*International Research Journal of Biological Sciences* _____ ISSN 2278-3202
Vol. **4(8),** 40-48, August **(2015)** *Int. Res. J. Biological Sci.*

# A Study of the Limnology and Ichthyology of Dhir Beel at Dhubri, Assam, India

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**Available online at: www.isca.in, www.isca.me**
Received 8th July 2015, revised 18th July 2015, accepted 9th August 2015

## Abstract

*The present study on the Ichthyofauna of one of the important Beel (proposed ramsar site), in Dhubri district near Chapar Town, at the South-Eastern fringe of Chakrashila Wi1d Life Sanctuary reveals 71 numbers of species of fishes including some riverine fishes like Amblyceps mangois, Tenualosa ilisha, Barilius barila, Bagarius bagarius etc due to the connection with the Brahmaputra river. The limnological parameters did not show much abrupt fluctuation with an average value of temperature of air 31.63$^0$C, temperature of water 28.75$^0$C, pH 7.15, Conductivity 0.13 mS, Total Dissolved Solids 107.5 ppm, Dissolved Oxygen 6.56mg/l, Turbidity 56.5NTU, Total Hardness 32.25mg/l, Free $CO_2$ 29.75 mg/l, Total Alkalinity 68.75 mg/l and Salinity 1450ppm. Although experimental studies indicate that these wetlands have a fairly high production potential, but the average estimated production of the beel is around 173kg/ha/yr as the current method, regulations and system of management are not conducive to sustainable production from the water bodies.*

**Keywords:** Beel, Chapar, Dhir, Wetland.

## Introduction

Wetlands are recognized as one of the most significant natural resources associated with the human settlement since the inception of civilization. Although there is worldwide uncertainty about the definition and categorization of the wetlands, the internationally agreed definition taken during Ramsar Convention in 1971 in Iran describes wetlands very broadly as "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water which is static or flowing, fresh, brackish or salt, including areas of marine waters, the depth of which at low tide does not exceed six meters"[1]. In addition to production of fishes the, wetlands are providing water for drinking as well as raising crops in the agricultural field, helping the mankind in various ways like controlling flood, controlling ground water recharge and discharge, nutrient recycling and improvement of water quality, etc. The wetlands also act as the breeding ground for the large growing riverine fishes along with other ornamental fishes. But, presently the wetlands are suffering from encroachment as human settlement, for boro-paddy and mustard cultivation, monoculture of fishes, etc in spite of their contribution as unique natural resource. The lower Assam has innumerable fresh water lakes, wetlands, oxbow lakes, marshes, and seasonal flood plains. The perennial floodplain wetlands (beels), a kind of ecotone, constitute the most important fishery resource suitable for culture-based fishery development but some of them are under capture fishery and considered as the most threatened of all natural resources.

Assam is gifted with 3,513 wetlands covering an area of 1,01,231.8 ha[2], around half of national wetland coverage and is capable producing 1000kg/ha/yr of fishes with moderate level of management[3]. This is close to 4% of the total floodplain area and 1.3% of the total area of the State. Although, there are 3,513 wetlands in Assam, only 1392 are listed floodplain wetlands, of which 423 are registered and remaining 969 are unregistered. The later are under the control of both government (505) and private (464) ownership[4]. But surprisingly, the present level of fish production from these beel is only $^1/_5$ of the potential i.e. 173 kg/ha/yr on average[3]. Dhir Beel is one of the flood plain wetlands in the North bank of river Brahmaputra in Dhubri district which provides a large variety of aquatic flora and fauna other than a great diversity of fishes and migratory birds. The Government of Assam (Forest department) proposed the name of the beel for recognition under Ramsar site in 2009[5].

