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DIVERSITY OF FISH FAUNA IN A WATER BODY RECEIVING EFFLUENT FROM NAGAON PAPER MILL IN ASSAM

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ABSTRACT
Effluents from paper mills are of concern as these might pollute the neighbouring water bodies. Treated water from Jagiroad paper mill reaches the Taranga beel through two outlets from the paper mill. The present study was carried out to see whether there has been some effect on the species composition of fishes in this beel over the years. Certain physico chemical parameters and diversity of fishes had been studied for a period of one year. Comparison of data with a control site has revealed that the beel harbours mostly fish species adapted to hypoxic conditions.

KEY WORDS: *Fish diversity, wetland (Elenga/taranga beel), Jagiroad, Assam.*

INTRODUCTION

Pulp and paper mill effluent is a major pollutant for the neighbouring waterbodies. Benthic macro invertebrate and fish communities in recipient lakes and streams often have fewer species, lower densities, and altered taxonomic composition Kelso (1977). In addition to lethal effects, pulp and paper mill effluent has been shown to have many sub lethal effects on fish. These include liver dysfunction Oikari & Nakari (1982), tainting of fish tissues, reduced growth rates Whittle & Flood (1977), and avoidance of polluted waters Kelso (1977). The present study includes assessment of certain physico chemical parameters of the beel water and fish diversity over a period of one year to study the possible effect of treated waste water from paper mill on the ecology and diversity of the fishes in selected sites of the Elenga / Taranga beel in Jagiroad in the Morigaon district of Assam.

Description of the Study area

Jagiroad is located about 50 km east of Guwahati and 24 km south of Morigaon. Major industry of the town is the Nagaon Paper Mill, run by Hindustan Paper Corporation Ltd. at Jagiroad, at the intersection of 92°4/ East longitude and 21°2/ North Latitude. The Elenga / Taranga beel (approximate 1,704 Sq K.M.) is located near the Industrial unit. This system receives ETP discharge and wastewater from Nagaon Paper Mill of HPC Ltd. Two outlets from the paper mill containing different types of sludge ultimately reach the beel ecosystem and cause siltation problem. In the lean season a small rivulet is seen but during rainy season, the entire low lying area becomes inundated and turns into a single water body. The study was taken up during August 2010 to July 2011.

Experimental sites

A. Ellenga Beel at Belguri, Jagiroad
The water body is in the village area. Vegetable and paddy cultivation is done in its vicinity. There is luxuriant growth of water hyacinth. The beel is Surrounded by forest area. Kapili River flows by the area. The beel is located at the intersection of 92°4/ East longitude and 21°2/ North Latitude and 195 meters msl.

B. Ellenga Beel System Pond, Jagiroad, Morigaon. This beel site is near HPC Nagaon Paper Mill outlet. Sampling site was selected on the other side of the bridge in the pond towards HPC Jagiroad. The pond is partially covered by water Hyacinth.

Control site

Control samples were collected from the Tolibor beel, Nagaon district, Assam situated at a distance of 60 Kms from the paper mill.
The average annual rainfall recorded during the study period was 1530.9 mm (annual average Rainfall 2006 – 2010; IMD) and temperature in winter varies from a maximum of 24.8° C to a minimum of 11.2° C while summer temperature varies between 25.5° C to 32.9° C. The annual average maximum temperature is 30.4° C and the minimum is 19.8° C.

METHODOLOGY

Fishes were collected seasonally from the beel so that fishes present in all the seasons could be recorded. Fishermen use indigenous gears like cast net, hook and baits and other common gears for fishing. The collected specimens were preserved in 6% formaldehyde by giving an abdominal incision to the specimen. Fish specimen were brought to the laboratory and identified with the help of standard literature viz Jayaram (1999), Talwar and Jhingran (1991) and Sen (1985).
Water samples were collected at monthly intervals from the study area as well as from the control area. To maintain uniformity of the data sampling time and place were maintained throughout the period of study. The parameters studied include air temperature, water

temperature, pH, turbidity, dissolve oxygen, free carbon dioxide and total alkalinity. Physico-chemical parameters were analysed following APHA (1998).

RESULTS

Fishes were recorded from the experimental site as well as the control site. The data is presented in Table -1 and table 2 respectively. Eleven species of fishes belonging to eight genera, seven families, four orders have been recorded from the study area (Site 1- Elenga / Taranga beel, Jagiroad, Morigaon, Assam.) during the period of study (2010 – 11).

Twenty-two species of fishes belonging to sixteen genera, ten families, six orders have been recorded from the control area (Site 2- away from industrial area).

TABLE –1. List of the fishes recorded in the Taranga beel and their local name, common name and conservation status as per IUCN 2011.

