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Ichthyofaunal diversity of Mayurakshi River at Birbhum District, West Bengal, India

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Abstract
In the present report an attempt has been made to provide information on species diversity of fish fauna collected from Mayurakshi River in Birbhum district along with their abundance, IUCN status and seasonal variation. Result reveals the existence of 80 species belonging to 23 families under 10 orders of which 3 are recently discovered new species. The most diverse family is Cyprinidae with 30 species and 16 genera. Ichthyofaunal diversity of Mayurakshi River is maximum compared to other eight major rivers of South Bengal. Maximum number of species and families are available in Monsoon and Post-monsoon period while in winter and summer, the number is minimum. Bray-Curtis dissimilarity index is minimum within the season while maximum in between two seasons either summer-monsoon or monsoon-winter.

Keywords: Abundance, Bray-Curtis dissimilarity index, IUCN status, new species, seasonal variation, Suri

1. Introduction
Rivers are dynamic and three-dimensional system that not only holds a great diversity of different species of fish but also have different functions both laterally and longitudinally [1,2]. Due to anthropological activities and intensive agricultural practices, freshwaters including river are the most threatened ecosystem in the world.
The shortage of information about ichthyofaunal diversity in a particular ecosystem like river is a big gap for understanding their role on stabilizing the environmental quality and protection of fish species especially those are little known. By this reason, detail survey of fish fauna, their distribution pattern and seasonal variation will help to develop effective conservation strategy and management of freshwater fishes. In India, especially in West Bengal, conservation of freshwater fishes has never been sufficiently addressed due to lack of scientific data. West Bengal, also known as the "Land of Many Rivers" is divided into two parts by the Ganges: North Bengal and South Bengal. The southern part of the state has many rivers and rivulets, most of which are tributaries like Ajay, Mayurakshi, Rupnarayan, Haldi, Jalangi, Churni, Damodar and others [3]. Nine important rivers drain the western part of South Bengal namely, Damodar, Rupnarayan, Shilabati, Darakeswar, Kangsabati, Keleghai, Mayurakshi, Ajay and Subarnarekha. These are mostly rain-fed rivers as they dried up in the summer and are often flooded in the rainy season. Among these nine rivers of South Bengal, ichthyofaunal diversity have been studied extensively of Damodar [4-8], Kangsabati [9-11], Subarnarekha [12, 13], Keleghai [14, 15], Rupnarayan [16-18]. But till today, there is no detailed report of fish faunal diversity either from Ajay or Mayurakshi river of Birbhum except the study of Rakshit and Ray [19] who reported occurrence of 137 fish species in the major rivers of South Bengal including Mayurakshi and Ajoy. In this context, an attempt has therefore been made to report species composition, seasonal variation and conservation status of freshwater fishes of Mayurakshi river of Birbhum District.

2. Materials and Methods
Fishes were mainly collected from the reservoir at Tilpara Barrage of Mayurakshi River at Suri. Fishermen used gill net to catch the fishes. Each piece of gill net is about 10-12 m long and 1.2-1.5 m wide with mesh size 10-15 mm. Five to eight pieces of nets are joined together to cover a large area of water.

These nets were set in the reservoir water in the afternoon and were taken out in the next morning with the help of small boat locally called "Donga". Beside this, local fishermen used other types of nets like push net, cast net and also used "chalk", "Jhoka", hooks etc. Fishes were collected from these local fishermen even from the anglers on weekly basis from March 2016 to February 2018. After collection, fishes were preserved in 10% formalin solution for further study. A few morphological characters including colour pattern of fishes were recorded at the time of collection for taxonomic confirmation. As number and species of fish varies widely in different season, seasonal variation has also been studied. Four seasons *viz*. summer (March to May), Monsoon (June to September), Post-Monsoon (October and November) and winter (December to February) were considered for assessment of seasonal variation. The fishes were identified with the help of taxonomic references of Qureshi and Qureshi [20], Talwar and Jhingran [21], Nath and Dey [22], and Jayaram [23, 24]. In addition, species of fishes were also verified by available web information. Most of the species are deposited in the "Hamilton Freshwater Fish Museum" Department of Zoology, Rampurhat College, Rampurhat-731224, Dist. Birbhum, West Bengal, India.