Dhir Beel situated in Dhubri District near Chapar Town in South-Eastern fringe of the Chakrashila Wild Life Sanctuary is famous for the Golden Langur (*Trachypithecus geei*) around 71 km away from the Dhubri town figure-1. The Beel is situated at latitude 26$^0$16'54.65'' North and longitude 90$^0$23'21.52'' East and altitude 9 m above msl and covers an area of about 668 ha of land. It is connected with the river Brahmaputra by an 11-km long channel called 'Dhir Dhara'. Maximum depth of the beel is 20 feet during monsoon and minimum is 4 feet during the winter. The Beel is under capture fishery and the leasee captures upto 4-6 quintals of fishes per day during peak season. The Beel is surrounded by village Satyapur, Mowatari and Santipur with inhabitations of about five thousand people. The traditional Hindu fisher populations are replaced by the Muslim migrants from neighbouring areas and at present majority fisher

populations are partially dependant on the beel. During the lean period, due to excess flood or draught, they sustain their livelihood through other profession like daily labour, cultivation, etc. Although the beel is registered and leased by AFDC (Assam Fisheries Development Corporation) recently NFDB (National Fisheries Development Board) in association with the leasee has started culture fishery in a small area at the base of the sanctuary in an experimental scale.

However, detailed systematic fish inventory on the ichthyofauna of the Dhir Beel except that of is not available[6]. Of course a few works on the other Beels of the lower Assam like on Urpod beel by recording 60 species, on Urpod and Kumri beel by reporting 48 species, on abundance of the exotic carps of the Urpod beel by is there[7-9]. Hence the present study aimed at listing the available fish species from the beel along with the study of water quality of the beel was undertaken.

