ISSN: 2347-5129
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.352
IJFAS 2016; 4(3): 604-610

www.fisheriesjournal.com
Received: 26-03-2016
Accepted: 27-04-2016

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Comparative study of ichthyofaunal diversity of sip and Jamner Rivers: A tributary of river Narmada (Central India)

Kripal Singh Vishwakarma and Vipin Vyas

Abstract
River consist of a complex mixture of distinctive habitats, which make it among the most productive and valuable ecosystem on earth. The Sip and Jamner rivers are the tributaries of the Narmada basin, which afford a lucrative field of ichthyological importance. River with its tributaries is a unique type of ecosystem which generally covers different types of climatic zones, landscapes and biogeographically regions. River is the natural drainage system of the land mass of the earth which move continuously. The findings from the study will benefit the planning and management of fish community structure and conservation of natural resources at national level. During the present investigation, rich ichthyofaunal diversity was observed in the Sip and Jamner tributary of River Narmada represented by 52 fish species, 34 genera, 12 families and 6 orders. The Cyprinidae family is dominant group.

Keywords: River Narmada, Conservation, Fish diversity, Ecosystem

1. Introduction
Water is a basic need of all living organisms on the earth. Lakes, Rivers and Reservoirs are most important water resource and used for several purposes. River Narmada is one of the most important natural sources of water and important ecological diversity in the state of Madhya Pradesh. Rich biodiversity of fishes present in Narmada River, therefore fishing commonly practiced in the river is responsible for the livelihood for a large number of fishermen families living in the vicinity of the river. Riverside capture of fisheries in The Narmada region is a very important source of household welfare for many of rural poor, particularly for providing nutrition (specially the much need protein), income and employment.

Fish constitute almost half of the total number of vertebrates in the world 21,723 living species of fish out of 39,900 species of vertebrates are so for recorded [13]. In India, there are about 2,500 species of fishes, of which 930 freshwater and 1,570 marine, are estimated [11]. Fishes have been found to exhibit enormous diversity in their morphology, habitat and their biology. They live in almost all conceivable aquatic habitats. India is one of the mega biodiversity countries in the world and occupying ninth position in terms of freshwater biodiversity. A clear manifestation of the most well known global diversity gradient, namely species diversity increases with latitude. Narmada River has been extensively studied for its fish fauna for the past seven decade by various workers.

A few recent works on different aspects of fish diversity were also confined main stream in central part of Narmada [27]. Very first record of fish diversity of Narmada was on hill stream of Satpura ranges [9]. Later Tawa and Barna tributaries were dammed to form reservoir and studies were done on these reservoirs. 52 species belonging to 28 Genera, 13 Families and 7 Orders was recorded in main tributaries of central Narmada [26]. Recently few studies on fish diversity was carried in Sip and Jamner rivers, 29 species belonging to 17 Genera, 8 Families and 3 Orders was documented in Sip River a tributary of River Narmada [24], While Jamner River recorded 27 species belonging to 4 order, 9 families and 16 genera [25]. The comparative study of Sip and Jamner River was also carried out which documented 34 species belonging to 17 Genera, 8 Families and 3 Orders [23]. Documented 57 species, belonging to 35 genera, 13 families and 6 orders from Middle Stretch of River Tawa [5]. The Barna Stream Network in Narmada basin reported 33 fish species belonging to 5 orders, 9 families and 21 genera [22].

Therefore, our objective in this study was to provide accounts of the fish diversity and species composition in Sip and Jamner River. The information from this investigation will serve as a baseline data for carrying out further study on ecology, conservation, sustainability and management of fisheries resources of these water bodies.

2. Material and Methods

2.1 Study area

River Narmada is one of the 13 prominent rivers of India, which covers 98,797 sq km of total watershed area. Narmada is considered to be the lifeline and west flowing river of the state of Madhya Pradesh. The Narmada is the longest west flowing river in India. It rises from a spring at a height of 1057m above MSL on the summit of Amarkantak Hill in Shahdol district of Madhya Pradesh in the Maikal hill range. Narmada receives 41 principal tributaries. Most of these tributaries have catchment area exceeding 500 km^2 out of which 22 tributaries join from the left bank and 19 from the right bank. The study area comprised two major, right bank tributaries of river Narmada namely Sip and Jamner. The Sip river originates from near Village Ramdasi of Ichhawar Tehsil in Sehore district of Madhya Pradesh, (Longitude 77^0 11'- 76^0 56' E & latitude 22^0 34'-22^0 54'N) at an elevation of above 432 M msl and joins river Narmada near village Satdev of Narsurlaganj Tehsil in Sehore district a total length of Sip River about 68 km. The Jamner River originates near Village Dolatpur of Ichhawar Tehsil in Sehore district of Madhya Pradesh (Longitude $76^0$58'- $76^0$59'E and latitude $22^0$45'-$22^0$29' N) at an elevation above 354 msl and total length of about 56 km. The Jamner river is also tributary of river Narmada and Joins in Village Nemawar, Dewas district Madhya Pradesh.

