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Fish diversity and habitat ecology of Jia Bhorelli River: A major tributary of river Brahmaputra

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Abstract
Hydrobiology and fisheries of River Jia Bhorelli, a major tributary of Brahmaputra River was studied during January to June 2013. Jia Bhorelli River is a snow-fed River and is perennial one. The river is a major tributary of the River Brahmaputra. A total of 12 hydrological parameters were monitored. Some of the parameters showed slightly monthly fluctuation. A total of 61 fish species belonging to 44 genera, 20 families and 7 orders were recorded during the study period. The dominant family was found to be Cyprinidae followed by Siluridae, Perciformidae, Synbranchidae, Clupiformidae, Belontidae, Tetraodontidae and Anguillidae. The present paper deals with an extensive work on Fish diversity and Habitat ecology of the River Jia Bhorelli. Conservation status[1] of the recorded species was assessed.

Keywords: fish diversity, habitat ecology and jia-bhorelli river

Introduction
Fish are cold-blooded animals with a backbone (vertebrates), gills for breathing underwater, and paired fins for swimming. They live underwater and are dependent on water for dissolved oxygen, support, food, and shelter. Fish constitutes almost half of the total number of vertebrates in the world. They live in almost all conceivable aquatic habitat. Out of a total of 2500 species of fish in India, 930 are in freshwaters and belong to 326 genera, 99 families and 20 orders [2]. India is one of the Mega biodiversity countries in the World and occupies 9th position in terms of freshwater Mega biodiversity [3]. The North eastern region of India is considered to be one of the hotspots of freshwater fish biodiversity in the world [4].
Physico-chemical parameters play a vital role in determining the distribution pattern and quantitative abundance of organisms inhabiting an aquatic ecosystem. Aquatic ecosystems are affected by several health stressors that significantly deplete biodiversity. In future, the loss of biodiversity and its effects are predicted to be greater for aquatic ecosystems than for terrestrial ecosystems [5]. Among the various types of inland freshwater bodies, the riverine system is a unique type of ecosystem, which generally covers different types of climatic zones, landscapes and bio-geographic regions. The major advantages of lotic systems are that there is no gravity and there are no waste disposal materials. However, cleanliness of rivers is vital to aquatic life and the much of the cleanliness is dependent on the land use activities in the river basin or catchment area.
There are also a few reports available on the hydrobiology and fisheries of the Brahmaputra River [6, 7]. However, no detailed systematic work or very few works on hydrobiology and fish inventory has been available in this river of Upper Assam. Moreover, the river is a vital resource to provide food, water and recreation for human beings as well as habitat for diverged species of aquatic plants and animals. The river is surrounded by tea garden on one side and the other by human habitation. Keeping this in view, an attempt has been made to investigate the water quality & fish diversity of Jia Bhorelli River of Sonitpur district, Assam.

Study Site
The River Jia Bhorelli is formed by the confluence of River Bishom and River Tenga in West Kameng district of Arunachal Pradesh. It originates in Okka hills of Arunachal Pradesh and flows for about 190 km in the state where it is known as River Kameng. It enters Sonitpur district of Assam at Bhalukpung after which it flows for 56 km in the plains before joining River Brahmaputra near Tezpur. The upper stretches of River Jia Bhorelli from Bhalukpung to Balipara (under Nameri Reserve Forest) in Sonitpur district spanning about 100 km provide excellent spots for sport fishing. It has many tributaries like Dinai, Diji, Dikorai, Nameri, Mansiri etc. For the present study 3 sampling sites were selected for the river. Different water types were selected for each sampling sites. At Bhalukpong, the first sampling site, the river forms a Confluence with a small stream locally known as "Pagla Nala". Here the water is riffle type. The second sampling site (13th Mile) is shallow type and the third site (Potasali) is a pool type. The river from Bhalukpong to Potasali flows with many meanders and somewhere it forms a straight channel. The soil type is sandy at all the sites with pebbles and boulders at the substratum. The water body is surrounded by forests on both sides at one sampling site and the rest two sampling sites are forested on one side and inhabitated by humans on the other. Sampling was done on monthly basis and the datas were recorded.

