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Note

Diversity and distribution of fish fauna in the Ib River, a tributary of Mahanadi, India

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ABSTRACT

Ichthyofaunal survey was conducted in the Ib River (21°44' to 22°50' N; 83°56' to 83°54' E), an important tributary of Mahanadi, to evaluate the diversity and distribution of freshwater fishes along six sites on seasonal basis between February, 2016 and January, 2017. A total of 55 species belonging to 42 genera, 21 families and 9 orders were recorded from the study area. Maximum number of species belonged to the Order Cypriniformes (41.8%) followed by Siluriformes (21.8%) and Perciformes (21.8%). Maximum value of species richness was observed in downstream areas; Sundargarh and Barghat and least in upper stretches of Pamsala. Shannon–Weiner diversity index ranged between 2.47 to 3.68 at the six sites of Ib River indicating healthy state of the river. Bray-Curtis similarity cluster analysis suggests that similarities between sites decrease with increasing distance, with highest similarity found between Sundargarh and Barghat sites. Baseline data on fish biodiversity has been generated in this study which can now be periodically monitored and form basis for future conservation plans.

Keywords: Fish diversity, Ib River, Mahanadi tributary, Species richness

India, being the home for about 11.72% of global fish biodiversity and with 4 of the 34 global biodiversity hotspots; plays a key role in the world's biological resources (Lakra *et al.*, 2011). Freshwater resources like rivers, streams, springs and headwaters are not only indispensable for the wellbeing of human life but also support a wide plethora of aquatic flora and fauna. Of the 3398 fish species reported in India, which includes 2936 native fishes and 462 exotic fishes, 936 are freshwater fish species (NBFGR, 2016). As the human interference is increasing in these water bodies, basic information on the occurrence, abundance and distribution is important to protect and conserve the existing fish diversity.

Mahanadi is one of the major rivers of India, flowing west to east and draining into the Bay of Bengal. It ranks third among the peninsular rivers, in water potential and flood producing capacity. Mahanadi drains an area of about 1,32,000 km^2 in Chhattisgarh, Odisha, Jharkhand and Maharashtra with a total length of 860 km (Singh *et al.,* 2013). The principal tributaries of Mahanadi are the Jonk, Seonath, Hasdeo, Mand, Ib, Ong and Tel. River Ib is one of its important tributaries as it is the parent river along with Mahanadi for the longest dam in the world, the Hirakud Dam. Ib tributary assumes importance as it is the source of water for many industries along the basin and also supports the livelihood of many people along its bank. Increasing population, habitat alteration and degradation can significantly affect the biodiversity and sustainability of its resources. Ib valley being an important centre for mining activities, it is important to document and monitor aquatic biodiversity for conservation and management, but little has been reported on fish diversity from Ib River. Hence, the present investigation was undertaken to study the ichthyofaunal diversity of the river Ib.

The Ib tributary rises at an elevation of about 762 m in the Raigarh District of Chhattisgarh. The river traverses for about 251 km before falling into the Hirakud reservoir and has a total catchment area of about 12,447 km^2 (Jain *et al.*, 2007). Being a rain-fed river, nearly 80% of runoff occurs during the monsoon months (June to October). Land and water uses include human settlement, agriculture, livestock and fishing. Many industries have

flourished on the banks of the river Ib due to which, the Ib valley area is counted as one of the most important industrial zones of Eastern India.

Based on a pre-field survey conducted in upstream, midstream and downstream areas; a total of 6 sites (Fig. 1.) including all habitat types along the stretches of Ib River were selected and GPS coordinates were recorded for the present study (Table1). Sampling was undertaken between February, 2016 and January, 2017 during pre-monsoon, monsoon and post-monsoon.