Phylum – Vertebrata
Class - Teleostomi

Sl.No	Systematic Position	Scientific Name	Common Name (English)	Local Name (Assamese)	IUCN Status
	Order: Osteoglossiformes				
1	Family: Notopteridae	*Notopterus notopterus* (Pallas, 1769)	Grey featherback	Kanduli	LRnt
	Order: Siluriformes				
2	Family: Claridae	*Clarius batrachus* (Linnaeus,1758)	Magur	Mahgur	VUL
3	Family: Claridae	*Heteropneustes fossilis* (Bloch, 1794)	Stinging catfish	Singee	VUL
	Order: Symbranchiformes				
4	Family: Symbranchidae	*Monopterus cuchia* (Hamilton, 1822)	Gangetic mureel	Kuchia	LRnt
	Order: Perciformes				
5	Family: Nandidae	*Nandus nandus* (Hamilton, 1822)	Mottled nandus	Gedgedi	LRnt
6	Family: Anabantidae	*Anabas testudineus* (Bloch 1792)	Climbing perch	Kawoi	DD
7	Family: Belontidae	*Trichogaster fasciata* Bloch & Schneider, 1801	Banded gaurami	Khalihona	LRnt
8	Family: Channidae	*Channa striatus* (Bloch, 1793)	Striped snakehead	Shol	LRlc
9	Family: Channidae	*Channa punctatus* (Bloch, 1793)	Spotted snakehead	Goroi	LRnt
10	Family: Channidae	*Channa stewartii* (Playfair, 1867)	Assamese snakehead	Chengalee	NE
11	Family: Channidae	*Channa marulius* (Hamilton, 1822)	Giant snakehead	Sal	LRnt

LRnt- Lower risk near threatened; VUL- Vulnerable; LRlc- Lower risk least concern;
NE- Not evaluated; DD – Data deficient.

LIST OF FISHES COLLECTED FROM CONTROL AREA

TABLE –2. List of the fishes recorded in the control area (Tolibor beel) and their local name, common name and conservation status as per IUCN 2011.

Phylum – Vertebrata
Class – Teleostomi

Sl.No	Systematic Position	Scientific Name	Common Name (English)	Local Name (Assamese)	IUCN Status
	Order: Osteoglossiformes				
1	Family: Notopteridae	*Notopterus notopterus* (Pallas, 1769)	Grey featherback	Kanduli	LRnt
2	Family: Notopteridae	*Chitala chitala* (Hamilton, 1822)	Humped featherback	Chital	NT
	Order: Clupeiformes				

3	Family: Clupeidae	*Gudisia chapra* (Hamilton, 1822)	Indian River Shad	Karati	LRlc
	Order: Cypriniformes				
4	Family: Cyprinidae	*Puntius ticto* (Hamilton, 1822)	Two spot barb	Chakari puthi	LRnt
5	Family: Cyprinidae	*Puntius sarana* (Hamilton, 1822)	Olive barb	Sannee puthi	VUL
6	Family: Cyprinidae	*Catla catla* (Hamilton, 1822)	Catla	Bhokua	VUL
7	Family: Cyprinidae	*Cirrhinus cirrhosus* (Bloch,1795)	Mrigal	Mirika	LRnt
8	Family: Cyprinidae	*Cirrhinus reba* (Hamilton, 1822)	Reba carp	Lachim	VUL
9	Family: Cyprinidae	*Labeo gonius* (Hamilton, 1822)	Kuria labeo	courie	LRnt
10	Family: Cyprinidae	*Labeo rohita* (Hamilton, 1822)	Rohu	Rau	LRnt
11	Family: Cyprinidae	*Labeo calbasu* (Hamilton, 1822)	Black rohu	Malhee	LRnt
	Order: Siluriformes				
12	Family: Siluridae	*Wallago attu* (Bloch & Schneider, 1801)	Boal	Barali	NT
13	Family: Claridae	*Clarius batrachus* (Linnaeus,1758)	Magur	Mahgur	VUL
14	Family: Claridae	*Heteropneustes fossilis* (Bloch, 1794)	Stinging catfish	Singee	VUL
	Order: Symbranchiformes				
15	Family: Symbranchidae	*Monopterus cuchia* (Hamilton, 1822)	Gangetic mureel	Kuchia	LRnt
	Order: Perciformes				
16	Family: Nandidae	*Nandus nandus* (Hamilton, 1822)	Mottled nandus	Gedgedi	LRnt
17	Family: Anabantidae	*Anabas testudineus* (Bloch 1792)	Climbing perch	Kawoi	DD
18	Family: Belontidae	*Trichogaster fasciata* Bloch & Schneider, 1801	Banded gaurami	Khalihona	LRnt
19	Family: Channidae	*Channa striatus* (Bloch, 1793)	Striped snakehead	Shol	LRlc
20	Family: Channidae	*Channa punctatus* (Bloch, 1793)	Spotted snakehead	Goroi	LRnt
21	Family: Channidae	*Channa stewartii* (Playfair, 1867)	Assamese snakehead	Chengalee	NE
22	Family: Channidae	*Channa marulius* (Hamilton, 1822)	Giant snakehead	Sal	LRnt

