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Ichthyofaunal diversity at the confluence of Pravara and Godavari Rivers (M.S.) India

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Abstract
The present work is an an inquiry into the fish fauna at the confluence of Pravara and Godavari rivers at Toka, Tal. Newasa, Dist. Ahmednagar in Maharashtra, India. The study zone was rapidly surveyed to assess the prevailing freshwater fishes. The outcome of the study revealed the occurrence of 21 fish species belonging to 6 orders. The order Cypriniformes was dominant with 10 fish species followed by order Perciformes with 5 species, order Beloniformes and Synbranchiformes with 2 species each; and Siluriformes and Osteoglossiformes with 1 species each, were the least dominant. Thus, carps, barbs, eels, snake-heads and other fish formed the bulk of collection. It is proposed that the scientific information on ichthyofaunal diversity and distribution status will surely help in serving the future purposes of sustainable exploitation and concurrent conservation of fish resources, besides estimation of fishery potential of the confluence zone and broad concern towards providing 'food security'.

Keywords: Freshwater ecosystems, river confluence, fish diversity.

1. Introduction
Biodiversity is the most valuable but least appreciated resource, and it can be a key to the maintenance of the world [1]. India is one of the 17 mega 'biodiversity hotspots' contributing 60-70% of the world's biological resources. Freshwater biodiversity is the overriding conservation priority during the International Decade for Action: 'Water for Life' – 2005 to 2015; inland waters and freshwater biodiversity constitute a valuable natural resource, in economic, cultural, aesthetic, scientific and educational terms; thus, their conservation and management are critical to the interests of all humans, nations and governments [2]. Biodiversity conservation in general and fish genetic resources in particular have become issues of great concern both globally and nationally [3].

From time immemorial, rivers are said to be the lifeline for living beings, as they have played a vital role in the development of human civilization, since they provide basic necessities of life, water and food, on which depends the survival of living-beings [4]. Riverine ecosystems and their biological components, including fish [5], provide many valuable ecosystem services. In tropical regions especially, river fish are an important source of food [6]. It is surely important to protect and sustainably harvest natural populations of freshwater fish to meet the protein needs of poor people [7]. Rivers as lotic waterbodies are a home to rich and varied life forms. Presently, the riverine ecosystems are endangered by various anthropogenic activities that pose a threat to its biotic inhabitants.

Rivers across all regions are adversely affected by human activities as a result of growing human settlements and industrial processes alongside the banks with their discharges, and toxic run-offs; which eventually lead to riverine pollution.

Freshwater ichthyological diversity is the most crucial part of biodiversity as it is difficult to be estimated and protected [8]. Freshwater ecosystems are among the most productive and diverse ecosystems and are estimated to support over 10,000 species of fish [9]. Fish are invariable living components of water bodies and are important food resource and good indicators of the ecological health of the waters they inhabit. Out of a total of 2,500 species of fish in India, 930 are in freshwaters and belong to 326 genera, 99 families and 20 orders; however, the rich biodiversity of freshwater fish of the Indian region has been rapidly dwindling because of increasing degradation of inland water [10].

As per the Report on 'Assessment of Riverine Fisheries and linking with Water Quality Restoration Programme – River Godavari in Maharashtra' by Maharashtra Pollution Control Board & Central Institute of Fisheries Education**:** India is endowed with vast expanse of open water fishery resources, noted for their variety as well as rich production potential. The 29,000 km of riverine resource of the country comprises 14 major rivers (catchment area >20,000 km²), 44 medium rivers (catchment area between 2,000 and 20,000 km²) and innumerable minor rivers (catchment area <2,000 km²). India is the fourth largest inland fish producer in the world (4.7 million tonnes in 2008-09). But during the last few decades, the production scenario in inland sector has indicated a mixed trend - an upward looking aquaculture with a declining fishery from riverine sector. Riverine fisheries have also been considered to be one of the important economic activities of the nation. It could be worthwhile to link water quality improvement programmes with biotic assessments, particularly for aquatic animals, *i.e.*, fishes and invertebrates. Thus, any strategy of fisheries development in the riverine sector needs to give equal emphasis to conservation of the biodiversity and fish production [4].

