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Fisheries and Hydrography of Baitarini at Jajpur, Odisha, East Coast of India

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Abstract- Investigation on the hydrography and fish fauna were undertaken from a period of February to September, 2012 at selective locations in river Baitarini, Jajpur. Twenty eight species of fish belonging to six orders, eleven families and nineteen genera were collected. Order Cypriniformes was most dominant constituting 33.33% followed by Siluriformes (30.3%), Perciformes (12.12%) and others like Mugiliformes, Osteoglossiformes and Synbranchiformes. Of the total fish species *Catla catla, Labeo rohita, Labeo calbasu, Ompok pabda, Puntius sophore,* crustaceans (*Macrobranchium rosenbergii* and *Macrobranchium malcolmsonii*) were abundantly found. Results of hierarchical clustering using group average linking for water quality parameters revealed two main clusters of stations based on similarities/dissimilarities of physicochemical hydrological parameters.

Index Terms- Baitarini, cluster analysis, crafts, fish fauna, gears, Hydrography.

I. Introduction

Rivers are essential freshwater systems necessary for the sustenance of all life. As waterways of strategic importance across the world, they provide the main water resources for domestic, industrial, and agricultural purposes (Faith, 2006). Rivers support fish fauna, the diversity and abundance of which reflects the existing hydrographic conditions of a water body. Riverine fisheries offer the main economic activity to local fishermen. In this context River Baitarani (latitude 20^0 31' North and longitude 85^0 33' East) of district Jajpur, in the state of Odisha (Figure 1), east coast of India was chosen for this study. It originates from the Guptaganga Hills in Gonasika in Keonjhar district at an elevation of 900 m above sea level. Along its' course though a distance of 360 km, the river and its tributaries are subject to the effects of industrialisation, mining, and sedimentation etc. before draining into the Bay of Bengal at Dhamra mouth near Chandbali.

A literature review on hydrography and fish fauna of rivers indicates works from tropical regions such as Turag, Bangladesh (Rahman, 2012); India (Sreekantha et al., 2007, Vishwanath, 2007, Tiwari, 2011, Katwate, 2011, Thirumala et al., 2011, Das et al., 2011); From Odisha, other than works on environmental flows in Brahmani and Baitarani River systems (Sharma et al., 2008) and water quality trends in the Baitarani River (Choudhury et al., 2006), studies on the hydrographical conditions and fisheries for the downstream region of Baitarani has not been recorded, hence the present investigation.

II. Study Area

The study area included 3 sites in the downstream region of Baitarini, Jajpur district namely Baruni Padia (20^0 51'25" N and 86^0 20''11'' E) near the vegetable market east of Jajpur town, Dashaswamedha Ghat (20^0 51''28''N and $86^0$20''19''E) south of Jajpur district and Rudhia (20^0 55'10.56''N and $86^0$16'26.4''E) in the north (Figure 1).

Figure 1: Map showing Jajpur and station locations.

III. Materials and Method

The physico-chemical and biological characteristics of water and fish fauna were studied at periodic monthly intervals from February-September, 2012, at three selective locations (Baruni Padia, Dashaswamedha Ghat and Rudhia) in river Baitarani at Jajpur.

Hydrography

Water quality estimations consisted of a series of environmental variables namely pH, temperature, transparency, calcium, magnesium, total hardness, chlorides and dissolved oxygen. Water samples (surface) were collected with the help of

polythene buckets from all selected locations. Surface water temperature was measured using a hand held centigrade thermometer of 0.5˚ sensitivity, transparency with the help of Secchi disc of 30 cm. diameter and pH with a pH meter, Orion. After collection the samples were transported to the laboratory in cold conditions. All the samples were filtered appropriately (e.g. Whatman G.F/C/F of 1µm) prior to analysis. The samples were analysed according to standard analytical methods as described in Standard methods for the estimation of water, 20th edition of American Public Health Association 2009 and Grasshoff et al., 1983.

