Decadal variation of fish species composition in Patharghata fish landing station of Bangladesh

[1]Shyama Prasad Bepari, [2]Nabonita Pal, [3]Pavel Biswas, [4]Sufia Zaman and [5]Abhijit Mitra
[1,2,3,4]Department of Oceanography, Techno India University, West Bengal, Kolkata-700091, India
[5]Department of Marine Science, University of Calcutta, 35 B.C. Road, Kolkata 700019, India

Abstract: Secondary data of fish landing was collected from Patharghata fish landing station of Bangladesh during 2007 and 2017 to evaluate the Catch Diversity Index, which is a measure of fish composition/diversity from the catch volume. ANOVA performed on the data exhibited significant variation between months and years, which confirms a change in fish diversity over a period of time. A more detailed analysis is needed to link the data bank with climate change.

Keywords **– Patharghata fish landing station, fish composition, Catch Diversity Index, ANOVA.**

I. INTRODUCTION

Bangladesh has 710 km long coastline extending from the tip of Teknaf in the Southeast to the west coast off Satkhira, which has enabled the country to achieve the goal of sustainable fish production. The country has recorded surplus fish production with an annual output of 41.34 lakh MT against a demand of 40.50 lakh MT in 2016-2017.

The fishery sector is contributing significantly to food security of the country through providing safe and quality animal protein; almost 60 percent animal protein comes from fish. It contributes 3.61 percent to the national GDP and around one-fourth (24.41 percent) to the agricultural GDP of the country. More than 11 percent of total population of Bangladesh are engaged with this sector on full time and part time basis for their livelihoods. This has significantly strengthened the backbone of National Economy of the country. Bangladesh earns a considerable amount of foreign currencies by exporting fish, shrimps and other fish products.

The picture of fishery sector also needs to be evaluated in the backdrop of climate change as there are several reports of compositional variation of fishes in response to changing salinity and temperature. Rapid change from physical forcing usually favours production of smaller, low-priced, opportunistic species that discharge large numbers of eggs over long periods (IPCC, 1996). Reports of decline of species numbers in fish due to increase of salinity have been published by several workers (Carpelan, 1967; Copeland, 1967; Hammer, 1986).

The main causes behind the alteration of fish community structure (preferably the increase in the abundance and diversity of trash fishes) due to increase in salinity (a consequence of seawater ingression because of warming effect) are:

1. Reproductive failure of fishes thriving in hyposaline environment (mostly commercially important fishes)
2. Interaction of other environmental parameters with salinity to cause excessive mortality (synergistic effect) of commercially important fishes that prefer hyposaline condition
3. Loss of primary food supply due to exceedance of salinity tolerance for that organism, and,
4. Direct mortality of hyposaline water loving fishes due to exceedance of salinity tolerance

The fish landing stations are the best test beds to monitor and analyse the change in fish composition. Hence an attempt has been taken in this research programme to evaluate the change in fish composition by considering the data of premonsoon 2007 and 2017 fish catch from Patharghata fish landing station of Bangladesh.

The secondary data collected from authentic sources from the Govt. of Bangladesh is the foundation stone for evaluating the diversity of fish species in the Patharghata landing station. These data were collected to meet the following objectives:

a. Evaluation of Catch Diversity Index on the basis of catch statistics of landing stations through modification of Shannon Weiner Species Diversity Index.
b. Evaluation of temporal variation of fish composition (considering the fish catch of 2007 and 2017) through ANOVA. It is to be noted in this context that in this paper, the catch of the premonsoon season (March-June) has been considered to meet the objectives.

II. MATERIALS AND METHODS

The entire network of the present work consists of the following phases:

a. Collection of authentic secondary data of fish catch from Patharghata landing station (Source: Report of Fishery Department, Govt. of Bangladesh).

b. Evaluation of Catch Diversity Index by modifying Shannon Weiner Species Diversity Index as per the expression:

$$\overline{H} = -\sum \frac{n}{N} \log_e \frac{n}{N}$$

where,

$\overline{H}$ = Shannon Weiner Species Diversity Index
n = No. of individuals per species
N = Total number of individuals of all species

In this research programme, 'n' is considered as landing volume of individuals per species and 'N' is treated as total landing volume of all species

We used the C+ programme to compute the Catch Diversity Index which is a modified version of Shannon Weiner Species Diversity Index. The ground zero data to evaluate the index was collected during the premonsoon period of 2007 from the Patharghata landing station of Bangladesh.

