ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2015; 1(9): 424-435
www.allresearchjournal.com
Received: 23-06-2015
Accepted: 25-07-2015

Arpita Dey
M.Sc, Research Scholar, Aquaculture and Limnology Research Unit, Department of Zoology, University of North Bengal, Darjeeling, Siliguri - 734 013, West Bengal, India.

Kripan Sarkar
Rainbow Ornamental Fish Farm, Baxipara, Raninagar, Mohitnagar -735101, West Bengal, India.

Sudip Barat
Department of Zoology, University of North Bengal, Darjeeling, Siliguri - 734 013, West Bengal, India.

Correspondence:
Arpita Dey
M.Sc, Research Scholar, Aquaculture and Limnology Research Unit, Department of Zoology, University of North Bengal, Darjeeling, Siliguri - 734 013, West Bengal, India.

Evaluation of fish biodiversity in rivers of three districts of eastern Himalayan region for conservation and sustainability

Arpita Dey, Kripan Sarkar, Sudip Barat

Abstract
The present study was conducted in the Eastern Himalayan region to generate a primary database on ichthyofauna diversity of seven rivers in three districts (Cooch Behar, Jalpaiguri and Alipurduar) of West Bengal, India. Out of the seven rivers, five rivers originate from Bhutan ghat hills, and the other two rivers the Teesta, originates from North Sikkim and river Karala from Jalpaiguri. 141 indigenous fish species belonging to 31 families were identified. The family Cyprinidae represented the largest diversity accommodating 21 genera and 46 species. Amongst all the fishes, 99 species have ornamental value and 87 species the food value. Ornamental fishes are dominant over the food fishes and carnivorous fishes are dominant over the omnivorous and herbivorous fishes. According to IUCN (International Union for Conservation of Nature) and CAMP (Conservation Assessment and Management Plan), the conservation status of the fishes are listed as 1 (1%) species as Critically Endangered, 12 (8%) species as Endangered, 33 (23%) species as Vulnerable, 17 (12%) species as at Lower Risk Near Threatened, 66 (47%) species as Lower Risk Least Concerned,8 (6%) species as Data Deficient and 4 (3%) species as Not Evaluated. About 44% fish species are near threats, vulnerable and endangered in this region. 20 endemic species are present in this region. It is concluded, that anthropogenic pressure arising out of agricultural run offs, high population growth, construction of highways, roads, bridges and dams, destruction of riparian vegetation and watershed forest cover, denudation causing high siltation, boulder and sand lifting, landslides, rampant fishing, disposal of untreated sewages, indiscriminatory use of fishing with new fishing technologies may cause the decline of the fish diversity. The conservation of ichthyodiversity is important for sustainable livelihood of fishermen and also essential for socio- economic development of the country.

Keywords: Ichthyofauna diversity, Eastern Himalayan Rivers, Threats, Conservation status, Sustainability

1. Introduction
The Eastern Himalaya comprises Bhutan, Northern part of West Bengal, Sikkim North-Eastern India and Southern, Central and Eastern Nepal. Strictly speaking, the Eastern Himalayan region comprises of two large hotspots: the Indo-Burma and the Himalaya Hotspots (CEPF 2005) [8]. This means that the region contains exceptional levels of plant endemism (at least 1,500 endemic species) and has lost 70% or more of its original habitat (Myers *et al.,* 2000) [22]. The Eastern Himalaya with rich biodiversity is under immediate threat of species extinction and habitat destruction due to tremendous pressure from demo technic growth and natural environmental changes. The fishery sector contributes significantly to foreign exchange earnings of India to the tune of many millions. In addition, aquatic germplasm resources are turning out to be an important source of various products with pharmaceutical and commercial value. Fishery plays an instrumental role in the socio-economic development of the country, as it is a valuable resource of livelihood for a huge section of economically backward population. It also generates gainful employment, alternate income and stimulates growth of new subsidiary industries (Goswami *et al.,* 2012) [15].

Fig 1: Physical map of the Eastern Himalayan region showing the rivers

A great number of species have been reported from most of the North Eastern states but in Cooch Behar, Alipurduar and Jalpaiguri districts of West Bengal there is very few report on fish biodiversity. Cooch Behar and Alipurduar districts are situated on the foothills of Eastern Himalaya. Jalpaiguri district is located at the Terai region of Eastern Himalaya. Among all the rivers flowing through the three districts Teesta, Jaldhaka, Karala, Torsa, Kaljani, Gadadhar and Raidak are the richest in fresh water fish biodiversity and originate from the Eastern Himalaya region. The Teesta river is 414 km long and originates from Chumbu Chu and outfalls into the river Brahmaputra in Bangladesh; river Jaldhaka is about 192 km long and arises from Bhutan border and outfalls into Jamuna river in Bangladesh; river Karala originates from Jalpaiguri district and outfalls into river Teesta and is about 141 km long; river Torsa originates from Torsa Chhu near Chhukha in Bhutan, about 358 km long and outfalls into Jamuna river in Bangladesh; river Kaljani which is about 96 Km long originates from Gabaur Bachhra forest, lying in the borders of Bhutan and West Bengal, and outfalls into Shiltorsa in Cooch Behar; river Gadadhar originates from Buxa hill forest, 117 km long and outfalls into Raidak river in West Bengal whereas, river Raidak originates from Raidak forest in West Bengal, about 95 km long and outfalls into Dud Kumar river in Balabhat, West Bengal.

The first assessment (Anonymous 1992–1993) [4] categorized 46 freshwater fish species as threatened. In the second assessment of 320 freshwater fish assessed, according to IUCN criteria (CAMP 1998) [7], 43 freshwater fishes species are critically endangered, 90 are endangered and 81 are vulnerable. The recent assessment for central India reported 41 species (56.58%) of freshwater fishes as threatened under divergent categories (Lakra and Sarkar 2007) [19]. The few contributors on fish diversity of Northern region of West Bengal were Barat *et al.,* (2005) [5], Mukherjee *et.al.,* (2011) [21], Patra (2011) [23], Jha *et al.,* (2004) [18], Das and Chakrabarty (2007) [10], Basu *et al.,* (2012) [6], Acharjee *et al.,* (2013 [3], 2014a [1] and 2014b [2]) and Dey *et al.,* (2015a [12] and 2015b[11]). Since the existing literatures do not give specific distribution of fish fauna in different water bodies of Cooch Behar, Alipurduar and Jalpaiguri districts. The present study, therefore, is aimed at to update the ichthyofaunal diversity in the rivers of the three districts and to get a database on the distribution of fish species.

