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Fish Species Diversity of the Lower Stretch of River Damodar with References to Pollution Effect

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Abstract:

Documentation of Icthyofauna reveals the present status of fish diversity and also indicates the effect of anthropogenic activities. Flow diversion is a serious problem of Damodar River in the lower valley, because the original pathway is totally dried up and in place of it a man-made channel has been drawn which represents the river at present. This channel joins river Hooghly at Attannogate. Investigation was done from Tarakeshwarup to Attannogate to reveal the existing fish faunal diversity of this confluence area. The present study reveals that the confluence stretches of Damodar River houses 65 fish species belonging to 13 Orders,24 Families and 49 Genera. The study indicates that 12 fish species recorded are brackish water fish.These brackish species entered due to tidal influences and are considered as transient species.The process of migration was revealed at this region,where those transient species were recorded to migrate upstream up to Tarakeshwar area. At Tarakeshwar spawns of these fishes were recorded during the post-monsoon season. At Tarakeshwar and Attannogate WQI is below 30, which indicates favourable aquatic habitat for fishes. Moreover, *Clupisoma garua,Gonialosa manmina,Septipinna phasa*had very high value catch data annually from Attannogate region which is a positive sign to the favorable aquatic condition.The physiochemical water quality parameters have been recorded during the study period and result indicated that water of Damodar river at the confluence was suitable for irrigation and also suitable habitat for fish conservation.

Keywords: *River; Pollution; Icthyofauna; Water Quality*

Introduction:

The Damodar River is a main tributary of River Hooghly and one of the most important among all other east flowing rivers. It flows through an undulating topography at its origin passes through hilly areas of Chotonagpur plateau created several falls and gorges on its way. The river originates from the hills of Chotonagpur in Jharkhand drains through undulating upper and middle valley and ultimately joins River Hooghly at Attannogate near Kolkata. The narrow upper valley flows through Gorge and rushing stream carries silt and mud with it which is deposited in the lower valley and as a result the depth of the riverbed rises, which leads to frequent flood. The river houses a good

number of food fishes in the past (Sarkar & Banerjee,2012) but this research reveals the ichthyofaunal diversity of the lowervalley in the context of increasing water pollution. So, it is utmost necessary to identify and create proper documentation of fish species of lower Damodar River in order to develop an estuarine fish species diversityinformation system.

Methodology

Collection of Fish species: The present study was conducted during August 2020 to December 2023 and fishes were collected from eight collection sites including 1.Tarakeshwar,2.Santhoshpur,3.Bikunthapur,4.Deulpara,5.Attannogate,6.Garchumuk,7 .Silampur, 8.Madaribar with the help of local fishermen using different type of nets, namely Cast net, Dragnet, Gill net, and Bharjal. Photographs were immediately taken in the field before preservation for further study. The fish landing stations at Attannogate were also studied during all the seasons. The fish species were identified by studying Morphometric and Meristic characters following reference Books and Journals, Day(1878), Jayaram(2010), Talwar and Jhingran(1991) Fricke *et al*. (2020), Das *et al*., (2004), Nelson, Grande and Wilson (2016). The heavy metal content limits in water and fish tissue (Muscle) were studied by using AAS(Atomic Absorption Spectro Photometer). The hydrological parameters of water were analyzed following standard methods APHA 1998.

Observation Table

Table 1: *Hydrology of 1. Tarakeshwar (a.Sanhoshpur, b.Bikunthapur,c.Deulpara) 2.Attannogate (a.Garchumuk,b.Silampur, c.Madaribar) at lower stretch of Damodar River during the study period*