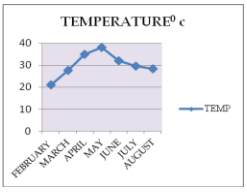
Fish fauna

Fish were collected from local markets and Baitarani River at 3 sites with the help of fishermen using different types of nets namely gill nets, cast nets, dragnets and country boats. Immediately photographs were taken with the help of a digital camera. Fishes were brought to the laboratory and preserved in 10% formalin solution in separate specimen jars according to the size of species. Small fishes were directly placed in the 10% formalin solution, while large fishes were given an incision in their abdomen and preserved. Fishes were measured and identified up to the species level, with the help of standard keys Nelson (2006) and published literature (Jayaram (1999), Menon (1999), Ponniah & Sarkar (2000), Vishwanath et al., (2007), Talwar & Jhingran (1991), and the website Fish base).

IV. Results and Discussion

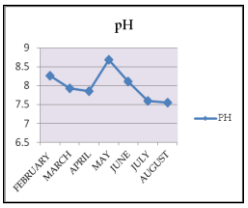
The results of hydrography are tabulated (Table 1) along with graphically presented observations on environmental parameters (Figure 2).

Temperature: Observations revealed a gradual increase in air temperature from the month of February to May, 2012 and then a decline. Changes in air temperature strongly influenced the water temperature (opp. Figure 2a).



pH: The highest pH was found in the month of May, 2012 and the lowest in July, 2012 (opp.Figure 2b;Table 1). Values were higher in summer than other seasons probably due to increased photosynthesis of the algal blooms resulting in the precipitation of carbonates of calcium and magnesium from bicarbonates (Prakash et al., 2007).

Transparency: The clarity of natural body of water is an important determinant of its condition and productivity. Suspended and colloidal matter such as clay, silt, finely divided organic/inorganic matter, plankton and other microscopic organisms determine transparency. The present study indicates higher summer values and lower monsoon values probably owing to sedimentation during summer seasons and the turbulence arising out of flood-like situations in the rainy season (opp. Figure 2c; Table 1).



Dissolved oxygen: Across the river, dissolved oxygen varied from 3.6 mg/l to 8.8 mg/l with a mean of 5.77 mg/l. It was observed that the amount of oxygen dissolved in water increased as temperature decreased with values indicating spatial and seasonal changes depending on, human and thermal activity.

Dissolved oxygen values were maximum during winter (February, 2012) and minimum during summer (May, 2012) (opp. Figure 2d; Table 1) which could be attributed to natural turbulence and higher algal productivity. Similar findings have been reported by other workers (Jitendra, 2008, Venkatesharaju, 2010).

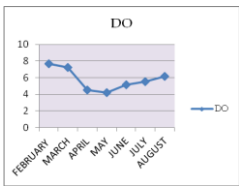
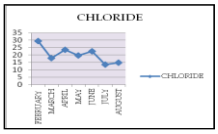


Table 1. Monthly data of water quality parameters with maximum, minimum and average value.

Survey	stations	P^H	DO	Chloride	Free Co_2	Calcium	Hardness	Magnesium	Temp. (^{0}C)	Transparency
			(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)		(cm)
1	Station1	8.35	7.2	26.14	2.28	18.5	82	15.49	21	71
	Station2	8.11	8.8	28.13	1.76	17.66	72	13.25	21	69
	Station3	8.33	7	33.79	1.76	18.5	80	15	21	37
2	Station1	8.2	7.04	14.21	4	18.5	86	16.47	27	22
	Station2	7.81	7.72	20.47	5.4	26.07	88	15.11	27	53