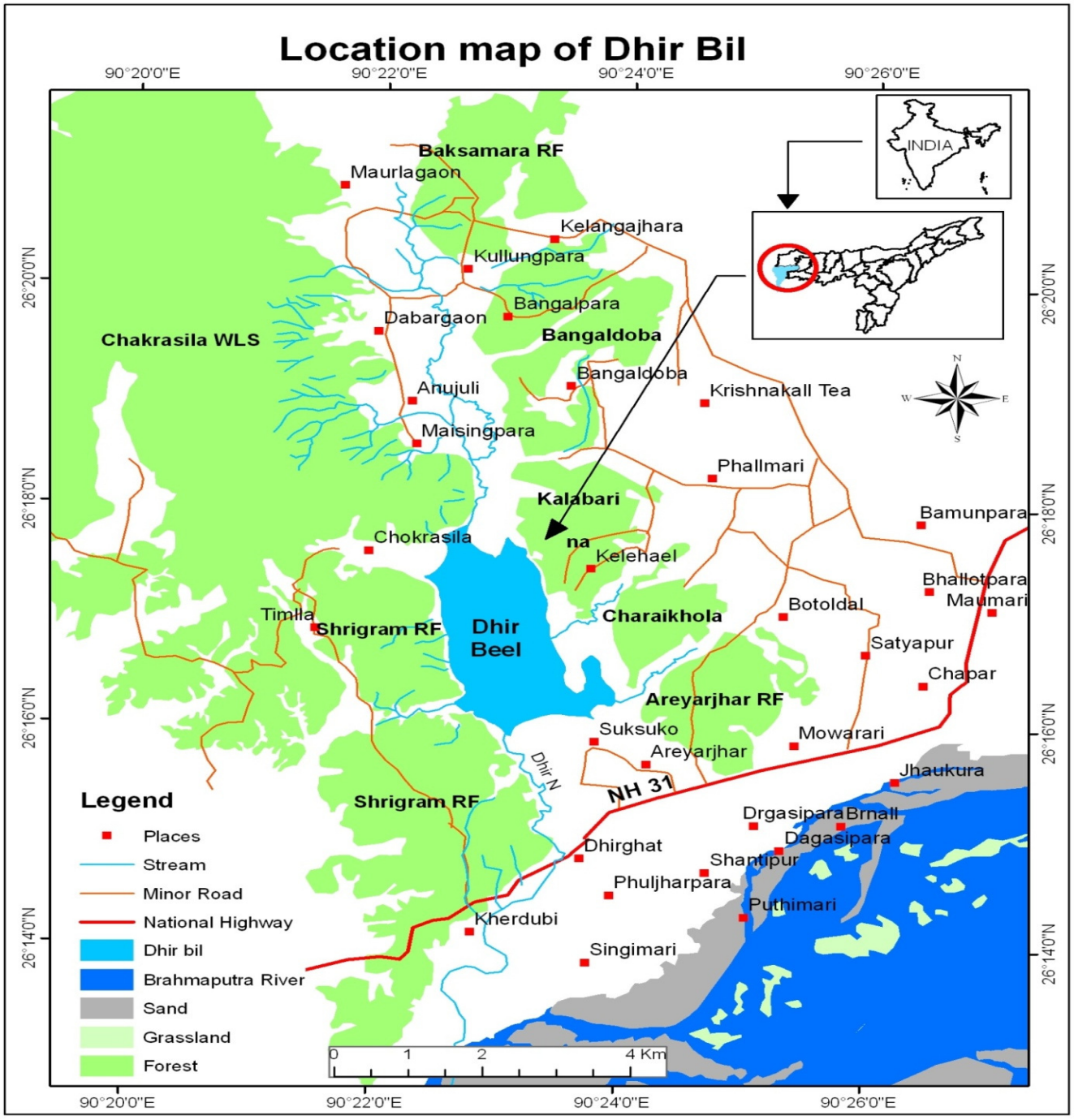


**Figure-1**
**Map of Dhir Beel along with the inlet and outlet**

## Material and Methods

The field surveys were conducted during March, 2014 - March, 2015 at least once in each season. Air and water temperature were measured on the field itself with the help of a mercury bulb thermometer (0-100°C). Water samples were collected in the pre-cleaned bottles to study other parameters like pH, dissolved oxygen (DO), Total Dissolved solid (TDS), Total Hardness, Specific Conductivity, Salinity, Free Carbon di-oxide ($FCO_2$), Total Alkalinity (TA), Turbidity, etc. in the laboratory. pH of the water samples were recorded using pH meter (make: Systronics; model: MK VI). Specific Conductivity, Salinity, TDS and Turbidity of the water sample were recorded using digital portable water analysis kit (make: MAC; model-MSW-551), while the other parameters like Free $CO_2$, TA, DO, Hardness of the water sample were measured by manual titration method. Some of the information was collected through interviews, group discussion with the leasee, fishermen and local peoples.

Fishes were sampled at the site with the help of local fishermen. The fish samples were then preserved in 5% formalin at the field stations. The specimens were morphologically and morphometrically studied and preliminary identification was done following standard literature[10,11]. After identification, the photographs of the fishes were taken with the help of digital camera and finally the specimens were kept in the Museum of the Department of Zoology, Goalpara College, Goalpara.

## Results and Discussion

**Pisces**: Of approximately 930 species inhabiting freshwaters of India, the Northeastern India is represented by 267 species belonging to 114 genera under 38 families and 10 orders[12,13]. Vishwanath *et al*, recorded 520 species of fishes from different water bodies of North-east India, whereas *Bhattacharyya et al.,* recorded 217 fish species from the water bodies of Assam[14,15]. Yadava recorded 74 fish species and estimated annual fish yield 108.4 metric ton from the Dhir beel[6]. He also recorded overall dominance of the clupeid *Gudusia chapra,* which enters during monsoon and the situation still persists. In the present study we have recorded 71 numbers of species table-1 of fishes under 8 orders, 26 families which *inter alia* includes some riverine fishes like *Amblyceps mangois, Tenualosa ilisha, Barilius barila, Bagarius bagarius* due to the connection of the beel with the Brahmaputra river. Out of the 71 species recorded 2 species are critically endangered, 6 species are endangered and 16 species are found to be vulnerable as per CAMP assessment, whereas as per IUCN assessment 2 and 6 species are found to be vulnerable and near threatened respectively[16,17].