Fish specimens were collected using gillnet, cast net, drag net and local indigenous traps. Experimental fishing was carried out using the expertise of local fishermen. Fish markets and landing centres associated with the river system were also visited to record species not captured during experimental fishing. Fish specimens

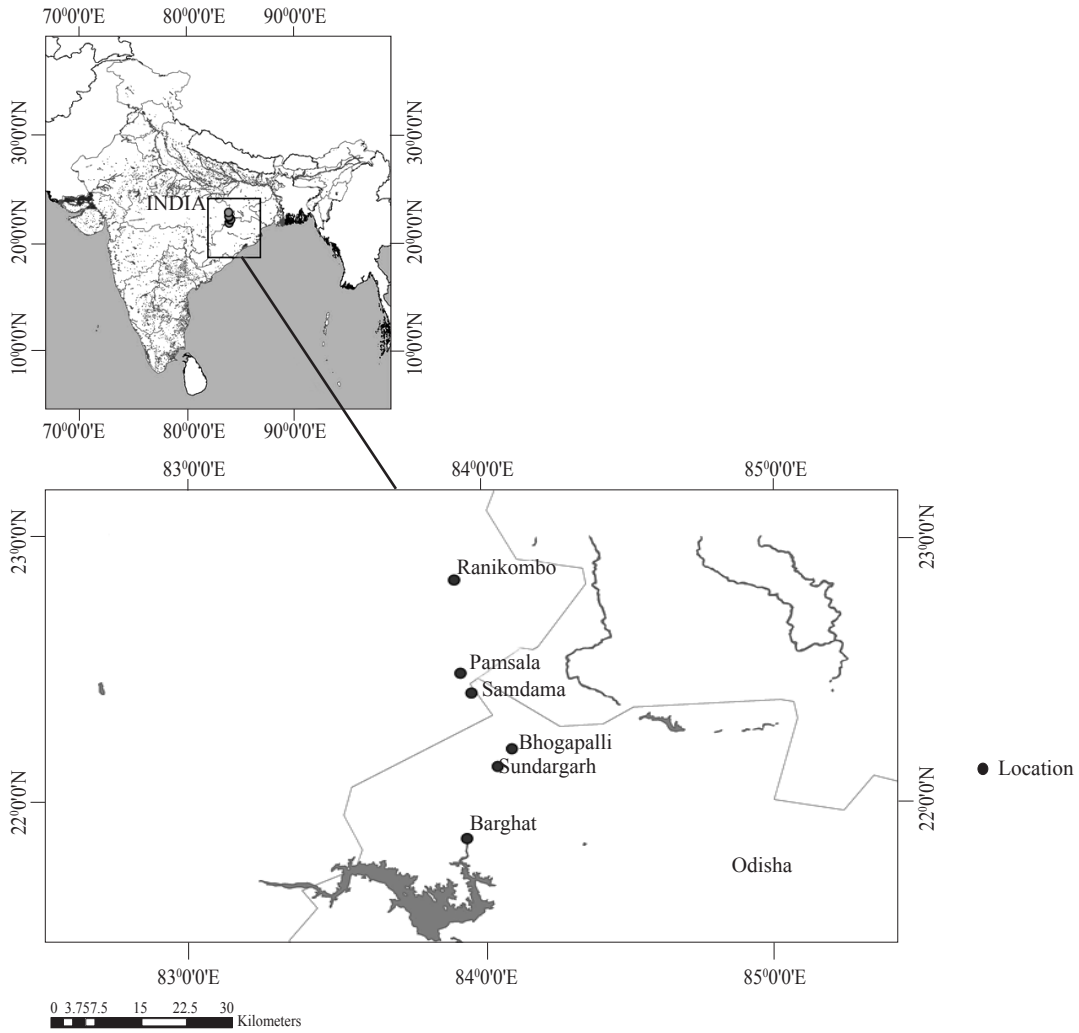

Fig. 1. Map showing sampling sites in Ib River

Table 1. Details of the study sites in Ib River

Site	Stream type	GPS Coordinates	Altitude (ft)
Barghat	Downstream	N 21° 51′ 49′′, E 83° 56′ 51′′	657
Sundargarh	Downstream	N 22° 8′ 4′′, E 84° 0′ 39′′	716
Bhogapalli	Midstream	N 22° 11′ 44′′, E 84° 6′ 2′′	774
Samdama	Midstream	N 22° 24′ 38′′, E 83° 57′ 46′′	935
Pamsala	Upstream	N 22° 29′ 6′′, E 83° 55′ 30′′	1175
Ranikombo	Upstream	N 22° 50′ 9′′, E 83° 54′ 9′′	1501

were immediately counted, photographed and identified to the lowest possible taxon. Species were identified and confirmed following standard literature (Talwar and Jhingran, 1991; Jayaram, 1999). Total number of species and total number of individuals were recorded from each location and representative samples were preserved in 10% formaldehyde for further study.