2. Materials and Methods

The study was conducted in the rivers of three districts namely Cooch Behar, Alipurduar and Jalpaiguri located in the northern region of West Bengal, India where, the rivers Torsa, Kaljani, Gadadhar, Raidak, Teesta, Jaldhaka and Karala cover an area of the lower reaches of the rivers. Survey and sampling were carried out for two years (January, 2013- December, 2014) at monthly interval from the selected sites. The sampling areas in Cooch Behar district were Torsa (Silbarihat, 26^0 50' N latitude and 89^0 32' E longitude), Kaljani (Bhelakhopa, 26^0 30' N latitude and 89^0 58' E longitude), Gadadhar (Ghogarkuthi, 26^0 30' N latitude and 89^0 63' E longitude), in Alipurduar district Kaljani (Birpara, 26^0 48' N latitude and 89^0 51' E longitude), Raidak (Chhipra, 26^0 49' N latitude and 89^0 70' E longitude), Gadadhar (Chikliguri, 26^0 49' N latitude and 89^0 59' E longitude). Whereas, in Jalpaiguri district, Teesta (Gazoldoba barrage, 26^0 75' N latitude and 88^0 59' E longitude), Jaldhaka (Jaldhaka fishing point, 26^0 86' N latitude and 89^0 80' E longitude) and Karala (Teesta Udyan, 26^0 52' N latitude and 88^0 72' E longitude).

Fishes were collected from different sites with the help of fishermen using different types of nets namely gill net, cast net, dip net, drag net and other locally designed fishing gears like *Katal* fishing gear. In *Katal* fishing technique, some area of the river is temporarily fenced off by bamboo and aquatic macrophytes *Eichhornia* or *Pistia* sp. After a few days, these areas are covered by nets and the fishes are caught by cast net. This method is applied throughout the year except monsoon. The harvested fishes were then preserved in 10 % formaldehyde solution according to Jayaram (1999) [17]. Fish photographs were taken from fresh samples by camera (Nikon, Coolpix L24) and were identified following their general body form, morphometric and meristic characteristics according to Talwar and Jhingran (1991) [26], Jayaram(1999) [17] and Vishwanath *et al.*, (2011) [27]. Conservation status of fish is given as per Conservation Assessment and Management Plan (CAMP, 1998) [7] and International Union for Conservation of Nature (IUCN 2010 [16]).

3. Results and Discussion

One hundred forty one (141) indigenous fish species belonging to 31 families were collected and identified from nine locations of the rivers of three districts. The family-wise interpretation (Fig. 2) revealed Cyprinidae as the largest family accommodating 21 genera and 46 species. The genus *Puntius*, ranked first among the genera with its numerical strength of 8 species. Family Sisoridae with 16, Bagridae with 13 and Cobitidae with 10 species. Balitoridae, Schilbeidae, Mastacembelidae, Siluridae, Badidae, Belontiidae family represented 4 species. Channidae represented 5 species, Psilorhynchidae and Clupeidae represented family with 3 species. Ambassidae, Amblycipitidae, Notopteridae showed 2 members from each and other 15 families like Belonidae, Anabantidae and so on represented single member from each. Among the three districts, fish diversity is richest in Jalpaiguri district. In Jalpaiguri district, Teesta river has the highest fish diversity than river Jaldhaka and Karala. River Teesta has 122 species and represents 29 families (Fig.3).

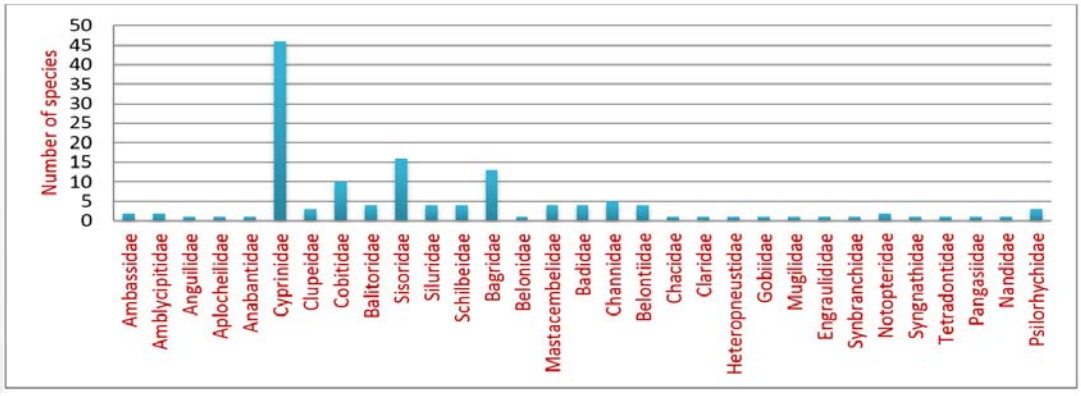

Fig 2: Total family wise distribution of fish diversity in the districts of Cooch Behar, Alipurduar and Jalpaiguri.

River Jaldhaka represents 113 species and 28 families. River Karala has a lower fish diversity than river Teesta and Jaldhaka. River Karala represents 75 species and 24 families. In Alipurduar district, river Raidak-2 has the highest and river Gadadhar has lowest fish diversity (Fig.4). River Raidak-2 represents 106 species and 26 families; river Kaljani represents 99 species and 26 families whereas, river Gadadhar has 89 species and 25 families. Fish diversity of river Kaljani in Cooch Behar is higher than river Torsa and Gadadhar (Fig 5). River Kaljani represents 119 species and 31 families, river Torsa has 115 species and 30 families, river Gadadhar has lowest fish diversity 99 species and 28 families. Comparative study between three districts showed that better environment is represented in Jalpaiguri and Cooch Behar districts than Alipurduar district (Fig.6). Data of above showed that 10 species such as *Puntius ticto, Puntius sophore, Puntius conchonius, Puntius chola, Barilius bendelisis, Cirrhinus mrigala, Mystus tengra, Channa punctatus, Mystus vittatus* and *Channa marulius* were abundant in the system and were collected from all locations throughout the year. Ghosh and Lipton (1982) [14] had reported 172 species of fishes from northeastern India. Choudhury (2005) [9] reported that rich ichthyodiversity of northeast India comprised 297 fish species belonging to 114 genera under 38 families and 10 orders. This forms about 33% of the total Indian fresh water fishes. Goswami *et al.*, (2012) [15] recorded 422 species from North East India; Mahapatra *et al.*, (2015) [20] reported 190 fish species from West Bengal. Acharjee *et al*. (2013) [3], 2014a [1] and 2014b [2]) reported 65 species from Teesta river, 25 species from river Relli and 20 species of loaches from Darjeeling Himalaya. Mahapatra *et al.*, (2015) [20] reported 190 native

freshwater fish species from West Bengal. Dey *et al*. (2015a) [12] reported 138 species from Kaljani river of Cooch Behar and Dey *et al*. (2015b) [11] reported 46 ornamental species from Ghargharia river of Cooch Behar.

Analysis showed, 33 species were commonly found in all the locations, but the number of specimens collected with respect to each species was relatively less. 98 species collected were very less in number. Ornamental fishes were dominant over the food fishes. 100 species have ornamental value and 88 species the food value. All the three types of feeding habits of fishes like carnivorous, omnivorous and herbivorous were available in all these regions. About 101 species of fishes are carnivorous, 29 species are omnivorous and 11 species are herbivorous fish (Table-1). Similar findings were also reported from other tropical rivers of India (Das and Chakrabarty 2007 [10]; Acharjee and Barat 2013 [3]; Dey *et al.*, 2015a [15]).