Abundance of fishes were classified on the basis of frequency of occurrence i.e. percentage in the catch. The classes are as follows: Very Common (VC) - 30% - 40%, Common (C) - 10% - 30%, Not Rare (NR) - 5% - 10%, Rare (R) - 1% - 5%, and Very Rare (VR) - < 1%. Information on the conservation status of all taxa was retrieved from the IUCN Red List categories and criteria [25].

A modified form of Bray-Curtis dissimilarity index [26] is applied to compare the samples of different families in between two months.

$$BC_{i1i2} = \sum (n_{i1} - n_{i2}) / n_{i1+} + n_{i2+}$$

Where, i1 and i2 are samples and counts are denoted by n_{i1} and n_{i2} and their sample totals are n_{i1+} and n_{i2+}.

This measure takes on values between 0 (identical samples) and 1 (completely non-identical samples). The value is multiplied by 100 for easy interpretation.

3. Results

The present study of fish fauna in the Mayurakshi River includes 80 species of 23 genus under 23 families of 10 orders (Table 1). There are three new species *viz*. *Esomus bengalensis*, *Gagata rhodobarbus* and *Pseudolaguvia flavipinna* discovered recently and which are very rare in occurrence. Acccording to the status of IUCN Red List categories, among these 80 species, more than 81% are 'Least Concern' and others belong to 'Vulnerable', 'Near threatened' and 'Data deficient' category. Among families, Cyprinidae contains more than 37% species followed by Sisoridae, Bagridae, Cobitidae, Chanidae, Siluridae, Schilbidae, Ambassidae. Family Notopteridae, Baltoridae, Mugilidae, Mastamcembelidae, Claridae and Anabantidae have two species each and rest of the families bear only one species each of the total catch, species belong to Cyprinidae are highest in number (70.68%) followed by Bagridae, Schilbidae, Ambassidae and Chanidae while others are less than 1% except Cobitidae (1.59%), Siluridae (1.61%), Sisoridae (1.11%) and Belonidae (1.46%). Seasonal variation is also distinct in different families of fish. Family Cyprinidae and Bagridae are observed throughout the year while other families are mostly absent in either summer or winter. A few families like Siluridae, Schilbidae, Amblycipitidae and Mastamcembelidae though available in summer but totally absent in winter. Moreover, Cyprinidae is the most diverse family comprised of 30 species under 16 genera. Seasonal variation in the number of fish is also remarkable. Monsoon covers 65.54% of total catch coinciding with the favourable conditions such as sufficient water and ample food resources followed by Post monsoon (19.88%), summer (10.22%) and winter (4.38%) (Table 2).

Table 1: List of freshwater fish species collected from Mayurakshi River with their abundance and IUCN status. (EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data Deficient, NE = Not Evaluated)

Family	Species	Abundance	Status with year of assessment and current population trend
Notopteridae	*Notopterus notopterus* (Pallas, 1769)	Rare	LC, 2019. Stable
	Chitala chitala (Hamilton, 1822)	Very rare	NT, 2010. decreasing
Anguillidae	*Anguilla bengalensis* (Gray, 1831)	Rare	NT, 2019. Unknown
Moringuidae	*Moringua raitaborua* (Hamilton, 1822)	Very rare	DD, 2019. Unknown
Clupeidae	*Gudusia chapra* (Hamilton, 1822)	Not rare	LC, 2009. Decreasing
Chanidae	*Channa punctata* (Bloch, 1793)	Very common	LC, 2019. Stable
	Channa striata (Bloch, 1793)	Common	LC, 2019. Stable
	Channa orientalis (Bloch & Schneider, 1801)	Not rare	VU, 2019. Decreasing
Cyprinidae	*Labeo rohita* (Hamilton, 1822)	Very common	LC, 2010. Unknown
	Labeo bata (Hamilton, 1822)	Very common	LC, 2011. Unknown
	Labeo calbasu (Hamilton, 1822)	Common	LC, 2010. Unknown
	Labeo dero (Hamilton, 1822)	Rare	LC, 2010. Unknown
	Labeo gonius (Hamilton, 1822)	Rare	LC, 2010. Unknown
	Barilius barna (Hamilton, 1822)	Rare	LC, 2011. Stable
	Barilius tileo (Hamilton, 1822)	Rare	LC, 2010. Unknown
	Esomus danricus (Hamilton, 1822)	Not rare	LC, 2009. Stable
	Esomus bengalensis Bhakat & Sinha, 2020	Very rare	New species
	Chela cachius (Hamilton, 1822)	Not rare	LC, 2010. Unknown
	Amblypharyngodon mola (Hamilton, 1822)	Very common	LC, 2009. Stable
	Osteobrama cotio (Hamilton, 1822)	Not rare	LC, 2009. Unknown
	Chagunius chagunio (Hamilton, 1822)	Very rare	LC, 2010. Unknown

