, physiological activities and tolerance to toxic substance.

It has been observed that the abundance of fishes is decreasing day by day due to flood, drought, and man made causes such as habitat destroying and degradation, use of agrochemical in farming, over fishing, over exploiting and other environmental factors. The fishermen have no any adequate training, and do not know the fisheries laws. For this, they are creating different problems, like over fishing, destructing the fish habitat, fishing in breeding season and using banned gears. So it is very much important to ensure training and teaching about the fishing laws immediately.

The following suggestions may provide the sustainable development of natural resources of beel khosba. Natural habitat of fishes and other aquatic resources should not be disturbed as much as possible. To conserve and develop biodiversity, fish and fisheries items, habitat should be improved through excavating bed for

brood one. Any poisonous or toxic substance should not be applied in the water body. Use of pesticides, weedicides and insecticides in the agricultural lands should be reduced to a tolerable limit and IPM (Integrated Pest Management) procedure should be encouraged. Beel area should be kept out of any type of environmental hazards. Endangered species should be conserved in a favourable condition. Open water stocking programme would be taken under proper management system. Community Based Management System should be also taken under proper supervision of local administration. Public and mass people participations have to be ensured in the integrated and sustainable natural resource management.

Table 1. Average physico-chemical conditions of water of beel Koshba for July 2005 to June 2007.

Months	Water Temp. (°C)	Water Depth (cm)	Transparency (cm)	Total hardness (mg/l)	Alkalinity (mg/l)	pH	DO (mg/l)	Free CO_2 (mg/l)	Ammonia (mg/l)
July	28.56	355	31.12	155.8	146.67	7.05	5.63	10.05	0.35
August	27.84	408.5	34.29	155.34	153.52	7.33	5.83	9.89	0.45
September	29.89	284.5	34.29	163.13	147.3	8.28	7.83	8.83	0.55
October	26.59	296	39.37	148.9	152.72	6.6	7.79	8.16	0.65
November	22.2	239.5	41.28	141.28	145.93	6.4	6.3	8.5	0.9
December	18.54	175	31.75	125.45	138.19	6.38	4.99	7.92	1.13
January	15.79	159	33.02	115.8	123.23	6.11	5.15	7.14	1.25
February	19.31	136	29.23	142.53	129.75	6.45	5.5	7.66	0.95
March	25.74	122.5	26.04	151.07	139.1	6.75	6.04	8.32	0.95
April	29.9	69.5	15.88	161.18	143.22	8.4	6.25	8.68	0.73
May	31.06	74.5	24.13	151.75	147.73	7.5	6.81	8.98	0.48
June	28.88	139.5	30.48	144.62	152.18	7.4	4.2	9.5	0.35
Mean ± SD	25.36 ± 5.12	204.96 ±110.36	30.91 ± 6.78	146.60 ± 13.96	143.30 ±9.32	7.05 ±0.75	6.03 ± 1.08	8.64 ± 0.88	0.73 ± 0.31

Table 2. Some important aquatic vegetation in the Beal Koshba.

Submerged	Floating	Rooted plants with floating leaves	Amphibian vegetation
Hydrilla verticillata	*Salvania natans*	*Elatine triandra*	*Monochoria hastate*
Ceratophyllum demersum	*Utricularia vulgaris*	*Ptamogeton odosus,*	*Polygonum barbatum*
Myriophyllum tuberculatum	*Azolla pinnata*	*P. mucronatus*	*Jussiacia repens*
Vallisneria piralis	*Eichornia crassipes*	*Ottelia alismodies*	*Oryza* sp.
V. Americana	*Pistia stratiotes*	*Aponogeton mucronatus*	*Scripus articulatus*
Drepanocladas sp.	*Lemna perpusila*	*Sagittaria cuneata*	*Leersia hexandra*
Najas graminea	*L. minor*	*Ludwigia adscendens*	*Hygroryza aristata*
Cryptocoryne retrospiralis	*Wolfia arrhiza*	*Nymphaea nouchali*	*Alternanthera phyloxerides*
Ludwigia sp.	*W. punctata*	*N. lotus*	*Enhydra fluctuans*
Potamogeton alpinus	*Nechamandra alternifolia*	*Trapa bispinosa*	*Ipomoea aquatica*
		Chara sp.	*Colocasia antiquorum*
		Nymphoides cristatum	*Cyperus kylingia*
		Orontium aquaticum	*Sporobolus indicus*
		Blyxa auberti	*Eleusine indica*
		Najas graminea	*Limnophyla cana*
		Marsilea quadrifolia	*Ipomoea reptans*
		Trapa natans	*Cyperus platistylis*
		Calla pulustris	*Limnophyla sessiliflora*
		Peltandra virginica	*Leptochloa chinensis*

Table 3. Some important phytoplankton in beel Koshba.