	Station3	7.76	6.92	19.18	3.8	15.97	72	13.67	29	48
3	Station1	8.15	4.24	19.88	3.6	18.5	76	14.03	35	15
	Station2	7.8	4	27.83	3	18.16	77.2	14.4	35	72
	Station3	7.6	5.2	22.86	3.2	16.82	76	14.43	35	56
4	Station1	8.75	4	13.91	2.8	22.96	84	14.89	38	15
	Station2	8.66	3.6	22.91	3	21.02	78	13.9	38	25
	Station3	8.68	5	22.46	3.2	19.59	68.6	11.95	38	70
5	Station1	8.29	5.2	14.51	3.6	8.41	27.2	4.58	32	9
	Station2	8.14	4.8	14.91	3.4	7.56	29.2	5.28	32	15
	Station3	7.9	5.4	37.77	4	7.56	30	5.47	32	35
6	Station1	7.85	5	13.2	4.2	6.13	48	10.2	30	5
	Station2	7.53	5.6	12.92	3.8	7.23	33.33	6.36	30	6
	Station3	7.42	6	14.21	4.6	8.66	27.33	4.55	29	8
7	Station1	7.34	7.2	10.93	5	7.23	26	4.57	28	8
	Station2	7.49	6.4	19.18	5.2	7.23	31.33	5.88	28	10
	Station3	7.82	4.8	14.51	4.8	8.41	32.66	5.91	29	12
Overall	Average	8.00	5.77	20.19	3.63	14.32	58.33	10.73	30.24	31.48
	Max	8.75	8.80	37.77	5.40	26.07	88	16.47	38.00	72
	Min	7.34	3.60	10.93	1.76	6.13	26	4.55	21.00	5

Chloride content: In all the stations the chloride content varied from 10.93 mg/l to 37.77 mg/l with mean of 20.19 mg/l (opp. Figure 2e; Table 1).The values reported in the present study are well within the BIS (Bureau of Indian Standard) recommendations (limit of 250 mg/l of chloride in drinking water).