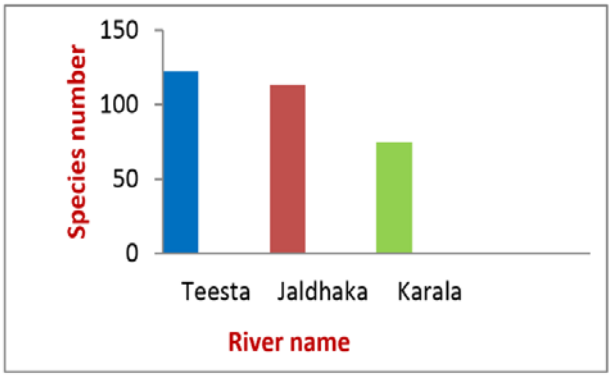

Fig 3: Fish diversity of the rivers of Jalpaiguri district

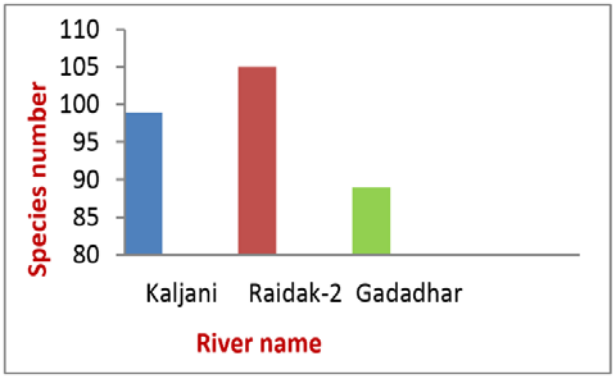

Fig 4: Fish diversity of the rivers of Alipurduar district

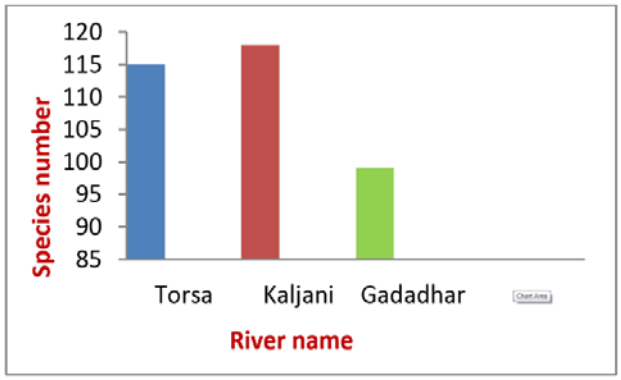

Fig 5: Fish diversity of the rivers of Cooch Behar district

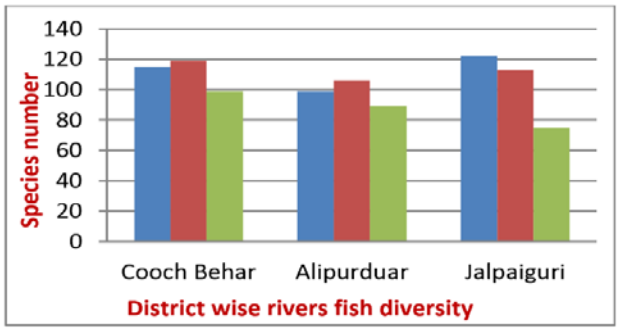

Fig 6: Bar diagram shows the comparative fish diversity of the districts of Cooch Behar, Alipurduar and Jalpaiguri

An insight into the conservation status of fishes as per CAMP (1998) [7] and IUCN (2010) [16] revealed, under the different categories, 66 species are under 'Low Risk Least Concern' (LRlc); 17 species were 'Low Risk Near Threatened' (LRnt); 33 species were 'Vulnerable' (VU). 12 species were 'Endangered' (EN); 8 species were 'Data Deficient' (DD). 4 fish species were 'Not Evaluated' category and One species was critically endangered (Fig7). Similar findings were also reported by Dutta *et al.*, (2012) [13] and Goswami *et al*. (2012) [15] from North- East India and Acharjee and Barat (2014b) [2] and Dey *et al.*, (2015a [12] and 2015b [11]) from West Bengal. *Notopterus notopterus, Notopterus chilata, Anguilla bengalensis, Ompok pabo, Ompok bimaculatus, Gudusia chapra, Tor putitora* and *Tor tor* are endangered fishes which have good economic and high nutrition value. Therefore about 44% fishes are near threats, vulnerable and endangered. In the present study it was indicated that species number increased during the months March to June and September to November (Fig 8). Highest number of species (106) were recorded in April, 2014 and lowest number of species (52) were recorded in August, 2013. At pre-monsoon period fishes migrated into suitable breeding grounds. During post monsoon period fishes migrated for mainly food and habitats. Low diversity of fishes were recorded during monsoon months due to difficulty in fish catching for elevated water level. The highest number of species were recorded while assessing the potential utilization of the collected fishes, it was realized that among 141 species, 100 species have ornamental value.

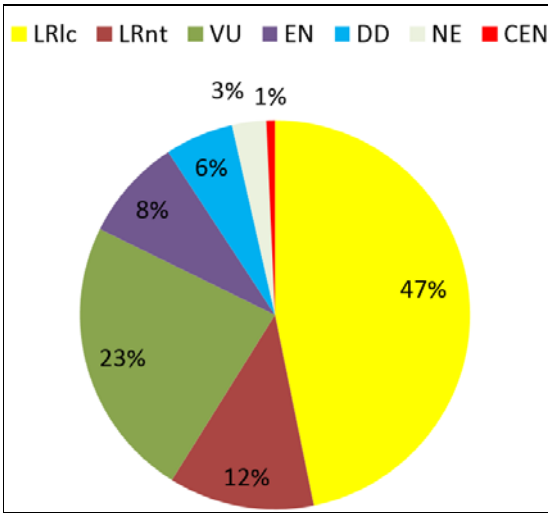

Fig 7: Bar diagram showing the present conservation status of fish in the districts of Cooch Behar, Alipurduar and Jalpaiguri

The highest demandable ornamental species are present like *Pseudambassis ranga, Chanda nama, Colisa lalia, Botia dario, Ctenops nobilis, Danio devario, Botia almorhae, Badis badis, Botia lohachata, Botia rostrata, Botia histrionic, Oreichthys casuatis, Oreichthys crenuchoides, Osteobrama cotio, Danio devario, Hara hara and Microphis deocata*. These species are of high ornamental value and therefore simultaneously can be exploited for commercial purpose. Swain (2008) [25] reported, that about almost 85 % of the exportable ornamental fish are contributed by the North Eastern states.

