

## In search of Ichthyofauna diversity: A study on Torsa river in Cooch Behar district of West Bengal

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### ABSTRACT

The present study was conducted to generate a primary database on ichthyofauna diversity of river Torsa flowing through Cooch Behar district of West Bengal, India. Initial base level study for two years led to an identification of 107 indigenous fish species belonging to 30 families. The family Cyprinidae represented the highest diversity accommodating 16 genera and 32 species. Amongst all the species 33% possess high ornamental value, 40% have only food value and 27%, in spite of being potentially ornamental, used commonly as food fish. Such categorization in diversity reveals the dominance of food fish over ornamental fish. So far as the study on conservation status is concerned, according to CAMP (1998) and IUCN (2010), 107 fish species were enlisted under seven different categories demonstrating 1 (0.93%) species as Critically Endangered, 9 (8.37%) species as Endangered, 16 (14.88%) species as Vulnerable, 14 (13.02%) species as at Lower Risk Near Threatened, 58 (53.94%) species as Lower Risk Least Concerned, 7 (6.51%) species as Data Deficient and 2 (1.86%) species as Not Evaluated status and the status clearly indicates a stress on fish diversity. In response to the outcome, it can be interpreted that anthropogenic pressure arising out of agriculture run offs, heavy pollution of water resources, indiscriminate fishing with harmful fishing technologies and widespread habitation of people are contributing much to such alarming vulnerability of the rich fish diversity in their natural habitat.

**Key words:** Ichthyofauna diversity, Torsa river, Cooch Behar, ornamental fish, food fish, Conservation status

### INTRODUCTION

Coochbehar district of West Bengal lying between 25°57'47" to 26°03'6" North latitude and between 89°05'43" to 88°04'44" East longitude, is very unique in its topography and climatic characteristics bearing terai agro-climatic characteristics and a total water stretch of more than 6121 ha including hill stream rivers, beels and others aquaculture resources. The total riverine network include some major rivers like Torsa, Ghargharia, Kaljani, Gadadhar etc which are the potential source of huge indigenous ichthyofauna diversity along with a considerable number of ornamental fish population. Earlier studies reported 230 fish species from the North Eastern India<sup>12</sup>. 422 species was reported from North East India by Goswami *et al.*<sup>6</sup>. Some information is available on fish diversity in Teesta, Kaljani and Torsa river of North Bengal<sup>1,11,9,4</sup>. Swain *et al.*<sup>13</sup> estimated more than 100 varieties of indigenous ornamental fishes from total Indian freshwater ecosystem. Overall, the reports, till date, are very scanty and insufficient with respect to rich fish diversity in northern part of West Bengal which prompted the present investigation for generation of a primary database on the ichthyofauna diversity and their environment status in Torsa river of Coochbehar district lying under North Bengal.

### MATERIALS AND METHODS

The present investigation was carried out in the river Torsa flowing through Cooch Behar district of West Bengal covering a stretch of 160 km. The river originates from Torsa Chhu located near Chhukha, Bhutan and outfalls in Jamuna river of Bangladesh. The data on occurrence and abundance of indigenous fish were collected during survey and sampling which were carried out for two years (Sep, 2012 to Aug, 2014) at fortnight interval from three selected sites namely Silbari hat, Pundibari and Rajarhat lying under different stretches of river course using cast nets and gill nets of different mesh size (Arun, 1998). The specific river sites and markets at Pundibari, Rajarhat and Cooch Behar barabazar fed with fish catch from Torsa river were surveyed for species diversity and relative abundance study. The specimen were counted, photographed and preserved in formaldehyde solution and identified using standard taxonomic keys of Jayaram<sup>7</sup>, Talwar and Jhingran<sup>14</sup>, Dholakia<sup>5</sup> and Vishwanath<sup>15</sup>. Data were analysed on the basis of availability of species at river sites and markets fed by the river resource.