Month	Temperature of Water Min	Max	pH Min	Max	Salinity(PSU Min	Max	DO(mg/l) Min	Max	Transperency (cm) Min	Max	Alkalinity (%) Min	Max
August	25.8	25.94	8.02	8.05	18.9	18.96	7.12	7.16	11	12.2	24.8	23.88
September	22.2	24.68	7.45	7.66	15.2	15.4	7.4	7.5	15	18.6	26	29.2
October	18.8	19.96	7.09	8	14.5	14.76	8.20	8.9	14	16.6	25.10	26.2
November	12.64	16	7.15	7.18	12	12.5	7.56	7.58	15	18.4	13.9	16
December	12.5	33.94	7.19	8	12.01	12.5	7.23	8	18.8	19.82	18.2	19.6
January	10.2	10.66	7	7.2	16.8	16.92	8	8.2	12	16.2	14.8	15.88
February	11.4	11.88	7.8	7.9	24.3	24.56	6.5	7	16.8	16.82	16.98	23.5
March	14.64	14.08	6.9	7	24.0	24.02	8	8.5	14	16.2	18.2	16.6
April	17.9	18.56	7	7.2	24.8	24.88	6.3	7	13	17.2	17	18.8
May	38.2	39.5	7.8	8	20.6	20.82	5.9	6	14.9	18.6	21.88	23.8

	8	8										8
June	37.70	38.12	7.9	8.2	24.5	24.8	8	8.4	8.5	9.01	14.8	16.6
July	**33.62**	**33.67**	**7.5**	**7.6**	**23.8**	**25.9**	**4.9**	**5**	**4.6**	**9.01**	**24**	**28.8**

Table 2: *Shows the Fish Species Diversity Indices During the Study Period*

S1	SPECIES RICHNESS	86	45	86	74
	MARGALEF INDEX	12.14253527	16.92261999	12.895674	12.84569
	SHANNON WIENER INDEX	5.08533234	5.08712858	5.846921	5.846971
S2	SPECIES RICHNESS	86	89	86	86
	MARGALEF INDEX	11.01297207	11.3027427	12.846325	12.7894587
	SHANNON WIENER INDEX	4.065523099	4.069572743	4.2189	4.3569
S3	SPECIES RICHNESS	86	87	86	86
	MARGALEF INDEX	11.06163392	19.25700165	16.89468	16.52398
	SHANNON WIENER INDEX	4.010821485	4.122511875	4.128459	4.15789
S4	SPECIES RICHNESS	86	89	89	89
	MARGALEF INDEX	11.15253527	16.67261999	16.28745	16.3258
	SHANNON WIENER INDEX	4.08533234	4.08712858	4.5892	4.6897
S5	SPECIES RICHNESS	89	89	82	82
	MARGALEF INDEX	11.01297207	11.3027427	11.5487	11.3659
	SHANNON WIENER INDEX	4.2569299	4.254672743	4.58762	4.02546
S6	SPECIES RICHNESS	89	87	89	89
	MARGALEF INDEX	11.06163392	19.25700165	15.32466	15.24879
	SHANNON WIENER INDEX	4.010821485	4.122511875	4.125846	4.236589
S7	SPECIES RICHNESS	89	89	89	89
	MARGALEF INDEX	12.01297207	12.3027427	12.35698	12.45698
	SHANNON WIENER INDEX	4.235689213	4.069572743	4.25789	4.650245
S8	SPECIES RICHNESS	89	89	89	89
	MARGALEF INDEX	10.01297207	10.3027427	10.56987	10.23659
	SHANNON WIENER INDEX	4.123895213	4.123533865	4.12587	4.25689

Table 3*: Shows the List of Fishes from the lower stretch of Damodar River in the Lower Stretch from Tarakeshwar to Attannogate*