Fish sampling was conducted at ten selected locations in the River Sip & Jamner, six sites located in a river Sip (Kaliyadev, Ambha Kadim, Jhirniya, Chhapri, Pandagaon, and Confluence Point of Sip– Narmada River) and four sites is located in Jamner river (Harngaon, Jeeyagaon, Sindalpur Briz, Confluence Point of Janment– Narmada River).

Table 1: Geographic position of sampling stations in Sip and Jamner River.

Station No.	Location	Longitude	Latitude	Elevation
Sip River				
Station - 1	Kaliyadev	77°05'40"E	22°54'13"N	491msl
Station - 2	Ambhakadim	77°11'27"E	22°47'38"N	366msl
Station - 3	Jhirniya	77°11'21"E	22°47'19"N	335msl
Station - 4	Chhapri	77°10'28"E	22°45'47"N	331msl
Station - 5	Pandagaon	77°11'27"E	22°38'29"N	307msl
Station - 6	Confluence Point	77°11'01"E	22°35'01"N	305msl
Jamner River				
Station - 7	Harangaon	76°58'11"E	22°44'58"N	354msl
Station - 8	Jeeyagaon	76°58'00"E	22°40'25"N	345msl
Station - 9	Sindalpur Bridge	76°58'22"E	22°34'27"N	302 msl
Station - 10	Confluence Point	76°59'00"E	22°29'35"N	294 msl

3. Data Collection

3.1 Field activities: Field work included two tributaries and eight samplings of the fish fauna during the dry season (October - Jun) and wet season (July - September). The whole methodology for analysis of physico-chemical properties was followed from American Public Health Association [3] and [1]. The air and water temperature was recorded with the help of mercury thermometer, pH, conductivity and Turbidity were recorded through digital equipment and dissolved oxygen was analyzed use Modified Winkler's Method. The study was carried out in May 2011 and April 2013.

The fishes were collected using monofilamentos gill nets of 10-50 mm mesh sizes. We also used cast nets of 10-25 mm mesh size for collecting fish in shallow areas. Fish samples were also collected from different fish landing sites and were preserved in 4% formaldehyde solution at the field.

3.2 Laboratory Procedures: Fishes brought to laboratory were preserved in 10% formaldehyde solution in separate specimen jar according to the size of specimen. The fishes were identified using standard keys of [10, 16, 12, 7, 18], and [19]. Fish Base website was also referred for various aspects of fish fauna (www.fishbase.org). The relative species abundance which refers to the relative representative of a species was determined by dividing the number of species (n) from tributaries by the total number of species (N) from all tributaries. The abundance was described using a subjective acronym (ACFOR): (A) abundance or (C) common or (F) frequent or (O) occasional or (R) rare within the stations.

The faunal similarities at different sites based on nominal data, were analyzed using indices of Jackson. The relative abundance of taxa that were common among the tributaries was calculated using Renkonen similarity. Simpson index (d) was employed to evaluate species richness. The Shannon-Weiner indeed (H) and evenness index (E) of Shannon and Weiner were used to evaluate species diversity.

4. Results and Discussion

4.1 Diversity and Composition

During the present investigation, rich ichthyofaunal diversity has been observed in the Sip and Jamner tributaries of River Narmada represented by 52 fish species, 34 genera, 12 families and 6 orders. The Cyprinidae family is dominant group and sub dominant family is Cobitidae. Out of which maximum 46 species were documented in winter season, 43 species in pre monsoon and 41 species in summer season and 38 species were documented in post monsoon season. The most dominant family was cyprinidae, accounting for 29 species in pre monsoon season, 27 species were recorded in summer, post monsoon and winter season followed by family Cobitidae which was represented by 3 species in the summer, one species in pre monsoon, 2 species in post monsoon and 3 species in the winter season, family Bagridae was represented by 4 species in pre monsoon, 3 species in winter, 2 species in post monsoon and one species in summer season. The family Heteropneustidae contributed in one species in all season. The Siluridae family was contributed 2 species in pre monsoon and winter season and one species in summer and post monsoon season. The family Ophiocephalidae was contributed 2 species in post monsoon and winter season and one species in summer and pre monsoon season. The family Gobiidae was represented by one species in summer, pre monsoon and winter season, family Ambassidae contributed 2 species in summer and winter season, one species in pre and post monsoon season, family Nandidae contributed one species in summer, pre monsoon and winter season, family Mastacembelidae were contributed 2 species in pre monsoon and winter season and one species in summer and post monsoon, family Blonidae were contributed one species in summer, post monsoon and winter season and family Notopteridae were contributed one species in summer and winter season (Table: 02).

