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Effect of Tonga River for Fish diversity, Karnataka

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Abstract: In the present study, an effort has been made to investigate the fish resources quantitatively by studying the ichthyofaunal biodiversity of Tunga River stretch from Gajanoor fishing village to Kudali of Shivamogga district. Monthly sampling was conducted at three centres during July 2010-June 2012 by using gill nets. A total of 45491 kg fishes from three landing centres were collected and Gondichatnalli recorded maximum followed by Shivamogga and Honnapura. The most abundant fish species was *Calta catla* (28%) followed by *Labeo rohita* (17%) and *Clarias gariepinus* (11%). During present investigation a total of 37 species belonging to 11 families and 4 orders were recorded. The order Cypriniformes found to be dominant with 23 fish species followed by Siluriformes 11 species and Perciformes 2 species. Although, 37 species were recorded, the family Cyprinidae recorded 19 fish species (51.35%) followed by Bagridae, 4 fish species (10.81%) and Claridae with 3 fish species (8.10%) each. The Simpson's index of diversity (1- Lambda') was highest in Gondichatnalli (0.8802) followed by Shivamogga (0.8580) and Honnapura (0.8523). This indicated the greater fish biodiversity in Gondichatnalli when compared to other two centres. The biomass of fish species was more in Gondichatnalli (S= 36, N=19014) followed by Shivamogga (S =31, N= 14671), and Honnapura (S =37, N= 11806). Further, the other indices such as Pielou's evenness (J'), Shannon H'(loge) and Simpson 1- Lambda' were also used to assess the richness of biodiversity of all the three fish landing centres. In this study an attempt has been made to evaluate the ichthyofaunal diversity in the region and suggests mitigating measures.

Keywords: Assessment, Fish diversity, Tunga River, Karnataka.

1. Introduction

Biodiversity is manifested at all levels of bio-organization i.e. from cell to ecosystem and refers to enumerable kinds of living organisms inhabiting terrestrial, marine and freshwater ecosystems (Ambasht *et al*., 1994). Ichthyofaunal diversity refers to variety of fish species depending on context and scale; it could refer to alleles or genotypes within of life forms within a fish community and to species or life forms across aqua regimes (Burton *et al*., 1992). About 21,723 living species of fish have been recorded in the world of these 8,411 are freshwater species and 11,650 are marine forms. India is one of the mega biodiversity countries in the world and occupies the ninth position in terms of freshwater mega biodiversity (Mittermeier and Mitemeir, 1997). In India there are 2,500 species of fishes of which 930 live in freshwater and 1,570 are marine (Kar *et al*., 2003). Studies of spatial and temporal patterns of diversity, distribution and species composition of freshwater fishes are useful to examine factors influencing the structure of the fish community (Galactos *et al*., 2004). The distribution and composition of the fish species in each habitat were closely associated with various factors such as the availability of food, breeding sites, water current, depth, topography and physic-chemical properties of water (Harris, 1995). Fish species are also an important indicator of ecological health. The abundance and health of fish will show the health of water bodies (Hamzah, 2007).

The damming of rivers and streams is often implicated as a cause for fish population decline and local extinction of freshwater fish (Christopher *et al*., 2001). However, with the increased recognition of the importance of the indigenous aquatic biodiversity and inherent ecological processes (Leal *et al*., 2005), rigorous examination of impoundment on smaller rivers and streams is needed. Biodiversity is essential for stabilization of ecosystem protection overall environmental quality for understanding intrinsic worth of all species on the earth (Ehrlich and

Wilson, 1991). Positive correlations between biomass production and species abundance have been recorded by various earlier workers (Nikolosky, 1978). As per economic importance and scope of fish and fisheries especially in Karnataka, it is natural to study the distribution and availability of fish from fresh water. Human activities such as modification of the environment, harvesting and culture and effects of modernization have contributed to the pollution of water bodies which serve as habitat for fishes (Tiwari, 2011 and Zhang *et al*., 2011). These activities have resulted in damage to the genetic resources of aquatic organisms. That includes modification of environment, harvesting and culturing of aquatic resources for food or other uses (FAO, 1985; Nelson and Soule, 1987). Physical and chemical changes culminate in new environmental conditions that can result in permanent alterations of biological communities (Karr, 1981 and Li *et al*., 1987). Reducing abundance of reproducing individuals results in increased rates of inbreeding and reduced genetic drift and thus increases the potential for further loss (Gall, 1987). Tunga River is one of the important rivers in Karnataka that need serious attention in its management and conservation of fishery resources. Detailed studies on this river are still lacking. It is partly for this reason that we were inspired to conduct the current study on Gajanoor- Kudali section of Tunga River so as to determine the current conditions of the fish fauna of the river.