### RESULTS AND DISCUSSION

Table 1. Fish diversity in Torsa river of Cooch Behar district

S. No.	Local name	Scientific name	Family	IUCN Status	Relative abundance	Type of fish
1	Puti	<i>Puntius conchoni</i> (Hamilton)	Cyprinidae	LRlc	+++	Or/Fd
2	Puti	<i>Puntius phutunio</i> (Hamilton)	Cyprinidae	LRlc	+++	Or/Fd
3	Sar puti	<i>Puntius sarana</i> (Hamilton)	Cyprinidae	VU	+	Fd
4	Puti	<i>Puntius sophore</i> (Hamilton)	Cyprinidae	LRlc	+++	Or/Fd
5	Puti	<i>Puntius stolicianus</i> (Day)	Cyprinidae	LRlc	+	Or/Fd
6	Puti	<i>Puntius terio</i> (Hamilton)	Cyprinidae	LRlc	+++	Or/Fd
7	Puti	<i>Puntius ticto</i> (Hamilton)	Cyprinidae	LRlc	+++	Or/Fd
8	Rohu	<i>Labeo rohita</i> (Hamilton -Buchanan)	Cyprinidae	LRnt	+	Fd
9	Calbaus	<i>Labeo calbasu</i> (Hamilton)	Cyprinidae	LRlc	+	Fd
10	Ghonia	<i>Labeo gonius</i> (Hamilton)	Cyprinidae	LRlc	+	Fd
11	Silghorea	<i>Labeo dyocheilus</i> (McClelland)	Cyprinidae	VU	+	Fd
12	Bata	<i>Labeo bata</i> (Hamilton)	Cyprinidae	LRlc	++	Fd
13	Catla	<i>Catla catla</i> (Hamilton-Buchanan)	Cyprinidae	LRlc	+	Fd
14	Mrigel	<i>Cirrhinus mrigala</i> (Hamilton-Buchanan)	Cyprinidae	LRnt	+	Fd
15	Puti	<i>Puntius chola</i> (Hamilton-Buchanan)	Cyprinidae	LRlc	+++	Or/Fd
16	Puti	<i>Oreochthys casuatis</i> (Hamilton-Buchanan)	Cyprinidae	LRlc	+	Or/Fd
17	Puti	<i>Oreochthys crenuoides</i>	Cyprinidae	DD	+	Or/Fd
18	Crossocheilus	<i>Crossocheilus burmanicus</i> (Hora)	Cyprinidae	LRlc	+	Fd
19	Klagachhi	<i>Garra kempfi</i> (Hora)	Cyprinidae	LRlc	+	Fd
20	Klagachhi	<i>Garra gotyla</i> (Gray)	Cyprinidae	VU	++	Fd
21	Klagachhi	<i>Garra lamta</i> (Hamilton)	Cyprinidae	LRlc	++	Fd
22	Boroli	<i>Barilius barila</i> (Hamilton)	Cyprinidae	VU	++	Fd
23	Pithkati	<i>Chagunius chagunius</i> (Hamilton)	Cyprinidae	DD	+	Fd
24	Gilachaki	<i>Osteobrama belangeri</i> (Valenciennes)	Cyprinidae	LRnt	+	Fd
25	Gilachaki	<i>Osteobrama cotio</i> (Hamilton)	Cyprinidae	LRlc	+	Fd
26	Mahasol	<i>Tor putitora</i> (Hamilton), Mahseer.	Cyprinidae	EN	+	Fd
27	Mahasol	<i>Tor tor</i> (Hamilton)	Cyprinidae	EN	+	Fd
28	Puti	<i>Devario devario</i> (Hamilton)	Cyprinidae	LRlc	++	Or/Fd
29	Darikana	<i>Rasbora daniconius</i> (Hamilton)	Cyprinidae	LRlc	+++	Or/Fd
30	Darikana	<i>Danio dangila</i> (Hamilton)	Cyprinidae	LRlc	+++	Or/Fd
31	Chela	<i>Salmophasia bacaila</i> (Hamilton)	Cyprinidae	LRnt	++	Or/Fd
32	Balichura	<i>Psilorhynchus sucatio</i> (Hamilton)	Cyprinidae	LRlc	+	Or
33	Gutum	<i>Lepidocephalichthys arunachalensis</i> (Datta and Barman)	Cobitidae	EN	+	Or
34	Gutum	<i>Lepidocephalichthys berdmorei</i> (Blyth)	Cobitidae	LRlc	+	Or
35	Gutum	<i>Lepidocephalichthys manipurensis</i> (Arunkumar)	Cobitidae	LRlc	+	Or
36	Lohachata	<i>Botia lohachata</i> (Chaudhuri)	Cobitidae	EN	+	Or/Fd
37	Bou	<i>Botia Dario</i> (Hamilton)	Cobitidae	VU	+	Or/Fd
38	Daria	<i>Pangio pangio</i>	Cobitidae	VU	+	Or