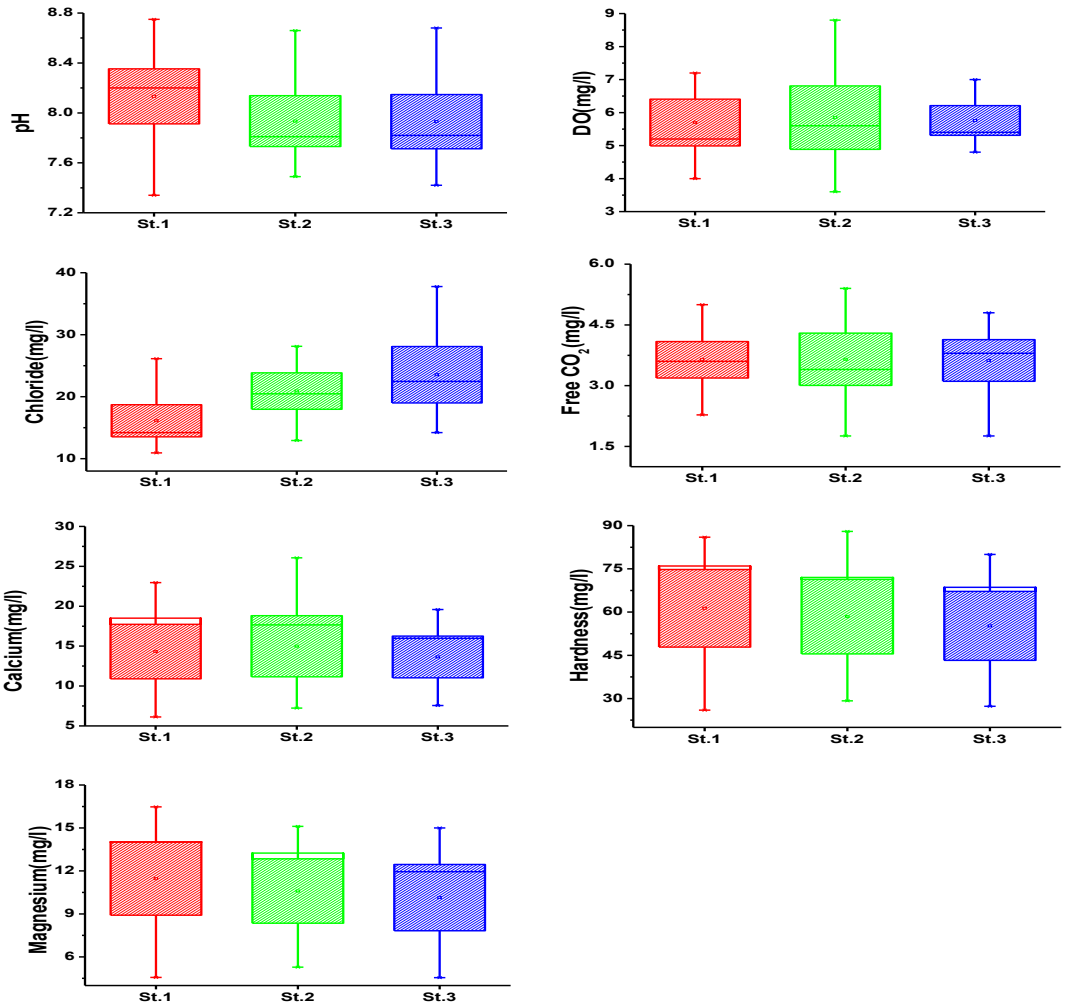


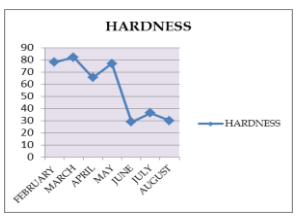
Figure 3: Box Plots Showing Overall Range, Mean, Standard Deviation For Each Parameter At The Three Study Sites.

Free carbon dioxide: Overall, the free carbon dioxide levels fluctuated from a range of 1.76 mg/l to 5.4 mg/l with a mean of 3.63 mg/l (Table 1).

Total hardness: Values fluctuated from a low of 26 mg/l to a high of 88 mg/l (mean 58.33 mg/l) (Table 1). Seasonal variations of river water hardness often occurred, reaching the highest values during low flow conditions (summer) and the lowest values during floods (monsoon). (Figure 2 f; Table 1). In general the recorded values varied from a low of 6.13 mg/l to a high of 26.07 mg/l (mean, 14.32 mg/l). At station 1 the maximum recorded calcium content was 22.96 mg/l (May, 2012) with a minimum 6.13 mg/l (July, 2012) (mean, 14.32 mg/l). In station 2 a low of 7.23 mg/l (July, August 2012) and high of 26.07 mg/l (March, 2012) (mean 14.99 mg/l) was observed. In station 3 the minimum and maximum calcium content were found to be 7.56 mg/l in June, 2012 and 19.59 mg/l in May, 2012 respectively with a mean of 13.64 mg/l (Table 1). BIS has recommended an upper desirable limit of 75 mg/l Ca^{+2} as $CaCO_3$. All the three stations have calcium concentration within the permissible limit.

A clear correlation between Magnesium and Hardness (r = 0.99), Temperature and DO (r = 0.73, p ≥ 0.0001), Calcium and Hardness (r = 0.88) was seen (Table 2; Fig.3).