	Puntius chola (Hamilton, 1822)	Common	LC, 2010. Unknown
	Puntius sophore (Hamilton, 1822)	Common	LC, 2010. Unknown
	Pethia ticto (Hamilton, 1822)	Common	LC, 2019. Unknown
	Puntius sarana (Hamilton, 1822)	Not rare	LC, 2010. Unknown
	Pethia gelius (Hamilton, 1822)	Not rare	LC, 2015. Unknown
	Pethia conchonius (Hamilton, 1822)	Not rare	LC, 2015. Unknown
	Cirrhinus mrigala (Hamilton, 1822)	Very common	LC, 2010. Stable
	Cirrhinus reba (Hamilton, 1822)	rare	LC, 2011. Stable
	Catla catla (Hamilton, 1822)	Very common	LC, 2010, Unknown
	Crossocheilus latius (Hamilton, 1822)	Not rare	LC, 2018. Unknown
	Garra gotyla (Gray, 1830)	Rare	LC, 2011. Unknown
	Garra mullya (Sykes, 1839)	Rare	LC, 2011. Stable
	Garra lamta (Hamilton, 1822)	Rare	LC, 2010. Unknown
	Aspidoparia morar (Hamilton, 1822)	Very rare	LC, 2010. Unknown
	Salmophasia acinaces (Valenciennes, 1844)	Not rare	LC, 2011. Unknown
	Salmophasia bacaila (Hamilton, 1822)	Common	LC, 2011. Stable
	Danio devario (Hamilton, 1822)	Not rare	LC, 2010. Unknown
Balitoridae	*Acanthocobitis botia* (Hamilton, 1822)	Not rare	LC, 2009. Decreasing
	Schistura beavani (Gunther, 1868)	Not rare	LC, 2010. Unknown
Cobitidae	*Botia rostrata* Gunther, 1868	Not rare	VU, 2010. Decreasing
	Botia dario (Hamilton, 1822)	Rare	LC, 2010. Decreasing
	Somileptus gongota (Hamilton, 1822)	Not rare	LC, 2009. Unknown
	Lepidocephalichthys guntea (Hamilton, 1822)	Not rare	LC, 2018. Stable
Bagridae	*Hemibagrus menoda* (Hamilton, 1822)	Rare	LC, 2010. Unknown
	Mystus bleekeri (Day, 1877)	Not rare	LC, 2010. Unknown
	Mystus vittatus (Bloch, 1794)	Common	LC, 2021. Decreasing
	Mystus cavasius (Hamilton, 1822)	Common	LC, 2010. Decreasing
	Mystus tengara (Hamilton, 1822)	Not rare	LC, 2010. Unknown
	Sperata aor (Hamilton, 1822)	Common	LC, 2011. Stable
Siluridae	*Ompok pabo* (Hamilton, 1822)	Not rare	NT, 2010. Decreasing
	Ompok bimaculatus (Bloch, 1794)	Common	NT, 2010. Unknown
	Wallago attu (Bloch & Schneider, 1801))	Common	VU, 2019. Decreasing
Schilbidae	*Clupisoma garua* (Hamilton, 1822)	Rare	LC, 2010. Decreasing
	Eutropiichthys vacha (Hamilton, 1822)	Not rare	LC, 2010. Decreasing
	Neotropius atherinoides (Bloch, 1794)	Not rare	LC, 2009. Unknown
Amblycipitidae	*Amblyceps mangois* (Hamilton, 1822)	Rare	LC, 2009. Unknown
Sisoridae	*Bagarius bagarius* (Hamilton, 1822)	Very rare	VU, 2022. Decreasing
	Gagata cenia (Hamilton, 1822)	Rare	LC, 2010. Unknown
	Gagata rhodobarbus Bhakat & Sinha, 2019	Very rare	New species
	Glyptothorax telchitta (Hamilton, 1822)	Not rare	LC, 2010. Unknown
	Glyptothorax cavia (Hamilton, 1822)	Rare	LC, 2010. Unknown
	Pseudolaguvia ferula (Ng, 2006)	Rare	DD, 2010. Unknown
	Pseudolaguvia flavipinna Bhakat, 2019	Very rare	New species
Claridae	*Clarias batrachus* (Linnaeus, 1758)	Common	LC, 2019. Stable
	Heteropneustes fossilis (Bloch, 1794)	Common	LC, 2019. Stable
Mugilidae	*Rhinomugil corsula* (Hamilton, 1822)	Rare	LC, 2010. Unknown
	Minimugil cascasia (Hamilton, 1822)	Rare	LC, 2009. Unknown
Belonidae	*Xenentodon cancila* (Hamilton, 1822)	Common	LC, 2019. Unknown
Synbranchidae	*Monopterus cuchia* (Hamilton, 1822)	Very rare	LC, 2010. Unknown
Mastamcembelidae	*Macrognathus pancalus* (Hamilton, 1822)	Not rare	LC, 2010. Unknown
	Mastacembelus armatus (Lacepede, 1800)	Not rare	LC, 2019. Stable
Ambassidae	*Chanda nama* (Hamilton, 1822)	Not rare	LC, 2010. Decreasing
	Parambassis lala (Hamilton, 1822)	Rare	NT, 2012. Stable
	Parambassis ranga (Hamilton, 1822)	Not rare	LC, 2012. Stable
Badidae	*Badis badis* (Hamilton, 1822)	Not rare	LC, 2010. Unknown
Gobiidae	*Glossogobius giuris* (Hamilton, 1822)	Not rare	LC, 2019. Unknown
Anabantidae	*Anabas cobojius* (Hamilton, 1822)	Very rare	DD, 2010. Unknown
	Anabas testudineus (Bloch & Schneider, 1801)	Common	LC, 2019. Stable
Belontidae	*Colisa fasciatus* (Bloch & Schneider, 1801)	Common	LC, 2010. Unknown