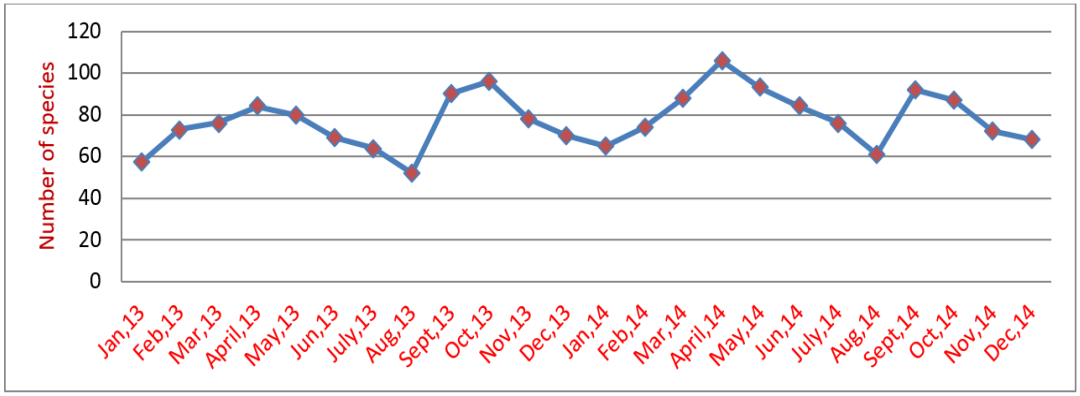

Fig 8: Graph showing the monthly average variation of number of fish diversity in the rivers of the three districts (2013-2014)

The present study showed that 20 endemic species are found in this region. According to CAMP (1998) [7], India has 191 endemic species. Eastern Himalayan rivers represented many endemic species like *Badis badis, Badis bengalensis, Badis assamensis, Ctenop nobilis, Chaca chaca, Conta conta, Olyra longicaudata* and so on. The Eastern Himalayas is an area of considerable endemicity in its freshwater ichthyofauna. Much of this endemicity stems from the presence of numerous hill stream species with highly restricted distributions for example, many members of the Balitoridae and Sisoridae. All known species of the genus Aborichthys are endemic to Brahmaputra drainage in northern Bengal, Meghalaya and Arunachal Pradesh. In monsoon months two *Hilsa* species recorded in rivers of Cooch Behar and Jalpaiguri districts. *Tenualosa toil* was recorded from river Kaljani and Gadadhar in July-August, 2013. *Tenualosa ilisha was* recorded from river Torsa, Kaljani and Teesta in July-August, 2014.

Damming, deforestation, diversion and withdrawal of water for irrigation, urban and industrial consumption have caused large scale changes in the channel bed and hydrology of the river in terms of flow, flow-rate, flood-rhythm and regime. The upland fast-moving habitat has been lost to reservoirs which are unfavourable for rheophilic species (Sarkar *et al.*, 2008) [24]. Wanton killing by stupefying methods of brood fishes in spawning season and juveniles during post-monsoon periods have affected a number of food and game fishes of upland waters. Over-fishing affects heritable life history parameters like growth and age of sexual maturity. Over-exploitation of fishery resources due to its higher economic value has increased the vulnerability of the population in different ecosystems, namely *Tor spp.* and *Schizothorax spp.* in upland waters, *Chitala chitala, Ompok pabda, Pangasius pangasius, Eutropiichthys vacha, Semiplotus semiplotus* and so on in warm water (Mahapatra *et al.*,2015) [21]. Global climate change is likely to result in severe droughts and floods with major impact on human health and food supplies, according to the India's report to the United Nations (Xenopoulos, 2005) [28] reduction in river discharge due to combined effect of climate change and water withdrawal will make up to 75% global freshwater fish biodiversity to become extinct by 2070.

4. Conclusion

A rich fish biodiversity of the Eastern Himalayan region is therefore represented with about 141 fish species in the three districts of Cooch Behar, Alipurduar and Jalpaiguri. Lakra *and* Sarkar (2007) [19] identified North-Eastern India as a hot spot of freshwater biodiversity. Fish diversity of northern part of North Bengal has close similarity with the North-Eastern states of India as shown in the present study. These areas are, therefore, considered as "hot spot"for fresh water fish biodiversity. The drastic modification of freshwater habitats by damming streams on rivers like Teesta river, siltation leading to reduction in their depth has also profoundly affected many fish species like the carp (*Labeo calbasu*), the catfish (*Bagarius bagarius*) and so on. Due to changed habitat, the life cycles of these species have been seriously disrupted. Therefore, unlimited exploitation of untapped wild germplasm resources is highly undesirable. These regions need a strategy for sustainable utilization of resources as well as the development and enhancement of potential untapped fishery resources. Species-specific recovery programmes and broad-area in-situ conservation programmes will enable us to preserve endangered species from becoming extinct due to anthropogenic stresses. 12 endangered species are present in these areas like *Tor putitora, Tor tor, Ompok pabo, Notopterus chitala, Notopterus notopterus, Anguilla bengalensis, Chaca chaca, Gudusia chapra, Botia lohachata, Botia almorhae, Lepidocephalichthys arunachalensis* and *Ompok bimaculatus*. These species have a high market value. The information on endangered fish habitats required can be rapidly acquired and effectively utilized by using modern techniques of remote sensing and Geographic Information Systems. By taking into consideration the socio-economic cost of in-situ conservation programmes and forming networks of local communities, non-governmental organizations (NGOs) and other organizations, the sustainability of such programmes can be ensured. There is also an urgent need to be established fish sanctuary to preserve fish stocks and indigenous brood fishes.

Table 1: Ichthyofauna Diversity of seven rivers of the three Districts (Cooch Behar, Alipurduar and Jalpaiguri) of Eastern Himalaya region.