During the study period, total 6 order were recorded while the dominant order was Cypriniformes was contributed 5 (42%) families and subdominant order were Ophiocephaliformes and Perciformes were contributed 2 (17%) families both and rest of order as given in Figure – 1.

Overall 52 fish species were encountered in the two year study period. The most dominant family was Cyprinidae, contributed for 30 species (57%) and sub dominant family was Bagridae, contributed for 5 species (9%) and rest of the families were in order of frequency as summarized in Figure-2.

During the two year study, a total of 2823 individuals were recorded out of which 2437 individuals (86.32%) represented Cyprinidae family, 103 individuals (3.64%) represented family Cobitidae and 51 individuals (1.80%) from Bagridae family followed by 41 individuals (1.45%) were represented Siluridae and Mastacembelidae family and rest of families were represented order of frequency as shown in figure- 3.

During the study period, a total number of 52 species were recorded out of which maximum 38 species were recorded at sampling site S-10 and minimum 8 fish species were recorded in sampling site S-7 and S-8, all site fish species composition as given in figure- 4.

During the study period a total number of 2823 individuals of fish were recorded. The highest 534 number of individuals were recorded at sampling site S-4 and lowest 59 number of individuals were recorded at sampling site S-7 as given in figure- 4.

4.2 Results of statistical analysis

During the two year study, data was analyzed statistically and results obtained from the analysis are given below:

The range of Dominance diversity index varied between 0.06 and 0.39. Minimum value was observed at sampling site S-10, while maximum value was recorded at sampling site S-8 (Figure – 5).

The range of Simpson diversity index varied between 0.60 and 0.93. Minimum value was observed at sampling site S-8, while maximum value was recorded at sampling site S-10 (Figure – 5).

The range of Evenness diversity index varied between 0.47 and 0.93. Minimum value was observed at sampling site S-6, while maximum value was recorded at sampling site S-7 (Figure – 5).

The range of Shannon diversity index varied between 1.407 and 3.054. Minimum value was observed at sampling site S-8, while maximum value was recorded at sampling site S-10 (Figure – 6).

The range of Margalef diversity index varied between 1.384 and 5.931. Minimum value was observed at sampling site S-8, while maximum value was recorded at sampling site S-10 (Figure – 6).

Table 2: Ichthyofaunal diversity of present – absent in Sip and Jamner River.

S. No.	Present- absent of Fish Species at Sip and Jamner River										
	Taxa	Sip River						Jamner River			
		S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
Order - Cypriniformes											
Family - Cyprinidae											
1	*Laubuca laubuca*	+	+	+	-	-	+	-	+	-	-
2	*Salmophasia bacaila*	+	-	-	+	+	+	-	-	-	-
3	*Securicula gora*	-	+	+	-	+	+	-	-	-	-
4	*Amblypharyngodon mola*	-	+	+	-	-	+	+	-	+	+
5	*Aspidoparia jaya*	-	-	+	-	+	+	-	-	+	+
6	*Catla catla*	+	-	-	-	-	+	-	-	-	+
7	*Cirrhinus reba*	+	+	+	+	-	+	-	-	-	+
8	*Cirrhinus mrigala*	-	+	+	+	-	-	-	-	-	-
9	*Garra gotyla gotyla*	+	+	+	+	+	+	+	-	+	+
10	*Labeo bata*	-	+	-	+	+	+	+	-	-	+
11	*Labeo boga*	+	+	-	-	+	-	-	-	-	+
12	*Labeo Pangusia*	-	-	-	-	+	+	-	-	+	+
13	*Labeo calbasu*	-	-	-	-	-	+	-	-	+	+
14	*Labeo boggut*	+	-	-	-	+	+	-	-	+	+
15	*Labeo rohita*	+	-	-	-	+	+	-	-	+	+
16	*Osteobrama cotio*	+	-	-	-	+	+	-	-	-	+
17	*Puntius sophore*	+	+	+	+	+	+	+	+	+	+
18	*Puntius dorsalis*	-	-	-	-	+	+	-	-	-	-
19	*Puntius amphibius*	+	+	-	+	+	+	-	+	-	+
20	*Puntius chola*	-	-	-	-	+	-	-	+	-	+
21	*Puntius chrysopterus*	+	+	+	-	+	+	-	+	-	-
22	*Pethia conchonius*	-	+	-	-	+	-	-	-	-	+
23	*Pethia ticto*	+	+	+	-	-	+	-	-	-	-
24	*Systomus sarana*	+	+	-	+	+	+	-	+	+	+
25	*Tor tor*	-	-	+	-	-	+	-	-	-	-
26	*Barilius bendelisis*	-	-	+	-	+	+	-	-	-	+
27	*Barilius vagra*	+	-	-	-	+	+	-	-	+	+
28	*Devario devario*	+	+	+	+	-	+	-	-	-	+
29	*Rasbora daniconius*	+	+	+	+	+	+	+	+	+	+
30	*Rasbora rasbora*	+	+	-	-	+	+	-	-	+	+
Family - Cobitidae											
31	*Lepidocephalichthys guntea*	-	-	-	-	-	+	-	-	-	+
32	*Acanthocobitis botia*	+	+	+	+	+	-	-	-	+	-