En- Endangered; LRnt- Lower risk near threatened; VUL- Vulnerable; LRlc- Lower risk least concern; NE- Not evaluated; NT – Near threatened; DD – Data deficient.

Certain abiotic parameters were analyzed at monthly interval and data has been presented in Table 3. Killing River during monsoon (June-August) and during winter (December-February) the area becomes partially dry.

TABLE-3: Monthly variation of Physico-chemical parameters of water of the study Site-1: Taranga beel; Site-2: Control.

Month	At.Temp (^oC)		W. Temp (^oC)		pH		D.O(mg^{-L})		T.Alkal (mg^{-L})	
	S1	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**
Aug/10	35.5	34.1	32.9	30.1	8.62	7.81	1.45	6.57	110.6	55.7
Sep/10	34.7	33.2	33.8	30.2	8.83	7.72	1.35	6.74	115.7	59.5
Oct/10	33.8	32.2	32.9	32.7	8.81	7.32	1.23	6.62	123.8	63.2
Nov/10	28.8	27.2	27.5	25.3	8.93	7.53	1.15	6.78	126.5	68.7
Dec/10	14.0	13.0	12.7	11.3	8.66	6.82	1.05	6.65	134.3	69.4
Jan/11	24.3	23.7	23.5	21.1	8.84	7.61	1.00	6.65	141.6	73.3
Feb/11	27.2	26.9	26.8	24.3	8.95	7.43	0.95	6.87	155.4	77.4
Mar/11	30.2	29.4	29.5	27.2	8.91	6.72	0.97	6.56	159.8	79.9
Apr/11	31.4	30.5	30.8	30.0	8.15	7.53	0.94	6.44	165.3	87.2
ay/11	33.2	32.4	32.8	30.2	8.23	6.81	0.96	6.53	159.7	88.7
Jun/11	34.4	33.8	33.7	33.2	8.07	7.72	1.12	6.88	146.8	76.5
Jul/11	36.8	36.2	33.0	32.4	8.95	7.73	1.22	6.57	148.4	75.3
Mean	30.36	29.38	29.16	27.33	8.66	7.39	1.11	6.65	140.66	72.9
SD	±6.33	±6.27	±6.12	±6.24	±0.32	±0.39	±0.16	±0.13	±18.34	±10.18
SE	±1.82	±1.81	±1.76	±1.80	±0.09	±0.11	±0.04	±0.03	±5.29	±2.94

DISCUSSION

The Elenga / Taranga beel remains inundated during monsoon (June-August) period with water from the river killing. In fact these areas turn virtually into several confined water bodies during winter (December-February) and the beels become partially dry. Though there is not much variation in temperature data and pH, DO and Total alkalinity showed much variation. The low DO level can be attributed to the fact that only fish species adapted to hypoxic condition are found in the beel. Scrimgeour (1989) while studying effects of paper mill effluent on micro invertebrates and fish population found that taxonomic richness and species diversity of invertebrates were highest in unpolluted sites. Catch of fishes was 1.5 to 2.8 times higher in unpolluted sites. Avoidance of waters receiving paper mill effluent by fish has been observed in various studies. Kelso (1977) found that yellow perch (*Perca flavescens*) were numerically dominated in areas uninfluenced by mill effluent in Nipigon Bay, Lake Superior, but were rare in areas where effluent was most concentrated. Similar results were obtained in the present investigation also where eleven species were recorded in the contaminated site and twenty two species could be recorded from unpolluted site. Site 1 recorded low DO in comparison to site 2 where more fish species were recorded.

Continuous disposal of the treated waste water over the years from the paper industry in the water bodies has become a problem as it causes increase in the pH and alkalinity in water. Presence of some air breathing fishes, which can thrive in the polluted environment may be due to the over growth of water Hyacinth which may deteriorate the dissolved oxygen level of the water body and thus making the environment unsuitable for the fishes which has low DO tolerance limit. Apart from these fishes, some minor carps can be found during the heavy rainfall period when the water flows in this beel from the Killing River. The study reveals that the Elenga beel system has accumulated pollutants over the years and has resulted in the decline in fish species composition in this habitat.

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