Sl. No.	Local name	Scientific name	Family	Conservation status	Relative abundance	Food habit	Economic importance	Cooch Behar			Alipurduar			Jalpaiguri		
								Torsa	Kaljani	Gadadhar	Kaljani	Raidak-2	Gadadhar	Teesta	Jaldhaka	Karala
1	*Rui*	*Labeo rohita*(Hamilton - Buchanan)	Cyprinidae	LRnt	+	H	Fd	+	+	+	+	+	+	+	+	+
2	*Calbaus*	*Labeo calbasu*(Hamilton)	Cyprinidae	LRlc	++	H	Fd	+	+	+	+	+	+	+	+	+
3	*Gonya*	*Labeo gonius* (Hamilton)	Cyprinidae	VU	++	H	Fd	+	+	+	+	+	+	+	+	–
4	*Silghorea*	*Labeo dyocheilus*(McClelland)	Cyprinidae	VU	+	H	Fd	+	+	+	+	+	+	+	+	–
5	*Bata*	*Labeo bata* (Hamilton)	Cyprinidae	LRlc	++	H	Fd	+	+	+	+	+	+	+	+	+
6	*Catla*	*Catla catla* (Hamilton-Buchanan)	Cyprinidae	LRlc	+	H	Fd	+	+	+	+	+	+	+	+	+
7	*Mrigel*	*Cirrhinus mrigala* (Hamilton-Buchanan)	Cyprinidae	LRnt	+++	O	Fd	+	+	+	+	+	+	+	+	+
8	*Punti*	*Puntius chola*(Hamilton-Buchanan)	Cyprinidae	LRlc	+++	C	Fd/Or	+	+	+	+	+	+	+	+	+
9	*Punti*	*Puntius conchonius*(Hamilton)	Cyprinidae	LRlc	+++	C	Fd/Or	+	+	+	+	+	+	+	+	+
10	*Punti*	*Puntius phutunio*(Hamilton)	Cyprinidae	LRlc	++	C	Fd/Or	+	+	+	+	+	+	+	+	+
11	*Sarpunti*	*Puntius sarana*(Hamilton)	Cyprinidae	VU	+	C	Fd	+	+	+	+	+	+	+	+	–
12	*Punti*	*Puntius sophore*(Hamilton)	Cyprinidae	LRlc	+++	C	Fd/Or	+	+	+	+	+	+	+	+	+
13	*Punti*	*Puntius stolickanus*(Day)	Cyprinidae	LRlc	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
14	*Teripunti*	*Puntius terio*(Hamilton)	Cyprinidae	LRlc	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
15	*Titpunti*	*Puntius ticto* (Hamilton)	Cyprinidae	LRlc	+++	C	Fd/Or	+	+	+	+	+	+	+	+	+
16	*Punti*	*Oreichthys casuatis* (Hamilton-Buchanan)	Cyprinidae	LRlc	+	C	Fd/Or	+	+	–	–	+	+	–	–	–
17	*Gilipunti*	*Puntius gelius* (Hamilton)	Cyprinidae	LRl	+	C	Fd/Or	+	+	+	+	+	+	+	+	–
18	*Punti*	*Oreichthys crenuchoides* (Schafer)	Cyprinidae	DD	+	C	Fd/Or	+	+	–	–	+	+		–	–
19	*Pithkati*	*Chagunius chagunius* (Hamilton)	Cyprinidae	DD	+	O	Fd/Or	+	+	+	+	+	+	+	+	–
20	*Gilachaki*	*Osteobrama belangeri* (Valencienes)	Cyprinidae	LRnt	+	C	Fd/Or	+	+	+	+	–	+	+	+	–
21	*Gilachaki*	*Osteobrama cotio* (Hamilton)	Cyprinidae	LRlc	+	C	Fd/Or	+	+	+	+	–	+	+	+	–
22	*Chepti puthi*	*Semiplotus semiplotus* (McClelland)	Cyprinidae	VU	+	C	Fd	+	+	+	+	+	+	+	+	–
23	*Putitor*	*Tor putitora* (Hamilton)	Cyprinidae	EN	+	O	Fd	+	–	–	–	+	–	+	+	–

24	*Mahasol*	*Tor tor* (Hamilton)	Cyprinidae	EN	+	O	Fd	+	–	–	–	+	–	+	+	–
25	*Katli*	*Neolissochilus hexagonolepis* (McClelland)	Cyprinidae	LRnt	+	O	Fd	+	–	–	–	+	–	+	+	–
26	*Mola*	*Amblypharyngodon mola* (Hamilton-Buchanan)	Cyprinidae	LRlc	+	H	Fd/Or	–	+	–	–	–	+	–	–	+
27	*Baspati*	*Aspidoparia morar* (Hamilton)	Cyprinidae	VU	+	C	Fd/Or	–	+	–	–	–	–	+	+	–
28	*Khargebata*	*Cirrhinus reba* (Hamilton)	Cyprinidae	VU	+	O	Fd	–	–	–	–	–	+	–	–	–
29	*Kalabatta*	*Crossocheilus latius* (Hamilton-Buchanan)	Cyprinidae	LRlc	+	O	Fd	+	+	+	+	+	+	+	+	+
30	*Klagachhi*	*Garra kempi* (Hora)	Cyprinidae	LRlc	++	H	Fd	+	+	+	+	+	+	+	+	+
31	*Klagachhi*	*Garra gotyla* (Gray)	Cyprinidae	VU	++	H	Fd	+	+	+	+	+	+	+	+	+
32	*Klagachhi*	*Garra lamta*(Hamilton)	Cyprinidae	LRlc	++	H	Fd	+	+	+	+	+	+	+	+	+
33	*Boroli*	*Barilius barila*(Hamilton)	Cyprinidae	VU	++	O	Fd	+	+	+	+	+	+	+	+	–
34	*Boroli*	*Barilius barna*(Hamilton)	Cyprinidae	LRnt	++	O	Fd	+	+	+	+	+	–	+	+	–
35	*Boroli*	*Barilius bendelisis*(Hamilton)	Cyprinidae	VU	+++	O	Fd	+	+	+	+	+	–	+	+	–
36	*Boroli*	*Barilius tileo* (Hamilton)	Cyprinidae	VU	++	O	Fd	+	+	+	+	+	–	+	+	–
37	*Boroli*	*Barilius vagra*(Hamilton)	Cyprinidae	VU	++	O	Fd	–	–	–	+	+	–	+	–	–
38	*Darikana*	*Danio dangila*(Hamilton)	Cyprinidae	LRlc	++	C	Or	+	+	–	+	+	–	+	+	+
39	*Chhebli*	*Devario aequipinnatus* (McClelland)	Cyprinidae	LRlc	++	C	Or	–	–	–	–	+	–	+	+	–
40	*Devriputhi*	*Devario devario*(Hamilton)	Cyprinidae	LRlc	++	C	Or	+	+	+	+	+	+	+	+	+
41	*Darikana*	*Rasbora daniconius* (Hamilton)	Cyprinidae	LRlc	+	C	Or	+	+	+	+	+	–	–	–	–
42	*Laubuca*	*Laubuca laubuca*(Hamilton)	Cyprinidae	LRlc	+	O	Or	–	–	–	–	–	–	+	–	–
43	*Bhola*	*Raiamas bola*(Hamilton)	Cyprinidae	VU	+	C	Fd/Or	–	+	+	–	–	–	+	–	–
44	*Darikana*	*Rasbora rasbora*(Hamilton-Buchanan)	Cyprinidae	LRnt	+	C	Fd/Or	–	–	–	–	–	–	+	+	
45	*Chela*	*Salmophasia bacaila*(Hamilton)	Cyprinidae	LRnt	++	C	Fd/Or	+	+	+	+	+	+	+	+	+
46	*Balitora*	*Psilorhynchus sucatio* (Hamilton)	Cyprinidae	LRlc	+	O	Or	+	+	+	+	+	+	+	+	+
47	*Chapila*	*Gudusia chapra*(Hamilton-Buchanan)	Clupeidae	EN	+	O	Fd	+	+	+	–	–	–	–	+	–