Sl. No	**Class**	**Family**	**Sub Family**	**Order**	**Name of the Fish**	**Status**
1.	Actinopterygii	Cyprinidae		Cypriniformes	*Amblypharyngodon mola*	LC
2.	Actinopterygii	Cyprinidae		Cypriniformes	*Aspidoporia jaya*	LC
3.	Actinopterygii	Cyprinidae		Cypriniformes	*Chagunius chagunio*	LC
4.	Actinopterygii	Cyprinidae		Cypriniformes	*Cirrhinus reba*	LC
5.	Actinopterygii	Cyprinidae		Cypriniformes	*Laubuka laubuca*	NT
6.	Actinopterygii	Cyprinidae		Cypriniformes	*Pangusius pangusia*	LC
7.	Actinopterygii	Cyprinidae		Cypriniformes	*Puntius sophore*	LC
8.	Actinopterygii	Cyprinidae	Danionidae	Cypriniformes	*Salmostoma bacaila*	LC
9.	Actinopterygii	Cyprinidae	Danionidae	Cypriniformes	*Salmostoma phulo*	LC
10.	Actinopterygii	Cyprinidae	Danionidae	Cypriniformes	*Securiculagora*	LC

11.	Actinopterygii	Cyprinidae	Danionidae	Cypriniformes	*Danio aequipinnatus*	LC
12.	Actinopterygii	Cobitidae		Cypriniformes	*Lepidocephalichthys guntea*	LC
13.	Actinopterygii	Cyprinidae	Barbinae	Cypriniformes	*Pethia conchonius*	LC
14.	Actinopterygii	Latidae		Perciformes	*Lates calcarifer*	LC
15.	Actinopterygii	Ambessidae		Perciformes	*Ambassis kopsii*	NE
16	Actinopterygii	Ambessidae		Perciformes	*Chanda nama*	LC
17.	Actinopterygii	Ambessidae		Perciformes	*Parambassis baculis*	LC
18.	Actinopterygii	Ambessidae		Perciformes	*Parambassis ranga*	LC
19.	Actinopterygii	Badidae		Anabantiformes	*Badis badis*	LC
20.	Actinopterygii	Nandidae		Anabantiformes	*Nandus nandus*	LC
21.	Actinopterygii	Osphronemidae		Anabantiformes	*Trichogaster fasciata*	LC
22.	Actinopterygii	Osphronemidae		Anabantiformes	*Trichogaster lalius*	LC
23.	Actinopterygii	Osphronemidae		Anabantiformes	*Trichogaster chuna*	LC
24.	Actinopterygii	Channidae		Anabantiformes	*Channa orientalis*	VU
25.	Actinopterygii	Channidae		Anabantiformes	*Channa punctata*	LC
26.	Actinopterygii	Channidae		Anabantiformes	*Channa striatus*	LC
27.	Actinopterygii	Belonidae		Beloniformes	*Xenentodon cancila*	LC
28.	Actinopterygii	Anguillidae		Anguilliformes	*Anguilla bengalensis*	LC
29.	Actinopterygii	Anguillidae		Anguilliformes	*Anguilla bicolor*	NT
30.	Actinopterygii	Clupeidae		Clupeiformes	*Corica soborna*	LC
31.	Actinopterygii	Clupeidae		Clupeiformes	*Gonialosa manmina*	LC
32.	Actinopterygii	Clupeidae		Clupeiformes	*Gudusia chapra*	LC