Chlorophyceae	Cyanophyceae	Bacillariophyceae	Euglenophyceae	Dinophyceae
Actinastrum gracillimum *Bulbochaete annularis* *Characium cylindricum* *Chlodetella longesita* *Chlorella sp.* *Closterim genneri* *C. libellula* *C. monileferum, Closterium sp.* *Cosmarium connatum* *C. lundellii* *C. pseudopyramidatum* *C. quadrum* *C. subprotumidum* *C. subtumidum* *Crucigenia fenestrata* *Euastrum membraniporum* *E. platycerum* *E. spinulosum* *E. spinulosum var. inermius* *Micrasterias alata* *M. rotata* *M. tropica* *Microspora sp, Mougeotia sp,* *M. viridis* *Oedogonium crispum* *O. dacchense* *O. intermidia* *Pandorina morum* *Pediastrum duplex* *P. simplex* *Pleodorina morum* *Scenedesmus longus* *S. opoliensis* *Spirogyra sp.* *Staurastrum coroniferum* *S. cyclacanthum* *S. longibrachiatum* *S. manfeldtii* *Tetraedron verrucossum* *Volvox carteri* *V. mononae* *Zygnema cylindrospermum* *Z. spontaneum*	*Alusira aenigmatica* *Anabaena anomala* *A. spherical* *A. variabilis* *Anabaenopsis circulari* *Aphanocapsa biformis* *A. montan* *Aphanothece microscopia* *A. naegell* *Choleochaete scutata* *Chroococcus limniticus* *C. minor* *Cylindrospermum indicum Gloeocapsa luteo fusca* *Gloeocapsa sp.* *G. stegophila* *Lyngbya hieronymusii* *Lyngbya sp.* *L. truncicola* *Merismopedia elegans* *M. punctata, Microcystis flosaqua* *M. robusta fusca* *M. viridis* *Nostoc corneum* *Oscillatoria princeps* *Oscillatoria sp.* *O. tenuis* *Rivularia aquatica* *R.. varia*	*Amphicampa eruca* *Cymbella hustedtii* *C. tumida* *C. turgida* *Fragilaria sp.* *Gomphonema olivecea* *Gyrosigma acuminatum* *G. acuminatum var. lacustre* *Melosira granulata* *M. variance* *Navicula sp.* *N. cuspidata* *N. exigna* *N. grimmei* *N. halophila* *N. halophila var. robusta* *N. menisculus Nitzschia acicularis Pinnularia sp.* *P. tabellaria* *P. gibba* *P. gibba var parva* *P. saga* *P. viridas* *Synedra acus*	*Euglena sp.* *E. acus* *E. charkowiensis* *E. flava* *E. rostifera* *E. rubra* *Phacus ranula P. elegans* *P. hamatus Phacus sp. Phacus sp.* *Phacus sp.* *Trachelomonas allorgei* *T. hispida* *T. oblonga* *T. superba* *T. volzii* *T. alna*	*Glenodinium quadridans* *Gonyaulax apiculata* *Peridinium sp.* *Peridinium sp.* *Peridinium sp.*

Table 4. Some important zooplankton in beel Koshba.