39	<i>Kukur botia</i>	<i>Cantophrys gongota</i> (Hamilton)	Cobitidae	NE	++	Or
40	<i>Poia</i>	<i>Schistura tirapensis</i> (Kottelat)	Balitoridae	LRlc	+	Or
41	<i>Bagari</i>	<i>Bagarius bagarius</i> (Hamilton)	Sisoridae	LRnt	+	Fd
42	<i>Tarkata</i>	<i>Conta pectinata</i> (Ng)	Sisoridae	DD	+++	Or
43	<i>Tinkta</i>	<i>Erethistes pussilus</i> (Muller and Troschel)	Sisoridae	LRlc	+	Or
44	<i>Tinkta</i>	<i>Erethistoides Montana</i> (Hora)	Sisoridae	DD	+	Or
45	<i>Tinkta</i>	<i>Erethistoides senkhiensis</i> (Tamang)	Sisoridae	DD	+	Or
46	<i>Tengra</i>	<i>Gagata cenia</i> (Hamilton)	Sisoridae	LRlc	+	Or/Fd
47	<i>Tengra</i>	<i>Gagata dolichonema</i> (He)	Sisoridae	LRlc	+	Or/Fd
48	<i>Tarkata</i>	<i>Hara hara</i> (Hamilton)	Sisoridae	LRlc	++	Or
49	<i>Ghura</i>	<i>Clupisoma garua</i> (Hamilton)	Schilbeidae	LRlc	+	Fd
50	<i>Murius</i>	<i>Eutropiichthys murius</i> (Hamilton)	Schilbeidae	LRlc	+	Fd
51	<i>Bacha</i>	<i>Eutropiichthys vacha</i> (Hamilton)	Schilbeidae	LRlc	+	Fd
52	<i>Tengra</i>	<i>Mystus bleekeri</i> (Day)	Bagridae	LRlc	+++	Or/Fd
53	<i>Tengra</i>	<i>Mystus carcio</i> (Hamilton)	Bagridae	LRlc	+++	Or/Fd
54	<i>Tarkata</i>	<i>Pseudolaguvia specula</i> (Ng and Lalraliana)	Sisoridae	NE	+	Or
55	<i>Sisor</i>	<i>Sisor barakensis</i> (Vishwanath and Darshan)	Sisoridae	VU	+	Or
56	<i>Sisor</i>	<i>Sisor rhabdophorus</i> (Hamilton)	Sisoridae	LRlc	+	Or
57	<i>Kanitengra</i>	<i>Glyptothorax indicus</i> (Talwar)	Sisoridae	LRlc	+	Or
58	<i>Kanitengra</i>	<i>Glyptothorax cavia</i> (Hamilton)	Sisoridae	LRlc	+	Or
59	<i>Dhal magur</i>	<i>Glyptothorax telchitta</i> (Hamilton)	Sisoridae	LRlc	+	Or
60	<i>Pabda</i>	<i>Ompok pabda</i>	Siluridae	VU	+	Or/Fd
61	<i>Pabda</i>	<i>Ompok pabo</i> (Hamilton)	Siluridae	EN	+	Or/Fd
62	<i>Tengra</i>	<i>Mystus cavasius</i> (Hamilton)	Bagridae	LRlc	+++	Or/Fd
63	<i>Tengra</i>	<i>Mystus tengara</i> (Hamilton)	Bagridae	LRlc	+++	Or/Fd
64	<i>Tengra</i>	<i>Mystus gulio</i>	Bagridae	LRlc	++	Or/Fd
65	<i>Tengra</i>	<i>Mystus vittatus</i> (Bloch)	Bagridae	LRlc	+++	Or/Fd
66	<i>Air</i>	<i>Sperata aor</i> (Hamilton)	Bagridae	VU	+	Fd
67	<i>Gugi</i>	<i>Sperata seenghala</i> (Sykes)	Bagridae	VU	+	Fd
68	<i>Boyal</i>	<i>Wallago attu</i> (Schneider)	Siluridae	VU	+	Fd