Table 2: Seasonal variation in the number of fish belongs to 23 families collected from Mayurakshi River (summation of two years 2016-2018, 4 samples / month)

Family	Summer			Monsoon				Post-monsoon		Winter			Total	%
	M	A	M	J	J	A	S	O	N	D	J	F		
Notop.	-	-	-	6	9	15	6	2	-	-	-	-	38	0.17
Anguil.	-	-	-	-	-	16	14	-	-	-	-	-	30	0.14
Moring.	-	-	-	-	3	6	2	-	-	-	-	-	11	0.05
Clupei.	-	-	1	24	28	25	23	11	5	-	-	-	117	0.53
Chanid.	-	7	21	179	195	190	132	20	-	-	-	-	744	3.37
Cyprin.	479	626	836	1580	1978	2744	2806	2058	1572	390	238	281	15588	70.68
Balito.	-	-	-	17	36	47	14	-	-	-	-	-	114	0.52
Cobiti.	-	-	1	56	86	86	66	34	12	-	-	-	351	1.59
Bagrid.	41	38	99	229	402	333	314	247	71	22	9	17	1822	8.26
Siluri.	1	2	4	58	75	91	69	39	15	2	-	-	356	1.61
Schilb.	8	8	17	152	211	205	116	13	32	2	-	-	764	3.46
Amblyc.	1	1	2	7	23	15	12	3	3	-	-	-	67	0.30
Sisori.	-	-	-	34	84	57	60	10	-	-	-	-	245	1.11
Clarid.	2	2	13	11	12	13	16	10	7	1	-	-	87	0.39
Mugili.	-	-	-	8	7	7	7	1	1	-	-	-	31	0.14
Beloni.	-	2	4	71	60	69	49	44	22	1	-	-	322	1.46
Synbra.	-	-	-	2	3	5	2	-	-	-	-	-	12	0.05
Mastam.	2	1	6	31	26	22	30	13	6	2	-	-	139	0.63
Ambass.	-	-	13	185	136	185	144	68	23	-	-	-	754	3.42
Badida.	-	-	2	13	15	15	12	6	-	-	-	-	63	0.29
Gobiid.	-	-	8	35	35	29	20	12	4	-	-	-	143	0.65
Anaban.	-	-	1	32	52	25	43	8	-	-	-	-	161	0.73
Belonti.	-	-	1	19	26	27	20	10	3	-	-	-	106	0.48
Total	534	687	1029	2749	3502	4227	3997	2609	1776	420	247	298	22055	
Mean (SE)	66.75 (8.72)	85.88 (4.98)	128.63 (14.25)	343.63 (8.16)	437.75 (34.65)	528.38 (18.36)	497.13 (21.55)	326.13 (46.51)	222.0 (5.95)	52.50 (5.97)	30.88 (2.06)	37.25 (4.04)		

Table 3: Ichthyofaunal diversity of some major riverine system of South Bengal.