33.	Actinopterygii	Clupeidae		Clupeiformes	*Nematalosa galatheae*	LC
34.	Actinopterygii	Clupeidae		Clupeiformes	*Tenualosa ilisha*	LC
35.	Actinopterygii	Pristigasteridae		Clupeiformes	*Llisha elongate*	LC
36.	Actinopterygii	Engraulidae		Clupeiformes	*Setipinna phasa*	LC
37.	Actinopterygii	Engraulidae		Clupeiformes	*Setipinna tenuifilis*	DD
38.	Actinopterygii	Siluridae		Siluriformes	*Wallago attu*	VU
39.	Actinopterygii	Siluridae		Siluriformes	*Ompok pabo*	NT
40.	Actinopterygii	Siluridae		Siluriformes	*Ompok bimaculatus*	NT
41.	Actinopterygii	Siluridae		Siluriformes	*Mystus cavasius*	LC
42.	Actinopterygii	Bagridae		Siluriformes	*Mystus bleekeri*	LC
43.	Actinopterygii	Bagridae		Siluriformes	*Mystus tengra*	LC
44.	Actinopterygii	Bagridae		Siluriformes	*Ailia coila*	NT
45.	Actinopterygii	Bagridae		Siluriformes	*Silonia silondia*	LC
46.	Actinopterygii	Pangasilidae		Siluriformes	*Pangasius pangasius*	LC
47.	Actinopterygii	Synodontidae		Aulopiformes	*Harpadon nehereus*	NT
48.	Actinopterygii	Mugilidae		Mugiliformes	*Planiliza macrolepis*	LC
49.	Actinopterygii	Mugilidae		Mugiliformes	*Chelon parsia*	LC
50.	Actinopterygii	Mugilidae		Mugiliformes	*Rhinomugil corsula*	LC
51.	Actinopterygii	Mugilidae		Mugiliformes	*Valamugil buchanani*	LC
52.	Actinopterygii	Oxudercidae	Oxudercinae	Gobiliformes	*Apocryptes bato*	LC
53.	Actinopterygii	Oxudercidae		Gobiliformes	*Apocryptodon madurensis*	LC
54.	Actinopterygii	Oxudercidae		Gobiliformes	*Glossogobius giuris giuris*	LC
55.	Actinopterygii	Oxudercidae		Gobiliformes	*Parapocryptes serperaster*	LC
56.	Actinopterygii	Oxudercidae		Gobiliformes	*Parapocryptes batoides*	LC
57.	Actinopterygii	Oxudercidae		Gobiliformes	*Periophthalmus kalolo*	LC
58.	Actinopterygii	Mastacembelidae		Synbranchiformes	*Macrognathus pancalus*	LC
59.	Actinopterygii	Mastacembelidae		Synbranchiformes	*Mastacembelus armatus*	LC
60.	Actinopterygii	Synbranchidae		Synbranchiformes	*Monopterus cuchia*	LC
61.	Actinopterygii	Notopteridae		Osteoglossiformes	*Notopterus notopterus*	LC
62.	Actinopterygii	Soleidae		Pleuronectiformes	*Synaptura albomaculata*	NE
63.	Actinopterygii	Cynoglossidae	Cynoglossinae	Pleuronectiformes	*Cynoglossus macrostomus*	VU
64.	Actinopterygii	Cynoglossidae	Cynoglossinae	Pleuronectiformes	*Cynoglossus lingua*	LC