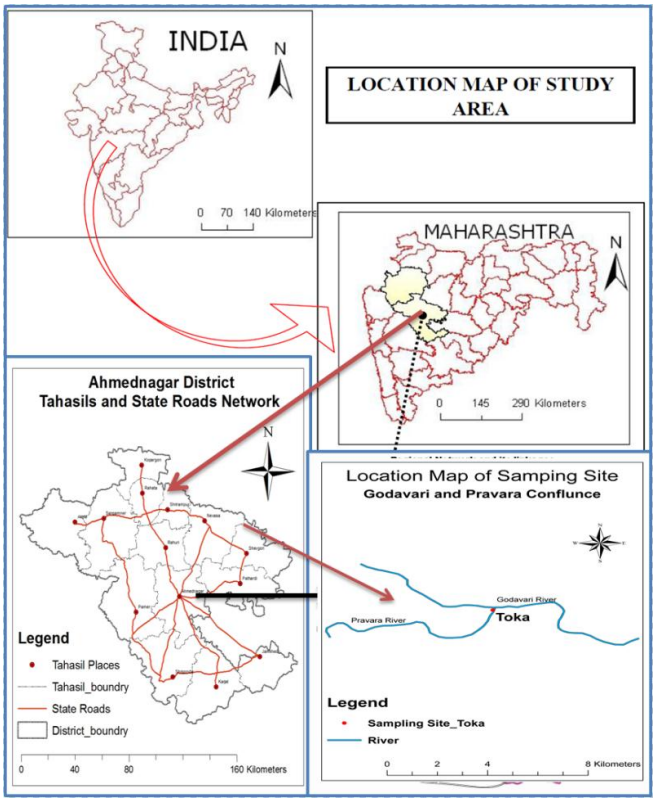
The adverse effects of human activities have resulted in degradation of stream and riverine ecosystem [11]. Globally, riverine fish face many anthropogenic threats including riparian and flood plain habitat degradation, altered hydrology, migration barriers, fisheries exploitation, environmental (climate) change, and introduction of invasive species; collectively, these threats have made riverine fishes some of the most threatened taxa on the planet [6]. Fish is sensitive to changes in water chemistry due to different anthropogenic activities from their catchment. Fish responses to environmental disturbances, including hydromorphological factors are different in time and space in comparison to simpler organisms, as they tend to be integrated over larger intervals; therefore, fish has been identified as suitable for biological assessment due to its easy identification and economic value [12, 13].

Globally, the faunal assemblages of many riverine ecosystems have not been rigorously assessed [6]. Fish assemblages may differ on longitudinal gradient in streams according to various biological aspects such as species diversity, stress tolerance, habitat preferences, feeding behaviours and origin of species [14]. Confluence of rivers provides a unique habitat for aquatic flora and fauna. Riverine fisheries have been a source of protein-rich food for the local populace but the fish catches seem to be dwindling in recent times. Though, the study zone and adjoining area might have been studied earlier for fish diversity, the same tends to change on spatial and temporal lines.

With the possibility of 'difference in fish assemblages on longitudinal gradient' in mind, the present work was undertaken as a part of 'rapid monitoring' of the riverine zone of the study area, which in course of time might have witnessed 'changes in diversity patterns due to water abstraction, sedimentation and pollution'. Information of fish and their habitation are helpful taxonomic and ecological data. The present work is significant as surveys of ichthyofauna are necessary in planning for conservation of biodiversity and control of pollution. Thus, the present study aimed to record the freshwater fish species occurring at the *Pravara-Godavari* confluence at Toka, Tal. Nevasa, Dist. Ahmednagar in Maharashtra, India.