69	<i>Kakila</i>	<i>Xenentodon cancila</i> (Hamilton)	Belonidae	LRlc	++	Or/Fd
70	<i>Panchax</i>	<i>Aplocheilus panchax</i> (Hamilton)	Aplocheilidae	LRlc	++	Or
71	<i>Bam</i>	<i>Macrognathus aral</i> (Bloch and Schneider)	Mastacembelidae	LRlc	+	Or
72	<i>Bam</i>	<i>Macrognathus morehensis</i> (Arunkumar and Tombi)	Mastacembelidae	LRlc	+	Fd
73	<i>Gota</i>	<i>Macrognathus pancalus</i> (Hamilton)	Mastacembelidae	LRlc	+++	Or
74	<i>Bam</i>	<i>Mastacembelus armatus</i> (Lacepede)	Mastacembelidae	LRlc	++	Or/Fd
75	<i>Napit</i>	<i>Badis assamensis</i> (Ahl)	Badidae	DD	+	Or
76	<i>Bot koi</i>	<i>Badis bengalensis</i>	Badidae	LRlc	+	Or
77	<i>Shol</i>	<i>Channa striata</i> (Bloch)	Channidae	LRlc	++	Fd
78	<i>Beheri</i>	<i>Channa bleheri</i> (Vierke)	Channidae	LRnt	+	Fd
79	<i>Chang</i>	<i>Channa gachua</i> (Hamilton)	Channidae	LRlc	+++	Fd
80	<i>Lata</i>	<i>Channa punctatus</i> (Bloch)	Channidae	LRlc	+++	Fd
81	<i>Koi</i>	<i>Anabas testudineus</i> (Bloch)	Anabantidae	VU	+	Or/Fd
82	<i>Tepa</i>	<i>Tetradon cutcutia</i>	Tetradontidae	LRnt	+	Or
83	<i>Pangasius</i>	<i>Pangasius pangasius</i> (Hamilton-Buchanan)	Pangasiidae	CEN	+	Fd
84	<i>Meni</i>	<i>Nandus nandus</i> (Hamilton-Buchanan)	Nandidae	LRnt	+	Or/Fd
85	<i>Balitora</i>	<i>Psilorhynchus sucatio</i> (Hamilton)	Psilorhynchidae	LRlc	+	Fd
86	<i>Balitora</i>	<i>Psilorhynchus balitora</i> (Hamilton)	Psilorhynchidae	LRlc	+	Fd
87	<i>Bamish</i>	<i>Anguilla bengalensis</i> (Gray)	Anguillidae	EN	+	Fd
88	<i>Cuchia</i>	<i>Amphipnous cuchia</i> (Hamilton-Buchanan)	Synbranchidae	LRlc	++	Fd
89	<i>Pholi</i>	<i>Notopterus notopterus</i> (Pallas)	Notopteridae	EN	++	Fd
90	<i>Chital</i>	<i>Notopterus chitala</i> (Hamilton- Buchanan)	Notopteridae	EN	+	Fd
91	<i>Pipe fish</i>	<i>Microphis deocata</i> (Hamilton-Buchanan)	Syngnathidae	LRnt	+	Or
92	<i>Gang magur</i>	<i>Amblyceps mangois</i> (Hamilton-Buchanan)	Amblycipitidae	LRlc	+	Or
93	<i>Gang magur</i>	<i>Amblyceps tuberculatum</i>	Amblycipitidae	DD	+	Or
94	<i>Balia</i>	<i>Glossogobius giuris</i> (Hamilton-Buchanan)	Gobiidae	LRnt	++	Fd
95	<i>Shingi</i>	<i>Heteropneustes fossilis</i> (Bloch)	Heteropneustidae	VU	++	Fd
96	<i>Khsola</i>	<i>Rhinomugil corsula</i>	Mugilidae	VU	+	Fd
97	<i>Kholisa</i>	<i>Colisa fasciatus</i> (Schneider)	Belontiidae	LRlc	+++	Or

