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Small indigenous fish species (SIS) diversity in the River Teesta, Jaldhaka and Torsa, West Bengal, India

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Abstract
Small indigenous fish species (SIS) are very important ecologically and economically. SIS are important source of protein, micro-nutrients, vitamins and minerals. A survey was done on the river Teesta, Jaldhaka and Torsa from March 2014 to February 2016.For each river two site were selected. Sampling was done on the monthly interval. A total of 85 SIS belonged to 6 order and 18 family were recorded from the three river. Cyprinidae was the most dominant family with 33 species followed by Balitoridae (8 species), sisoridae, Cobitidae and Sisoridae (7 species each), Bagridae (6 species), Osphronemidae, Centropomidae and Nandidae (3 species each), Amblyopsidae, Mastacembelidae, Channidae, Olyrida and Psilorhynchus (2 species) and Aplocheilus, Anabantidae, Clupeidae, Clariidae and Schilbeidae (1 species each). Seventy seven SIS were recorded from the river Teesta and Jaldhaka and 67 SIS from the river Torsa. Small indigenous fish species (SIS) were dominant in monsoon season. Number of SIS declined due to over and illegal fishing, habitat destruction, pollution etc.

Keywords: SIS, protein, micro-nutrients, vitamins, minerals

1. Introduction
Teesta, Jaldhaka and Torsa are three important rivers of North Bengal and parts of Brahmaputra drainage system. All the three rivers are glacier feeds and so continuous flow of water. All the rivers of the Dooars region are rich in fish diversity.
Fish which can grow to a maximum size of 25 cm in their mature or adult stage and native to the area is known as small indigenous fish species (SIS) (Felts, 1996) [6]. SIS are important source of protein, macro and micro-nutrients, vitamins and minerals (Thilsted, 1938) [19]. Poor people of North Bengal have consumed SIS and mitigating protein and vitamin deficiency. *Puntius* sp. contain double quantity of iron in comparison to cultured carps such as *Labeo rohita* and *Amblypharyngodon mola* contains fifty times more vitamin-A and three times more calcium than that of *L. rohita* (Villif, 1993) [20]. SIS are still existing in various water bodies such as river, ditches, heels, ponds and Paddy field of North Bengal. But their number decline day by day due to indiscriminate and over fishing, pollution, habitat destruction (Sarkar and Pal, 2017) [15]. If these trends are continuing, SIS will not be available in future. SIS have been already substituted by some exotic carps in their meal in rural area of North Bengal due to limited supply of SIS and suffering from malnutrition.
Considerable study have been done by Shaw and Shebbeare (1937) [17], Hora and Gupta (1941) [7], Menon (1954) [12], Chakraborty and Bhattyachary (2008) [1], Jha and Mandal (2004) [10], Sakar and Pal(2009), Sakar and Pal(2015), Sakar and Pal (2017) [15], Pal (2009), Patra (2011), Acherjee (2012), Patra (2013), Sekhar (2013), Bandyopadhya (2014), Patra (2014), Debnath (2015) [3], Dey *et al*. (2015a) [4], Dey *et al*. (2015b) [5], on the fish diversity of North Bengal but no such study on SIS had been done in this area. Aims of the study was to evaluated the SIS diversity in the river Teesta, Jaldhaka and Torsa.

2. Materials and Methods
Duration of study: Duration of study is two year, from March 2014 to February 2016.

Site of study: Two sites of each river were selected for sampling.

Table 1: Sampling sites of each river.