2. Material and Methods

2.1 Study area

This study was performed in the catchment area of the Tunga River. This river rises in the Western Ghats near Samse in the Karnataka state and flow about 150 Km, before joining the river Bhadra near Kudali. This study was conducted at the Gajanoor-Kudali section of Tunga River viz., Honnapura (A), Shivamogga (B) and Gondichatnalli (C) (Figure 1). The section is only small part of the river with length of about 40 km. Fish were sampled monthly at three sampling stations set up in the study section of the river. Fish samples were collected for two years from July, 2010 to June, 2012. Fish sampling was conducted using gill nets (mesh size measuring 30, 45, 50 and 60 mm) at all the three centres.

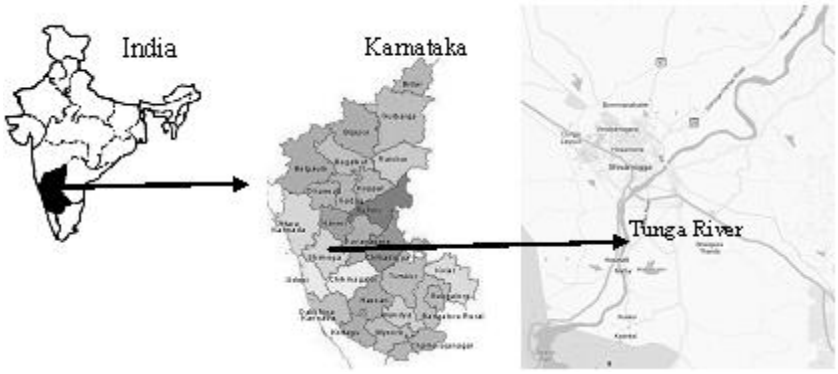

Figure 1: Location of the study area

2.2 Identification of fish species

All fish caught were identified to species level using standard taxonomic viz. Fishes of India, FAO identification sheets, ITIS (Integrated Taxonomic Information System) standard report (http://www.itis.gov), Fish Base (http://fishbase.org) and other reference books.

2.3 Diversity indices

The diversity of fishes was calculated by Shannon- Weiner and Pielou's evenness indices. Since individual size of fish species differed greatly, the indices are expressed in terms of biomass and not in terms of number of individuals. Hill's abundance was used to examine the variation in the number of dominant species. Species richness was calculated by Margalef's index. The similarity in species composition was studied by calculating the Bray-Curtis Coefficient. However, all the diversity indices were done by using the PRIMER V.6 analytical package developed by Plymouth Marine Laboratory, U.K.

3. Results

The result of the present study revealed the occurrence of 37 fresh water fish species belonging to 4 orders. The order Cypriniformes was dominant with 23 fish species followed by order Siluriformes 11, Perciformes 2, and Symbranchiformes with one fish species. The list of fish species recorded form three fish landing centres are given in Table 1. Although, 37 species were recorded, the Cyprinidae was observed as the dominant family with 19 fish

species (51.35%) followed by Bagridae, 4 fish species (10.81%) and Claridae with 3 fish species (8.10%) each (Fig. 2).

The distribution of fish species is quite variable because of geographical and hydrological conditions. The fish species density, abundance and distribution recorded from three fish landing centres are shown in Table 1. Among the recorded fish species, the high abundance of fish species with maximum availability was *Catla catla* (12713kg), Murrel the *Channa striatus* (1111Kg), the Cat fish *Clarias gariepinus* (5017 kg) and *Ompok pabda* (1304 kg). The highest abundance of fish *Catla catla* followed by *Labeo rohita, Clarias gariepinus, Cirrhinus mrigal, Cyprinus carpio nudus, Clarias batrachus, Oreochroms niloticus, Ctenopharhyngodon idella, Ompok pabda, Oreochromis mossambicus, Cyprinus carpio specularis, Channa striatus, Ompok bimaculatus, and Labeo calbasu* were recorded in all the sites. Fish species such as *Tor sp. (Juveniles), Puntius ticto, Puntius vittatus, Puntius dobsoni, Labeo gonius, Noemacheilus rupelli, Puntius filamentosus, Rasbora danioconius, Silonia silondia, Garra gotyla, Rita pavimentata, Puntius sarana, Labeo bata and Hypophthalmichthys molitrix* were recorded in larger quantities.