Name of the river and their location	Fish diversity			Reference
	Species	Family	Order	
Damodar				
Burdwan district	46	18	07	Saha & Patra, 2013 [6]
Durgapur Barrage	36	14	-	Dey *et al.*, 2013 [7]
Panchet Resrvoir	62	20	-	Sandhya *et al.*, 2019 [8]
Upstream and downstream	79	-	-	Rakshit & Ray, 2022 [19]
Kangsabati				
Reservoir	47	-	-	Mukherjee & Praharaj, 2009 [9]
Reservoir	39	15	07	Bera *et al.*, 2014 [10]
Paschim Medinipur district	45	17	08	Kar *et al.*, 2016 [11]
Upstream and downstream	117	-	-	Rakshit & Ray, 2022 [19]
Keleghai				
Medinipur district	20	17	09	Jana *et al.*, 2015 [14]
Entire stretch	55	21	09	Pahari *et al.*, 2017 [15]
Upstream and downstream	124	-	-	Rakshit & Ray, 2022 [19]
Rupnarayan				
Kolaghat, Purba Medinipur	38	24	10	Ghorai, 2018 [16]
Purba Medinipur district	36	24	08	Bera & Mishra, 2021 [18]
Upstream and downstream	112	-	-	Rakshit & Ray, 2022 [19]
Subarnarekha				
Entire stretch	66	21	07	Karmakar *et al.*, 2008 [12]
Upstream and downstream	125	-	-	Rakshit & Ray, 2022 [19]
Shilabati				
Upstream and downstream	92	-	-	Rakshit & Ray, 2022 [19]
Darakeswar				
Upstream and downstream	82	-	-	Rakshit and Ray, 2022 [19]
Ajoy				
Upstream and downstream	64	-	-	Rakshit & Ray, 2022 [19]
Mayurakshi				
Upstream and downstream	67	-	-	Rakshit & Ray, 2022 [19]
Tilpara Barrage	80	23	11	Present study

Table 4: Values of Bray-Curtis dissimilarity index in between two months, calculated on the number of fish collected per month from Mayurakshi River in two years (2016-2018).

	Summer			Monsoon				Post-monsoon		Winter		
	M	A	M	J	J	A	S	O	N	D	J	F
A	13.19											
M	31.67	19.23										
J	67.47	60.01	45.63									
J	73.54	67.20	54.62	14.16								
A	77.57	72.04	60.84	21.90	13.39							
S	76.32	53.39	58.85	23.25	16.59	5.34						
O	66.02	58.31	43.87	21.13	17.30	23.67	20.77					
N	53.77	44.78	31.05	17.08	32.70	40.83	38.26	19.86				
D	12.37	22.76	42.03	73.49	78.58	81.92	80.90	72.27	61.75			
J	36.75	67.77	61.29	83.51	86.82	87.15	88.30	82.70	75.58	25.79		
F	28.37	38.78	55.09	77.16	84.32	85.04	86.06	78.63	71.26	16.99	9.36	

Compared to species diversity of fish fauna of other major rivers of South Bengal, Mayurakshi River have more species in a particular locality (80 species of 23 families of 11 order). In Damodar River, Panchet Reservoir contains maximum number of species (62 belongs to 20 orders) [8], while Kangsabati Reservoir house 47 species [9]. Entire stretch of Keleghai and Subarnarekha River contain 55 [15] and 66 [12] species of fish respectively. But Rupnarayan River of Purba Medinipur district have only 36 species of fish belong to 24 family [18] (Table 3).