**Temperature:** Temperature in aquatic ecosystems is one of the most important limiting factors as it controls the metabolic activities and growth rate in organisms[18, 19]. It plays a vital role in biochemical reactions and self purification of aquatic systems. Temperature, regulates the dissolved oxygen concentration of water and primary productivity, causes a great variability in plant and animal distribution. In Indian subcontinent water temperature in various water bodies varies from $7.8^0$C – $45.5^0$C. However, in North Eastern region it generally lies between $14^0$C to $40.5^0$C. The average water temperature of the beel was recorded to be $28.75^0$C table-2.

**Table-1**
**The list of fish species recorded from Dhir Beel along with their local name and current conservation status.**

| Sl. No. | Scientific Name | Conservation Status CAMP, 1997* | Conservation Status IUCN, 2014** |
|---|---|---|---|
| I. ORDER: OSTEOGLOSSIFORMES | | | |
| A. Family: Notopteridae | | | |
| 1 | *Notopterus notopterus* (Pallas, 1769) | LRnt | LC |
| 2 | *Chitala ornata* (Gray, 1831) | EN | LC |
| II. ORDER: CLUPEIFORMES | | | |
| B. FAMILY: Clupeidae | | | |
| 3 | *Tenualosa ilisha* (Hamilton, 1822) | VU | LC |
| 4 | *Gudusia chapra* (Hamilton, 1822) | LRlc | LC |
| III. ORDER: CYPRINIFORMES | | | |
| C. FAMILY: Cyprinidae | | | |
| 5 | *Hypophthalmichthys molitrix* (Valenciennes, 1844) | NE | NT |
| 6 | *Hypophthalmichthys nobilis* (Richardson, 1845) | NE | DD |
| 7 | *Salmophasia bacaila* (Hamilton, 1822) | LRlc | LC |
| 8 | *Cabdio morar* (Hamilton, 1822) | LRnt | LC |
| 9 | *Barilius barila* (Hamilton, 1822) | VU | LC |
| 10 | *Laubuca laubuca* (Hamilton, 1822) | LRlc | LC |

| | | | |
|---|---|---|---|
| 11 | *Chela cachius* (Hamilton, 1822) | NE | LC |
| 12 | *Esomus danrica* (Hamilton, 1822) | LRlc | LC |
| 13 | *Amblypharyngodon mola* (Hamilton, 1822) | LRlc | LC |
| 14 | *Ctenopharyngodon idella* (Valenciennes, 1844) | NE | NE |
| 15 | *Cyprinus carpio* Linnaeus, 1758 | NE | VU |
| 16 | *Puntius chola* (Hamilton, 1822) | VU | LC |
| 17 | *Puntius ticto* (Hamilton, 1822) | LRnt | LC |
| 18 | *Puntius sophore* (Hamilton, 1822) | LRnt | LC |
| 19 | *Puntius terio* (Hamilton, 1822) | LRnt | LC |
| 20 | *Pethia conchonius* (Hamilton, 1822) | VU | LC |
| 21 | *Systomus sarana* (Hamilton, 1822) | VU | LC |
| 22 | *Cirrhinus mrigala* (Hamilton, 1822) | LRnt | LC |
| 23 | *Cirrhinus reba* (Hamilton, 1822) | VU | LC |
| 24 | *Gibelion catla* (Hamilton, 1822) | VU | LC |
| 25 | *Labeo gonius* (Hamilton, 1822) | LRnt | LC |
| 26 | *Labeo calbasu* (Hamilton, 1822) | LRnt | LC |
| 27 | *Labeo rohita* (Hamilton, 1822) | LRnt | LC |
| 28 | *Labeo bata* (Hamilton, 1822) | LRnt | LC |
| 29 | *Bangana ariza* (Hamilton, 1807) | CR | LC |
| D. FAMILY: Balitoridae | | | |
| 30 | *Acanthocobitis botia* (Hamilton, 1822) | NE | LC |
| E. FAMILY: Cobitidae | | | |
| 31 | *Botia dario* (Hamilton, 1822) | NE | LC |
| 32 | *Botia rostrata* Günther, 1868 | NE | VU |
| 33 | *Lepidocephalichthys guntea* (Hamilton, 1822) | NE | LC |
| IV. ORDER: SILURIFORMES | | | |
| F. FAMILY: Bagridae | | | |
| 34 | *Rita rita* (Hamilton, 1822) | LRnt | LC |
| 35 | *Sperata aor* (Hamilton, 1822) | NE | LC |
| 36 | *Sperata seenghala* (Sykes, 1839) | NE | LC |
| 37 | *Mystus vittatus* (Bloch, 1794) | VU | LC |
| 38 | *Mystus cavasius* (Hamilton, 1822) | LRnt | LC |
| 39 | *Mystus bleekeri* (Day, 1877) | VU | LC |
| 40 | *Batasio batasio* (Hamilton, 1822) | NE | LC |
| G. FAMILY: Siluridae | | | |
| 41 | *Ompok pabo* (Hamilton, 1822) | EN | NT |
| 42 | *Wallago attu* (Bloch and Schneider, 1801) | LRnt | NT |
| H. FAMILY: Schilbidae | | | |
| 43 | *Ailia coila* (Hamilton, 1822) | VU | NT |
| 44 | *Clupisoma garua* (Hamilton, 1822) | VU | LC |
| 45 | *Eutropiichthys vacha* (Hamilton, 1822) | EN | LC |
| 46 | *Eutropiichthys murius* (Hamilton, 1822) | LRnt | LC |
| I. FAMILY: Pangasidae | | | |
| 47 | *Pangasius pangasius* (Hamilton, 1822) | CR | LC |
| J. FAMILY: Amblycipitidae | | | |
| 48 | *Amblyceps mangois* (Hamilton, 1822) | LRnt | LC |