River	Site-I	Site-II
Teesta	Gajoldoba ($26^0$44'55.4''N $88^0$35'37.0''E)	Haldi Bari ($26^0$23'01.2''N, $88^0$50'38.0''E)
Jaldhaka	Betgara ($26^0$34'41.0''N, $88^0$55'49.4''E)	Mathabhanga ($26^0$19'27.8''N, $89^0$14'17.6''E)
Torsa	Sona Pur ($26^0$30'22.0''N, $89^0$19'38.0''E)	Coochbehar City ($26^0$30'22.0''N, $89^0$19'38.0''E)

Sampling Methods
Sampling was done at monthly interval with the help of local fisherman by using casting net, gill net etc. and then measured the length of fishes and SIS were separated. Immediately photographs were taken with the help of digital camera. Fishes were identified up to the species level with the help of standard references- Shaw and shebbeare (1937) [17], Talwar and Jhingran (1991) [18], Sen (1992) [16], Jayaram (1981, 99) [8, 9] and then preserved in 8% formalin.

3. Result and Discussion
A total of 85 indigenous fish species (SIS) belonged to 18 family and 6 order were found during the study period. Cypriniformes was the dominant order with 50 species followed by Siluriformes (19 species), Perciformes (12 species), Synbranchiformes (2 species) and

Cyprinodontiformes, Clupeiformes one species each. Cyprinidae was the most dominant family with 33 species followed by Balitoridae (8 species), sisoridae, Cobitidae and Sisoridae (7 species each), Bagridae (6 species), Osphronemidae, Centropomidae and Nandidae (3 species each), Amblyopsidae, Mastacembelidae, Channidae, Olyrida and Psilorhynchus (2 species) and Aplocheilus, Anabantidae, Clupeidae, Clariidae and Schilbeidae (1 species each). Highest number of SIS were recorded in the river Teesta and Torsa followed by Jaldhaka.

A total of 77 species belonged to 6 order and 18 family were found in the river Teesta and Torsa. In the river Jaldhaka 67 SIS belonged to 6 order and 18 family were recorded. In river Teesta order Cypriniformes with four family (46 species), order Siluriformes with 6 family (17 species), order perciformes with 5 family (11 species), Cyprinodontiformes, Clupeiformes and Synbranchiformes with one family and one species each. In river Jaldhaka order Cypriniformes with four family (41 species), order Siluriformes with 5 family (13 species), order perciformes with 4 family (9 species), Synbranchiformes with one family (2 species) and Cyprinodontiformes and Clupeiformes with one family and one species each

Table 2: Check list of small indigenous fish species (SIS) in the three rivers and their average size.