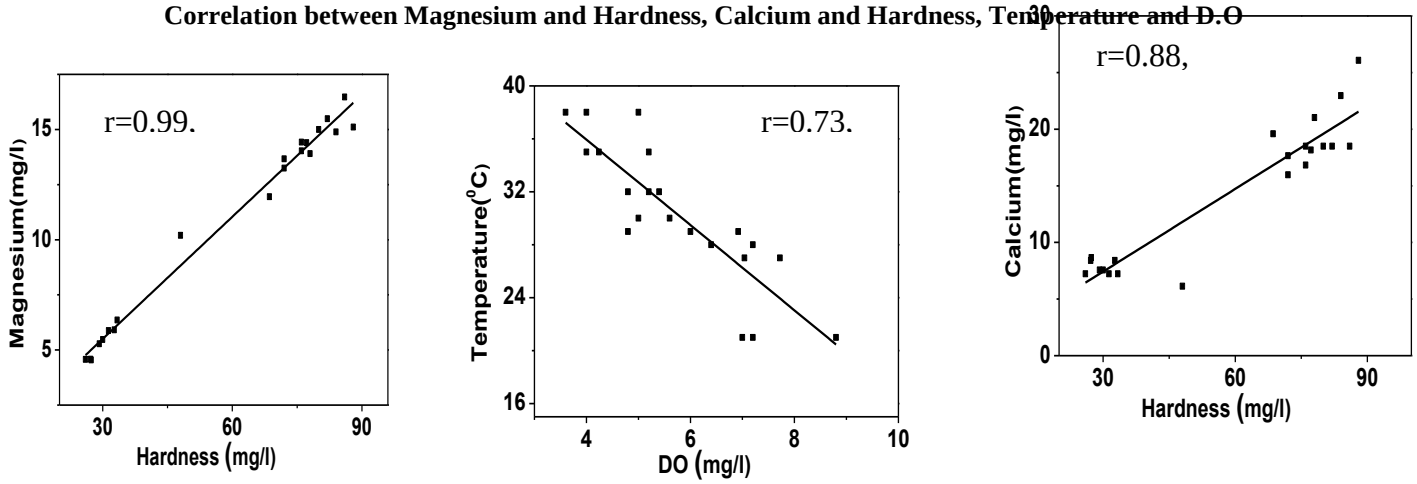
Table 2. Correlation co-efficient between physicochemical parameters in the stretch of river Baitarani



	pH	DO	Chloride	Free Co_2	Calcium	Hardness	Magnesium	Temp.
pH								
DO	-0.31							
Chloride	0.25	0.12						
Free Co_2	-0.61	-0.02	-0.55					
Calcium	0.57	0.04	0.39	-0.46				
Hardness	0.52	0.05	0.39	-0.51	0.94			
Magnesium	0.49	0.06	0.39	-0.52	0.89	0.99		
Temp.	0.22	-0.86	-0.20	0.21	0.05	-0.03	-0.05	

Fig 3.

Correlation between Magnesium and Hardness, Calcium and Hardness, Temperature and D.O