| | | | |
|---|---|---|---|
| K. FAMILY: Sisoridae | | | |
| 49 | *Bagarius bagarius* (Hamilton, 1822) | VU | NT |
| L. FAMILY: Claridae | | | |
| 50 | *Clarias batrachus* (Linnaeus, 1758) | VU | LC |
| M. FAMILY: Heteropneustidae | | | |
| 51 | *Heteropneustes fossilis* (Bloch, 1794) | VU | LC |
| N. FAMILY: Chacidae | | | |
| 52 | *Chaca chaca* (Hamilton, 1822) | NE | LC |
| V. ORDER: BELONIFORMES | | | |
| O. FAMILY: Belonidae | | | |
| 53 | *Xenentodon cancila* (Hamilton, 1822) | LRnt | LC |
| VI. ORDER: CYPRINODONTIFORMES | | | |
| P. FAMILY: Aplocheilidae | | | |
| 54 | *Aplocheilus panchax* (Hamilton, 1822) | DD | LC |
| VII. ORDER: SYNBRANCHIFORMES | | | |
| Q. FAMILY: Synbranchidae | | | |
| 55 | *Monopterus cuchia* (Hamilton, 1822) | LRnt | LC |
| R. FAMILY: Mastacembelidae | | | |
| 56 | *Macrognathus aral* (Bloch and Schneider, 1801) | LRnt | LC |
| 57 | *Macrognathus pancalus* Hamilton, 1822 | LRnt | LC |
| 58 | *Mastacembelus armatus* (Lacepede, 1800) | NE | LC |
| VIII. ORDER: PERCHIFORMES | | | |
| S. FAMILY: Ambassidae | | | |
| 59 | *Chanda nama* Hamilton, 1822 | NE | LC |
| 60 | *Parambassis ranga* (Hamilton, 1822) | NE | LC |
| 61 | *Parambassis lala* (Hamilton, 1822) | NE | NT |
| T. FAMILY: Nandidae | | | |
| 62 | *Nandus nandus* (Hamilton, 1822) | LRnt | LC |
| U. FAMILY: Badidae | | | |
| 63 | *Badis badis* (Hamilton, 1822) | NE | LC |
| V. FAMILY: Gobiidae | | | |
| 64 | *Glossogobius giuris* (Hamilton, 1822) | LRnt | LC |
| W. FAMILY: Anabantidae | | | |
| 65 | *Anabas testudineus* (Bloch, 1792) | VU | DD |
| X. FAMILY: Osphronemidae | | | |
| 66 | *Trichogaster fasciata* Bloch and Schneider, 1801 | LRnt | LC |
| 67 | *Trichogaster lalius* (Hamilton, 1822) | NE | LC |
| Y. FAMILY: Channidae | | | |
| 68 | *Channa gachua* (Hamilton 1822) | VU | LC |
| 69 | *Channa punctatus* (Bloch, 1793) | LRnt | LC |
| 70 | *Channa striatus* (Bloch, 1793) | LRlc | LC |
| Z. FAMILY: Tetraodontidae | | | |
| 71 | *Tetraodon cutcutia* Hamilton, 1822 | LRnt | LC |