33	*Nemacheilus duyi*	+	+	-	-	+	+	-	-	+	+
Family - Bagridae											
34	*Mystus vittatus*	-	+	-	-	-	+	-	-	-	-
35	*Mystus cavasius*	-	+	-	-	+	+	-	-	+	-
36	*Mystus tengara*	-	-	-	-	-	+	-	-	-	+
37	*Mystus bleekeri*	+	-	-	-	+	+	-	-	-	+
38	*Sperata seenghala*	+	-	-	-	+	+	-	-	-	+
Family - Heteropneustidae											
39	*Heteropneustes fossilis*	-	-	-	-	+	+	+	-	+	+
Family – Siluridae											
40	*Ompok bimaculatus*	+	+	-	+	+	+	-	-	+	-
41	*Wallago attu*	-	+	-	-	-	-	-	-	-	+
Order - Ophiocephaliformes											
Family - Ophiocephalidae											
42	*Channa punctatus*	-	-	-	-	+	+	-	-	-	+
43	*Channa gachua*	-	+	+	-	+	-	-	-	-	+
44	*Channa striatus*	-	-	-	-	-	-	-	-	-	+
Family - Gobiidae											
45	*Glossogobius giuris*	-	+	-	+	+	+	-	-	+	+
Order - Perciformes											
Family - Ambassidae											
46	*Chanda ranga*	-	+	-	-	+	-	+	-	-	+
47	*Chanda nama*	-	-	-	-	-	-	-	-	-	+
Family - Nandidae											
48	*Nandus nandus*	-	+	-	-	+	+	-	-	-	-
Order – Mastacembeliformes											
Family - Mastacembelidae											
49	*Mastacembelus armatus*	-	+	-	-	-	-	-	-	+	-
50	*Macrognathus pancalus*	-	+	-	+	+	+	-	+	-	+
Order - Beloniformes											
Family - Belonidae											
51	*Xenentodon cancila*	+	-	-	-	+	+	-	-	-	+
Order - Osteoglossiformes											
Family – Notopteridae											
52	*Notopterus notopterus*	-	-	-	-	-	+	-	-	-	+

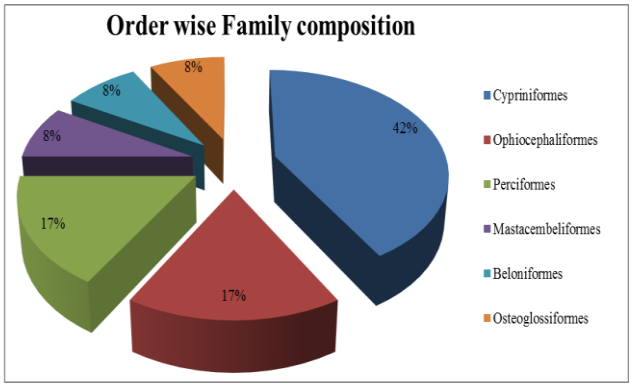

Fig 1: Order wise family composition.

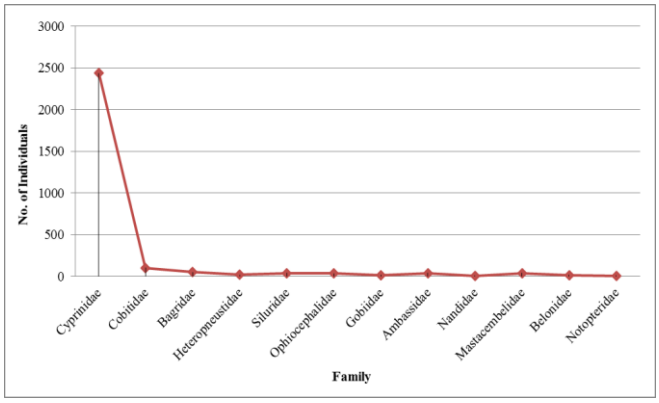

Fig 3: Family wise Individuals composition.

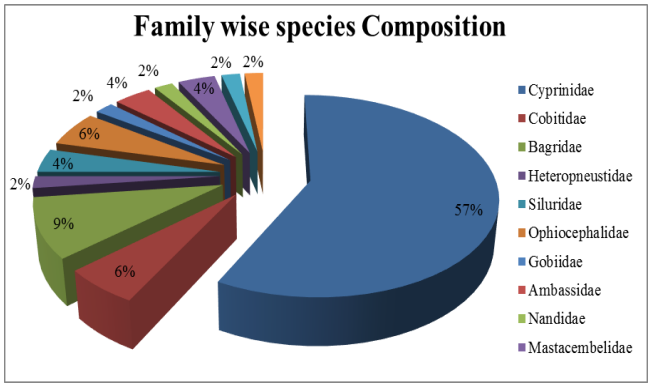

Fig 2: Family wise species composition.