Sr. No.	**Order**	**Family**	**Small indigenous fish species(SIS) found**	TST	JAL	TS	Average length
1.	Cypriniformes	Cyprinidae	*Amblypharyngodon mola* (Hamilton)	+	+	+	7-9 CM
2.			*Amblypharyngodon microlepis* (Bleeker)	+	+	+	7-9 CM
3.			*Aspidoparia morar* (Hamilton)	+	+	+	7-11 CM
4.			*Aspidoparia jaya* (Hamilton)	+	+	+	8-10 CM
5.			*Barilius barila* (Hamilton)	+	+	+	8-12 CM
6.			*Barilius barna* (Hamilton)	+	+	+	9-14 CM
7.			*Barilius shacra* (Hamilton)	-	+	+	8-15 CM
8.			*Barilius vagra* (Hamilton)	+	-	+	9-22 CM
9.			*Barilius bendalesis* (Hamilton)	+	+	-	8-21 CM
10.			*Barilius tileo* (Hamilton)	+	+	+	8-18 CM
11.			*Bengala elanga* (Hamilton)	-	-	+	5-9 CM
12.			*Chela laubuca* (Hamilton)	+	+	+	9-14 CM
13.			*Crossocheilus latia* (Hamilton)	+	-	+	6-13 CM
14.			*Danio devario* (Hamilton)	+	+	+	6-9 CM
15.			*Danio rerio* (Hamilton)	+	+	+	6-8 CM
16.			*Danio aequipinnatus* (McClelland)	+	-	-	5-7 CM
17.			*Danio dangila* (Hamilton)	+	+	+	4-6 CM
18.			*Esomus danricus* (Hamilton)	+	+	-	4-6 CM
19.			*Rasbora daniconius* (Hamilton)	+	+	+	3-74CM
20.			*Garra gotyla* (Gray)	+	+	+	4-7 CM
21.			*Garra annandalei* (Hora)	+	-	+	4-6 CM
22.			*Garra lamta* (Hamilton)	+	+	+	4-5 CM
23.			*Garra mcclellan* (Jerdon)	+	+	+	4-6 CM
24.			*Garra meganensis* (Hora)	+	-	+	4-5 CM
25.			*Osteobrama cotio* (Hamilton)	-	+	-	4-6 CM
26.			*Puntius conchonius* (Hamilton)	+	+	+	3-5 CM
27.			*Puntius gelius* (Hamilton)	+	+	+	3-5 CM
28.			*Puntius phutunio* (Hamilton)	+	+	+	3-4 CM
29.			*Puntius stigma* (Hamilton)	+	-	+	3-5 CM
30.			*Puntius sophore* (Hamilton)	+	+	+	3-5 CM
31.			*Puntius ticto* (Hamilton)	+	+	+	3-5 CM
32.			*Oreichthys cosuatis* (Hamilton)	+	-	+	3-4 CM
33.			*Semiplotus semiplotus* (McClelland)	+	+	+	4-6 CM
34.		Psilorhynchus	*Psilorhynchus balitora* (Hamilton)	+	+	+	2-4 CM
35.			*Psilorhynchus sucatio* (Hamilton)	+	+	+	3-4 CM
36.		Balitoridae	*Aborichthys elongatus* (Hora)	+	+	+	5-10 CM
37.			*Nemacheilus botia* (Hamilton)	+	+	+	5-9 CM
38.			*Nemacheilus devdevi* (Hora)	+	-	+	6-10 CM
39.			*Schistura corica* (Hamilton)	+	+	+	6-8 CM
40.			*Schistura repecula* (McClelland)	-	+	+	4-7 CM
41.			*Schistura savona* (Hamilton)	+	+	+	4-6 CM
42.			*Schistura bevani* (Gunther)	+	+	+	5-7 CM
43.			*Schistura multifasciata* (Day)	+	+	+	8-12 CM
44.		Cobitidae	*Acanthocobitis botia* (Hamilton)	+	+	+	6-9 CM
45.			*Acanthophthalmus pangio* (Hamilton)	+	+	-	6-8 CM
46.			*Botia dario* (Hamilton)	+	+	+	5-8 CM
47.			*Botia lohachata* (Chaudhuri)	+	+	+	5-9 CM