Among Cypriniformes, the Cyprinidae contribute (51.35%) represented with *Catla catla, Labeo rohita, L. calbasu, L. fimbriatus, L. bata, L. gonius, Cirrhinus mrigal, Cyprinus carpio nudus, C. carpio specularis, C. carpio communis, Ctenopharhyngodon idella, Hypophthalmichthys molitrix, Puntius sarana, P. filamentosus, P. dobsoni, P. vittatus, P.ticto, Tor sp., Garra gotyla*. The Genus *Labeo* and *Puntius* represented by 5 species in each followed by Genus *Cyprinus*. The other families like Cichlidae, *Rasbor*idae, Balitoridae contributing 5.4%, 2.7%, and 2.7% respectively to the total fish species (Fig. 2).

The order Siluriformes contributed 11 fish species, among them the family Bagridae contributed 10.8% followed by Claridae (8.1%), Siluridae (5.41%), Schilbeidae and Loricardiidae (2.7%) each to the total fish species. The order Perciformes contributed 2 fish species, among them the family Channidae contributing 5.4% to the total fish species and the order Symbranchiformes contributed one fish species with family Mastacembalidae contributing 2.7% to the total fish species (Fig. 2).

Table: 1. Fish catch data (in Kg) of Tunga River

Sl. No.	Fish species	Family/Orders	Sampling Centre		
			A (Honnapura)	B (Shivamogga)	C (Gondichatnalli)
	CYPRINIFORMES				
1	*Catla catla* (Hamilton,1822)	Cyprinidae	3675	4326	4712
2	*Labeo rohita* (Hamilton,1822)	Cyprinidae	2152	2561	3018
3	*Labeo calbasu* (Hamilton,1822)	Cyprinidae	128	331	217
4	*Labeo finbriatus (*Hamilton,1822)	Cyprinidae	123	156	184
5	*Labeo bata* (Hamilton,1822)	Cyprinidae	52	63	32
6	*Labeo gonius* (Hamilton,1822)	Cyprinidae	12	0	14
7	*Cirrhinus mrigal* (Hamilton,1822)	Cyprinidae	593	718	925
8	*Cyprinus carpio nudus* (Linnaeus, *1758)*	Cyprinidae	527	761	812
9	*Cyprinus carpio specularis (*Linnaeus, *1758)*	Cyprinidae	362	481	379
10	*Cyprinus carpio communis (*Linnaeus, *1758)*	Cyprinidae	498	220	314
11	*Ctenopharhyngodon idella (*Valenciennes,1844)	Cyprinidae	325	413	610
12	*Hypophthalmichthys molitrix(*Valenciennes,*1844)*	Cyprinidae	67	12	71
13	*Puntius sarana* (Hamilton,1822)	Cyprinidae	54	0	61
14	*Puntius filamentosus* (Hamilton,1822)	Cyprinidae	13	7	18
15	*Puntius dobsoni* (Hamilton,1822)	Cyprinidae	12	3	4
16	*Puntius vittatus* (F. Day, 1865)	Cyprinidae	3	4	8
17	*Puntius ticto* (Hamilton,1822)	Cyprinidae	5	0	9
18	*Tor sp.* (Juveniles)	Cyprinidae	8	0	0
19	*Garra gotyla (*Gray, 1830)	Cyprinidae	28	0	46
20	*Rasbora danioconius* (Hamilton,1822)	Rasboridae	9	14	21
21	*Oreochromis mossambicus* (Peters 1852)	Cichlidae	168	671	450
22	*Oreochromis niloticus (*Linnaeus, *1758)*	Cichlidae	491	518	371
23	*Noemacheilus rupelli (*Sykes 1839)	Balitoridae	11	0	23
	SILURIFORMES				
24	*Sperata aor* (Hamilton-Buchanan,1822)	Bagridae	85	56	131
25	*Sperata seenghala* (Sykes,1839)	Bagridae	97	187	240
26	*Mystus cavasius (*Hamilton, 1822	Bagridae	48	34	126