*As per CAMP. Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Lower Risk-near threatened (LR-nt), Lower Risk-least concern (LR-lc), Date Deficient (DD), Not Evaluated (NE). **As per IUCN. NE=Not Evaluated, DD=Data Deficient, LC= Least Concern, NT=Near Threatened, VU=Vulnerable.

**Table-2**
**Physico-chemical characteristics of the water of Dhir Beel at different season of the study period**

| Sl. No. | Parameters | Pre-monsoon | Monsoon | Post-monsoon | Winter | Avg. |
|---|---|---|---|---|---|---|
| 1 | Air temperature ($^0$C) | 32 | 32.5 | 33 | 29 | 31.625 |
| 2 | Water temperature ($^0$C) | 30.5 | 30.5 | 28 | 26 | 28.75 |
| 3 | pH | 7.6 | 7.0 | 7.2 | 6.81 | 7.1525 |
| 4 | Conductivity (mS) | 0.09 | 0.07 | 0.19 | 0.16 | 0.1275 |
| 5 | Total dissolved solids (TDS) ppt | 0.06 | 0.05 | 0.17 | 0.15 | 0.1075 |
| 6 | Dissolved oxygen (DO) ppm | 8.7 | 7.2 | 5.6 | 4.8 | 6.575 |
| 7 | Turbidity (NTU) | 44 | 79 | 65 | 38 | 56.5 |
| 8 | Total Hardness (mg/l) | 25 | 40 | 30 | 34 | 32.25 |
| 9 | Free $CO_2$ (mg/l) | 24 | 37 | 30 | 28 | 29.75 |
| 10 | Total Alkalinity (mg/l) | 72 | 65 | 68 | 70 | 68.75 |
| 11 | Salinity (ppm) | 1500 | 1400 | 1500 | 1400 | 1450 |

**pH:** Hydrogen ion concentration *i.e.* pH of water is the measure of relative acidity and alkalinity. $H^+$ ion concentration is one of the most important parameters of any aquatic system since all the biochemical activities depend on pH of surrounding water. The pH is generally considered as a measure of environmental suitability and a range of 7-8.5 is considered to support a rich biota and fish[20]. The pH of the water should be mildly alkaline, as acidic or highly alkaline pH affects fish growth. The pH of most of the inland waters of India including North Eastern region is alkaline without much variation. In the present study the pH of the beel ranges between 7.6 in pre monsoon to 6.81 in the winter.

**Turbidity**: Turbidity is a function of light dispersing and absorbing properties of water and is a striking characteristic to know the physical status of the rivers. It is caused by the presence of suspended matters like clay, silt, colloidal organic particles and plankton. The turbidity is greatly influenced by surface and drainage run off. Turbidity of water always has a negative effect on the biotic communities. It decreases light penetration in water, checks the process of photosynthesis in aquatic plants and decreases the potability and productivity of water[21]. The average turbidity of the water body was recorded as 56.5 NTU during the present study period.