Bray-Curtis dissimilarity index values were calculated on the basis of the number of fish of different families collected per month and presented in Table 4. The lowest values are observed within the season e.g., 5.34 in between August-September (Monsoon) or 9.36 in between January-February (winter). It indicates families within a particular season are mostly common. While the values are maximum i.e. most dissimilar, in between two different season e.g., 88.30 in between September-January (monsoon and winter) or 77.57 in between March-August (summer and monsoon).

4. Discussion

Rakshit and Ray [19] studied fish faunal diversity in the upstream and downstream locations of major rivers of south Bengal and recorded 137 species of fish with their orders and families including Mayurakshi river of Birbhum district. They reported 67 species of fish collected from Mayurakshi River and its adjacent wetlands but are not provided the species list. But the present study includes 80 species of fish of which a few genera and species are not recorded in their report. These are *Gagata rhodobarbus* (new species), *Esomus bengalensis* (new species), *Pseudolaguvia flavipinna* (new species), *Pseudolaguvia cenia*, *Glyptothorax cavia*, *Glyptothorax telchitta*, *Aspidoparia morar*, *Garra lamta*, *Barilius teleo*, *Hemibagrus menoda*, *Amblyceps mangois*, *Acanthocobitis botia*, *Moringua raitaborua*.

The present work reveals that Mayurakshi River is comparatively rich in fish faunal diversity among rivers of South Bengal. Mongalekar *et al.* [27] reported 267 species of fish belonging to 123 genera, 40 families of 12 orders from West Bengal. Later, Chanda and Jana [28] in their review recorded 297 species of fish from the state. Rakshit and Ray [19] reported 137 species of fish in major rivers of South Bengal. The present study constitutes 26.94% of the freshwater fish species of West Bengal and 58.39% of fish fauna of South Bengal. A huge number of fish as well as species in different season indicates the rich biodiversity of the Mayurakshi River. The fish faunal diversity is low in both summer and winter, only a few families are observed in these two months. In summer, it is due to scarcity of water and high temperature while in winter, due to very low temperature. But both in Monsoon and Post-monsoon, species richness is maximum due to availability of water and food resources and thus almost all families are available in these months.

5. Conclusion

In the present study, report of a few uncommon genera and species including discovery of new species from Mayurakshi River indicates healthy sustainable environment for survivability of fish species. This can be endorsed by the study of Ghosh *et al.* [29] who showed that limited human-influenced disturbance of the water quality of the Mayurakshi riverine system. On the basis of utilization criteria of the river water *viz.* degree of domestic use, agricultural practices and fisheries, the water quality of this river was found ecologically sustainable with self-purification capacity [29]. Though in recent years, illegal sand mining in the river bed poses a great threat in the natural flow of the river and in some area, it changes the natural habitat and niche of the small fishes. To preserve the integrity of the aquatic ecosystem of Mayurakshi River, different conservation strategies should be strictly enforced including total stoppage of illegal sand mining. The present findings would be very helpful for future planning, management and conservation of fish resources of Mayurakshi River.

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7. References

1. Marchetti ZY, Minotti PG, Ramonell CG, Schivo F, Kandus P. NDVI patterns as indicator of morphodynamic activity in the middle Parana River floodplain. Geomorphology. 2016;253:146-158.
2. Petts GE, Amoros C. The fluvial hydro system. In: The Fluvial Hydro systems. Springer, Dordrecht; c1996. p. 1-12.
3. Mirza MMQ. The Ganges water diversion: Environmental effects and implications - an introduction. In: The Ganges Water Diversion: Environmental Effects and Implications. Springer, Dordrecht; c2004. p. 1-12.
4. Sarkar L, Banerjee S. Ichthyofauna of Damodar river system. Proceedings Zoological Society, Calcutta. 2000;53(1):41-54.
5. Sarkar L, Banerjee S. Breeding ground profile of food fish species in Damodar River System. International