III. RESULTS

Table 1 and 2 reflect the month-wise fish catch (in Kg) during premonsoon periods of 2007 and 2017.

Table 1: Month wise fish composition from the catch of landing stations in Patharghata during 2007

Species	Pre-Monsoon			
	March	April	May	June
Tenualosa ilisha	180	380	23558	319930
Polynemus paradiseus	36778	36700	7262	0
Sillaginopsis sp.	5131	5140	0	0
Dussumieria acuta	11119	12120	501	3900
Epinephelus sp.	0	0	0	0
Katsuwonus sp.	17106	0	1100	12010
Penaeus spp.	1710	17220	0	0
Anguilla sp.	1710	1160	0	0
Eleutheronema tetradactylum	102	1120	500	0
Coilia sp.	2565	2500	3506	0
Nemapteryx sp.	0	0	2275	0
Otolithoides sp.	6842	6800	1020	0
Kajikia sp.	5264	1362	2121	0
Aetomylaeus sp.	205	204	200	0
Auxis sp.	0	0	0	4210
Aspidoparia sp.	0	0	0	4780
Rastrelliger sp.	0	0	0	6788
Lates calcarifer	0	0	0	0
Hexanematichthys sp.	0	0	0	0
Plotosus sp.	0	0	0	0
Acanthopagrus sp.	0	0	0	0
Pangasius sp.	0	0	0	0
Coryphaena sp.	0	0	0	0
Pampus sp.	0	0	0	0

Harpadon nehereus	0	0	0	0
Escualosa sp.	0	0	0	0
Heteropriacanthus sp.	0	0	0	0
S	12	11	10	6
N	88712	84706	42043	351618
Catch Diversity Index	1.7619	1.6621	1.4600	0.4388

Table 2: Month wise fish composition from the catch of landing stations in Patharghata during 2017

Species	Pre-Monsoon			
	March	April	May	June
Tenualosa ilisha	11299	3481	75156	138818
Polynemus paradiseus	16419	4956	3743	0
Sillaginopsis sp.	6794	3592	0	0
Dussumieria acuta	8582	3899	6789	4867
Epinephelus sp.	0	0	0	0
Katsuwonus sp.	3288	424	1000	2000
Penaeus spp.	22214	6193	14975	0
Anguilla sp.	0	4598	0	0
Eleutheronema tetradactylum	3509	576	3000	0
Coilia sp.	6594	4988	8999	0
Nemapteryx sp.	2221	0	7802	0
Otolithoides sp.	4562	1953	6809	0
Kajikia sp.	2462	11691	14778	4401
Aetomylaeus sp.	5988	3111	11202	0
Auxis sp.	0	0	0	15880
Aspidoparia sp.	5260	8986	9575	4599
Rastrelliger sp.	0	0	0	22399
Lates calcarifer	0	3288	4923	0
Hexanematichthys sp.	0	0	0	0
Plotosus sp.	0	4577	0	0
Acanthopagrus sp.	0	0	0	0
Pangasius sp.	999	0	0	0
Coryphaena sp.	0	0	0	0
Pampus sp.	0	0	0	0
Harpadon nehereus	0	0	0	0
Escualosa sp.	5692	0	0	0
Heteropriacanthus sp.	0	0	0	0

S	15	15	13	7
N	105883	66313	168751	192964
Catch Diversity Index	2.445	2.5054	1.978	1.0079