Materials and Methods
The study was carried out during January to June 2013. For this study 3 sampling sites were selected for the river. The

positioning of the three sampling sites was done with the help of Global Positioning System (GPS). The latitudes and longitudes of each sampling sites have been recorded and listed below. Site I: $27^0$00'37.6'' N & $92^0$39'25.9'' E, Site II: $26^0$59'40.4'' N & $92^0$44'23.3'' E & Site III: $26^0$56'01.4'' N & $92^0$50'04.8'' E

Water Quality analysis was done on monthly basis. The water samples were collected from the area near the bank of the River between 6:30 to 9:30 am and analyzed the selected physico-chemical parameters (Air & water temperature, pH, transparency, dissolved oxygen, total solids) as per standard procedures [8, 9].

The fishes were caught from the stretch of the River at sampling sites. The collected specimens were preserved in 5% formalin and identified with the help of standard keys [2, 10]. The abundance and status of the recorded fish species was also evaluated [1]. The documentation of present study was carried out with the help of local fishermen, having more than 25 years of fishing experience.

Results and Discussion

The average value of the physico-chemical parameters of water recorded from three different sites of Jia Bhorelli River is presented in Table 1 and is summarized as below:

Table 1

Parameters/Months	January	February	March	April	May	June
Air Temp (°C)	20±0.57	22.3±0.33	22±0.67	22.7±0.33	25.6±0.88	27.3±0.66
Water Temp (°C)	21±0.88	23±0.57	24±0.33	24±0.57	24.6±0.33	28.3±0.33
pH	7.2±0.03	7.2±0.03	7.4±0.03	7.2±0.22	7.5±0.17	7.06±0.14
Conductivity (μScm^{-1})	77±0.88	61.67±1.66	54±1.0	43.7±0.33	60.66±9.8	48.3±3.38
Current Flow (m/s)	0.43±0.08	0.57±0.18	0.7±0.15	0.64±0.03	0.54±0.32	0.7±0.07
TDS (mg/l)	24±0.88	27±0.33	27.6±0.57	22±0.88	23.66±1.33	23.6±2.33
Transparency(cm)	47±3.38	53±3.03	56±3.98	40.64±4.39	61.92±7.47	45.6±11.4
Depth(cm)	60±4.97	62±6.28	75.5±7.39	80.4±11.9	83.82±9.15	115.1±7.55
DO (mg/l)	7.2±0.19	6.80.19	6.93±0.28	7.07±0.25	7.43±0.35	7.58±0.23
FCO_2 (mg/l)	1.8±0.04	1.8±0.07	1.7±0.04	1.59±0.03	1.73±0.04	1.58±0.02
Total Alkalinity (mg/l)	24±0.46	29.8±2.10	32±0.54	21.9±0.42	26.7±2.74	29.3±0.95
Total Hardness (mg/l)	20.2±0.21	23.4±1.65	34±0.51	24.4±0.58	27.5±1.73	29.3±1.37

Temperature: Temperature regulates various physico-chemical as well as biological activities and thus has enormous significance. The atmospheric temperature recorded during the study period ranged from (20^0C -27^0C) minimum being in January which gradually increased in and the maximum was recorded in June.

The surface water temperature varied in accordance of ambient temperature and ranged from (21^0C-28.3^0C) lowest water temperature was recorded in January and the highest was recorded in June. Again, surface water temperature was observed to be higher than the atmospheric temperature in all the sampling sites throughout the study period indicating a strong influence on the former by the later.

***pH*:** The river water depicted alkaline nature throughout the study period ranging between (7.06-7.5) with very minor fluctuation. The alkaline nature of river water was also reported by earlier workers from the region [11, 12].

Conductivity: The specific conductivity is an index of the amount of water soluble salts present in the water indicating the state of mineralization in an aquatic system[13]. During the present study conductivity of the river water varied from $43.7\mu scm^{-1}$ to $77\mu scm^{-1}$. The lowest conductivity was recorded in April and the highest was observed in January. The conductivity of water showed wide variations throughout the study months.

Current flow: Hill streams usually have higher velocity of water due to the nature of gradient. Similarly, the up-streams of rivers have faster current, which gradually becomes slower as it proceeds towards the low gradient plains. Current flow is one of the important physical parameter of river water. The current flow was measured with the help of a digital speedometer. The current flow varies from 0.43m/s – 0.72 m/s. The current flow recorded in January showed the slowest current flow and the fastest was recorded in March & June.

Total Dissolved Solid: Measurement of dissolved solids indicates the total concentration of dissolved ions that has a wide bearing on the productivity [13]. The total dissolved solid value ranged between 22-27.6ppm and the highest value was recorded in March and the lowest was in April.