2. Materials and Methods

According to Ahmednagar Gazetteer**:** The Ahmednagar District is partially situated in the upper basin of the *Godavari* and in part in the basin of Bhima. The *Godavari* forms the boundary between Ahmednagar and Aurangabad Districts. The joint waters of *Pravara* and the *Mula* enter on the right bank of the *Godavari*, at the Toka village. As, the *Pravara* enters Nevasa Taluka, it receives the waters of the Mula River and the collective flow turns to the north-east and falls into the *Godavari* at the Pravara Sangam near Toka. Toka is a small village at a distance of 7 miles to the Northeast of Nevasa, on the left bank of the *Pravara* at its meeting with the *Godavari* [15]. Kaigaon Toka is geographically located at latitude 19° 36' 32.63'' N and longitude 75° 03' 02.05'' E, 45 km away from Aurangabad (M.S.) India [16]. Toka is located on the borders of Nevasa Taluka of the Ahmednagar District and Gangapur Taluka of the Aurangabad district. The sampling site for collection of riverine fishes was located at the confluence of *Pravara* and *Godavari* Rivers, near Toka (See Map 1).



Map 1: Location Map of Pravara-Godavari Confluence

During the period of investigation - from July 2012 to April 2013, monthly fish samples were collected, photographed, identified and preserved for future reference. The fish specimens were collected by hiring services of local fishermen. In spite of hiring services for fish collection, several difficulties were faced in examining the riverine environment owing to the speedy flow, inaccessibility, erratic depths and remote locations. Fishing was done usually during the morning and evening periods. Fishing gear like cast net, gill net, *maccharjal* (mosquito net) used as drag net and disco nets were popular among small fishermen who operated in the waters. Fishing crafts like thermocol rafts and small boats or wheel-tyre tubes were used for moving in river waters. For identification and classification of fishes, standard key: *Freshwater Fishes of the Indian Region* by Jayaraman [17] was

followed. Fish specimens were preserved as wet collections in absolute alcohol, whereas few specimens were preserved in formalin after giving abdominal cut.

3. Results and Discussions

Ichthyodiversity refers to variety of fish species; depending on context and scale, it could refer to alleles or genotypes within piscian population, to species of life forms across aquaregimes [18]. Unfortunately, over the last few decades the riverine ecosystems have been subjected to intense anthropogenic pressure resulting in its degradation and habitat loss for the fishes with a consequence that many riverine fish species have become highly endangered [19]. Biological factors like food, competition, and predation also have a critical influence in determining the fish diversity pattern in rivers [20].

Heda [21] explored fish diversity in 2 rivers of the Northeastern Godavari basin – Adan and Kathani are the tributaries of the Painganga and the Wainganga, respectively. Though, both of them are part of the same basin, still they witness different ecological, climatic and anthropogenic conditions. 'Catch per unit effort' criterion was used for sampling and 47 species of fish were identified. Species richness and diversity measures were calculated and their values showed that, in terms of fish diversity, Kathani was a more diverse ecosystem than the Adan, the difference being mainly because the Adan experienced more anthropogenic influences.

Shinde *et al*. [22] investigated fish biodiversity to census commercially important fishes in the Pravara River at Pravara Sangam Dist. Ahmednagar (M.S). They found occurrence of 41 fish species belonging to 7 orders, 14 families and 26 genera. Among the collected species, order Cypriniformes was most dominant constituting 50% followed by order Siluriformes constituting 19%, order Perciformes constituting 14.28%, order Osteoglossiformes and Synbranchiformes constituting 4.76% and orders Mugiliformes and Beloniformes constituting 2.38% of the total fish species.

Vijaylaxmi *et al*. [23] studied freshwater fish distribution and diversity status of Mullameri River, a minor tributary of Bheema River of Gulbarga District, Karnataka. They recorded 14 freshwater fish species belonging to 5 orders from which order Cypriniformes was dominant with 7 fish species followed by order Siluriformes with 4 species, and the order Channiformes, Mastacembeliformes and Osteoglossiformes, each with 1 species.