Information on fish assemblage structure was estimated by adopting different diversity indices namely; Shannon Weiner diversity index (1963), Simpson's evenness index (1949), Margalef species richness index (1958), Berger Parker dominance index (1970) and Equitability index. To better understand the similarity of fish assemblage structure between sampling sites, dendrograms were constructed using Bray-Curtis similarity index employing non-transformed species abundance data. All the analyses and calculations of diversity indices were performed using PAST software 3.15 (Hammer *et al.,* 2001).

A total of 3923 individuals were sampled and studied from all the sites along the stretches of river Ib. A total of 55 species belonging to 42 genera, 21 families and

Table 2. Fish diversity of river Ib

Taxon	Name of the species	Category: Food fish/Ornamental Fish
Order: Cypriniformes	1. *Catla catla*	Food Fish
Family: Cyprinidae	2. *Labeo calbasu*	Food Fish
	3. *Labeo gonius*	Food Fish
	4. *Labeo rohita*	Food Fish
	5. *Labeo bata*	Food Fish
	6. *Labeo boga*	Food Fish
	7. *Cirrhinus reba*	Food Fish
	8. *Cirrhinus mrigala*	Food Fish
	9. *Puntius sophore*	Ornamental Fish
	10. *Puntius phutunio*	Ornamental Fish
	11. *Pethia ticto*	Ornamental Fish
	12. *Systomus sarana*	Food Fish
	13. *Amblypharyngodon mola*	Food Fish/ Ornamental fish
	14. *Chela laubuca*	Ornamental Fish
	15. *Salmophasia phulo*	Food Fish
	16. *Barilius barila*	Ornamental Fish/Food Fish
	17. *Barilius bendilisis*	Ornamental Fish/Food Fish
	18. *Osteobrama cotio*	Ornamental Fish/Food Fish
	19. *Garra mullya*	Ornamental Fish
	20. *Garra gotyla*	Ornamental Fish
	21. *Rasbora daniconius*	Ornamental Fish
Family: Cobiitidae	22. *Lepidocephalychthys guntea*	Ornamental Fish
Family: Balitoridae	23. *Neonemacheilus botia*	Ornamental Fish
Order: Siluriformes	24. *Ompok bimaculatus*	Food Fish/ Ornamental Fish
Family: Siluridae	25. *Wallago attu*	Food Fish
Family: Schilbeidae	26. *Ailia coilia*	Food Fish
	27. *Clupisoma garua*	Food Fish
	28. *Silonia silondia*	Food Fish
	29. *Eutropiichthys vacha*	Food Fish
Family: Bagridae	30. *Rita chrysea*	Food Fish
	31. *Sperata seenghala*	Food Fish
	32. *Sperata aorella*	Food Fish
	33. *Mystus cavasius*	Food Fish
	34. *Mystus bleekeri*	Food Fish/ Ornamental Fish
Family: Saccobranchidae	35. *Heteropneustes fossilis*	Food Fish/ Ornamental Fish

(Conti....)

Taxon	Name of the species	Category: Food fish/Ornamental Fish
Order Perciformes	36. *Channa marulius*	Food Fish
Family: Channidae	37. *Channa punctatus*	Food Fish
Family Centropomidae	38. *Chanda nama*	Ornamental Fish
Family: Nandidae	39. *Nandus nandus*	Food Fish/ Ornamental Fish
Family: Ambassidae	40. *Paraambassis lala*	Ornamental Fish
	41. *Parambassis ranga*	Ornamental Fish
Family: Cichlidae	42. *Oreochromis niloticus*	Food Fish
	43. *Oreochromis mossambicus*	Food Fish
Family: Anabantidae	44. *Anabas testudineus*	Food Fish/ Ornamental Fish
	45. *Colisa fasciata*	Ornamental Fish
Family: Sciaenidae	46. *Johnius coitor*	Food Fish
Family: Gobiidae	47. *Glossogobius giuris*	Food Fish/ Ornamental Fish
Order: Synbrachiformes	48. *Mastacembalus armatus*	Food Fish/ Ornamental Fish
Family: Mastacembalidae	49. *Macrognathus aral*	Food Fish/ Ornamental Fish
Order: Beloniformes	50. *Xenentodon cancila*	Ornamental fish
Family: Belonidae		
Order: Osteoglossiformes	51. *Notopterus notopterus*	Food Fish/ Ornamental Fish
Family: Notopteridae		
Order: Mugiliformes	52. *Rhinomugil corsula*	Food Fish
Family: Mugilidae		
Order:Clupeiformes	53. *Gudusia chapra*	Food Fish
Family: Clupeidae	54. *Goniolosa manmina*	Food Fish
Order: Tetraodontiformes	55. *Tetraodon cutcutia*	Ornamental fish
Family: Tetraodontidae		

