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Fish Diversity in Selected Stretch of the River Mahanadi in Odisha and the Livelihood of Inhabiting Fisher Community

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Abstract

A study was undertaken during January, 2013 to March, 2014 to observe the fish diversity of the Mahanadi River in four selected areas of the Mahanadi stretch starting from Hirakud Reservoir to Banki of Odisha down stream. Besides, it was in thought to study the fisher community residing in these areas and their involvement in fishing activities for livelihood sustenance as well as their socio-economy. Based on collected data from the study, it is observed that there is an occurrence of 56 species belonging to 35 genera, 19 families and 7 orders. The present socio-economic status of the fishers of these regions reveals that the fisher communities inhabiting in the selected stretch are seasonally associated with fishing in major areas whereas some of them are fully engaged in fishing. Most of the families of these communities are falling in the below poverty line category. There is a need to develop a targeted policy by the Government to improve the socio-economic conditions of these communities keeping in view the sustainable management of the fish diversity of these areas.

Keywords: Species diversity, fishers community, Mahanadi river, hirakud Reservoir, satakosia tiger reserve.

Introduction

Out of 2, 246 indigenous finfishes described in India, 765 fishes are categorised as freshwater species[1]. Fisheries which also include aquatic resources, is nothing without fishers. Fish diversity and fishers' community move and live together. If this movement is in sustainable manner, fish diversity flourishes enhancing species richness of the region. This ultimately brings a continuous source of income as well as fish protein to the most vulnerable group of Fisheries Sector viz. fishers. So, where biodiversity of fish is rich, the role of socioeconomics of the fishers for the sustainable growth is the most needed. Studying fish diversity alongwith a comparative approach towards the fisher community is an interesting phenomenon which links the fish diversity with the livelihood of the fisher communities inhabiting these regions[2-4].

In India, the Mahanadi River is considered as the third largest river in the peninsular region, and shares its drainage basin ($80^0$30'- $86^0$50'E and $19^0$20'- 23^0 35' N) within the States of Chhattisgarh (75136 km^2), Odisha (65580 km^2), Jharkhand (635 km^2) and Maharashtra (238 km^2).

It starts from the Bastar Hills of Chhattisgarh and passes through different geological locations especially of Eastern Ghats and finally joins the Bay of Bengal in the form of different branches passing along the coastline of Odisha. It is about 860 km long and has an annual runoff of 50×10^9 m^3 with a peak discharge of 44740 m^3 s^{-1}. The Hirakud Dam which was built on the river in 1957 is a big reservoir for fishes, located at 80^0 E longitudes and 21^0 30'N latitude[3, 5-7].

Review of literature reveals that studies on the fish diversity of the Mahanadi River have been undertaken by different researchers. Day is credited to report 146 species mostly collected from Cuttack region of the Mahanadi. According to Tamboli and Jha, the Scientists who had reported different fish species in the Mahanadi River are Hora 43 species; Chouhan 54 fish species from the Tel River, a tributary of river Mahanadi, Jayaram and Majumdar 42 fish species, Desai and Shrivastava 48 fish species from the Mahanadi River and Om Prakash *et. al.* 65 fish species. Besides, Tamboli and Jha reported 58 fish species in the Mahanadi River in Janjgir-Champa district of Chhattisgarh[3, 5-12].

The present study was carried out at four selected places along the upper and upper-middle stretch of the Mahanadi River basin in Odisha in anticipation of good amount of information on diversity pattern. These areas include Hirakud Region ($80^0$30'- $86^0$50'E and $19^0$20'- 23^0 35' N) of Sambalpur district, Satakosia ($84^0$48'- $85^0$00'E and $20^0$34'- 20^0 48' N) Angul district, Kantilo ($85^0$13'E and $20^0$22' N) Nayagarh district and Banki ($85^0$25'E and $20^0$21' N) of Cuttack district[13]. The present study was undertaken to look into the fish diversity of the Mahanadi River and classify the reported of fishes into food fish, ornamental fishes and both food and ornamental fishes. In addition, the objective of the present study was to correlate finding with the socioeconomics of the fisher community inhabiting around the selected stretches of the Mahanadi River. The study also aims at identifying challenges to the fish diversity and suggesting the conservation measures for the same[2-4].