Ichthyofaunal studies were undertaken by Rankhamb [24] in Godavari River at Mudgal Tq. Pathri, Dist. Parbhani; revealing occurrence of 26 fish species belonging to 05 orders, 07 families and 15 genera – the order Cypriniformes was dominant with 15 species, followed by Siluriformes with 05 species, Channiformes 04 species, Mastacembaliformes 01 species, and Perciformes 01 species. Rathod and Khedkar [25] studied the variety and abundance of freshwater fishes in Godavari River with reference to the elevation, latitude and longitude. Their results revealed the occurrence of 53 fish species belonging to 9 orders, 21 families and 37 genera.

As per Das *et al*. [26], Indian rivers with rich fish diversity are subjected to severe anthropogenic stress resulting in habitat degradation and the factors such as: surface area of the river basin followed by fish habitat availability potential, and a combination of variables like rainfall, discharge and sediment load were the most influential determinants of species richness. The study by Jayalekshmy & Sanalkumar [8] involved estimation of the fish diversity of Pallickal River in relation to physico-chemical parameters. 30 fishes belonging to 16 families of 9 orders were obtained, in which the dominant family was Cyprinidae.

Located at a distance of ten miles from Nevasa, *Pravara Sangam* is considered to be a sacred place and as the name indicates there is the confluence of the rivers *Pravara* and *Godavari* at the place. Vyas *et al*. [27] have attempted to identify a natural sacred site at Betwa River in Madhya Pradesh and compared the fish diversity and distribution to two non-sacred sites. 60 fish species recorded at a sacred ghat belonged to 15 families and 34 genera. The most abundant family was Cyprinidae.

Fish biodiversity assessment was carried out by Gedekar & Tijare [28] on ecological aspects of Wainganga river at Markanda village, District Gadchiroli (M.S.), which showed 49 different species of fishes belonging to 33 genera, 07 orders and 15 families – culturable species like *Catla catla, Labeo rohita* and *Cirrhinus mrigala* and other species *viz., Puntius sophore, Mystus vittatus, Channa striatus* were found in most of the sampling sites and analysis of different species revealed that most of them belonged to order Cypriniformes followed by Ophiocefaliformes, Beloniformes, Mastacembeliformes, Perciformes, Siluriformes, and Clupeiformes and Anguilliformes.

Sheikh [29] conducted ichthyofaunal studies on Pranhita River at Sironcha Dist, Gadchiroli; recording occurrence of 37 fish species belonging to 21 different genera, in 08 orders and 11 families – the members of order Cypriniformes were dominant with 18 species followed by Siluriformes with 08 species, Perciformes 03, Mastacembeliformes 03, Channiformes 02, Atheriniformes 01, and Anguilliformes 01.

In the present study, identification of the fish specimens was followed by their orderwise categorisation. 21 fishes species collected and identified belonged to 6 orders (Osteoglossiformes, Cypriniformes, Siluriformes, Beloniformes, Synbranchiformes and Perciformes); 9 families (Notopteridae, Cyprinidae, Siluridae, Belonidae, Hemiramphidae, Mastacembelidae, Chandidae, Gobiidae and Channidae); and 17 genera (*Notopterus, Salmostoma, Rasbora, Osteobrama, Puntius, Cirrhinus, Catla, Labeo, Ompok, Xenentodon, Hyporhamphus, Macrognathus, Mastacembelus, Chanda, Parambassis, Gobius* and *Channa)*. A list of the freshwater fish collected and identified from the study area is given according to systematic position in Table 1. The Table 2 shows the habitat, utility and IUCN status of the fish collected.