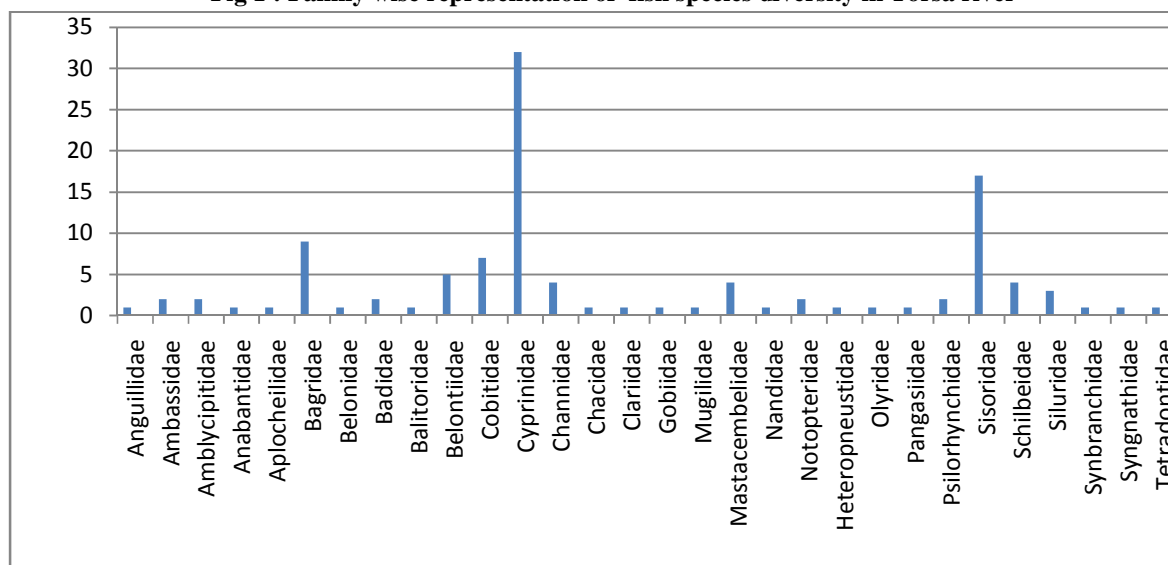
98	<i>Kholisa</i>	<i>Colisa labiosus</i> (Day)	Belontiidae	LRnt	+++	Or
99	<i>Kholisa</i>	<i>Colisa lalia</i> (Hamilton -Buchanan)	Belontiidae	LRlc	++	Or
100	<i>Kholisa</i>	<i>Colisa sota</i> (Hamilton-Buchanan)	Belontiidae	LRlc	+	Or
101	<i>Kholisa</i>	<i>Colisa chuna</i> (Hamilton)	Belontiidae	LRlc	+	Or
102	<i>Chanda</i>	<i>Pseudambassis ranga</i> (Hamilton-Buchanan)	Ambassidae	LRnt	++	Or
103	<i>Chanda</i>	<i>Chanda nama</i> (Hamilton-Buchanan)	Ambassidae	LRnt	++	Or
104	<i>Ritha</i>	<i>Rita rita</i> (Hamilton -Buchanan)	Bagridae	VU	+	Fd
105	<i>Chaca</i>	<i>Chaca chaca</i> (Hamilton-Buchanan)	Chacidae	EN	+	Or
106	<i>Bot-singhi</i>	<i>Olyra longicaudata</i> (McClelland)	Olyridae	LRnt	+	Or
107	<i>Magur</i>	<i>Clarius batrachus</i> (Linnaeus)	Clariidae	VU	++	Fd