Material and Methods

Sampling was carried out by collecting fish species from different fishing grounds, landing centres and fish markets in selected regions with the help of local fishers and the State Government staff. For taxonomic study, fish samples were preserved in 5% formaldehyde solution. The taxonomic identification was done by referring Day[6], Talwar-Jhingran[14] and Jayaram [8]. The scientific names of the identified fishes were also checked by referring the website of fishbase[15]. Identifications were further confirmed with the help of Zoological Survey of India, Kolkata. The status of the available ornamental fishes were determined according to the Threatened freshwater fishes of India, National Bureau of Fish Genetic Resources, 2010 and IUCN Red list of Threatened Species, 2012.2 version[17]. The samples recorded and the data collected in this regard were as per the format developed by the author for the study[6,8, 14-18].

The diversity index for the surveyed and collected samples was determined by using Shannon and Wiener formula, which is as follows:

$$H = -\sum_{i=1}^{S} P_i \ln(P_i)$$

Evenness of the diversity index was calculated by using the formula:

$E = H/H_{max}$

Where: H= Shannon-Wiener index of diversity, S= total number of species, H_{max}= ln (S), P*i*= (N*i*/N) proportion of total sample represented by species *i,* N= total number of individual of all species, N*i*= total number of specimens of each species[19-23].

The similarity of the species in all sampling station was calculated by following Jacquard's index:

$Sj = j/(x+y-j)$

Where: *Sj is* the similarity between any two zones X and Y, *j* is the number of species common to both the zones X and Y, *x* is the total number of species in zone X and *y* is the total number of species in zone Y[19-23].

To analyse important hydrological parameters, water samples were collected from fishing ground with the help of the local fishers and staff of Directorate of Fisheries, Government of Odisha. Water temperature, dissolved oxygen and pH were measured *in situ* with the help of digital sensors, while free CO_2, total alkalinity, hardness, inorganic nutrients, viz., ammonia, nitrite, nitrate and phosphate were measured using standard methods by following APHA (1998)[24-25].

Information on the habitat and data on economic aspect of fishes were also collected from fishermen and local fish retailers. To study socioeconomics of the fishers' communities, personal interactions and interviews were conducted with the fisher families in the different selected regions as well as the fish retailers in the market of these regions. The information especially on the fishing gear used by them, mechanism of operation and types of fish caught, marketing of the fish catch and income earned there from, etc. were recorded[2,26].

Results and Discussion

The samples of fish species were identified and arranged according to their taxonomic order, family, genus and species. The economic importance and their conservation status were taken into consideration while doing so. The study recorded 56 species belonging to 35 genera, 19 families and 7 orders (table-1). The study shows that Cyprinidae is the most abundant family contributing 37.5% of the total species of all the families found in this region (figure-1) while among the orders, Perciformes topped the list (figure-2). The calculated diversity indices of the four areas selected along the stretch of Mahanadi River on the basis of the Shannon–Weiner diversity index reveal that they ranged between 1.51 (at Satakosia) and 3.23 (at Hirakud). The result indicates that the species richness is high at Hirakud while it is low at Satakosia. The evenness varies between 0.65 (Satakosia) and 0.91 (Hirakud). This indicates that Satakosia tiger reserve has less diverse fish species whereas Hirakud reservoir is highly diverse in this regard. The similarity index states that the highest similarity is between Hirakud and Kantilo (0.535) followed by the index between Hirakud and Banki (0.517), and Kantilo and Banki (0.475). The lowest similarity index is between Hirakud and Satakosia (0.178). The data analysis for the similarity index in respect of Satakosia with other three selected sites demonstrates lower indices viz: Hirakud and Satakosia (0.178), Satakosia and Kantilo (0.212) and Satakosia and Banki (0.3). This may be attributed to the limited access to this area for fishing due to restriction being a reserve forest area. Although due to reserve forest, the Satakosia stretch is presumed to have rich fish species diversity, the findings of the present study do not confirm this. In order to understand the exact fish species diversity of Satakosia, the further study would require elaborative and intensive fishing methods.