Table 1: Freshwater Fish Species from Pravara-Godavari Confluence during 2012-13

Sr.No.	Common Name	Order	Family	Genus	Species
1	Ghost knifefish	Osteoglossiformes	Notopteridae	*Notopterus*	*notopterus*
2	Large razorbelly minnow	Cypriniformes	Cyprinidae	*Salmostoma*	*bacaila*
3	Boopis razorbelly minnow	Cypriniformes	Cyprinidae	*Salmostoma*	*boopis*

4	Slender barb	Cypriniformes	Cyprinidae	*Rasbora*	*daniconius*
5	Cotio	Cypriniformes	Cyprinidae	*Osteobrama*	*cotio*
6	Olive barb	Cypriniformes	Cyprinidae	*Puntius*	*sarana*
7	Pool barb	Cypriniformes	Cyprinidae	*Puntius*	*sophore*
8	Ticto barb	Cypriniformes	Cyprinidae	*Puntius*	*ticto*
9	Indian Major Carp	Cypriniformes	Cyprinidae	*Cirrhinus*	*mrigala*
10	Indian Major Carp	Cypriniformes	Cyprinidae	*Catla*	*catla*
11	Indian Major Carp	Cypriniformes	Cyprinidae	*Labeo*	*rohita*
12	Butter catfish	Siluriformes	Siluridae	*Ompok*	*bimaculatus*
13	Garfish	Beloniformes	Belonidae	*Xenentodon*	*cancila*
14	Red-tipped halfbeak	Beloniformes	Hemiramphidae	*Hyporhamphus*	*xanthopterus*
15	Barred spiny eel	Synbranchiformes	Mastacembelidae	*Macrognathus*	*pancalus*
16	Spiny eel	Synbranchiformes	Mastacembelidae	*Mastacembelus*	*armatus*
17	Elongate glass perchlet	Perciformes	Chandidae	*Chanda*	*nama*
18	Indian glassy fish	Perciformes	Chandidae	*Parambassis*	*ranga*
19	Bar-eyed goby	Perciformes	Gobiidae	*Gobius*	*giuris*
20	Spotted snakehead	Perciformes	Channidae	*Channa*	*punctatus*
21	Striped snakehead	Perciformes	Channidae	*Channa*	*striatus*

Table 2: Habitat, Utility and IUCN Status of Freshwater Fish Species from Pravara-Godavari Confluence at Toka

Sr. No.	Fish Species	Local Name	Habitat	Utility	IUCN Status
1	*Notopterus notopterus*	514halet/patre, phulo, pholi, golhi	Demersal	Food Fish**	LRnt
2	*Salmostoma bacaila*	gangehela, chela, chelliah	Benthopelagic	Ornamental Fish	N.A.
3	*Salmostoma boopis*	amali	Benthopelagic	Ornamental Fish*	LRlc
4	*Rasbora daniconius*	dandai	Benthopelagic	Ornamental Fish **	LRnt
5	*Osteobrama cotio*	bhongi	Benthopelagic	Ornamental Fish	VU
6	*Puntius sarana*	darai/chalti	Benthopelagic	Food Fish**	VU
7	Puntius *sophore*	katch-karawa, potthiah, pothi	Benthopelagic	Ornamental Fish **	LRnt
8	*Puntius ticto*	kotree, kaolii pothia	Benthopelagic	Ornamental Fish **	LRlc
9	*Cirrhinus mrigala*	mrugal/mrigal/mirgal	Benthopelagic	Food Fish**	LRlc
10	*Catla catla*	catla/kathla/chepi	Benthopelagic	Food Fish***	VU
11	*Labeo rohita*	rohu/rahu	Benthopelagic	Food Fish**	LRlc
12	*Ompok bimaculatus*	gongavari	Demersal	Food Fish**	VU
13	*Xenentodon cancila*	Sooi maasa	N.A.	N.A.	N.A.
14	*Hyporhamphus xanthopterus*	choch maasa	N.A.	N.A.	VU
15	*Macrognathus pancalus*	vambat	N.A.	Food Fish	N.A.
16	*Mastacembelus armatus*	vam, vat, bam, bami, aaraah	Demersal	Food Fish*	LRlc
17	*Chanda nama*	kackki-chembardi, chand, sirsa	Benthopelagic	Ornamental Fish *	LRlc
18	*Parambassis ranga*	kachki, ranga-chanda	Demersal	Ornamental Fish	N.A.
19	*Gobius giuris*	bele, bailla	Demersal	Food Fish*	LRlc
20	*Channa punctatus*	lata, taki, phool-dhok, kuchi	Benthopelagic	Food Fish**	LRnt
21	*Channa striatus*	dhok/dhoke	Benthopelagic	Food Fish**	LRlc