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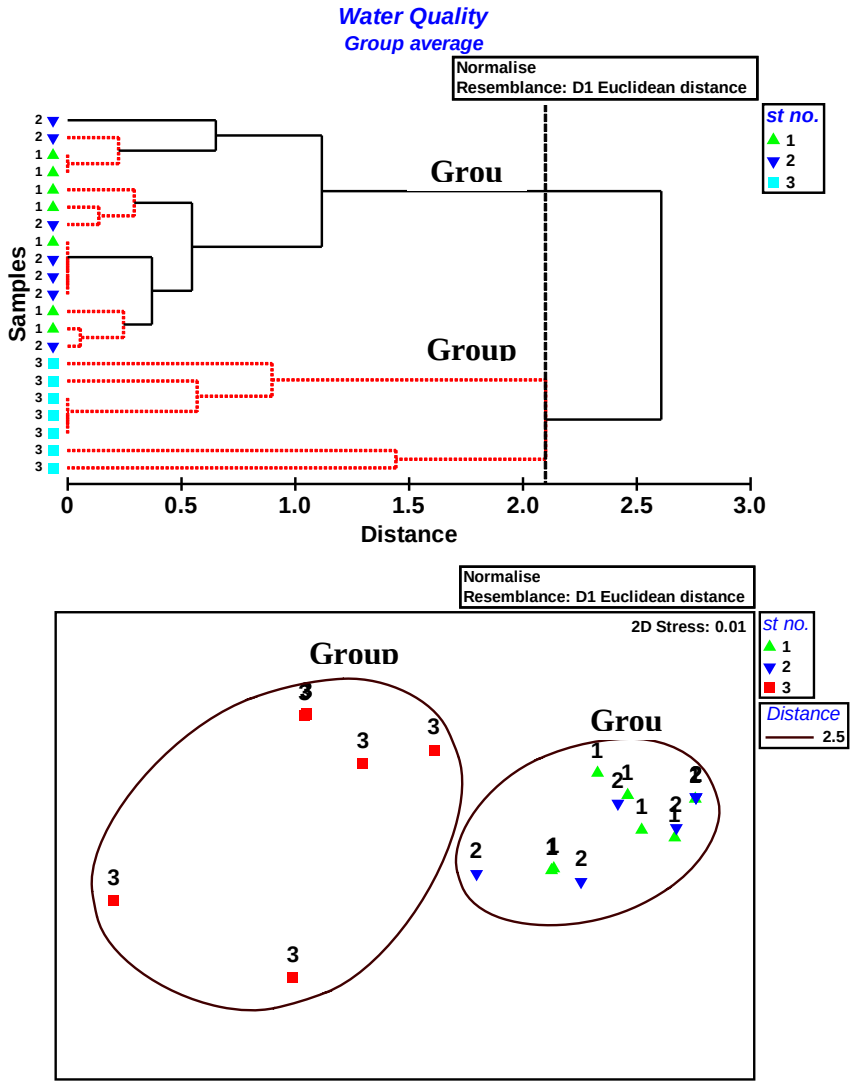

Figure4. Similarity among stations of the study area and position of stations based on factor analysis.

On the basis of hierarchical clustering using group average linking, Bray Curtis similarities were calculated on square root transformed data for the stations using water quality data. The results obtained show a dendrogram clearly displaying 2 groups, indicating the similarities of stations. Further a factor analysis also revealed clustering into two groups taking into consideration the similarities in hydrographical conditions between the stations. Interestingly, stations 1(Baruni padia) and and 2 (Dasaswemedha ghat) on Baitarini have been delineated into one cluster whereas station 3 (Rudhia) on Budha branch of Baitarini is seen as a separate cluster indicative of different hydrological conditions.

V. FISH AND FISHERIES

Results of present study revealed twenty eight species of fish belonging to six orders, eleven families and nineteen genera. Order Cypriniformes was most dominant constituting 33.33% followed by Siluriformes (30.3%), Perciformes (12.12%) and others like Mugiliformes, Osteoglossiformes and Synbranchiformes (opp. Fig.5).Cypriniformes as the dominating order of fish was also reported in other studies (Vijaylakshmi et.al., 2010; Patra et.al.,2011).Of the total fish species *Catla catla, Labeo rohita, Labeo calbasu, Ompok pabda, Puntius sophore,* crustaceans (*Macrobranchium rosenbergii* and *Macrobranchium malcolmsonii*) were abundantly found (Table 2).

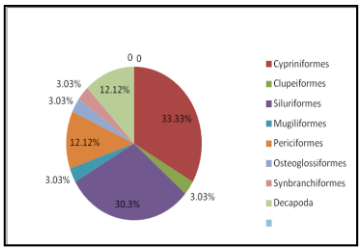

Table 2. Fish diversity and abundance at study site Baitarani River, Jajpur, 2012.
++++Very abundant, +++abundant, ++many, +present