Out of the reported 56 fish species, 20 species are considered as only ornamental fishes, 30 species as only food fishes and 6 species as both ornamental and food fishes (figure 3). It is observed that fish species like *Amblypharyngodon mola* (Ham.), *Catla catla* (Ham.), *Cirrhinus mrigala* (Ham.), *Labeo rohita* (Ham.), *Osteobrama cotio* (Ham.), *Puntius sophore* (Ham.) and *Wallago attu* (Bl. & Schn.) are found almost in all the four sites of the selected stretches. The values of water quality parameters of the selected stretches indicative of fish productive habitat between low to medium range (table-2)[4,6-7,15,18,27-30].

Socio-economics of the fisher community: The socioeconomics of fishers of Hirakud region was studied by collecting data from a sample of 100 families with population of 647 persons. There are 246 fisher families in Satakosia with population of 1154 persons, 70 fisher families in Kantilo with

population of 380 persons and 23 families in Banki with 154 persons. It is observed that the sex ratio of the fisher population of the four selected stretches varies from 656 (Banki) to 830 (Hirakud) females per 1000 males. In the social structure of local fishers, it was found that most of them belong to Kewat caste under different sub-caste viz: Behera, Mirdha who follow Hindu religion. It is also observed that the fisher population is educationally backward. The percentage of literacy varies from 54% to 58% in the population of selected stretches. Women are the most illiterate among these populations. While the younger population of the fisher community is among the highest literate in the community, the aged fisher population are mostly illiterate. The average income of a fisher family of the selected stretches varies between Rs.1000 and Rs.3200 per month, which seems quite low. Besides fishery, the fishers adopt agriculture and other related activities as alternative sustenance livelihood because fishing fetches income only in fishing seasons. The age group of 16–35 years of fishers are more in number with more active role in fishing activities. As regards the fishers in the age group of 46 – 60 years they are not directly engaged in fishing but most of them are involved in ancillary activities including making and repairing of craft and gear[2-3,26]. During the study, it was also observed that Fishermen's Cooperative Societies are found only in Hirakud Reservoir stretch whereas village committees or groups are undertaking welfare measures for fishers in the other three stretches[2,26].