**Dissolved Oxygen (DO)**: Like temperature and pH, dissolved oxygen is also a most important limiting factor of aquatic environment to indicate water purity and to determine the distribution and abundance of various algal groups. It plays a vital role in metabolic processes of organisms. The occurrence of DO in water depends mainly on a physical process (direct diffusion from air) and biological process (photosynthesis of autotrophs). Its concentration is significantly influenced by the temperature, salinity, concentration of dissolved salts and water movements[22]. The dissolved oxygen of the beel fluctuates between 8.7 in pre monsoon to 4.8 in winter. Although the DO value is suitable for the growth and development of fishes throughout the year it reduces in the winter due to receding water level with increase in planktons and weeds in the beel.

**Free Carbon di-oxide ($FCO_2$)**: Aquatic vegetation and phytoplankton require $CO_2$ for photosynthetic activity. The decomposition of organic matter and respiratory activity of aquatic plant and animals produces $CO_2$. The level of free carbon di-oxide was recorded to be maximum i.e. 37mg/l in the monsoon and minimum 24 mg/l in the pre monsoon. Higher value of free $CO_2$ was recorded in the monsoon due to higher decomposition of organic matter and de-oxygenation. Many of the previous workers also reported $FCO_2$ as absent in limnetic water[23].

**Total alkalinity (TA):** Total alkalinity of water is its buffering capacity or capacity to neutralize acid. It is an aggregate property of water due to presence of carbonate, bicarbonate and hydroxyl compounds of calcium, magnesium, sodium, potassium, etc. Alkalinity is mainly due to bicarbonate present in water. The fluctuation in alkalinity may be due to rainfall as observed by. The fluctuation in alkalinity values depends upon nature of bottom deposits, rainfall and autotrophs of water. The total alkalinity is directly related to aquatic productivity[24]. The maximum value of total alkalinity of the beel was recorded to be 72 mg/l in the premonsoon period.

**Salinity**: Salinity is a measure of the amount of dissolved particles and ions in water. The change in the salinity that is salt content of a water body greatly affects the distribution and abundance of fishes. In the case of fishes the consumption of Oxygen increases along with the increase in salinity. Salinity

rarely changes in isolation from the other environmental factors such as dissolved oxygen, carbon di-oxide level, pH and temperature, etc[25]. The salinity of the water body fluctuates between 1400ppm -1500ppm throughout the year without much variation.

**Total Hardness**: Total hardness normally indicates the total calcium and magnesium salts present in water along with some other polyvalent metals such as iron, aluminium, manganese etc. It determines the suitability of water for domestic, industrial and drinking purposes and attributed to presence of bicarbonates, sulphates, chloride and nitrates of calcium and magnesium[26]. The total hardness of the water body was in the range between 25mg/l in the pre monsoon to 40 mg/l in the monsoon.

**Total Dissolved Solid (TDS):** TDS is a measure of all dissolved substances in water, including organic and inorganic suspended particles that can pass through a very small filter. Primary sources for TDS in wetland waters are agricultural and residential runoff, leaching of soil contamination and point source water pollution, discharge from industrial or sewage treatment plants. Sorensen *et al.,* recorded a precipitous decrease in biomass of organic matter (Phytoplankton) with about 1200ppm TDS. The TDS of the water body ranges from 50ppm in monsoon to 170ppm in postmonsoon[27].

**Conductivity**: The conductivity is a measure of water's capacity to conduct an electric current. The relationship of the conductivity to ionised matter concentration varies with both quality and quantity of the ions present. The specific conductivity was observed very low during present investigation; however, it shows a well marked seasonal pattern[28]. The specific conductivity was found to increase during the late winter and early spring but with the onset of monsoon a gradual decline was observed. This may be due to dilution by the rain water and increase in temperature as temperature affects the ionic velocity. The maximum conductivity of the water body was recorded during the postmonsoon 0.19 mS, while minimum was recorded during monsoon 0.05 mS.