According to IUCN and CAMP, DD= data deficient, NE= Not evaluated, VU= vulnerable, EN= endangered, CNE= critically endangered, lower risk near threatened (LRnt), lower risk least concern (LRlc).

### Species diversity

One hundred eleven (107) indigenous fish species belonging to 30 families were collected and identified from three locations of Torsa river and its adjacent landing centres and markets (Table 1). The list of fish were collected together with their local names, commercial values and categorized into highly ornamental (ho), potential ornamental (po) or food fish (fo) species and relative abundance has been illustrated in Table 1. Among the family, Cyprinidae exhibited the largest representation by 32 species, Sisoridae represented 14 species, Bagridae represented 9 species, Cobitidae represented 7 species, Belontiidae represented 5 species and Mastacembelidae, Channidae represented 4 species each. Schilbeidae and Siluriformes represented 3 species each. Ambassidae, Amblycipitidae, Notopteridae, Psilorhynchidae, Badidae showed 2 members from each family and other 16 families like Clupeidae, Anabantidae etc represented single member from each (Fig 1).

Fig 1 : Family wise representation of fish species diversity in Torsa river



### Evaluation of fish germplasm for commercial utilization

While assessing the potential utilization of the collected fishes, it was found that 36 species (33%) like *Lepidocephalichthys berdmorei*, *Olyra longicaudata*, *Colisa fasciatus*, *Colisa lalia*, *Chanda ranga*, *Conta pectinata*, *Pangio pangio*, *Cantophrys gongota*, *Amblyceps mangois* etc possess high ornamental value (33% were identified as 'or'). 29 species (27%) like *Botia dario*, *Botia lohachata*, *Mastacembelus pancalus*, *Macrognaathus aculeatus*, *Esomus danricus*, *Somileptes gongota*, *Danio devario*, *Xenentodon cancila*, *Puntius sophore*, *Puntius ticto*, *Nemacheilus botia*, *Notopterus notopterus*, *Nemacheilus arunachalensis* are potential ornamental fishes and simultaneously can be exploited for commercial purpose (27% were identified as 'Fd/Or'). Remaining 42 species (40%) such as *Barilius barila*,

, *Glossogobius giuris*, *Channa gachua*, *Channa striatus*, *Channa punctatus*, *Rita rita* and *Pseudotropius atherenoides* are primarily used as food fish 40% identified as 'Fd') (Table 1).