65.	Actinopterygii	Cynoglossidae	Cynoglossinae	Pleuronectiformes	*Cynoglossus arel*	LC

LC:Least concerned category; NT: Nearly Threatened; NE: Not Evaluated ; VC: vulnerable category; DD : Data deficit ; ED: Endangered species. (IUCN, 2021)

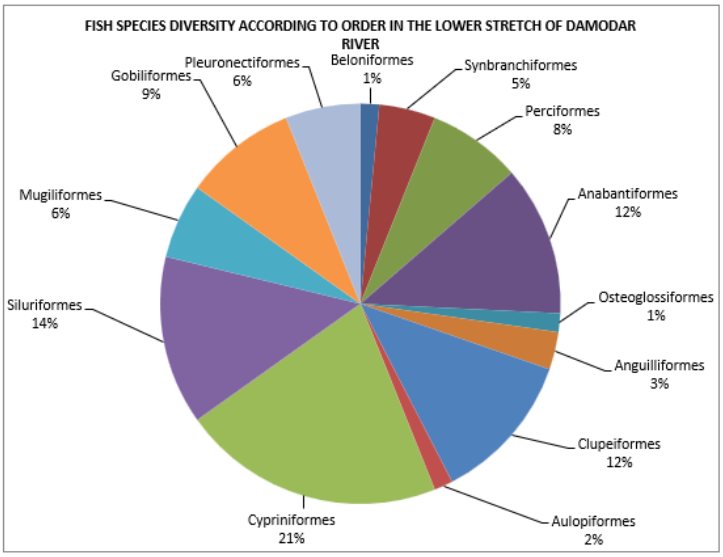


Figure 1: Damodar River Fish Diversity According to Orders

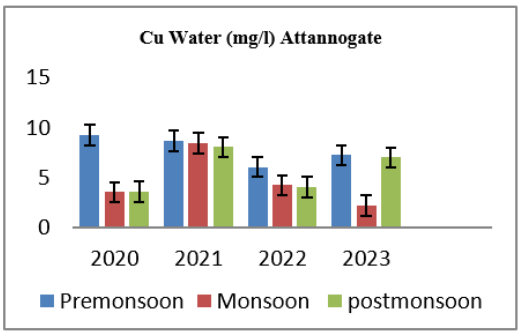


Figure 2

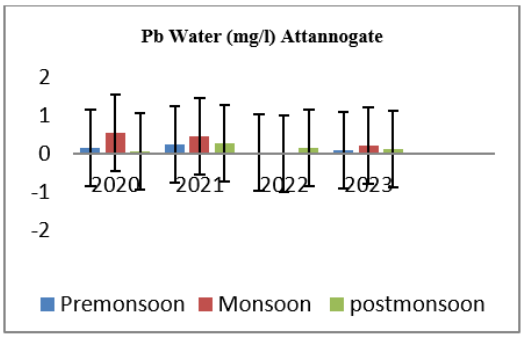
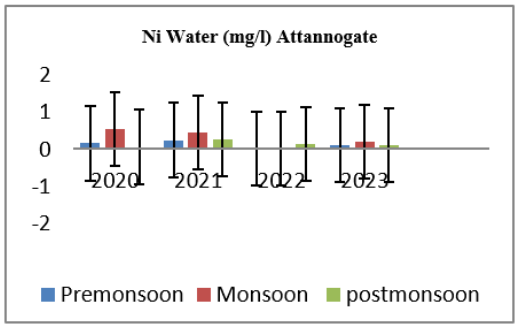


Figure 3



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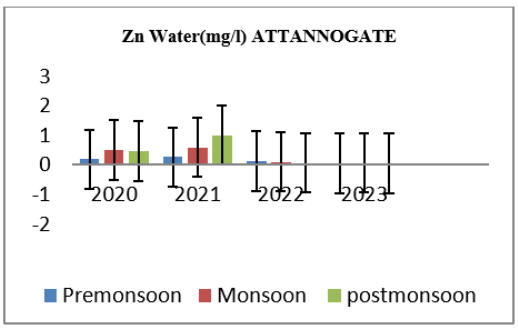

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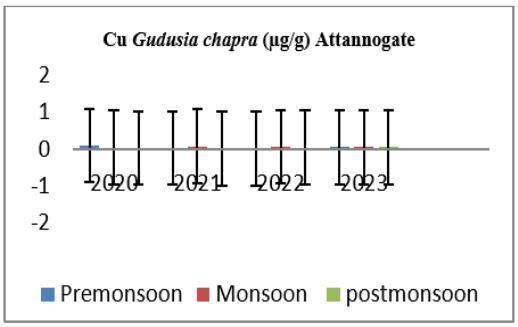

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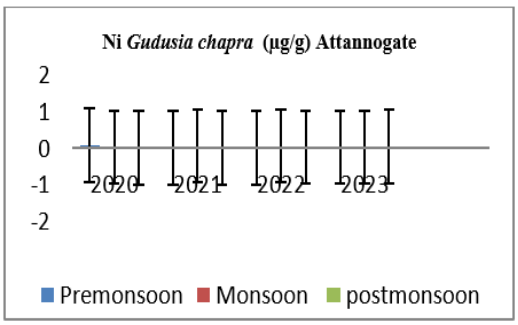

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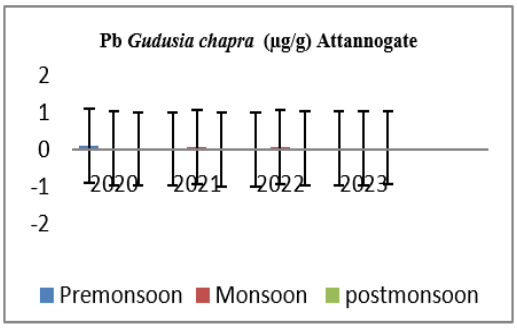