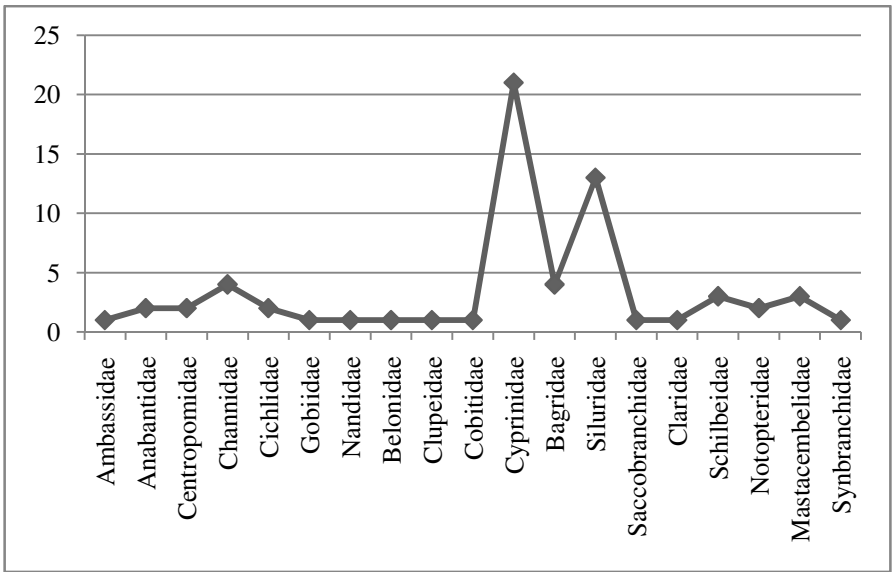

Figure-1
Distribution of fish species within different families

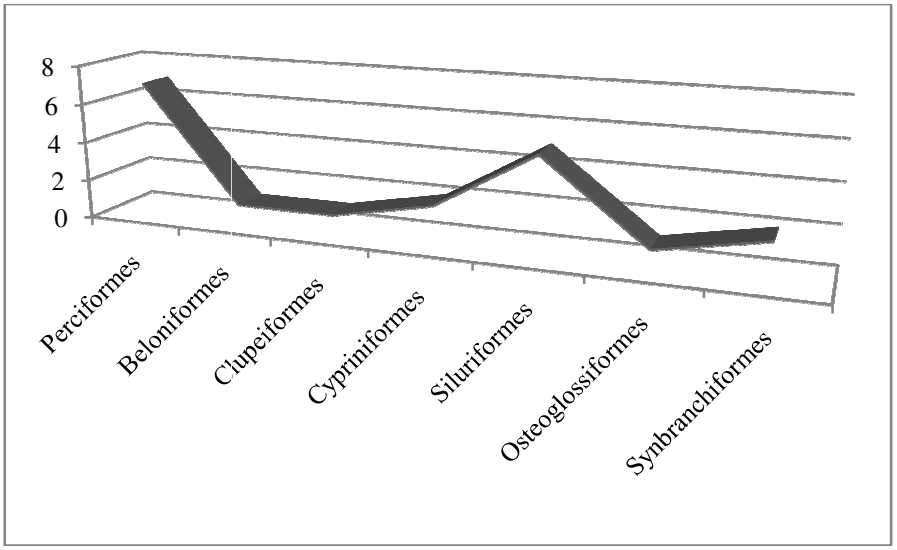

Figure-2
Distribution of fish families within different orders

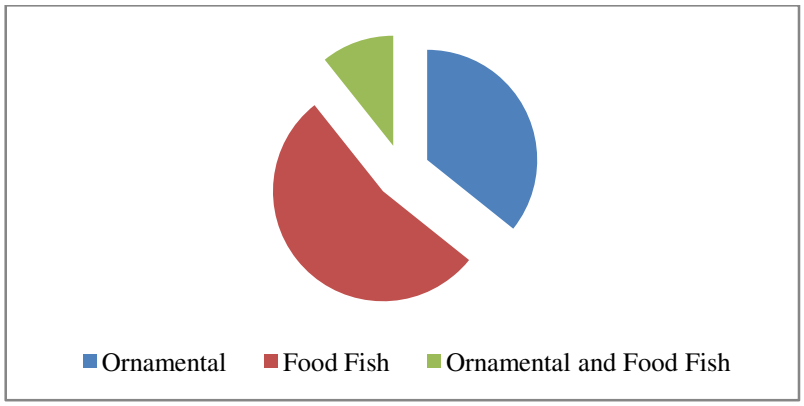

Figure-3
Percentage of Ornamental fish species to the total fish varieties

Table-1
Different fish species found at the four selected areas

Name of the Order	Name of the Family	Sl. No.	Name of the species	Hirakud Region	Satakosia	Kantilo	Banki	IUCN Status
1. Perciformes	1. Ambassidae	1	*Parambassis lala* (Ham.)	+	-	+	-	LRnt
	2. Anabantidae	2	*Anabas testudineus* (Bloch)	+	-	+	-	VU
		3	*Colisa fasciatus* (Bloch& Schn.)	+	-	+	+	LRnt
	3. Centropomidae	4	*Chanda nama* (Ham.)	+	+	+	+	LRlc
		5	*Chanda ranga* (Ham.)	+	-	+	-	LRlc
	4. Channidae	6	*Channa gachua* (Ham.)	+	-	-	+	VU
		7	*Channa marulius* (Ham.)	+	-	+	+	LRnt
		8	*Channa punctatus* (Bloch)	+	-	+	-	LRnt
		9	*Channa striatus* (Bloch)	+	-	+	+	LRlc
	5. Cichlidae	10	*Oreochromis mossambicus* (Peters)	+	-	-	+	Intrd.
		11	*Oreochromis niloticus* (Linn.)	+	-	-	-	Intrd.
	6. Gobiidae	12	*Glossogobius giuris* (Ham.)	+	-	+	+	LRlc
	7. Nandidae	13	*Nandus nandus* (Ham.)	+	-	-	+	LRnt
2.Beloniformes	8. Belonidae	14	*Xenentodon cancila* (Ham.)	+	-	+	-	LRlc
3. Clupeiformes	9.Clupeidae	15	*Gudusia chapra* (Ham.)	+	-	-	-	LRlc
4. Cypriniformes	10.Cobitidae	16	*Lepidocephalichthys guntea* (Ham.)	+	-	+	+	LRlc
	11. Cyprinidae	17	*Amblypharyngodon mola* (Ham.)	+	-	+	+	LRlc
		18	*Catla catla* (Ham.)	+	+	+	+	VU