Utility and IUCN status as per Kurup *et al*. [30]; Common name and habitat as per www.fishbase.org
*Important, **Highly important, *** Very highly important, VU – Vulnerable, LRnt – Low risk nearly threatened, LRlc – Low risk least concern, N.A. – Information not available.

Dominance of the family Cyprinidae / order Cypriniformes was revealed by various workers like Shinde *et al*. [22]; Vijaylaxmi *et al*. [23]; Rankhamb [24]; Jayalekshmy & Sanalkumar [8]; Vyas *et al*. [27]; Gedekar & Tijare [28] and Sheikh [29]. This finding coincides with the outcome of present investigation of freshwater fish diversity at the confluence of Godavari – Pravara Rivers.

Orderwise List of Freshwater Fishes Identified:

[A] Order – Osteoglossiformes
1. *Notopterus notopterus*

[B] Order – Cypriniformes
1. *Salmostoma bacaila*
2. *Salmostoma boopis*
3. *Rasbora daniconius*
4. *Osteobrama cotio*
5. *Puntius sarana*
6. *Puntius sophore*
7. *Puntius ticto*
8. *Cirrhinus mrigala*
9. *Catla catla*
10. *Labeo rohita*

[C] Order – Siluriformes
1. *Ompok bimaculatus*

[D] Order – Beloniformes
1. *Xenentodon cancila*
2. *Hyporhamphus xanthopterus*

[E] Order – Synbranchiformes
1. *Macrognathus pancalus*
2. *Mastacembelus armatus*

[F] Order – Perciformes
1. *Chanda nama*
2. *Parambassis ranga*
3. *Gobius giuris*
4. *Channa punctatus*

5. *Channa striatus*

The percent representation of different orders of fishes is depicted in Figure 1.

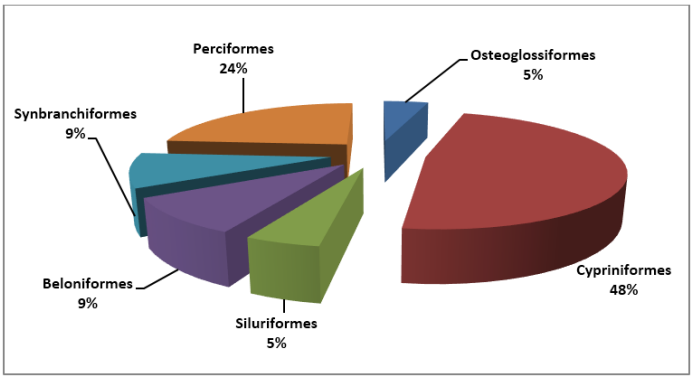


Fig 1: Orderwise Percent Representation of Freshwater Fishes in Pravara-Godavari Confluence during 2012-13

4. Conclusion and Suggestions

The present study revealed the occurrence of 21 fish species belonging to 6 orders. The order Cypriniformes was dominant with 10 fish species followed by order Perciformes with 5 species, order Beloniformes and Synbranchiformes with 2 species each; and Siluriformes and Osteoglossiformes, with 1 species each.

As per the FAO, lack of data can hamper the efforts for maximum utilisation of the freshwater fishery resources, and consequently in designing the conservation strategies for sustainable management of freshwater fish species, which face extinction, threatening or endangerment. Considering the probable spacial and temporal variations in freshwater fish assemblages, there is a continuous need to inventorise, document and monitor freshwater fish diversity, as suggested by various researchers. This will help in fish conservation efforts eventually serving to the larger cause of providing "food security" to the masses.

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