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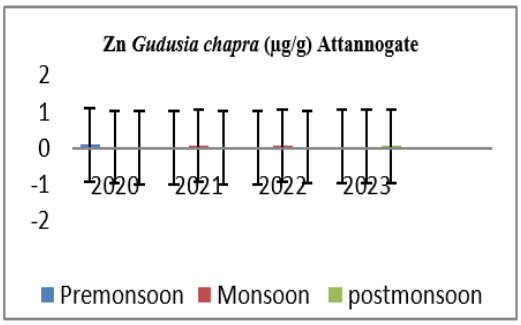
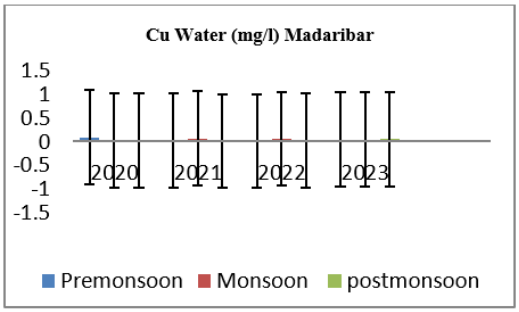


Figure 9

Figure 6 – 9: Shows the metal content in Gudusiachapra atAttannogate



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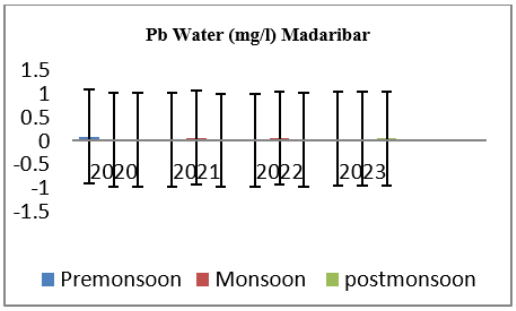

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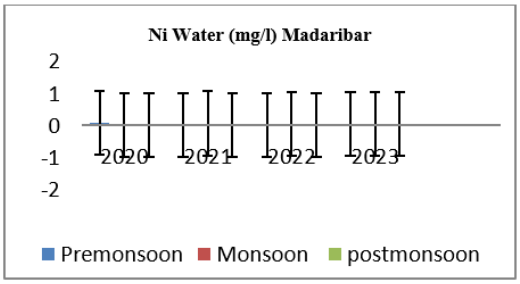

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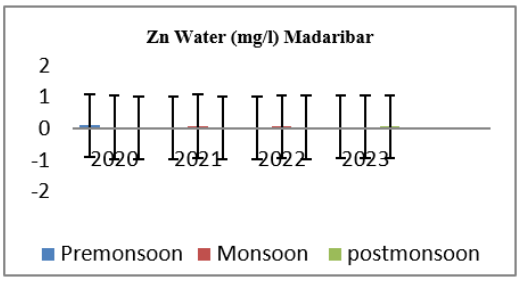
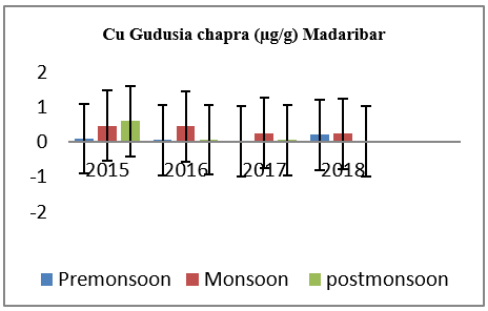