		19	*Cirrhinus mrigala* (Ham.)	+	+	+	-	LRlc

		20	*Cirrhinus reba* (Ham.)	+	-	-	-	VU
		21	*Ctenophryngodon idella* (Val.)	+	-	-	-	Intrd
		22	*Cyprinus carpio* (Linn.)	+	-	-	+	Intrd.
		23	*Danio devario* (Ham-Buch.)	+	-	-	-	LRlc
		24	*Danio (Brachydenio) rerio* (Ham.)	+	-	-	-	LRlc
		25	*Hypophthalmichthys molitrix* (Val.)	+	-	-	-	Intrd.
		26	*Labeo bata* (Ham.)	+	-	-	-	LRlc
		27	*Labeo calbasu* (Ham.)	+	-	-	+	NT
		28	*Labeo fimbriatus* (Bloch)	+	-	-	+	LRlc
		29	*Labeo gonius* (Ham.)	+	-	-	-	LRlc
		30	*Labeo rohita* (Ham.)	+	+	+	+	LRlc
		31	*Osteobrama cotio* (Ham.)	+	-	+	+	VU
		32	*Osteobrama vigorsii* (Sykes)	+	-	+	-	VU
		33	*Puntius sarana* (Ham- Buch.)	+	+	+	+	VU
		34	*Puntius sophore* (Ham.)	+	+	+	+	LRlc
		35	*Puntius ticto* (Ham.)	+	+	-	-	LRlc
		36	*Rasbora daniconius* (Ham.)	+	-	-	-	LRnt
		37	*Salmostoma bacaila* (Ham.)	+	+	+	+	LRlc
5. Siluriformes	12. Bagridae	38	*Mystus (Aorichthys) aor* (Ham.)	+	+	+	+	DD
		39	*Mystus (Aorichthys) seenghala* (Sykes)	+	-	+	+	LRlc
		40	*Mystus tengara* (Ham.)	+	-	+	+	LRlc
		41	*Mystus vitatus* (Bloch)	+	-	-	-	LRlc
	13. Siluridae	42	*Ompok bimaculatus* (Bloch)	+	-	+	-	VU
		43	*Ompok pabda* (Ham.)	+	-	+	+	VU
		44	*Ompok pabo* (Ham.)	+	-	-	-	LRnt
		45	*Wallago attu* (Bl. & Schn.)	+	+	+	+	LRnt
	14. Saccobranchidae	46	*Heteropneustes fossilis* (Bloch)	+	-	-	+	VU
	15. Claridae	47	*Clarias batrachus* (Linn.)	+	-	-	+	VU
	16.Schilbeidae	48	*Ailia coila* (Ham.)	+	-	+	-	NT
		49	*Clupisoma garua* (Ham.)	+	-	-	-	VU
		50	*Eutropiichthys vacha*	+	-	-	-	LRlc