Journal of Biology. 2010;2(1):51-61.
6. Saha M, Patra BC. Present status of ichthyofaunal diversity of Damodar River at Burdwan District, West Bengal, India. International Journal of Scientific and Research Publications. 2013;3(6):1-11.
7. Dey S, Roy US, Pal A. Studies on fish fauna at Durgapur barrage and its adjacent wetland areas with an eye to the physicochemical conditions of Damodar river from Durgapur, West Bengal, India. Journal of Applied Sciences in Environmental Sanitation. 2013;8(1):17-22.
8. Sandhya KM, Lianthuamluaia L, Karnatak G, Sarkar UK, Kumari S, Mishal P, *et al.* Fish assemblage structure and spatial gradients of diversity in a large tropical reservoir, Panchet in the Ganges basin, India. Environmental and Pollution Research. 2019;26(18):18804-18813.
9. Mukherjee M, Praharaj A. Kangsabati Reservoir fisheries development new policy approaches through multidisciplinary field demonstration to rural people. Fishing Chimes. 2009;29(1):112-121.
10. Bera A, Bhattacharya M, Patra BC, Sar UK. Ichthyo-faunal diversity and water quality in the Kangsabati Reservoir, West Bengal, India. Advances in Zoology. 2014;674313:1-8.
11. Kar A, Bhattacharya M, Ghorai M, Patra S, Patra BC. Ichthyofaunal diversity of Kangsabati River at Paschim Medinipur District, West Bengal, India. Proceedings of the Zoological Society. 2017;70(2):165-173.
12. Karmakar AK, Das A, Banerjee PK. Fish fauna of Subarnarekha. Records of the Zoological Survey of India. Occasional paper. 2008;283:1-57.
13. Ghosh A, Bhaumik U, Satpathy BB. Fish diversity of Subarnarekha estuary in relation to salinity. Journal Inland Fisheries Society of India. 2011;43(1):51-61.
14. Jana A, Sit G, Maiti K. Ichthyofaunal diversity of Keleghai River at Medinipur district in West Bengal. International Research Journal of Basic and Applied Sciences. 2015;1:24-26.
15. Pahari PR, Chakraborty D, Sarkar SK, Bhattacharya T. Ichthyofaunal diversity of Keleghai River, West Bengal, India. International journal of Pharmaceutical Research and Bioscience. 2017;6(6):24-26.
16. Ghorai M. Diversity and present conservation status of fish fauna in the Rupnarayan River in Kolaghat of Purba Medinipur District of West Bengal, India. International Journal of Scientific Development and Research. 2018;3(2):115-123.
17. Ghorai M. Patra BC. Sar UK. Bhattacharya M. Jana HK, Kar A. the impact of coal fly power station on distribution and diversity of freshwater fishes in Rupnarayan River, West Bengal, India. International Journal of Current Research. 2015;7(12):23954-23961.
18. Bera S, Mishra NK. Water quality and fish diversity of Rupnarayan River in Kolaghat of Purba Medinipur District of West Bengal, India. International Journal of Fisheries and Aquatic Studies. 2021;9(6):01-06.
19. Rakshit A, Ray S. Niche heterogeneity in vulnerable habitat conditions maintains and amplify fish diversity in rivers of South Bengal, India. Ecology, Environment & Conservation. 2022;28(1):479-490.
20. Qureshi TA, Qureshi NA. Indian fishes. Bhopal (MP), Brij Brothers, 1983, 1-209.
21. Talwar PK, Jhingran AG. Inland fishes of India and adjacent countries. Oxford and IBH Publishing Co., New Delhi. 1991;1(2):1-1158.
22. Nath P, Dey SC. Fish and fisheries of north eastern India (Arunachal Pradesh). Delhi, Narendra Publishing House; c2000. p. 1-217.
23. Jayaram KC. Catfishes of India. Delhi, Narendra Publishing House; c2009, 22+383.
24. Jayaram KC. The freshwater fishes of the Indian region. 2nd Ed. Delhi, Narendra Publishing House; c2013, 30+616.
25. IUCN. The IUCN Red List of Threatened Species. IUCN, Gland, Switzerland and Cambridge, UK; c2022.
26. Bray JR, Curtis JT. An ordination of the Upland Forest Communities of Southern Wisconsin. Ecological Monographs. 1957;27(4):325-349.
27. Mongalekar HS, Canciyal J, Ansar CP, Bhakta D, Biswas I, Kumar Deepak. Freshwater fish diversity of West Bengal, India. Journal of Entomology and Zoology Studies. 2017;5(2):37-45.
28. Chanda A, Jana A. A comparative review on freshwater fish fauna between West Bengal and Odisha, two middle-east Indian states. Journal of Fisheries. 2021;9(2):93302.
29. Ghosh S, Chaudhury S, Manoj K. An appraisal of the Mayurakshi river system water quality: The Agrarian Basin. SSRG International Journal of Agriculture & Environmental Science. 2017;4(4):50-56.