Figure 13

Figure 10 – 13: Shows the metal content in Water at Madaribar



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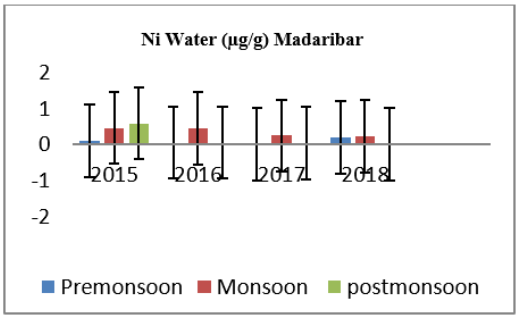

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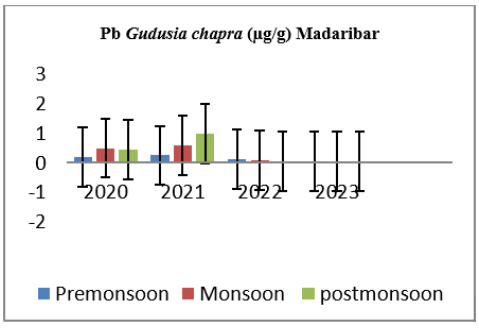

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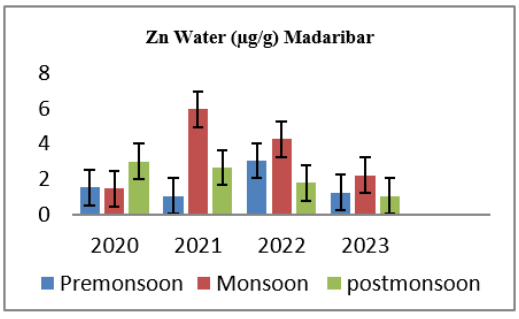

Figure 17

Figure 14 – 17: Shows the Metal Content in Gudusia chapra at Madaribar

Figure 2 – 17: Shows the Metals Content of Water and Gudusia chapra fish at Attannogate