27	*Rita pavimentata (*Valenciennes 1840)	Bagridae	26	21	34
28	*Ompok bimaculatus (*Bloach,1794)	Siluridae	178	314	415
29	*Ompok pabda (*Hamilton 1822)	Siluridae	234	90	980
30	*Silonia silonda (*Hamilton, 1822)	Schilbeidae	26	17	13
31	*Wallago attu (*Bloach&Schneider,1801)	Claridae	189	233	245
32	*Clarias batrachus (*Linnaeus,1758)	Claridae	456	415	716
33	*Clarias gariepinus (*Burchell, 1822)	Claridae	799	1561	2657
34	*Hypostomus plecostomus* (Linnaeus, 1758)	Loricardiidae	63	28	76
	PERCIFORMES				
35	*Channa striatus (*Bloch,1793)	Channidae	179	213	719
36	*Channa gachua (*Ham, 1822)	Channidae	62	176	239
	SYMBRANCHIFORMES				
37	*Mastacembalus armatus* (Lacepede,1800)	Mastacembalidae	48	67	124
Total (Kg)			**11806**	**14671**	**19014**

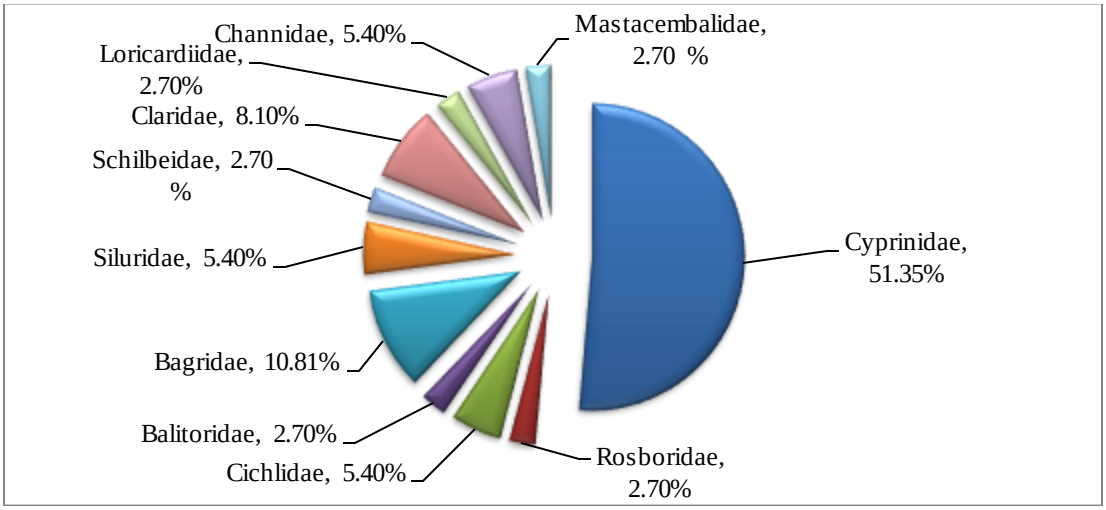

Figure 2: Diagrammatic representations of the % number contribution of each family

The species richness, abundance and biodiversity indices in all the three sites are shown in Table 2. In line with the higher number of species and their abundance, Shannon diversity H' ($\log_e$) was more in fish landing centre C (2.601) than in other two centres **A (**2.508**)**, and **B (**2.455). The Pielou's evenness (J') of the species was also more in **C** (0.725). However, Margalef's species richness (d) showed clear differences between the centres. Further the number of dominant species (N_2) was more in C**.**

The similarity in species composition and abundance among centres was in the range of 314.48 -780.88 (Table 3). Overall the quantity of fish landings was more in **C** (N= 19014) followed by **B (N=** 14671), **A (N=** 11806) and the species richness (d) was more in **C** (3.5522) (Table 2). This indicated the greater fish biodiversity in **C** when compared to other two fish landing centres. The fish species richness, abundance and biodiversity indices in all the three sites are shown in Table 2 & 3.