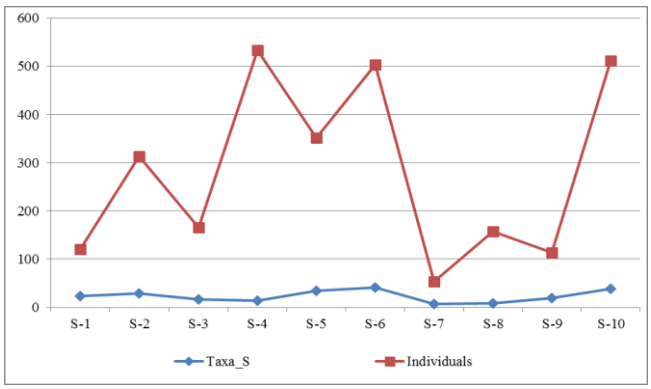

Fig 4: Station wise Species and Individuals composition.

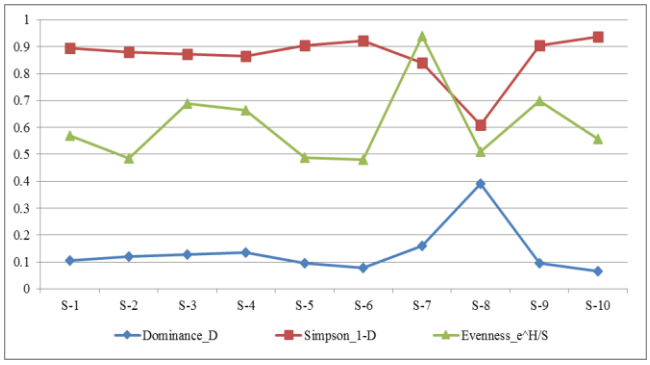

Fig 5: Station wise Dominance, Simpson and Evenness Indices.

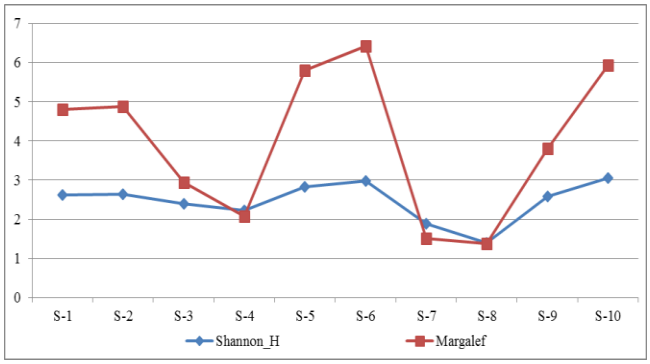

Fig 6: Station wise Margalef and Shannon Indices.

4.3 Conservation status of fishes of Sip and Jamner River

International Union for Conservation of Nature and Natural resources (IUCN) is the global agency involved with the conservation of the flora and fauna and it has published red data book enlisting species of fishes, amphibians, reptiles, birds and mammals which are globally endangered, threatened or rare.

According to [6] status, five species are Endangered which are *Puntius dorsalis, Tor tor, Acanthocobitis botia, Ompok bimaculatus* and *Notopterus notopterus,* nine species are Vulnerable, these are *Cirrhinus reba, Garra gotyla gotyla, Puntius chola, Systomus sarana, Mystus vittatus, Mystus bleekeri, Heteropneustes fossilis, Chanda nama* and *Mastacembelus armatus* are given in (Table -1). Whereas 21 fish species fall under Lower risk near threatened, viz., *Catla catla, Cirrhinus mrigala, Labeo bata, Labeo boga, Labeo calbasu, Labeo boggut, Osteobrama cotio, Puntius sophore, Pethia conchonius, Pethia ticto, Barilius bendelisis, Devario devario, Mystus cavasius, Sperata seenghala, Wallago attu, Channa punctatus, Channa striatus, Glossogobius giuris, Nandus nandus, Macrognathus pancalus* and *Xenentodon cancila,* six fish species fall under Lower risk lest concern category viz., *Laubuca laubuca, Amblypharyngodon mola, Labeo rohita, Rasbora daniconius, Lepidocephalichthys guntea* and *Chanda ranga,* while six species are Data deficient which are *Salmophasia bacaila, Securicula gora, Labeo Pangusia, Puntius amphibious, Nemacheilus dayi* and *Mystus tengara,* five fish species are Not Evaluated species which are *Aspidoparia jaya, Puntius chrysopterus, Barilius vagra, Rasbora rasbora* and *Channa gachua*.