Rotifera	Cladocera	Copepoda	Ostracoda
Brachionus caudatus B. diversicornis *B. falcatus* *B. forficula* *B. havanensis* *B. nilsoni* *B. quadridentatus* *B. urceolaris* *Filinia longiseta* *F. opolinesis* *F. terminalis* *Hexarthera sp.* *Keratella cochlearis* *K. tropica* *Lecane curvicornis* *L. luna* *L. ploensis* *Lepadella cristata Lindya sp.* *Monostyla furcata* *M. lunaris* *Notholca sp.* *Platiyias quadricornis Polyarthra sp. Pomphodyx sulcata Rotaria neptunia Squantinella sp. Testudinella sp. Trichocerca braziliensis* *T. cylindrica*	*Alona costata* *A. rectangula Bosmina coregoni Ceriodaphnia laticaudata* *C. pulchella, Chydorus globosus* *C. sphaericus Daphnia magna* *D. pulex Diaphanosoma beuchtembergianum D. brachyurum Kurzia latissima Leydigia acanthocercoides Macrothrix laticornis* *M. rosea* *Moina brachiata* *M. macropoda* *Moina sp.* *Oxyurella tenuicaudis Schapholeberis kingi Simocephalus sp.* *S. serrulatus*	*Cyclops nanus* *C. varicans* *C. vernalis* *Diaptomus gracilis* *D. pergrinator Eudiaptomus sp. Heliodiaptomus contortus H. latifi* *Macrocyclops destictus Mesocyclops dybowskii* *M. hyalinus* *M. inversus* *M. leuckarti* *Microcyclops sp. Neodiaptomus strigilipes*	*Centrocypris* sp. *Cyclocypris sp*. *Cypris sp*. *Eucypris sp*. *Heterocypris* *Stenocypris sp*.

Table 5. Some important annelids, arthropods, mollusks and amphibians in beel Koshba.

Annelids	Arthropods	Mollusks	Amphibian
Lampito mauritii Perionyx excavatusm *Metrephire posthuma* *Pontoscolex corethrurus Glyphidrilus tuberosus Dichogaster bolaui Tubifex sp.* *Hirudo medicinalis*	*Cancer pagurus Macrobrachium malcocolmsonii* *M. dayanum* *M. lamarrei* *M. dolichodactylus Belostoma sp*. *Melanopus sp*. *Culex sp.* *Anopheles sp*. *Apis sp*. *Formica sp*. *Pleris sp*.	*Pila globosa* *P. theobaldi* *Ballamya bengalensis* *B. dissimilis* *Lymnaea acuminata* *L. luteola* *L. stagnalis* *Indoplanobis exustus Gyraulus convexiusculus Achatina fulica* *Limax sp*. *Thiara tuberculata Lamellidens marginalis Parreysia pernodulosa* *P. daccaensis*	*Rana tigrina* *R. hexadactyla* *Limnonectes limnocharis Hoplobatrachus tigrina Euphlyctis cyanophlyctis* *Bufo melanostictus Microhyla ornata Polypedates leucomeysta*

Table 6. Some important reptiles, aves and mammals in beel Koshba.

Reptiles	Avis		Mammals
Kachuga tectum Hardella thurgi Trionyx gangeticus Trionyx hurum Lissemys punctata Chitra indica Kachuga tentoria Natrix piscator Rhavdophis subminiata Atritium chistosum Elaphe radiata Ptyas mucosus Varanus bengalensis V. flaviscens Naja naja Bangarus fasciatus Ptyasmu cosus Bangerus caerulous Mabuya dissimilis Calotes versicolor Hemidactylus brooki	*Alcedo athys Pelargopis capensis Halcyon pileata H. smyrnensis Milvus migrans Falco peregrinus Haliaster indus Haliaetus leucoryphus Ichthyphaga ichthyacu Bubo bubo Tyto alba Sturna aurantia Rynchops albicollis Larus runnicephalus Latus marinus Vanellus indicus Capella minima Ciconia episcopus Leptoptilas dubius Ciconia ciconia Ardea cinerea*	*Nycto corax nyctocorox Ixobrychus cinnamomeas I. sinensis Phalacrocorax niger Anhinga rufa Tadorna ferrugined Anser indicus Anas poecilorhyncha Rallus aquaticus Porphyrio porphyrio Porzana porzana Corvus splendens Acridatheris fuscus A. tristis Passer domestica Eudynamys scolopacea Cuculus varius Centropus simensis Dinopium bengelensis*	*Lutra lutra Vulpes bengalensis Canius familiaris Capra hircus Bos indicus Bubalis bubalis Musculus booduga Bandicota bengalensis Rattus rattus Mus* sp. *Harpestes bengalensis*

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