Transparency: The transparency value of the river under study showed significant fluctuation during the study period. The transparency value was found to be in between 40.6cm and 61.92cm. The transparency value was found to be highest in May and the lowest transparency was recorded in April**.** March showed highest transparency but after that there was a sharp decline in transparency.

Depth: The depth of River Jia Bhorelli ranged from 60cm–115.1cm. The lowest depth was found to be in the month of January which gradually kept an increasing trend after the winter months and the highest depth was recorded in the month of June during the study period.

Dissolved oxygen: Dissolved oxygen (DO) is a critical factor in natural waters and is significant both as regulator of metabolic process and indicator of water quality [14]. Dissolved oxygen showed a distinct pattern of fluctuation and it ranged from 6.80 – 7.58 mg/l. The minimum value of dissolved oxygen was recorded to be in February, while the highest

concentration was recorded to be in June. Higher concentration of DO in the river water during the June may be due to turbulence and oxygenation resulting from high rainfall and mixing up of well aerated run- off. These observations are in conformity with the findings [15-17]. The dissolved oxygen was above the tolerance limit of 5mg/l[18]. The variations in the dissolved oxygen level depend on the primary production and respiration of aquatic organism present in the water.

Free carbon dioxide: Seasonal data of free CO_2, an indicator of biological respiration of aquatic systems, showed a narrow range of fluctuation during the study period. The concentration of free CO_2 is greater in winter than other seasons possibly due to greater biological activities and abundant growth of algal bloom in shallow marginal areas of the river. The free CO_2 value of the Jia Bhorelli River ranged between 1.58 – 1.8mg/l. The variation in CO_2 was due to absorption by plants for photosynthesis and due to the activity of other living organisms.

Total Alkalinity: Total Alkalinity of the water ranged between 21.9-32mg/l. The highest alkalinity was recorded in March and the lowest in April. Data recorded from the experiment showed that there was fluctuation of alkalinity during the whole survey period. Alkalinity may be due to the waste discharge from the nearby areas and heavy rains.

Total Hardness: Hardness of the River Jia Bhorelli was found to range between 20.2 - 34mg/l, the highest hardness of water was recorded in February and the lowest was recorded in April.

Table 2: Fish species abundance in Jia Bhorelli River

Scientific name	Local Name	Family	Conservation status
1. *Notopterus notopterus* (Pallas)	Kanduli	Notopteridae	LR-nt
2. *Chitala chitala* (Ham-Buch)	Chital		NT
3.*Labeo rohita* (Ham-Buch)	Rohu	Cyprinidae	LR-nt
4.*Labeo bata* (Ham-Buch)	Bata		LR-nt
5.*Labeo gonius* (Ham-Buch)	Kurhi		LR-nt
6. *Labeo calbasu (Hamilton)*	Mali		LC
7. *Labeo boga* (Ham)	Bhangon		LC
8. *Labeo dero* (Ham)	Nephura		LC
9.*Catla catla* (Ham-Buch)	Bahu		Vu
10. *Aspidoparia morar* (Ham-Buch)	Boriola		LC
11.*Amblypharygodon mola* (Ham-Buch)	Mowa		LR-nt
12.*Barilius barna* (Ham-Buch)	Balisonda		LC
13. *Chela laubuca* (Ham-Buch)	Harbhagi		NT
14. *Chela atpar* (Ham)	Selkona		LC
15. *Puntius sophore* (Ham-Buch)	Puthi		LC
16. *Puntius sarana* (Ham-Buch)	Cheniputhi		LC
17.*Cirrhinus reba* (Ham-Buch)	Laseem		Vu
18.*Cirrhinus mrigala* (Ham)	Mirika		LC
19.*Esomus danricus* (Ham-Buch)	Darikona		LC
20.*Rasbora elenga* (Ham-Buch)	Eleng		NE
21.*Osteobrama cotio cotio* (Ham-Buch)	Haffo		LR-nt
22.*Barilius bendelisis* (Ham-Buch)	Korang		LR-nt
23. *Garra gotyla gotyla* (Gray)	Sil Kamura		LC
24. *Bagarius bagarius* (Ham)	Gorua		LC
25. *Cyprinus carpio* (Linn)	Common carp		Vu
26. *Tor tor* (Ham)	Jonga Pithia		NT
27. *Tor putitora* (Ham)	Pithia		EN
28. *Tor Mossal* (Ham)	Lobura		NT
29. *Neolissochilus hexagonalepis* (McClelland)	Boka pithia		NT
30. *Lepidocephalus guntea* (Ham-Buch)	Botia	Cobitidae	LC
31. *Acanthocobitis botia* (Ham-Buch)	Balibotia		LC
32. *Rita rita* (Ham-Buch)	Litha	Bagridae	LR-nt
33. *Mystus bleekeri* (Day)	Singora		LC
34. *Mystus cavasius* (Ham-Buch)	Borsingorah		LC
35. *Mystus menoda* (Ham-Buch)	Gagol		NE
36. *Aorithys aor* (Ham-Buch)	Ari		LC
37.*Ompok pabda* (Hamilton)	Pavo	Siluridae	NT
38. *Wallago attu* (Bloch-Schneider)	Borali		LC
39.*Clupisoma garua* (Ham-Buch)	Neria	Schilbeidae	NT
40.*Eutropiichthys vacha* (Ham-Buch)	Vacha		LC
41. *Heteropneustes fossilis* (Bloch)	Singhi	Heteropneustidae	LC
42.*Clarias batrachus* (Linn)	Magur	Clariidae	EN
43. *Xenentodon cancila* (Ham-Buch)	Kokila	Belonidae	LC