According to the IUCN red list of 4 species near threatened (7.69%), 40 species least concern (76.92%), 1 species data deficient (1.92%), 7 species not evaluated (13.46%), (Figure - 7).

The conservation status of recorded species was based on IUCN list (www.iucnredlist.org).

Various workers have done work on main river whereas very little is known about the tributaries of Narmada river. First detailed work on Narmada was done [8] attempted to study fish fauna of river Narmada and surveyed only hill stream, which flow into Narmada in Satpura range and identified 40 species. Fish diversity of River Narmada carried out biological investigations on the fish and fisheries of River Narmada and revealed the status of fish diversity, production and location of spawning grounds [14]. A total 77 fish species belonging to 41 Genera, 19 Families and seven Orders were recorded. In a stretch from Jabalpur to Khalghat, [2] reported 46 species belonging to 27 Genera, 14 Families and seven Orders. Rao *et al*., studies on pre impoundment survey at Punasa, Omkareshwar, Mandleshwar, Maheshwar and Barwani pertaining to the river and have enlisted 84 fish species belonging to 45 Genera, 20 Families and six Orders [17]. Unni studied ecology of Narmada River, which showed various environmental aspects of the River [20]. Nath and Shrivastava reported declining trend of carp fisheries of Narmada River in the context of construction of dam on the river and tributaries [15]. Arya *et al*., [4] studied biodiversity and fisheries potential of Narmada basin with special reference to fish conservation and divided fish species of Narmada into five categories of which four categories containing 17 species might be adversely affected by dam whereas one category of fishes comprising 25 species were likely to be increased in the reservoir. Dubey [8] studied the fish biodiversity of River Narmada in relation to its physical, chemical and economic aspects. Vyas *et al*., [26] reported 47 fish species belonging to 29 genera, 15 families and six orders in River Narmada.

Very first record of fish diversity of Narmada was on hill stream of Satpura ranges [9] reported 41 species. Vyas *et al*., [27] studied on fish fauna of tributaries and recorded 52 species belonging to 28 Genera, 13 Families and 7 Orders. Vyas and Vishwakarma [23] more recently worked on Sip tributary of river Narmada which Joins Narmada River near the backwaters of Indira Sagar reservoir and have been recorded 29 fish species belonging to 17 Genera, eight Families and three Orders. Bose *et al*., [5] have reported 57 species, belonging to 35 Genera, 13 Families and six Orders from Middle Stretch of River Tawa.

Table 3: Conservation status of Fish species in Sip and Jamner River (CAFF, 2006) and IUCN List.

S. No.	Species Name	Sip river	Jamner river	CAFF status	IUCN status	Distribution
1	*Laubuca laubuca*	+	+	LR-lc	LC	S1,S2,S3,S6,S8
2	*Salmophasia bacaila*	+	-	DD	LC	S1,S4,S5,S6
3	*Securicula gora*	+	-	DD	LC	S2,S3,S5,S6
4	*Amblypharyngodon mola*	+	+	LR-lc	LC	S2,S3,S6,S7,S9,S10
5	*Aspidoparia jaya*	+	+	NE	LC	S3,S5,S6,S9,S10
6	*Catla catla*	+	+	LRnt	NE	S1,S6,S10
7	*Cirrhinus reba*	+	+	VU	LC	S1,S2,S3,S4,S6,S10
8	*Cirrhinus mrigala*	+	-	LRnt	LC	S2,S3,S4