			(Ham.)					
6. Osteoglossiformes	17. Notopteridae	51	*Chitala chitala* (Ham.)	+	-	-	-	LRnt
		52	*Notopterus notopterus* (Pallas)	+	-	+	-	LRnt
7. Synbranchiformes	18.Mastacembelidae	53	*Macrognathus aral* (Bloch & Schn.)	+	-	-	+	LRlc
		54	*Mastacembelus armatus* (Lacepede)	+	-	+	+	LRlc
		55	*Mastacembelus puncalus* (Ham.)	+	-	-	+	LRlc
	19. Synbranchidae	56	*Monopterus cuchia* (Ham.)	+	-	-	+	VU

Note: Low Risk near threatened (LRnt), Vulnerable (VU), Low Risk least concern (LRlc), Introduced (Intd.), Near Threatened (NT), DD-Data Deficient.

Table-2
Water Quality Parameters of the Study Areas

Sl.No.	Water Parameters	Hirakud Region		Satakosia		Kantilo		Banki	
		Min	Max	Min	Max	Min	Max	Min	Max
1.	Temperature ^{0}C	19	39.6	16.2	38.6	19.1	38.2	18.6	38.6
2.	pH	7.8	8.2	7.5	8.4	7.9	8.4	7.6	8.1
3.	Dissolved Oxygen (mg/l)	6.2	9.2	6.0	8.1	6.4	8.6	6.1	8.0
4.	Total Alkanity (ppm)	39.6	82.2	42.0	81.4	41.2	80.6	40.2	79.6
5.	Total Hardness (ppm)	41.2	72.3	40.2	81.3	39.9	79.2	42.1	81.1
6.	Carbon Dioxide (ppm)	4.2	5.6	3.8	4.4	3.5	4.3	3.3	4.7
7.	Nitrate -N(mg/l)	0.05	2.05	0.03	1.80	0.03	1.05	0.04	1.55
8.	Nitrite-N (mg/l)	0.001	0.42	0.001	0.31	0.002	0.30	0.001	0.36
9.	Phosphate (mg/l)	0.025	0.04	0.022	0.032	0.021	0.03	0.021	0.028

Conclusion

The larger rivers of India although render livelihood and nutritional security to the poor fishers through their rich biodiversity, the biodiversity management especially the fish diversity of these rivers is inadequately studied. It is a difficult task to understand the pattern of impact of the fish diversity and the aquatic ecosystem on the livelihood of poor fishers due to non-availability of baseline information. However, the awareness is increasing as to how the aquatic biodiversity is supporting livelihood and sustainable development. There is an urgent need to focus attention for conservation and management of threatened fish species present in these rivers for saving from further endangerment. Therefore, the documentation and characterization of biodiversity is a vital step to assure sustainable development and conservation[3-4,29].

A recent review of literature on fish diversity of the Mahanadi River indicates that the Mahanadi River is also one of the diverse rivers for a wide variety of indigenous fish species. The findings of the present study show that the selected stretches have rich fish diversity and also support the earlier studies. A significant number of these fishes are considered ornamental species. Hence, potential ornamental fishes among them may be used for aquarium purpose by systematic collection in sustainable manner from the wild[2-3,30].

Inland fishers are more vulnerable in comparison to their counterparts in marine fishing aquaculture sector. As fishers are the primary stakeholder group in the fishery sector, the growth of this sector shall not be achieved without inclusive growth and improvement of their socio-economic condition. Lower living standard, limited access to income source, shortage of basic amenities and most importantly the lack of education are the huddles that exist in the sector. Although it is a good sign that the fishers are trying to provide education to their children, there is a greater need to enhance the socio-economic conditions of the fishermen in order to augment productivity through thoughtful policies and targeted implementation. The fishers may however be encouraged to form Self Help Groups to bring them together for effective fishing and management. Besides, meaningful awareness is required to make the uneducated and poor fishers understand the biodiversity, the major threats and the right approach towards sustainable development for improving socioeconomic condition[2-3,12,26].

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