48	*Chandan-Ilish*	*Tenualosa toli*(Valenciennes)	Clupeidae	VU	+	C	Fd	–	+	+	–	–	–	–	–	–
49	*Ilishmach*	*Tenualosa ilisha*(Hamilton-Buchanan)	Clupeidae	VU	+	C	Fd	+	+	_	–	–	–	+	–	–
50	*Betrongi*	*Botia Dario*(Hamilton)	Cobitidae	VU	+	C	Fd/Or	+	+	+	+	–	–	+	–	–
51	*Ladder loach*	*Botia rostrata*(Gunther)	Cobitidae	VU	+	C	Or	–	+	+	–	–	–	–	–	–
52	*Lohachata*	*Botia lohachata (Chaudhuri)*	Cobitidae	EN	+	C	Or	+	+	+	–	–	–	+	+	–
53	*Lohachata*	*Botia almorhae (Grey)*	Cobitidae	EN	+	C	Or	+	+	+	–	–	–	+	+	–
54	*Lohachata*	*Botia histrionic (Blyth)*	Cobitidae	VU	+	C	Or	+	+	_	–	–	–	+	+	_
55	*Daria*	*Pangio pangio(Hamilton)*	Cobitidae	VU	+	C	Or	+	–	+	–	+	–	+	+	–
56	*Ghor poia*	*Cantophrys gongota* (Hamilton)	Cobitidae	VU	+	C	Or	+	+	+	+	+	+	+	+	+
57	*Gutum*	*Lepidocephalichthys arunachalensis*(Datta and Barman)	Cobitidae	EN	++	C	Or	+	+	+	+	+	+	+	+	+
58	*Gutum*	*Lepidocephalichthys berdmorei* (Blyth)	Cobitidae	LRlc	++	C	Or	+	+	+	+	+	+	+	+	+
59	*Gutum*	*Lepidocephalichthys manipurensis* (Arunkumar)	Cobitidae	LRlc	++	C	Or	+	+	+	+	+	+	+	+	+
60	*Balitora*	*Balitora brucei*(Gray)	Balitoridae	NE	+	O	Or	+	+	+	+	+	+	+	+	+
61	*Gutum*	*Aborichthys elongatus*(Hora)	Balitoridae	LRlc	+	O	Or	–	–	–	–	–	–	+	+	–
62	*Poia*	*Schistura fasciata*(Lokeshwar and Vishwanath)	Balitoridae	NE	+	O	Or	–	+	+	+	+	+	+	+	–
63	*Poia*	*Schistura tirapensis*(Kottelat)	Balitoridae	LRlc	+	O	Or	+	+	+	+	+	+	+	+	+
64	*Bagari*	*Bagarius bagarius*(Hamilton)	Sisoridae	VU	+	C	Fd	+	+	+	+	+	+	+	+	+
65	*Tinkata*	*Conta pectinata*(Ng)	Sisoridae	DD	++	C	Or	+	+	–	–	–	–	–	–	–
66	*Tinkantia*	*Erethistes pussilus* (Muller and Troschel)	Sisoridae	LRlc	+	C	Or	+	+	+	+	+	+	+	+	+
67	*Tinkantia*	*Erethistoides Montana*(Hora)	Sisoridae	DD	+	C	Or	+	+	+	+	+	+	+	+	+
68	*Kaoya tengra*	*Gagata cenia*(Hamilton)	Sisoridae	LRlc	+	C	Fd/Or	–	–	–	–	+	+	+	+	–
69	*Kaoya tengra*	*Gagata dolichonema*(He)	Sisoridae	LRlc	+	C	Fd/Or	+	+	+	+	+	+	+	+	–
70	*Tinkata*	*Hara hara*(Hamilton)	Sisoridae	LRlc	++	C	Or	+	+	+	–	–	–	–	–	–
71	*Tinkata*	*Hara Jerdoni*(Day)	Sisoridae	LRlc	++	C	Or	+	+	+	+	+	+	+	+	+
72	*Tinkata*	*Hara koladynensis*	Sisoridae	DD	++	C	Or	–	–	–	–	+	–	–	–	–

		(Anganthoibi and Vishwanath)														
73	*Tinkata*	*Pseudolaguvia ferula* (Ng)	Sisoridae	NE	++	C	Or	–	–	–	–	–	–	+	–	–
74	*Tinkata*	*Pseudolaguvia shawi* (Hora)	Sisoridae	NE	+	C	Or	+	+	–	–	–	–	–	–	–
75	*Sisor*	*Sisor barakensis* (Vishwanath and Darshan)	Sisoridae	VU	+	C	Or	+	+	–	–	–	–	–	–	–
76	*Sisor*	*Sisor rhabdophorus*(Hamilton)	Sisoridae	LRlc	+	C	Or	+	+	–	+	+	–	+	+	+
77	*Kani tengra*	*Glyptothorax indicus* (Talwar)	Sisoridae	LRlc	+	C	Or	+	+	–	+	+	–	+	+	–
78	*Kani tengra*	*Glyptothorax cavia* (Hamilton)	Sisoridae	LRlc	+	C	Or	+	+	–	+	+	–	+	+	–
79	*Kani tengra*	*Glyptothorax telchitta* (Hamilton)	Sisoridae	LRlc	+	C	Or	+	+	–	+	+	–	+	+	–
80	*Pabda*	*Ompok pabda*(Hamilton)	Siluridae	VU	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
81	*Pabda*	*Ompok pabo*(Hamilton)	Siluridae	EN	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
82	*Pabda*	*Ompok bimaculatus* (Bloch)	Siluridae	EN	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
83	*Boyal*	*Wallago attu*(Schneider)	Siluridae	VU	+	C	Fd	+	+	+	+	+	+	+	+	+
84	*Gharya*	*Clupisoma garua*(Hamilton)	Schilbeidae	LRlc	+	C	Fd	+	+	+	+	+	+	+	+	+
85	*Kocha*	*Clupisoma Montana*(Hora)	Schilbeidae	LRlc	+	C	Fd	+	+	+	+	+	+	+	+	+
86	*Muri bacha*	*Eutropiichthys murius* (Hamilton)	Schilbeidae	LRlc	+	C	Fd	+	+	+	+	+	+	+	+	+
87	*Bacha*	*Eutropiichthys vacha*(Hamilton)	Schilbeidae	LRlc	+	C	Fd	+	+	+	+	+	+	+	+	+
88	*Golsha tangra*	*Mystus bleekeri*(Day)	Bagridae	VU	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
89	*Kabasi-tengra*	*Mystus cavasius*(Hamilton)	Bagridae	LRlc	+	O	Fd/Or	+	+	–	+	+	–	–	+	+
90	*Tengara*	*Mystus tengara*(Hamilton)	Bagridae	LRlc	+++	C	Fd/Or	+	+	+	+	+	+	+	+	+
91	*Golsha tengra*	*Mystus gulio*(Hamilton)	Bagridae	LRlc	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
92	*Tengra*	*Mystus vittatus*(Bloch)	Bagridae	VU	+++	C	Fd/Or	+	+	+	+	+	+	+	+	+
93	*Aar*	*Sperata aor* (Hamilton)	Bagridae	VU	+	C	Fd	+	+	+	+	+	+	+	+	+
94	*Guji*	*Sperata seenghala*(Sykes)	Bagridae	VU	+	C	Fd	+	+	+	+	+	+	+	+	+
95	*Batasio*	*Batasio batasio*(Hamilton)	Bagridae	LRlc	+	C	Or	–	–	–	–	–	–	+	–	–
96	*Batasio*	*Batasio fasciolatus*(Ng)	Bagridae	LRlc	+	C	Or	–	–	–	–	–	–	+	+	–
97	*Batasio*	*Batasio merianensis*	Bagridae	DD	+	C	Or	–	–	–	–	–	–	+	+	–