44.*Glossogobius giuris* (Ham-Buch)	Patimutura	Gobiidae	LC
45.*Channa gachua* (Bloch-Schneider)	Cheng	Channidae	LC
46.*Channa punctatus* (Bloch)	Goroi		LC
47.*Channa striatus* (Bloch)	Shol		LC
48. *Channa marulius* (Ham-Buch)	Sal		LC
49. *Channa stewarti* (Playfair)	Chengeli		LC
50.*Macrognathus aral* (Bloch-Schneider)	Tura	Mastacembelidae	LC
51.*Macrognathus pancalus (*Ham-Bloch)	Tora		LC
52.*Tetraodon cutcutia* (Ham-Buch)	Gangatup	Tetraodontidae	LC
53.*Gudusia chapra* (Ham-Buch)	Koroti	Clupeidae	LC
54.*Badis badis* (Ham-Buch)	Randhani	Nandidae	LC
55. *Nandus nandus* (Ham-Buch)	Gedgedi		LC
56. *Monopterus cuchia* (Ham)	Cuchia	Amphipnidae	LC
57. *Chanda nama* (Ham-Buch)	Chanda	Chandidae	LC
58. *Chanda ranga* (Ham)	Chanda		LC
59. *Anabus testudineus* (Bloch)	Kawoi	Anabantidae	DD
60. *Polyacanthus fasciata* (Schneider)	Kholiona	Belontidae	LC
61. *Anguilla bengalensis* (Gray)	Bami	Anguillidae	LC

Legend: LC= Least Count, NT= Near Threatened, EN= Endangered, Vu= Vulnerable, LR-nt = Lower Risk near threatened, DD= Data Deficient & NE = Not evaluated.

Fish Diversity: Altogether 61 fish species belonging to 44 genera, 20 families and 7 orders has been recorded from Jia Bhorelli River (Table 2). Some species like, *Mystus cavasius, Puntius sophore, Puntius sarana, Aorithys aor, Labeo rohita, Labeo gonius, Labeo bata, Amblypharyngodon mola, Chanda nama, Cirrhinus reba*, were mostly recorded during study period. While some species such as *Xenentodon cancila, Glossogobius giuris, Ompok pabda, Tor mossal* showed some degree of seasonality. Species like *Monopterus cuchia, Macrognathus aral, Macrognathus pancalus, Rita rita*, *Tor putitora*, *Neolissochilus hexagonalepis* were found occasionally. Similarly, *Aorithys aor, Notopterus notopterus, and Labeo rohita* were mostly dominant during pre-monsoon season. According to the local fishermen, carnivorous fishes like *Heteropneustes fossilis, Channa gachua, Channa punctatus, Channa striatus, Tor and Hexagonalepis spp.* are becoming rare. 2 species were included in Vulnerable category (Vu); 8 species in Lower Risk near threatened (LR-nt); 4 species Near Threatened (NT), 2 species Endangered (EN), 36 species Least Concern (LC) 1 Data Deficient (DD) and rest of species are not evaluated yet (NE)[1].