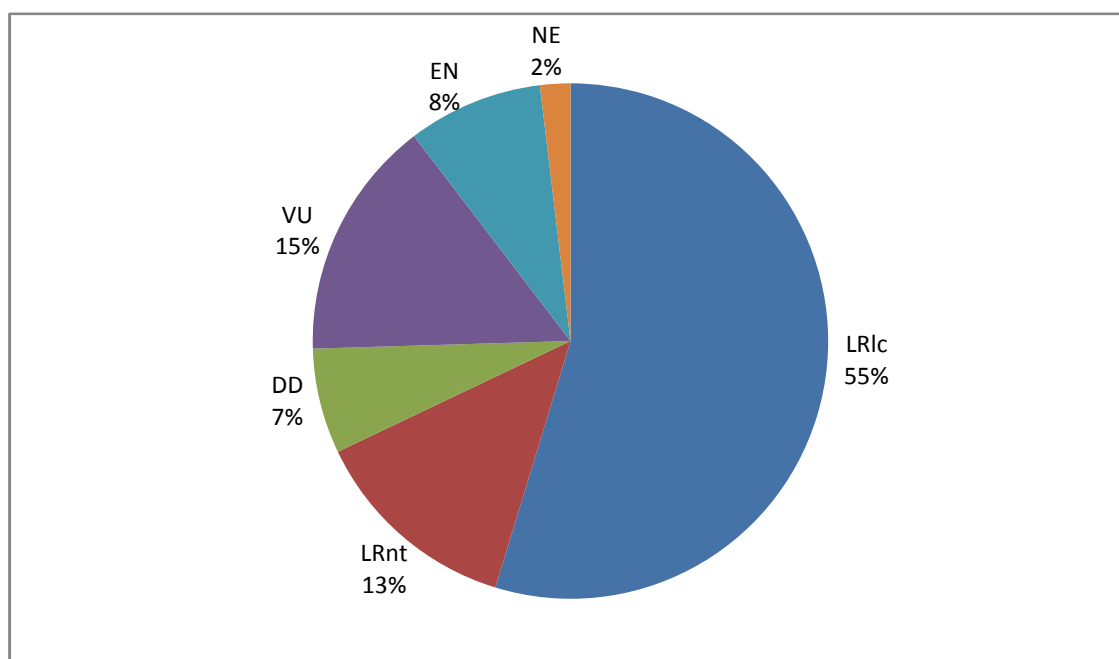
### Relative abundance of fish species

Relative abundance of fish species revealed 19 species such as *Puntius ticto*, *Puntius chonchonius*, *Rasbora daniconius*, *Esomus danricus* and *Pseudotropius atherenoides*, *Conta pectinata*, *Mystus vittatus* etc were plenty in the system and were collected from all locations throughout the year (+++). Whereas 21 species were recorded in all the locations but the number of specimens collected with respect to each species was relatively less (++) . Species such as *Labeo bata*, *Gara gotyla*, *Barilius barila*, *Devario devario*, *Amphipnus cuchia*, *Macragnathus aculeatus*, *Mystus gulio*, *Colisa fasciatus*, *Chanda nama* and *Salmostoma bacaila* belong to this category. Rest 67 species like *Puntius sarana*, *Labeo calbasu*, *Labeo gonius*, *Tor putitora*, *Tor tor* , *Botia lohachata*, *Botia Dario*, *Ompok pabda*, *Pangasius pangasius*, *Nandus nandus* etc were found rare in this area, which could not be collected from more than two locations and the numbers of specimen obtained was very less (+).

### Conservation status of fish

An insight into the conservation status of collected fish as per CAMP<sup>16</sup> (Table1&Fig 2) identified 7 species under 'Data Deficient' (DD) category. 16 species were found vulnerable (VU) and 9 were endangered (EN). 14 species were accounted under the 'low risk near threatened' category (LRnt) and 58 fish species under 'low risk least concern' category (LRlc). 2 species were detected under not evaluated category (NE) and 1 under critically endangered category (CEN). However, irrespective of variable conservation status of fish species, it can undoubtedly be surmised that all the species under threat need adequate attention towards conservation of the individual species as well as their natural habitat with a holistic approach.

Fig 2 : Overall conservation status of fish species in Torsa river of Cooch Behar district



### Anthropogenic Interference

Anthropogenic interference on riverine as well as wetland resources in the form of improper and irrational fish catch, disposal of municipal wastes into the water resources, aquatic weed infestation, agricultural run-off, pesticide use in upper stretch of river for fish catch etc<sup>11</sup> were found to be very common in the present study area also. Fortunately, the chance of industrial pollution in the area under study is very less due to lesser growth of industrial sector.

### CONCLUSION

The present investigation can be treated as a valuable contribution in making the database on the ichthyofauna diversity in different reaches of river Torsa in particular and North Bengal in general. Being closer to North-Eastern part of India, the area also demonstrates its richness towards fish fauna diversity and acts as nursery ground for a huge number of highly demanding ornamental fish species like *Chanda nama*, *Colisa lalia*, *Botia dario*, *Botia lohachata*, *Oreochthys casuatis*, *Oreochthys crenuchoides*, *Osteobrama cotio*, *Conta pectinata Hara hara*, *Lepidocephalichthys berdmorei*, *Olyra longicaudata*, *Colisa fasciatus*, *Pangio pangio*, *Cantophrys gongota*, *Amblyceps mangois*, *Nemacheilus arunachalensis* etc.. The area also depicts rich diversity in food fish. Swain<sup>13</sup> earlier reported the contribution of about 85 % exportable ornamental fish from the North Eastern States though a declining trend of fish diversity due to anthropogenic stress on natural resources of North Bengal had also been pointed out by Sarkar and Ray<sup>11</sup>. Present investigation revealed about 37.32 % of threatened fish population in the river Torsa which is quite lesser than that of river Kaljani and Ghargharia (55%) , two other important rivers of Coochbehar district, as illustrated by Barat et.al.<sup>3</sup> and Sarkar et al.<sup>11</sup> It may be due to introduction of more exotic fishes, as a part of aquaculture for commercial gains, resulting in loss of indigenous ichthyofauna diversity<sup>8</sup>. The intensified fishing activities with the introduction of modern fishing gears and techniques may be another reason for decline in fish population. Therefore, fish sanctuary needs to be established to preserve fish stocks and indigenous brood fishes. Awareness programmes amongst the fishers, strict ban on illegal monsoon fishing and use of proper mesh size nets should also be followed. Besides, the protection of breeding grounds from agricultural run-offs and prohibition of indiscriminate fishing of commercially important fish species should be facilitated which, in future, can ultimately protect and conserve the precious fish germplasm in the river Torsa, Kaljani and many other rivers of North Bengal.