9 orders were recorded from the study area (Table 2). Cypriniformes represented by 23 species was found to be the most dominant order (41.8%) followed by Siluriformes and Perciformes, both with 12 species each (21.8%). Cyprinidae was the richest family (21 species) followed by Bagridae (5 species) and Schilbidae (4 species).

The maximum population density of cyprinids was recorded from Barghat site. The most abundant genus recorded was *Labeo* (comprising *L. rohita. L. gonius, L. calbasu, L. bata* and *L. boga*). Two exotic species *viz.*, *Oreochromis mossambicus* and *O. niloticus* were also recorded even though their distribution was limited to lower stretches of the river possibly due to its movement from Hirakud Reservoir and poor flow of water. *O. mossambicus* was recorded in very low density compared to *O. niloticus. Rita chrysea,* popularly known as 'Mahanadi rita', an endemic species to Mahanadi River (Menon, 1999), was also recorded. *R. chrysea* was recorded only in the lower and middle stretches of river Ib, possibly due to its amphidromous behaviour. Out of the 55 fish species reported, 27 species are food fishes, 15 have ornamental value while 13 species have both food and ornamental importance (Table 2). Though ornamental potential of the fishes was not exploited to the fullest, many such species (16 species) are consumed as food fish in the area. Maximum number of fishes were recorded from Barghat (1565), followed by Sundargarh (1296). The bulk of fishes from these sites were due to dominance of juveniles during the summer months because of indiscriminate fishing activity. Indigenous drag nets are operated intensely, capturing fingerlings and juveniles of *Osteobrama cotio, Chanda nama, Parambassis lala* and *Gudusia chapra* which constituted major share. Forty nine species were recorded in the lower stretch; 22 in middle stretch and the least in upper stretch with 13 species. The number of species recorded from the sites Barghat, Sundargarh, Bhogapalli, Samdama, Pamsala and Ranikombo were 49, 48, 22, 20, 13 and 13, respectively (Table 3).

Large diversity and abundance of species recorded in the lower and middle stretches may be attributed to the availability of larger water volume due to development of artificial bundhs, migration of fish and wider river course. Being a rainfed river, water in the upper and middle stretches dries up eventually after the monsoon. To meet the water requirements, the water is held in bundh in the lower stretches which might be the possible reason for high abundance and diversity of species from this stretch. The increase in species richness along the upstream to downstream of the river can also be attributed to the presence of numerous pools along the stretch where diverse phyto and zooplankton dwell forming the

Table 3. Variation in diversity factors along the different sites of Ib River

Factor \ Site	Barghat	Sundargarh	Bhogapalli	Samdama	Pamsala	Ranikombo
Taxa	49	48	22	20	13	13
Individuals	1565	1296	373	284	209	196
Dominance Index	0.04221	0.02907	0.05373	0.06060	0.09073	0.08585
Simpson evenness index	0.9578	0.9709	0.9463	0.9394	0.9093	0.9142
Shannon-Weiner diversity index	3.544	3.689	2.995	2.888	2.475	2.502
Margalef richness index	6.526	6.558	3.546	3.363	2.246	2.274
Equitability index	0.9106	0.9530	0.9688	0.9641	0.9651	0.9756

preferred food for many species (Raghavan *et al.,* 2008). The dominance of rocks and boulders in the upstream stretches inhibited the operation of dragnets and gillnets and hence fishing was carried out employing traps and cast nets in these areas. As drag nets sweep the bottom and perform indiscriminate fishing, the lack of usage of this gear may be responsible for the lower abundance of species recorded during the present study.