48.			*Lepidocephalichthys guntea* (Hamilton)	+	+	+	6-9 CM
49.			*Lepidocephalichthys annandalei* (Chaudhuri)	+	+	+	5-9 CM
50.			*Somileptes gongota* (Hamilton)	+	+	+	7-14 CM
51.	Siluriformes	Bagridae	*Batasio batasio* (Hamilton)	+	+	+	4-8 CM
52.			*Batasio tengana* (Hamilton)	+	+	+	4-8 CM
53.			*Batasio fasciculate* (Ng)	+	-	-	4-8 CM
54.			*Mystus vittatus(Bloch)*	+	+	+	7-12 CM
55.			*Mystus bleekeri*(Day)	+	-	+	7-12 CM
56.			*Mystus tengra* (Hamilton)	-	+	+	7-11 CM
57.		Schilbeidae	*Ailia coila* (Hamilton)	+	-	+	6-12 CM
58.		Sisoridae	*Glyptothorax cavia* (Hamilton)	+	+	+	7-10CM
59.			*Glyptothorax horai* (Shaw & Shakespeare)	+	-	+	6-9 CM
60.			*Glyptothorax lineatus* (Day)	+	+	+	8-10 CM
61.			*Glyptothorax pectinopterus* (McClelland)	-	+	+	6-9 CM
62.			*Glyptothorax telchitta* (Hamilton)	+	+	+	6-10 CM
63.			*Gagata cenia* (Hamilton)	+	+	+	3-4 CM
64.			*Nangra punctata* (Day)	+	+	+	3-5 CM
65.		Olyrida	*Olyra kempi* (Chaudhuri)	+	+	+	4-6 CM
66.			*Olyra longicaudata* (McClelland)	+	-	+	4-6 CM
67.		Amblyopsidae	*Amblyceps mangois* (Hamilton)	+	+	+	5-7 CM
68.			*Amblyceps apangi* (Nath and Dey)	+	-	+	5-7 CM
69.		Clariidae	*Clarias batrachus* (Linnaeus),	+	+	+	18-22 CM
70.	Perciformes	Anabantidae	*Anabas testudineus*(Bloch)	+	-	+	6-10 CM
71.		Channidae	*Channa punctatus* (Bloch)	+	-	+	12-24 CM
72.			*Channa gachua* (Hamilton)	+	+	+	12-24 CM
73.		Centropomidae	*Parambassis baculis* (Hamilton)	+	+	+	2-3CM
74.			*Parambassis ranga* (Hamilton)	+	+	+	2-3 CM
75.			*Chanda nama* (Hamilton)	-	+	-	2-4 CM
76.		Nandidae	*Badis badis* (Hamilton)	+	+	+	3-4 CM
77.			*Badis kanabos*	+	+	-	3-4 CM
78.			*Nandus nandus* (Hamilton)	+	+	+	4-8 CM
79.		Osphronemidae	*Colisa chuna* (Bloch)	+	+	+	5-8 CM
80.			*Colisa fasciatus* (Schneider)	+	+	+	5-8 CM
81.			*Colisa labiosus* (Das)	+	-	+	5-8 CM
82.	Cyprinodontiformes	Aplocheilus	*Aplocheilus panchax* (Hamilton)	+	+	+	4-5 CM
83.	Clupeiformes	Clupeidae	*Gudusia chapra* (Hamilton)	+	+	+	6-8 CM
84.	Synbranchiformes	Mastacembelidae	*Mastacembelus pancalus* (Hamilton)	+	+	+	8-10 CM
85.			*Rhynchobdella aculeate (Bloch)*	-	+	+	7-11 M

TST- Teesta, JAL- Jaldhaka, TS- Torsa, '+' = present '-'= absent

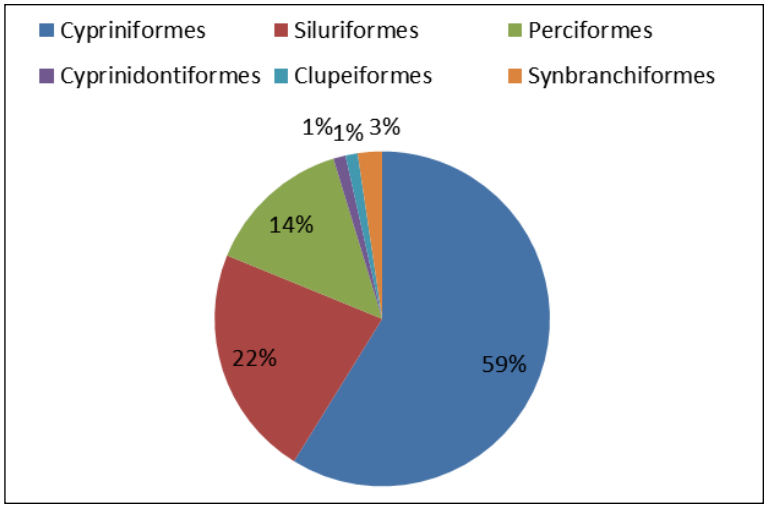

Fig 1: Percent composition of order of SIS in the three rivers

Table 3: Number of species under different Orders in the three rivers.