Table: 2. The centre wise diversity indices of finfish in Tunga River

Fish Landing Centres	Species	Quantity (Kg)	Species Richness	Pielou's evenness	Shannon	Simpson	Hills abundance	
	S	N	D	J'	H' (loge)	1- Lambda'	N_1	N2
A	37	11806	2.8394	0.694	2.508	0.8523	12.281	6.768
B	31	14671	3.1271	0.711	2.455	0.8580	11.655	7.041
C	36	19014	3.5522	0.725	2.601	0.8802	13.485	8.344

Table: 3 - Bray - Curtis similarities for Fish catch data of Tunga River

Centres	A	B	C
A	-	-	-
B	777.81	-	-
C	314.48	780.88	-

4. Discussion

The overall diversity of fish (37 fish species) found in the present study was considerably higher than the number of species (33) reported from river Bhadra (Thirumala *et al* 2011). Ahirrao and Mane (2000) recorded 32 fish species belonging to 25 genera, 8 families and 2 orders from fresh waters of Parbhani district of Maharashtra state and Sakhare (2001) recorded 23 fish species belonging to 7 orders in Jawalgaon reservoir in Solapur district. Hiware and Pawar (2006) recorded 43 fish species from Nath Sagar dam, Pathan, in Aurangabad district. In a study from neighboring state of Andhra Pradesh Savalla Murli Krishna and Piska (2006) recorded 31 fish species from secret lake Durgamcheruvu, Ranga Reddy district near Hyderabad.

The present study of fish fauna in Tunga River showed that most of the fish species recorded were widely distributed in the streams and rivers of Western Ghats and the present investigation reveals that Cyprinid fishes are found to be the more dominant group than others. Wilson (1988) pointed out that changes in habitat caused due to dam construction often limit the migratory fish fauna to the upper reaches of the river. This view indicated that the upstream river stretch and its tributaries could play an important role in survival of indigenous fish fauna. The native fishermen opined that the indigenous carnivorous fishes like *Wallago attu, Channa marulius, Heteropneustes fossilis,* and more importantly *Ompok bimaculatus* are becoming rare in the river. Similar situation is reported in Linganamkki reservoir (Sreekantha and Ramachandra, 2005). The considerable quantity of Indian major carp such as *Catla catla, Labeo rohita* and *Cirrhinus mrigal* were recorded in all the three landing centres.

The *Clarias gariepinus* has an immense impact on the indigenous species competing for space and food resulting in decline of indigenous fish stock. The department has banned the introduction of this species under the guidelines given by Govt. of India. This species also called as African cat fish and with the introduction of this species, some water bodies are found to be completely devoid of all the indigenous fish fauna as they devour the aquatic animals of all kinds without sparing any one. The highly carnivorous African cat fish which is illegally introduced to the aquatic system of India caused severe damage to indigenous fish fauna. The union agriculture ministry has ordered killing of these fishes *en masse* and preventing further culture of these fishes (Biju Kumar, 2000) but this order did not have any impact as it lacked any specific guidelines to destroy this fish. The intensive stocking of advanced fingerlings under National Fisheries Development Board and the Department of fisheries Karnataka helped in improvement of Indian major carp landings. Considerable landing of *Oreachromis massambicus* in three landing centres were recorded and according to local fishermen, the catch of Tilapia is increasing over the years. Due to the least demand for this fish in local markets, fishermen treat this fish as an unwanted catch. Scientifically, this fish is regarded as a hardy, territorial and a powerful competitor in nature. Ecologically, these fishes have adverse effect on the fish diversity. Fishermen reported that the maximum weight that this fish can attain is 1.0kg in Tunga river. Although they were never officially promoted by any agency but they are now found in all types of waters of the state.

The present study largely focuses on species richness and diversity of Tunga River. It is apparent that concentration of fish biodiversity is a major issue facing the region and it is in direct conflict with the rapid development activities taking place in the watersheds, including those related to aquaculture. There is a need to formulate sustainable strategies to save fish community of this river system as a whole. Being important river of Western Ghats, Tunga River supports variety of fish fauna. Each species often consists of several indigenous groups with a distinct genetic makeup. There could be uncertainties with all scientific endeavors to monitor abundance and productivity of stocks and the underlying causes. Further, there are uncertainties with regard to climate change, aquatic ecosystem productivity, predation and fishing pressure. Fishery resources at the river were being over-exploited and this was evidenced by low catches observed by fishermen during the course of the study. There are two declared fish sanctuaries for the protection and conservation of important fish species of the river *viz.* Chibbalagudde in the Tirthahalli taluka and Matturu in the Shivamogga taluka for further strengthening of the conservation measures of this system.

5. Aknowledgement

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