9	*Garra gotyla gotyla*	+	+	VU	NE	S1,S2,S3,S4,S5,S6,S7,S9,S10
10	*Labeo bata*	+	+	LRnt	LC	S2,S4,S5,S6,S7,S10
11	*Labeo boga*	+	+	LRnt	LC	S1,S2,S5,S10
12	*Labeo Pangusia*	+	+	DD	NT	S5,S6,S9,S10
13	*Labeo calbasu*	+	+	LRnt	LC	S6,S9,S10
14	*Labeo boggut*	+	+	LRnt	LC	S1,S5,S6,S9,S10
15	*Labeo rohita*	+	+	LR-lc	LC	S1,S5,S6,S9,S10
16	*Osteobrama cotio*	+	+	LRnt	LC	S1,S5,S6,S10
17	*Puntius sophore**	+	+	LRnt	LC	S1,S2,S3,S4,S5,S6,S7,S8,S9,S10
18	*Puntius dorsalis*	+	-	EN	LC	S5,S6
19	*Puntius amphibius*	+	+	DD	DD	S1,S2,S4,S5,S6,S8,S10
20	*Puntius chola*	+	+	VU	LC	S5,S8,S10
21	*Puntius chrysopterus*	+	+	NE	NE	S1,S2,S3,S5,S6,S8
22	*Pethia conchonius*	+	+	LRnt	LC	S2,S5,S10
23	*Pethia ticto*	+	-	LRnt	LC	S1,S2,S3,S6
24	*Systomus sarana*	+	+	VU	LC	S1,S2,S4,S5,S6,S8,S9,S10
25	*Tor tor*	+	-	EN	NT	S3,S6
26	*Barilius bendelisis*	+	+	LRnt	LC	S3,S5,S6,S10
27	*Barilius vagra*	+	+	NE	LC	S1,S5,S6,S9,S10
28	*Devario devario*	+	+	LRnt	LC	S1,S2,S3,S4,S6,S10
29	*Rasbora daniconius**	+	+	LR-lc	LC	S1,S2,S3,S4,S5,S6,S7,S8,S9,S10
30	*Rasbora rasbora*	+	+	NE	LC	S1,S2,S5,S6S9,S10
31	*Lepidocephalichthys guntea*	+	+	LR-lc	LC	S6,S10
32	*Acanthocobitis botia*	+	+	EN	LC	S1,S2,S3,S4,S5,S9
33	*Nemacheilus dayi*	+	+	DD	NE	S1,S2,,S5,S6,S9,S10
34	*Mystus vittatus*	+	-	VU	LC	S2,S6
35	*Mystus cavasius*	+	+	LRnt	LC	S2,S5,S6,S9
36	*Mystus tengara*	+	+	DD	LC	S6,S10
37	*Mystus bleekeri*	+	+	VU	LC	S1,S5,S6,S10
38	*Sperata seenghala*	+	+	LRnt	LC	S1,S5,S6,S10
39	*Heteropneustes fossilis*	+	+	VU	NE	S5,S6,S7,S9,S10
40	*Ompok bimaculatus*	+	+	EN	NT	S1,S2,S4,S5,S6,S9
41	*Wallago attu*	+	+	LRnt	NT	S2,S10
42	*Channa punctatus*	+	+	LRnt	NE	S5,S6,S10
43	*Channa gachua*	+	+	NE	LC	S2,S3,S5,S10
44	*Channa striatus*	-	+	LRnt	NE	S10
45	*Glossogobius giuris*	+	+	LRnt	LC	S2,S4,S5,S6,S9,S10
46	*Chanda ranga*	+	+	LR-lc	LC	S2,S5,S7,S10
47	*Chanda nama*	-	+	VU	LC	S10
48	*Nandus nandus*	+	-	LRnt	LC	S2,S5,S6,S7
49	*Mastacembelus armatus*	+	+	VU	LC	S2,S9
50	*Macrognathus pancalus*	+	+	LRnt	LC	S2,S4,S5,S6,S8,S10
51	*Xenentodon cancila*	+	+	LRnt	LC	S1,S5,S6,S10
52	*Notopterus notopterus*	+	+	EN	LC	S6,S10
	Total	50	44	CAFF – 5 EN, 9 VU, 21 LRnt, 6 LR-lc, 6 DD, 5 NE		
				IUCN – 4 NT, 40 LC, 1 DD, 7 NE		

* = most common (present at all sampling stations)

(EN = Endangered, NT = Near Threatened, VU = Vulnerable, LRnt = Lower Risk near threatened, LR-lc = Lower Risk least concern, LC = Least Concern, DD = Data Deficient, NE = Not Evaluated)

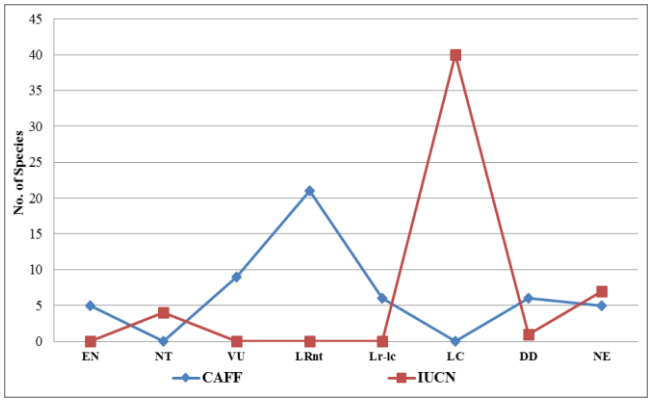

Fig 7: Number of species under different categories of threat as per CAFF and IUCN criteria.

5. Conclusion

Documentation of biodiversity has become very much important aspect to understand different ecosystem and influences on them. The present study mainly focuses on fish assemblage and distribution in Sip and Jamner River. Total number of species recorded during this study period has show a good indication of rich biodiversity. The Sip and Jamner River support many unique ecosystems and a wide array of globally threatened species. In terms of species number, Sip and Jamner River can be considered as an ecological hotspot since it has a biodiversity close to or greater than that of many other rivers in Madhya Pradesh. So, formulation of sustainable strategies to save fish population of this river system as a whole is required. Destruction of ecosystem and environmental degradation seriously affect the fish species. Conservation of fish diversity is an important issue under changing situation of gradual habitat destruction [21]. Data on available resources and identification of faunal biological characteristics is the key for resource conservation and maintenance. This study will provide future strategies for development and fish conservation.