In the present study, in Jia Bhorelli River, Cyprinidae family are the dominant group (27 species) with 44%. Next to Cyprinidae was found Bagridae & Channidae (5 species each) with a percentage of 8% and followed by Notopteridae, Siluridae, Cobitidae, Schilbeidae, Nandidae, Chandidae & Mastacembelidae (2 species each) with 3%; Tetraodontidae, Clariidae and Amphipnidae, Anabantidae, Gobiidae, Anguillidae, Clupeidae, Belontidae & Belonidae (1 species each) with 3% each. Cyprinids are the most dominant group among the recorded fish species in the river.

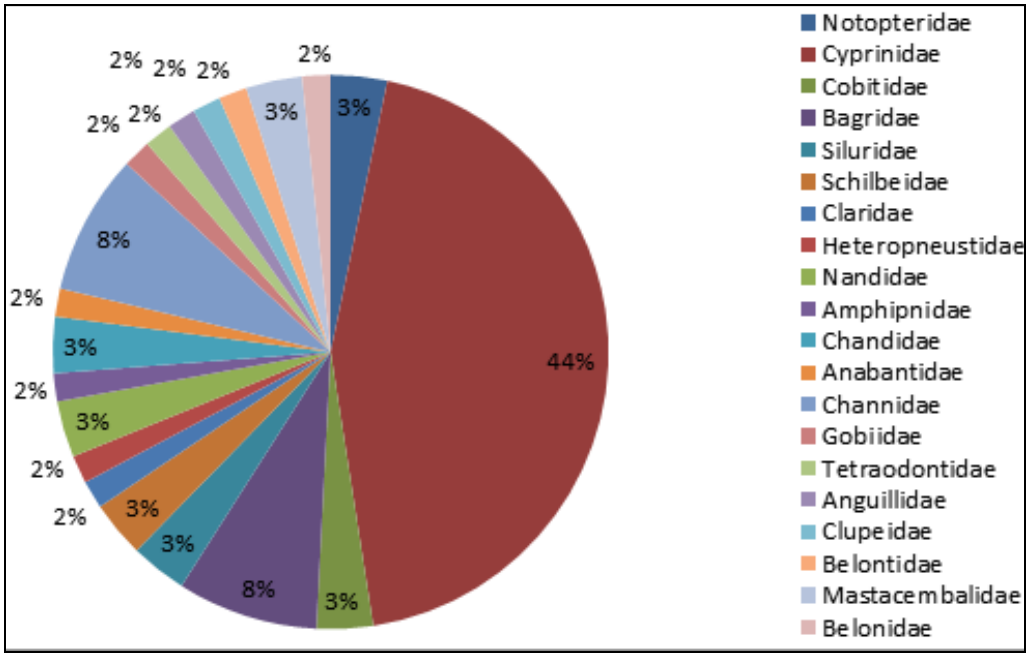

Fig 1: Family wise abundance of Fish in River Jia Bhorelli.

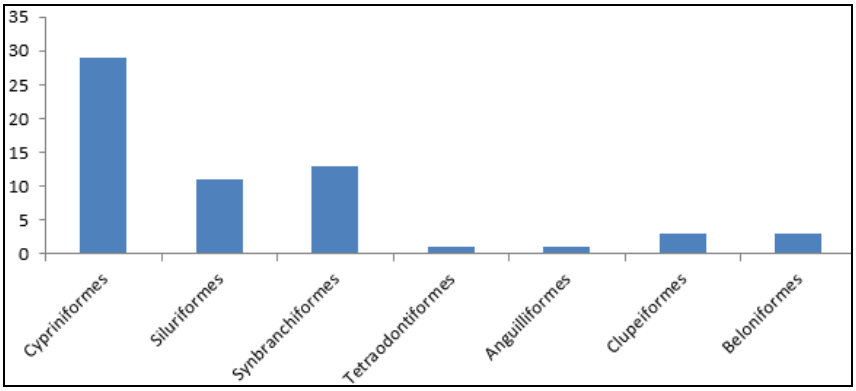

Fig 2: Order wise Abundance of fish in Jia Bhorelli River.

Conclusion

This paper compiles a preliminary study on habitat ecology, fish diversity in the river. From the above discussion, it is clear that a distinct monthly variation is seen in selected physico-chemical parameters of the river. However, temperature, transparency, dissolved oxygen; free CO_2, alkalinity and different forms of solids are within approximate range or within permissible range[18]. The present study indicates rich concentration of fish species in the river.

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