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### REFERENCES

1. Acharjee, M.L. and 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*, **2**: 258-264 (2014).
2. Acharjee, M.L. and Barat, S., Ichthyofaunal Diversity of Teesta River in Darjeeling Himalaya of West Bengal, India. *Asian Journal of Experimental Biological Sciences*, **4(1)**: 112-122 (2013).
3. Barat, S., Jha, P. and Lepcha, R.F., 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, 66-69 (2005).
4. Dey, A., Nur, R., Sarkar, D. and Barat, S., Ichthyofauna Diversity of river Kaljani in Cooch Behar District of West Bengal, India, *Int. J. Pure App. Biosci.*, **3(1)**: 247-256 (2015).
5. Dholakia, A.D., In:Ornamental Fish Culture and Aquarium Management. Published by Daya Publishing House, (2009).
6. Goswami, U.C., Basistha, S.K., Bora, D., Shyamkumar, K., Saikia, B. and 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*, **4(15)**: 592-613 (2012).

7. Jayaram, K.C., The Freshwater Fishes of Indian Region. New Delhi: Narendra Publishing House (1999).
8. Kar, D., Nagarathna, A.V., Ramachandra, T.V. and Dey. S.C., Fish diversity and conservation aspects in an aquatic ecosystem in North Eastern India, *Zoo's Print Journal*, **21(7)**: 2308-2315 (2006).
9. Mukherjee, M. and Sarkar, G., In: Endangered fishes of West Bengal, with a special reference to North Bengal on research, restoration, and Future Plan of action. Published by Deptt. of Fisheries, Aquaculture, Aquatic resources and Fishing Harbour, April (2005).
10. Patra, A.M., Catfish (Teleostei: Siluriformes) diversity in Karala River of Jalpaiguri District, West Bengal, India, *Journal of Threatened Taxa*, (2011).
11. Sarkar, D. and Ray, N., Evaluation of human interference on sustainable fish productivity in the rivers of Coochbehar district of West Bengal. In: Recent advances in Animal Science Research: Vol-III. pp-516-520. Publish by Orion Press International, (2004).
12. Sinha, M., Fish genetic resources of the North Eastern Region of India, *Journal of Inland Fisheries Society of India*, 26: 1-19 (1994).
13. Swain, S.K., Indigenous Ornamental Fish and Their Export Potential. Originally Published as a research article in 8th Indian Fisheries Forum Souvenir Article, Nov (2008).
14. Talwar, P.K. and Jhingran, A.G., Inland Fishes of India and Adjacent Countries. New Delhi: Oxford and IBH Co., Private Limited. 1158 pp (1991).
15. Vishwanath, W., Mahanta, P.C., Anganthoibi, N. and Sarma, D., Coldwater Fishes of India-An Atlas. Directorate of Coldwater Fisheries Research (ICAR),Bhimtal, Uttarakhand, India (2011).
16. 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).
17. IUCN Red List of Threatened Species [<http://www.iucnredlist.org/apps/redlist/search>] Version (2010).
18. Huh, M.K., Fluvial Landscape Ecology and Water Quality at the Jupoo River, Korea *Int. J. Pure App. Biosci.* **3 (3)**: 1-9 (2015).
19. Peter Paul, J.P., *In vitro* Callogenesis of *Solidago virgaurea* L. in Combined Plant Growth Regulators, *Int. J. Pure App. Biosci.* **1(2)**: 1-5 (2013).
20. Mahesha, H.B. and Thejaswini, P.H., Studies on isozymes of amylase, superoxide dismutase and esterase during induction of tolerance against nuclear polyhedrosis in silkworm *Bombyx mori* L., *Int. J. Pure App. Biosci.* **2(2)**: 48-55 (2014).
21. Zuraida, A.R., Erny Sabrina, M.N., Mohd Shukri, M.A., Razali, M., Norma, H., Wan Zaliha, W.S. and Ayu Nazreena, O., *In vitro* Micropropagation of a Valuable Medicinal Plant, Piper crocatum. *Int. J. Pure App. Biosci.* **3 (3)**: 10-16 (2015).