IV. Discussion

Bangladesh has rich fish diversity owing to presence of a long coastal stretch somewhere studded with mangroves. The fish catch of the fish landing stations serves as a first order analytical tool for fish diversity evaluation. The common species observed in the catch basket are attached as Annexure A. Out of a total 27 commonly caught fish species, the dominance of *Tenualosa ilisha*, *Dussumieria acuta*, *Kajikia* sp., *Aspidoparia* sp. is noted. *Penaeus* spp. are also caught, but their complete absence in June is a striking feature, which speaks of the seasonal affinity of the species in the water bodies. June is the onset of monsoon, which is characterised by low salinity and hence many stenohaline species cannot adjust to high dilution factor of the aquatic phase. ANOVA carried out with Catch Diversity Index shows significant variations between years and months ($p < 0.05$) (Table 3). This may be attributed to change in the water quality due to climate variation as witnessed in Indian part of Sundarbans (Mitra, 2013; Mitra and Zaman, 2014; Mitra and Zaman, 2015; Mitra and Zaman, 2015). However, there is high probability that factors like pollution and other anthropogenic parameters create a 'noise' in the overall scenario of compositional variation of fishes in the Patharghata fish landing station (as anthropogenic factors with their magnitude have not been considered in this paper). A more critical analysis considering the continuous data bank and covering all seasons along with surrounding anthropogenic factors may drive the work towards the lane of climate change.

Table 3: Temporal variation of Catch Diversity Index (CDI)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Years	0.853798	1	0.853798	82.11733	0.002839	10.12796
Between Months	2.513958	3	0.837986	80.59656	0.002295	9.276628
Error	0.031192	3	0.010397	Comment: There are significant variations in CDI of fish species in Bangladesh between years and stations ($p < 0.05$)		
Total	3.398947	7				

References

[1] Carpelan LH (1967) Invertebrates in Relation to Hypersaline Habitats. Invertebrates in Super saline waters. University of Texas Contribution Marine Science 12: 219-229.

[2] Copeland BJ (1967) Environmental Characteristics of Hypersaline Lagoons. University of Texas Contribution Marine Science 12: 207- 218.

[3] Hammer UT (1986) Saline Lake Ecosystems of the world. Dr. W Junk Publishers. Dordrecht, The Netherlands.

[4] IPCC (1996) The Regional Impacts of Climate Change. WG II, Chapter 6. Executive Summary.

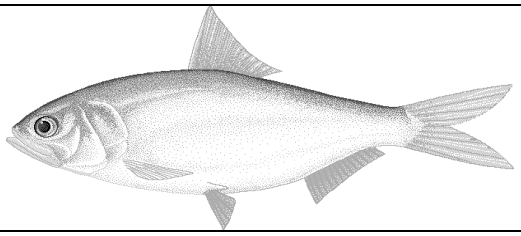
[5] Mitra, A. (2013) In: Sensitivity of Mangrove ecosystem to changing Climate. Springer. DOI:10.1007/978-; 81-322-1509-7, 323.

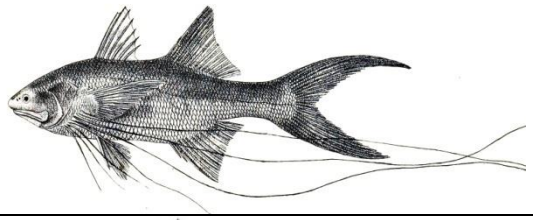
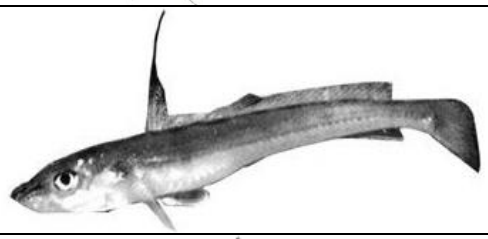
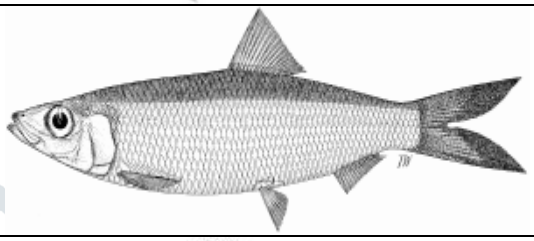
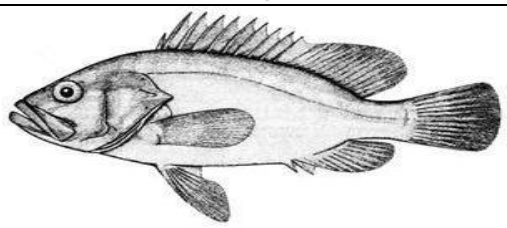
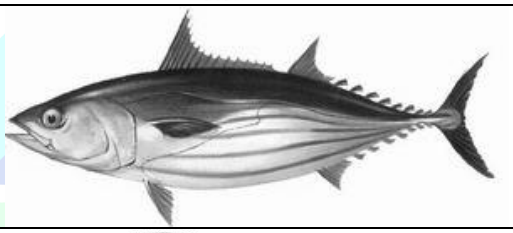
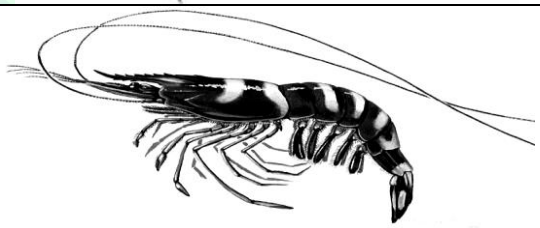
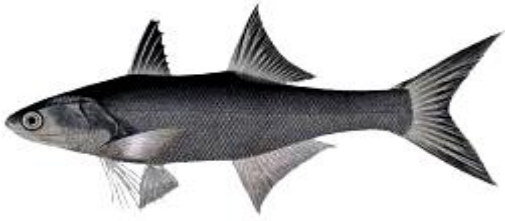
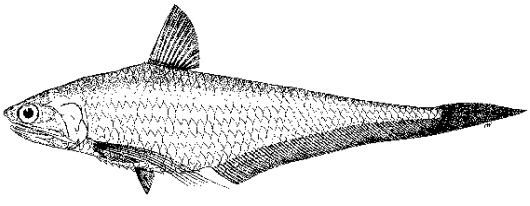
[6] Mitra, A. & Zaman, S. (2014) Carbon Sequestration by Coastal Floral Community. Published by The Energy and Resources Institute (TERI) TERI Press, India.