		(Chaudhuri)														
98	*Batashi*	*Batasio tengana* (Hamilton)	Bagridae	LRlc	+	C	Fd/Or	–	–	–	–	–	–	+	+	–
99	*Ritha*	*Rita rita* (Hamilton - Buchanan)	Bagridae	VU	+	C	Fd/Or	–	–	–	–	–	–	+	+	–
100	*Kakhila*	*Xenentodon cancila* (Hamilton)	Belonidae	LRlc	+	C	Or	+	+	+	+	+	+	+	+	+
101	*Panchokha*	*Aplocheilus panchax* (Hamilton)	Aplocheilidae	LRlc	+	O	Or	+	+	+	+	+	+	+	+	+
102	*Bhaim*	*Macrognathus aral* (Bloch and Schneider)	Mastacembelidae	LRlc	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
103	*Bhaim*	*Macrognathus morehensis* (Arunkumar and Tombi)	Mastacembelidae	LRlc	++	C	Fd/Or	+	+	+	+	+	+	+	+	+
104	*Bhaim*	*Macrognathus pancalus* (Hamilton)	Mastacembelidae	LRlc	++	C	Fd/Or	+	+	+	+	+	+	+	+	+
105	*Bhaim*	*Mastacembelus armatus* (Lacepede)	Mastacembelidae	LRlc	++	C	Fd/Or	+	+	+	+	+	+	+	+	+
106	*Napit*	*Badis assamensis* (Ahl)	Badidae	DD	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
107	*Botkoi*	*Badis badis* (Hamilton)	Badidae	LRlc	+	C	Fd/Or	–	+	–	+	+	–	–	–	–
108	*Botkoi*	*Badis badis burmanicus*(Ahl)	Badidae	LRlc	+	C	Fd/Or	–	–	–	–	+	–	–	–	–
109	*Botkoi*	*Badis bengalensis*(Hamilton)	Badidae	LRlc	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
110	*Shol*	*Channa striata* (Bloch)	Channidae	LRlc	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
111	*Cheng*	*Channa bleheri* (Vierke)	Channidae	LRnt	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
112	*Cheng*	*Channa gachua* (Hamilton)	Channidae	LRlc	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
113	*Sal*	*Channa marulius* (Hamilton)	Channidae	LRlc	+++	C	Fd/Or	–	–	–	–	–	–	+	–	–
114	*Lata*	*Channa punctatus* (Bloach)	Channidae	LRlc	+++	C	Fd/Or	+	+	+	+	+	+	+	+	+
115	*Koi*	*Anabas testudineus*(Bloch)	Anabantidae	VU	+	C	Fd	+	+	+	+	+	+	+	+	+
116	*Koleehona*	*Ctenops nobilis* (McClelland)	Belontiidae	LRnt	+	O	Or	–	+	–	+	+	–	–	–	–
117	*Khalisha*	*Colisa fasciatus* (Schneider)	Belontiidae	LRlc	++	C	Or	+	+	+	+	+	+	+	+	+
118	*Khalisha*	*Colisa lalia*(Hamilton - Buchanan)	Belontiidae	LRlc	+	C	Or	+	+	+	+	+	+	+	+	+
119	*Chuna-Khalisha*	*Colisa sota*(Hamilton-Buchanan)	Belontiidae	LRlc	+	C	Or	+	+	–	–	–	–	–	–	–
120	*Lal chanda*	*Pseudambassis ranga* (Hamilton-Buchanan)	Ambassidae	LRnt	++	C	Or	+	+	+	+	+	+	+	+	+
121	*Namchanda*	*Chanda nama* (Hamilton-Buchanan)	Ambassidae	LRnt	++	C	Or	+	+	+	+	+	+	+	+	+

122	*Checa*	*Chaca chaca*(Hamilton-Buchanan)	Chacidae	EN	+	C	Or	+	+	+	+	+	+	+	+	+
123	*Bot-singhi*	*Olyra longicaudata* (McClelland)	Bargridae	LRnt	+	C	Or	+	+	+	+	+	+	+	+	+
124	*Magur*	*Clarius batrachus* (Linnaeaus)	Clariidae	VU	+	C	Fd/Or	+	+	+	+	+	+	+	+	+
125	*Singhi*	*Heteropneustes fossilis* (Bloch)	Heteropneustidae	VU	++	C	Fd/Or	+	+	+	+	+	+	+	+	+
126	*Gang magur*	*Amblyceps mangois* (Hamilton-Buchanan)	Amblycipitidae	LRlc	++	C	Or	+	+	+	+	+	+	+	+	+
127	*Gang magur*	*Amblyceps tuberculatum* (Linthoingambi and Vishwanath)	Amblycipitidae	DD	+	C	Or	+	+	+	+	+	+	+	+	+
128	*Bele*	*Glossogobius giuris* (Hamilton-Buchanan)	Gobiidae	LRnt	+	C	Fd	+	+	+	+	+	+	+	+	+
129	*Khsola*	*Rhinomugil corsula*(Hamilton)	Mugilidae	VU	+	H	Fd/Or	+	+	–	–	–	–	+	–	–
130	*Phesa*	*Setipinna phasa* (Hamilton- Buchanan)	Engraulididae	LRnt	+	C	Fd	–	+	+	–	–	–	–	–	–
131	*Bamish*	*Anguilla bengalensis*(Gray)	Anguillidae	EN	+	O	Fd	+	+	+	+	+	+	+	+	–
132	*Cuchhia*	*Amphipnous cuchia* (Hamilton-Buchanan)	Synbranchidae	VU	+	O	Or	+	+	+	+	+	+	+	+	+
133	*Pholi*	*Notopterus notopterus*(Pallas)	Notopteridae	EN	++	C	Fd	+	+	+	+	+	+	+	+	+
134	*Chital*	*Notopterus chitala* (Hamilton- Buchanan)	Notopteridae	EN	+	C	Fd	+	+	+	+	+	+	+	+	+
135	*Pipe fish*	*Microphis deocata* (Hamilton-Buchanan)	Syngnathidae	LRnt	+	O	Or	+	+	–	+	–	–	+	–	–
136	*Tepa*	*Tetradon cutcutia*(Hamilton-Buchanan)	Tetradontidae	LRnt	++	O	Or	+	+	+	+	+	+	+	+	+
137	*Pangus*	*Pangasius pangasius* (Hamilton-Buchanan)	Pangasiidae	CEN	+	C	Fd	+	+	+	+	+	+	+	+	–
138	*Meni*	*Nandus nandus* (Hamilton-Buchanan)	Nandidae	LRnt	+	C	Or	+	+	+	–	–	–	+	+	–
139	*Balitora*	*Psilorhychus sucatio*(Hamilton)	Psilorhynchidae	LRlc	+	O	Or	+	–	–	–	+	–	+	+	–
140	*Balitora*	*Psilorhychus balitora* (Hamilton)	Psilorhynchidae	LRlc	+	O	Or	+	+	–	–	–	–	+	+	–
141	*Balitora*	*Psilorhychus homaloptera* (Hora and Mukherji)	Psilorhynchidae	LRlc	+	O	Fd	–	–	–	–	–	–	+	–	–

Note: Feeding habit: O= Omnivorous, C= Carnivorous, H=Herbivorus, Economic importance: Fd= Food fish, Or= Ornamental fish. Conservation status: According to IUCN (2010) [16] and CAMP (1998) [7] DD= Data deficient, NE= Not evaluated, VU= Vulnerable, EN= Endangered, CNE= critically endangered, LRnt=Lower risk near threatened, LRlc=lower risk least concern. Abundance category: +++ =abundand species, ++ = less abundand and+ = rear species.