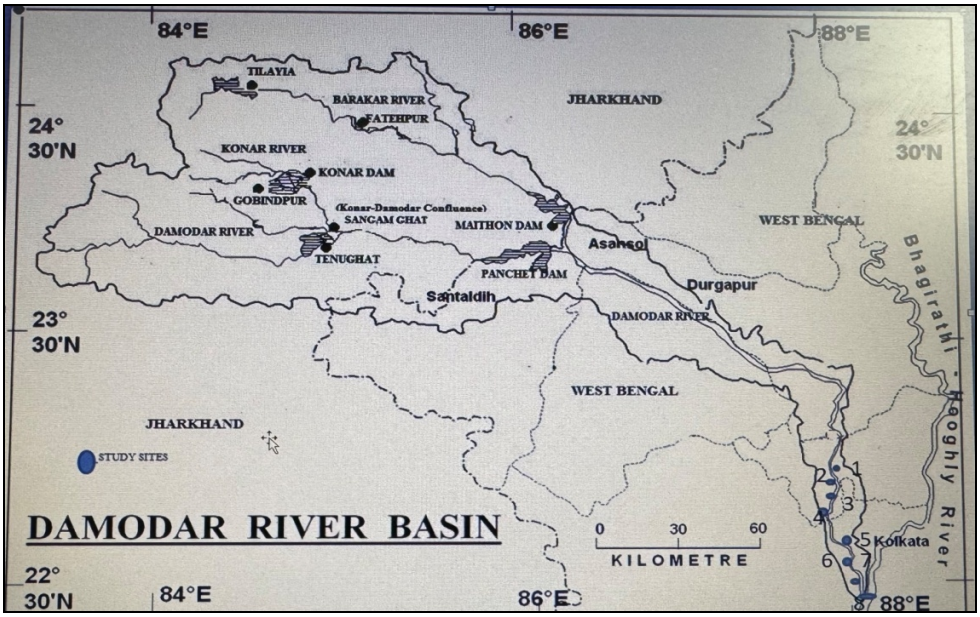

Figure 18: Map showing the study sites

Results and Discussion

The fishes studied from the lower stretch of the Damodar Riverbelong to 24 families,13 Orders, 49 Genera and 65 Species (Table 3). Among these fishes the most dominant species belongs to the Order Cypriniformes(21%), followed by Siluriformes(14%),then Clupeiformes, and Anabantiformes (12%), followed by, Gobiliformes (9%), Perciformes (8%), Pleuronectiformes and Mugiliformes(6%), Synbranchiformes (5%) Anguliformes(3%) Aulopiformes(2%) and the least Osteoglossiformes and Beloniformes(1%) (Figure 2). The present study reveals that the area of Damodar River beyond lock gate specially, Attannogate andGarchumuk houses a good number of estuarine fish species like *Harpadon nehereus, Chelon parsia,Valamugil buchanani, Apocryptes bato, Apocryptodon madurensis, Setipinna phasa,Gonialosa manmina, Gudusia chapra. Synaptura albomaculata, Cynoglossus macrostomus, Cynoglossus lingua, Cynoglossus arel*, which also shows restricted distribution in the area. Records from fish landing stations revealed that those fish were transported not only to local market but also to Bihar and Orissa fish market. The statistical analysis of the fish collection data reveals that the Highest Species richness 89 was found during the year 2021 in S2, S4 showed Highest Species richness 89 during the years 2021,2022,2023 and S7 and S8 showed Highest Species richness 89 during the all the study years (Table 2). This similarly in species richness (Table 2) in those study sites may be due to the similar aquatic conditions in all those study sites also may be due to similar nutrient available (Habit *et al*.,2006; Das *et al*., 2004). The Shannon diversity index indicates the relative abundance of the fish species, it shows

almost similar pattern throughout study period(Table 2).Shelke(2023);Nelson, Grande and Wilson(2016); Chatla and Padmavathi (2021) revealed that the water quality of a river had immense effect on the diversity and distribution of ichthyofaunal status of the river.The present study indicates that the hydrological data(Table 1.) of the study sites varies within narrow range and that might be the cause of similar pattern of Shannon diversity index (Table 2) analysed for this study.

According to Khobragade and (2016) the food security of the society in terms of fishery can be established with the help of proper research information and regular survey of the ichthyofaunal diversity of the river confluence zone. Not only that, but it will also serve the conservation of the fish resource of the river system as well. Malik *et al*. (2021) revealed the fish faunal diversity of River Ganga in the upper basin might be the cause of seasonal nutrient variation, but the present study showed no such variation. During the present study the ichthyo species composition shows a larger number of estuarine fishes than the freshwater fishes in comparison to the study of Sarkar and Banerjee, 2012.

The toxic metals in river water are the major source of heavy metal contamination in aquatic vertebrates Elinge *et al*. (2019). The fish *Gudusia chapra* was selected for metal analysis as this fish was collected from all collection sites and found to be the most abundant species and a good food fish. The study of Heavy metals in river water (Figure 1-4 and Figure11-14) and the muscle tissue (Figure 7-10 and Figure 15-18) shows that the level of the metals was within acceptable limit according to(WHO, 2008; CPCB, 2011). The result reveals that concentration of heavy metals in muscle of *Gudusia chapra* sampled from all stations does not exceed the acceptable level for food sources for human consumption (WHO, 2008).

Conclusion

The present study indicates that Damodar River confluence area where Damodar joins the Hooghly River shows a high salinity in average during all the seasons because of the influence of high tide from Bay of Bengal through the Hooghly River. The species composition shows a larger number of estuarine fishes than the freshwater fishes. The salinity of the water at Garchumuk and Silampur was higher than the average freshwater salinity. The increased salinity and inflow from lock gate might have increased the estuarine species diversity. The fingerlings of some estuarine fish species were found at Santhoshpur, Bikunthapur, Deulpara,Garchumuk, Silampur and Madaribar as well during the post monsoon season. Thus, a detailed long-term investigation of the lower Damodar River fish diversity is required to protect and conserve the available fish species by taking effective measures. This will serve the fish-eating population of us well as the neighbor state as well.

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