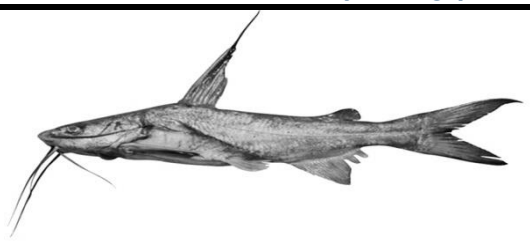
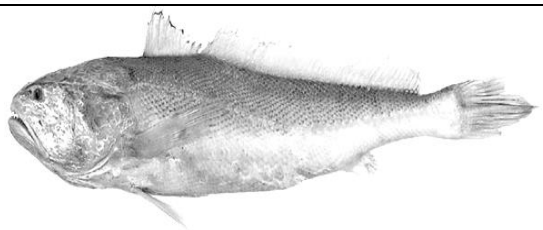
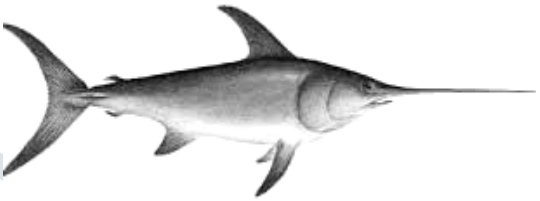
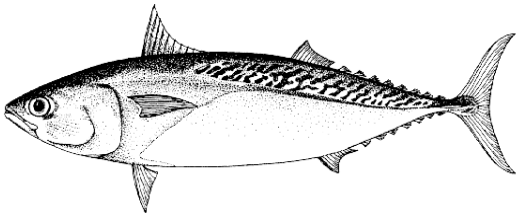
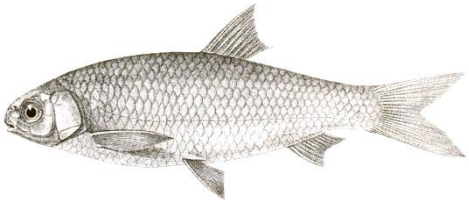
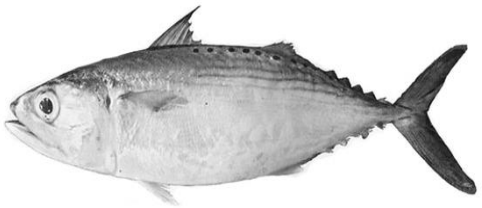
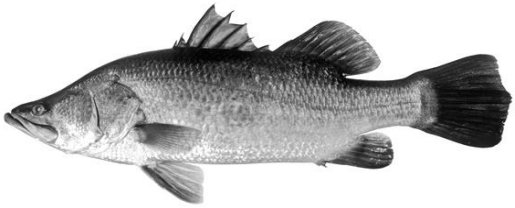
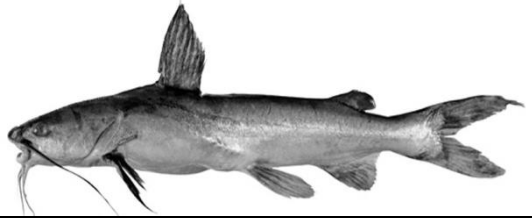
[7] Mitra, A. & Zaman, S. (2015) Blue carbon reservoir of the blue planet. Published by Springer. ISBN 978-81-322-2106-7 (Springer DOI 10.1007/978- 81-322-2107-4).