Mystus cavasius, M. bleekeri, *Cirrhinus reba, Labeo boga, Puntius sophore* and *Barilius bendelisis* were recorded from all three stretches of the river Ib. *M. cavasius* has been reported from a wide variety of habitats, including both fast and slow flowing rivers and streams (Nath and Dey, 2000) explaining its occurrence in all the three stretches of river Ib along with *M. bleekeri*. Ubiquitous distribution of cyprinids in all the three stretches (upper, lower and middle) was also recorded by Shahnawaz *et al.* (2010) in river Bhadra of Western Ghats. The Cyprinid fish species; *Garra gotyla, G. mullya, Lepidocephalychthys guntea, Neonemacheilus botia* and *Pethia ticto* were rare and were recorded only from the upper stretches, as they are known to occur in areas with boulders and rocks. A total of 27 fish species were recorded only from the lower stretches which were not recorded from the middle and upper stretches of the river. Maximum value of species richness was for Sundargarh site (6.558) followed by Barghat (6.526) and least for Pamsala (2.246). Higher richness was recorded in downstream areas and least in upper stretches.

The value of Shannon-Weiner diversity index calculated based on fish assemblage for the six sites of Ib River ranged between 2.475 to 3.689 (Table 3). Sundargarh exhibited highest value (3.689) while Pamsala, the least (2.475). Simpson index (1-D) values did not differ much and ranged between 0.90 in Pamsala to 0.97 in Sundargarh. This reveals that even though species richness is varying, the evenness of sample distribution among species is very high. High equitability values recorded (0.91-0.97) are reflecting a fish assemblage coexisting equitably in the river system. However, it was observed that the calculated Simpson's dominance index were very low, ranging from 0.029 to 0.090. Similar results have been reported by many researchers (Ramasundar, 2005; Herder and Freyhoff, 2006; Higgins and Strauss, 2008; Corpuz *et al.,* 2016). Low dominance and high evenness values indicate that, dominant and non-dominant fish species are occupying separate aquatic niches (Ramasundar, 2005), especially in Sundargarh and Barghat where lots of variations in river habitat were noticed. Highest similarity was seen between Sundargarh and Barghat (0.824), the lower stretch sites followed by Bhogapalli and Sundargarh. The lowest similarity index is between Ranikombo and Barghat (0.087). Based on the Bray-Curtis similarity cluster analysis, the species composition in Ib River basin exhibited two distinct clusters (Fig. 2); Pamsala and Ranikombo, representing upstream areas formed one cluster while the rest of the sites formed another cluster. The dendrogram trend suggests that as the distance between the sites increases the similarity decreases.

Many researchers have carried out studies on fish diversity of the Mahanadi River. Day (1889) reported 146 species; Hora (1940) 43; Job *et al*. (1955) 103, Jayaram and Majumdar (1976) 42, Desai and Shrivastava (2005) 48; Om Prakash *et al.* (2005) 65 and Tamboli and Jha

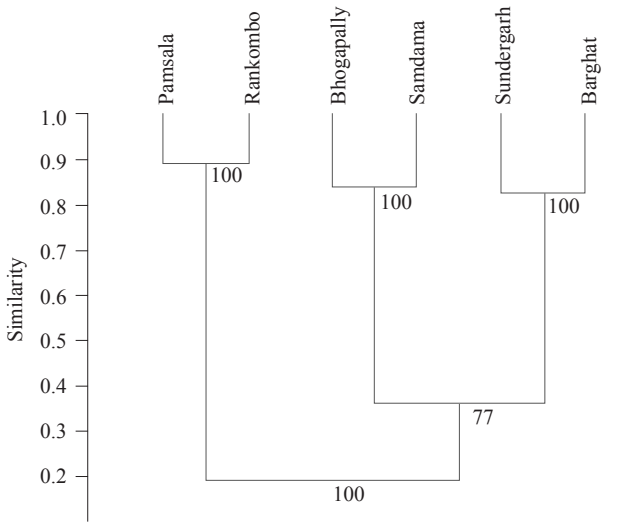

Fig. 2. Dendrogram showing Bray-Curtis similarities between the study sites

(2010) 58 from various stretches of Mahanadi. Chouhan (1947) reported 54 fish species from the Tel River, a larger tributary of Mahanadi. There seems to exist variation between the fish species richness and abundance in various tributaries of Mahanadi.

The present study has documented the fish diversity of Ib River and revealed that the river is endowed with rich diversity of fish species. Like many other rivers, Ib River too, is facing threat due to anthropogenic activities and indiscriminate fishing activity, especially during the summer months. In order to ascertain the future of this river, conservation and management plans need to be formulated and the baseline data generated on fish diversity would be helpful in formulation of effective conservation strategies.

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