Order of SIS	Teesta	Jaldhaka	Torsa
Cypriniformes	46	41	45
Siluriformes	17	13	18
Perciformes	11	9	10
Cyprinodontiformes	1	1	1
Clupeiformes	1	1	1
Synbranchiformes	1	2	2

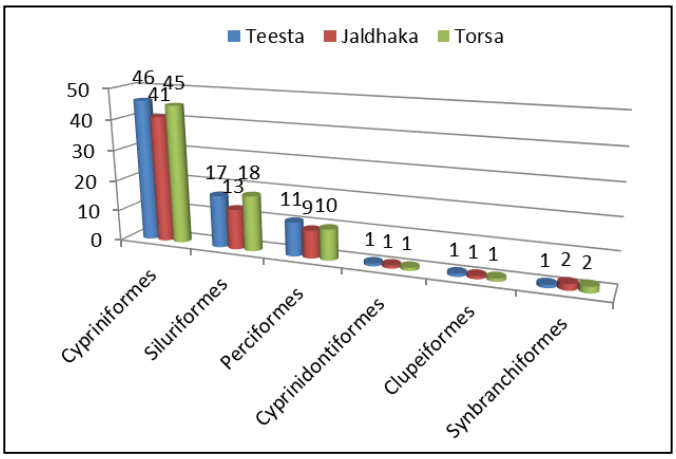

Fig 2:.Number of species under different orders in the three rivers

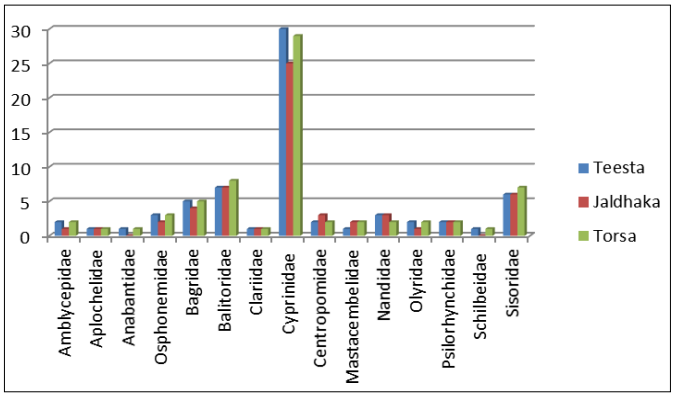

Fig 3: Number of species under different family in the three rivers during the investigation.

In river Jaldhaka order Cypriniformes with four family (45 species), order Siluriformes with 5 family (18 species), order perciformes with 4 family (10 species), Synbranchiformes with one family (2 species) and Cyprinodontiformes and Clupeiformes with one family and one species each.

Many SIS have high market value and demand such as *Barilius* spp. *Batasio batasio*, *Mystus tengra*, *Ailia coila*, *Aspidoparia morar*, *Crossocheilus latia* etc. Over fishing of the above high demand SIS leads to decline their number. Supply of the above SIS are very limited. But other SIS have less market value and demand such as *Puntius* spp., *Danio* spp., *Esomus* sp. *Channa* sp., *Badis* spp., *Colisa* spp. etc. Most dominant indigenous fish species (SIS) are *Puntius* spp., *Barilius* spp., *Nemacheilus* spp., *Lepidocephalichthys* spp. in the three rivers. SIS are dominated during monsoon season in all the rivers but their number decrease gradually in winter season. Most dominated SIS are *Puntius* spp., *Colisa* spp., *Lepidocephalichthys* spp., *Aspidoparia jaya*, *Nemacheilus* spp., *Rasbora daniconius*, *Parambassis baculis* etc.

Among the 85 SIS few are cold water fishes such as *Barilius barila*, *Aspidoparia morar*, *Crossocheilus latia*, *Acanthophthalmus pangio etc.* and few have ornamental value such as *Colisa* spp., *Badis* spp., *Danio rerio* etc.

4. Conclusion

The present investigation indicated that these three rivers are rich in SIS diversity. SIS diversity decrease due to overfishing, habitat destruction, pollution etc. Immediate steps should be taken to prevent fishing during breeding season, prevent over fishing and parts of the river may be treated as sanctuary.

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