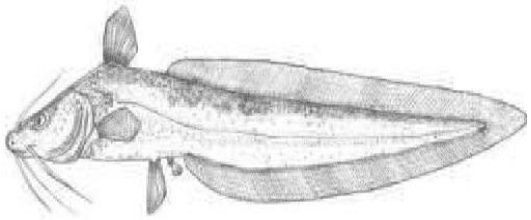
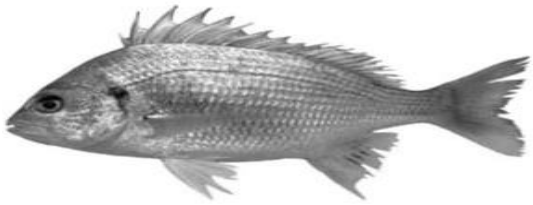
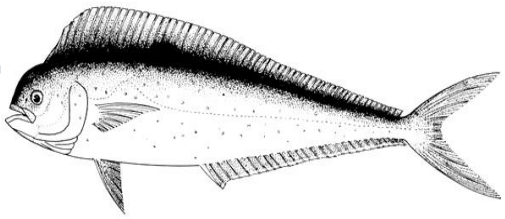
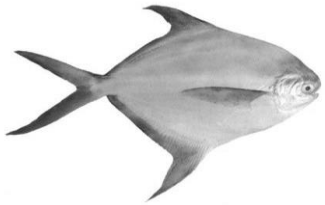
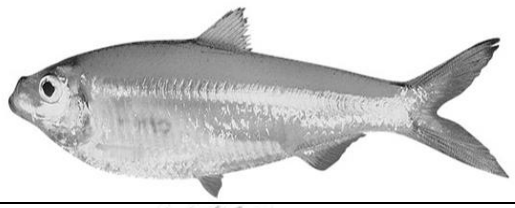
[8] Mitra, A. & Zaman, S. (2016) Basics of Marine and Estuarine Ecology. Springer. ISBN 978-81- 322-2705-2.

Annexure A

Common Name	Scientific Name	Pictures
Hilsha	*Tenualosa ilisha*	

Taposy	*Polynemus paradiseus*	
Tular dadi	*Sillaginopsis* sp.	
Dhella	*Dussumieria acuta*	
Boll	*Epinephelus* sp.	
Tunna	*Katsuwonus* sp.	
Shrimp	*Penaeus* sp.	
Byne	*Anguilla* sp.	
Lakka	*Eleutheronema tetradactylum*	
Bairagi	*Coilia* sp.	

Kanta	*Nemapteryx* sp.	
Poma	*Otolithoides* sp.	
Golpata	*Kajikia* sp.	
Shapla Pata	*Aetomylaeus* sp.	
Surma	*Auxis* sp.	
Rass	*Aspidoparia* sp.	
Kauwa	*Rastrelliger* sp.	
Koral	*Lates calcarifer*	
Med	*Hexanematichthys* sp.	

Mochon	*Plotosus* sp.	
Jaba	*Acanthopagrus* sp.	
Pangas	*Pangasius* sp.	
Dolphin Fish	*Coryphaena* sp.	
Rupchada	*Pampus* sp.	
Loitta	*Harpadon nehereus*	
Gober ati	*Escualosa* sp.	
Rangachokha	*Heteropriacanthus* sp.