The water quality, nutrient level and fish fauna of the beel show changes from time to time as it receives different types of water at different part of the year. During monsoon the water from river Brahmaputra enters the beel along with nutrients, fishes and inundates the beel. Again the combined flow from the rivulet in the upstream along with nutrient and water from the catchment area reverts the flow back to Brahmaputra that continues till the flood recede. Therefore, in both the cases a large number of fishes enter the beel along with and against the water current giving a dual benefit to the beel.

## Conclusion

Just like the other wetlands of the state the Dhir Beel experience the most dramatic changes in their trophic status and biota. There is a gradual shrinkage in the size of the wetland due to encroachment, agricultural activities, forest cover change in the adjoining reserved forests and human settlement within the wetland causing an imbalance in the wetland eco-system. The wetlands, in contrast, maintain to a high extent their major biotic and abiotic components, though many fish and bird populations have been directly affected by floods due to climate change and human intervention.

Although the Millennium Ecosystem Assessment estimates that wetlands cover seven percent of the earth's surface and deliver 45% of the world's natural productivity and ecosystem services. The existence of these unique resources in this region of the country is under threat due to differential developmental activities and population pressure. This calls for a long-term planning for preservation and conservation of these resources[29].

From the present observation it can be concluded that encroachment, siltation, brick-kiln, jute retting and surface run-off carrying fertilizer from agricultural field affect the wetlands badly. The water quality of Dhir Beel is deteriorating as years are passing by resulting in prolific weed growth, thereby, affecting sustainable food production and potable water for humans and livestock. A large number of people residing in or on the fringe areas of wetlands are partially or entirely dependent upon the aquatic resources of the Beel. The Beel is a habitat of diverse groups of organisms and harbours vast array of aquatic resources. These include fish and fiber, recreational opportunities, water purification, climate regulation, flood regulation, tourism. Loss of wetlands or degradation of water quality harms them directly. Therefore, restoration of the Beel is very much important for maintaining the bio-diversity.

Fish is an important component in people's diets, providing about 2.9 billion people with almost 20 percent of their average intake of animal protein[30]. Fishery sectors are particularly important in developing countries, for providing both food and livelihoods. The Beel offer immense potential for increasing fish production, employment generation and several other additional source of income for the rural population of lower Assam.

The present study also reveals the occurrence of several riverine fishes like *Tenualosa ilisha, Amblyceps mangois,* etc in the beel at seasonal level that migrates during monsoon for feeding purposes. Yadava also reported occurrence of the anadromous clupeid from the beel. On the other hand the report of Hilsa fry by from other lentic water bodies further establishes it lentic adaptability and is of special significance[31,32].

Although, there are various agencies like Department of Fisheries, Forestry, Wildlife, Revenue, AFDC, CIFRI, NFDB etc having their individual roles in regulating the wetland resources of the state but in the case of Dhir Beel only the AFDC is performing its partial role of revenue collection as emanated from the discussion with the leasee and local fishers.

Therefore, if we can attract the attention of all the regulating bodies for the better scientific management and maintenance along with the introduction of culture based fishery than the fish production of the beel can be increased 3 fold i.e. upto 668 tonnes of fishes per year.

It is our considered opinion that the fish production of the beel can be augmented if the beel is taken under culture based fishery using proper scientific management framework. This will require support from the Government specially in i. regulating the flow of flood water from river Brahmaputra, ii. leasing the beel to the co-operative society with traditional (*Koiborta, Mahimal*) and trained fisher, iii. strict enforcement of regulations (Indian Fisheries Act, 1897) regarding fishing access, period, time, type, mesh size, gears, encroachment and free riders, iv. training the fisher about the recent scientific technique.

## Acknowledgement

The authors are thankful to the Principal, Goalpara College and Head Department of Zoology, Goalpara College, Goalpara for giving permission to conduct the basic survey work and using the laboratory.

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