5. References

1. Acharjee ML, Barat S. Seasonal Dynamics of Ichthyofaunal Diversity in a Hill stream of the Darjeeling Himalaya, West Bengal, India. Journal of Threatened Taxa 2014a; 6(14):6635-6648.
2. Acharjee ML, Barat S. Loaches of Darjeeling Himalaya and adjoining areas of West Bengal: their prospects as Ornamental fish and constraints. International Journal of Pure and Applied Bioscience 2014b; 2:258-264.
3. Acharjee ML, Barat S. Ichthyofaunal Diversity of Teesta River in Darjeeling Himalaya of West Bengal, India. Asian Journal of Experimental Biological Sciences 2013; 4(1):112-122.
4. Anonymous. Annual report. National Bureau of Fish Genetic Resources, Lucknow, Uttar Pradesh, India, 1992-1993.
5. Barat S, Jha P, Lepcha RF. Bionomics and Cultural prospects of Katli, Neolissocheilus hexagonolepis (McClelland) in Darjeeling district of West Bengal. In Coldwater Fisheries Research and Development in North-East Region of India (Eds. B. Tyagi, Shyam Sunder and M. Mohan). NRCCWF, Bhimtal. Vikrant Computers Haldwani, 2005, 66-69.
6. Basu A, Dutta D, Banerjee S. Indigenous ornamental fishes of West Bengal. Recent Research in Science and Technology 2012; 4(11):12-21.
7. CAMP. Conservation Assessment and Management Plan Workshops, (Ed) Sanjay Molur and Sally Walker. Published by Zoo Outreach organization. National Bureau of Fish Genetics Resources. Lucknow, India, 1998.
8. CEPF. Ecosystem Profile: Eastern Himalayas Region.Critical Ecosystem partnership fund available: http://www.cepf.net/Documents/final.ehimalayas.ep.pdf, 2005.
9. Choudhury M. Riverine fishery resources of Northeast India. In Coldwater fisheries research and development in North East region of India. eds. Tyagi, B. C., Sunder. S., and Mohan, M. National Research Centre on Cold Water Fisheries (ICAR) Bhimtal, Uttaranchal 2005, 17-19.
10. Das SK, Chakrabarty D. The use of fish community structure as a measure of ecological degradation: a case study in two rivers of India. Bio Syst 2007; 90:188-196.
11. Dey A, Mukherjee A, Sarkar D, Ray N. Status of indigenous ornamental fish diversity and abundance in Ghargharia river in Coochbehar district of West Bengal. Int. J Pure App. Biosci. 2015b; 3(1):133-137.
12. Dey A, Nur R, Sarkar D, Barat S. Ichthyofauna Diversity of river Kaljani in Cooch Behar District of West Bengal, India. Int. J Pure App. Biosci. 2015a; 3 (1):247-256.
13. Dutta NN, Borah S, Baruah D. Potential Ornamental Ichthyofauna of Bordoibam Bilmukh Bird Sanctuary (IBA-site) and implication for conservation, North Eastern India. European Journal of Experimental Biology 2012; 2(5):1632-1638.
14. Ghosh SK, Lipton AP. Ichthyofauna of the NEH Region with special reference to their economic importance. ICAR Research Complex, NEH Region 1, Shillong, 1982, 119-126.
15. Goswami UC, Basistha SK, Bora D, Shyamkumar K, Saikia B, Changsan K. Fish diversity of North East India, inclusive of the Himalayan and in Burma biodiversity hotspots zones: A checklist on their taxonomic status, economic importance, geographical distribution, present status and prevailing threats. International Journal of Biodiversity and Conservation 2012; 4(15):592-613.
16. IUCN. Red List of Threatened Species, 2010. [http://www.iucnredlist.org/apps/redlist/search].
17. Jayaram KC. The Freshwater Fishes of Indian Region. New Delhi: Narendra Publishing House, 1999.
18. Jha P, Mandal A, Barat S. Mahananda Reservoir, W.B.: Its Ichthyofauna, Fishery and Socio- Economic Profile of Fish Production. Fishing Chimes 2004; 24(6):14- 17
19. Lakra WS, Sarkar UK. Fish diversity of Central India. NBFGR Publication, Lucknow, Uttar Pradesh, 2007, 1-183.
20. Mahapatra BK, Sarkar UK, Lakra WS. A Review on Status, Potentials, Threats and Challenges of the Fish Biodiversity of West Bengal. Biodiversity, Bioprospecting and Development, 2015. http:/dx.doi.org/10.4172/2376-0214. 1000140.
21. Mukherjee M, Lepcha RF, Chakraborty C. In: Fish and Fisheries of Himalayan and Terai Region of West Bengal with Ornamental Touch. Published by Daya P.H., 2011, 40-45.
22. Myers N, Mittermeier RA, Fonseca CG, Kent J. Biodiversity hotspots for conservation priorities'. *Nature* 2000; 403:853-0858.
23. Patra AM. Catfish (Teleostei: Siluriformes) diversity in Karala River of Jalpaiguri District, West Bengal, India. Journal of Threatened Taxa. 2011.
24. Sarkar UK, Pathak AK, Lakra WS. Conservation of freshwater fish resources of India: new approaches, assessment and challenges. Biodivers. Conserv 2008; 17:2495-2511.
25. Swain SK. Indigenous Ornamental Fish and their Export Potential. Originally published as a research article in 8th Indian Fisheries Forum Souvenier Article, Nov, 2008.
26. Talwar PK, Jhingran AG. Inland Fishes of India and Adjacent Countries. New Delhi: Oxford and IBH Co., Private Limited, 1991, 1158.
27. Vishwanath W, Mahanta PC, Anganthoibi N, Sarma D. Coldwater Fishes of India-An Atlas. Directorate of Coldwater Fisheries Research (ICAR), Bhimtal, Uttarakhand, India, 2011.
28. Xenopoulos MA, Lodge DM, Alcamo J, Marker M, Schulze K. Scenarios of freshwater fish extinctions from climate change and water withdrawal. Global Change Biology 2005; 11:1557-1564.