S.N	Genus	Order	Family	St.2	St.3
1	*Catlacatla*	Cypriniformes	Cyprinidae	+	+
2	*Labeo rohita*	Cypriniformes	Cyprinidae	+	+
3	*L. calbasu*	Cypriniformes	Cyprinidae	+	+
4	*L. bata*	Cypriniformes	Cyprinidae	+	+
5	*Puntius sophore*	Cypriniformes	Cyprinidae	+	+
6	*P. serana*	Cypriniformes	Cyprinidae	+	+
7	*Cirrhinus mrigala*	Cypriniformes	Cyprinidae	+	+
8	*C. reba*	Cypriniformes	Cyprinidae	+	+
9	*Esomus danricus*	Cypriniformes	Cyprinidae	+	+
10	*Rasbora danricus*	Cypriniformes	Cyprinidae	+	+
11	*Amblypharyngodon mola*	Cypriniformes	Cyprinidae	+	+
12	*Tenualosa*	Cypriniformes	Cyprinidae	+	+
13	*Mystus gulio*	Siluriformes	Bagridae	+	+
14	*M. vittatus*	Siluriformes	Bagridae	+	+
15	*Aorichthys seenghala*	Siluriformes	Bagridae	-	+
16	*Ompok pabda*	Siluriformes	Siluridae	+	+
17	*Ompok bimaculatus*	Siluriformes	Siluridae	+	+
18	*Pangasius pangasius*	Siluriformes	Pangasiidae	+	+
19	*Eutropiichthys vacha*	Siluriformes	Schilbeidae	+	-
20	*Arius malaculatus*	Siluriformes	Ariidae	+	+
21	*Glossoglobius giuris*	Perciformes	Gobiidae	+	+
22	*Wallago attu*	Siluriformes	Siluridae	+	+
23	*Rinomugil corsula*	Mugiliformes	Mugilidae	+	-
24	*Channa marulius*	Perciformes	Channidae	+	+
25	*C. punctatus*	Perciformes	Channidae	+	+
26	*C. gachua*	Perciformes	Channidae	+	+
27	*Notopterus chitala*	Osteoglossiformes	Notopteridae	+	+
28	*Macrognathus aral*	Synbranchiformes	Mastacembolidae	+	+
29	*Macrobranchium rude*	Decapoda	Palaemonidae	+	+
30	*M. rosenbergii*	Decapoda	Palaemonidae	+	+
31	*M. malcolmsonii*	Decapoda	Palaemonidae	+	+
32	*M. scabriculum*	Decapoda	Palaemonidae	+	+

Fish Diversity

Diversity of fishes mainly depends upon biotic, abiotic factors, type of ecosystem, age of the water body, mean depth and water level fluctuations. (Thirumala et al., 2011). Changes in physicochemical characteristics also affected the diversity of species at each sampling stations. Fish catch is high in the months of July to November. *Catla catla, Labeo rohita, Labeo calbasu, Ompok pabda, Puntius sophore, Macrobranchium rosenbergii and Macrobranchium malcolmsonii* (Plates1) were more abundantly found from Baitarani river from the month of July to January.

Plate 1. (1) *Catla catla, Labeo rohita, Cirrhinus mrigala* (2) *Pangasius sutchi* (3) *Puntius sophore* and *Puntius serrana* (4) *Chirrhinus mrigala* (5) *P. sutchi, C.mrigala, Catla catla* (6) *Ompok bimaculatus* (7) *Arius malaculatus* (8) *Labeo calbasu and Cirrhinus mrigala* 9*) Catla catla* (10) C. mrigala (11) *Ompok pabda* (12) *Labeo rohita* (13) *Sperata seenghala* (14) *Catla catla* (15) *Catla catla, Labeo rohita, Tenualosha ilisha*

VI. CONCLUSIONS

Over the last few decades riverine ecosystems have been subjected to intense anthropogenic pressure resulting in degradation and habitat loss for fish. As a consequence, many riverine fish species have become highly endangered (Sarkar et al., 2009). The concern for the habitat degradation in India has at present been compounded by the impact of climate change on these aquatic ecosystems (Vass et al., 2009). The area under consideration for this study is undoubtedly pristine. Every effort should be made to retain this state in the years to come.

ACKNOWLEDGMENT

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