6. Acknowledgement
Authors are thankful to Dr. Dinesh Damde and Dr. Vivek Parashar for their kind support during the work is gratefully acknowledged. Thanks will be due to Mr. Ankit Kumar, Mrs. Reetu Sharma and Mr. Syam panwar who helped during field visits. Our special thanks are due to the DBT-IPLS-BU-Progarmme, Barkatullah University, Bhopal, and University Grants Commission, New Delhi for providing funds in the form Junior Research fellow during the course of the present study. Without this financial support I could never have been able to complete my research.

7. References

1. Adoni AD, Joshi G, Ghosh K, Chourasia SK, Vaishya A. K. *et al.*
2. Anon. Fisheries department, M.P. Fisheries survey in Narmada River, 1971, 1967-71.
3. APHA. Standard methods for the examination of water and wastewater, American, 1998.
4. Arya SC, Rao KS, Shrivastava S. Biodiversity and Fishery potential of Narmada river Basin western zone (M.P. India) with special reference to Fish Conservation. Environment, Agriculture and pollution in Ssouthern Asia, 2001, 108-112.
5. Bose AK, Jha BC, Suresh VR, Das AK, Parasar A, Ridhi. Fishes of the Middle Stretch of River Tawa, Madhya Pradesh, India. J Chem Bio Phy Sci Sec A. 2013: 3(1):706-716.
6. CAFF. Fresh water fish diversity of central India, (Ed. By Lakra WS, Sarkar UK.). Workshop proceeding. Organized by NBFGR at ICAR Bhopal MP, and India, 2006, 1-183.
7. Day F. The Fishes of India, Jagmander Book Agency, New Delhi, 1994.
8. Dubey GP. 50 years of developing fisheries scenario of Narmada valley in M.P. Depicting progress in fish production from reservoirs etc. Fishing Chimes. 2006; 26(1):123-132.
9. Hora SL, Nair KK. Fishes of Satpura Range, Hoshangabad District, Central Province, Rec. Indian Mus. 1941; 43:361-373.
10. Jayaram KC. The Freshwater fishes of India, Pakistan, Bangladesh, Burma and Srilanka, A handbook of Edited by Zoological, Survey of India Calcutta, 1981, 12.
11. Jayaram KC. The freshwater fishes of Indian region. Narendra Publishing House, New Delhi, 1999, 1-551.
12. Jhingran VG. Fish and Fisheries of India, Hindustan Pub. Co., New Delhi, 1991, 727.
13. Kar DA, Kumar C, Bohra, Sigh LK. (Eds) Fishes of Barak drainage, mizaram and Tripura; In: Environment, pollution and management, APH Publishing Corporation, New Delhi. 2003; 604:203-211.
14. Karamchandani SJ, Desai VR, Pisolkar MD, Bhatnagar GK. Biological investigation on the fish and fisheries of Narmada River (1958-66). Bull cent. Inland Fish. Res. Inst. Barrackpore. 1967; 10:40. (Mimeo).
15. Nath D, Shrivastava NP. Decline in carp fisheries in Narmada in the context of construction of dama on the river and its tributaries. J Inland Fish Soc India. 1999; 31(2):25-27.
16. Qureshi TA, Qureshi NA. Indian fishes, Publisher: Brij Brothers, Sultania Road, Bhopal. (M.P.), 1983, 5-209.
17. Rao KS, Chatterjee SN, Singh KA. Studies on preimpoudment fishery potential of Narmada Basin (Western Region) in the context of Indira Sagar, Maheshwar, Omkareshwar and Sardar Sarovar reservoirs. J Inland Fish India. 1991; 23(1):34-91.
18. Shrivastava G. Fishes of U.P. and Bihar, Sevnth edition, Vishwavidalaya Prakashan, Chowk Varanasi India Pub, 1998.
19. Talwar PK, Jhingran AG. Inland Fishes of India and Adjacent Countries. Oxford & IBH Publishing, New Delhi. 1991; I(II):1158.
20. Unni Sankaran K. Ecology of River Narmada. A.P.H. Publishing house, New Delhi, 1996, 1-371.
21. Vijaylaxmi C, Rajshekhar M, Vijaykumar K. Freshwater fishes distribution and diversity status of Mullameri River, a minor tributary of Bheema River of Gulbarga District, Karnataka. Int. J Sys Bio. 2010; 2:1-9.
22. Vishwakarma KS, Mir AA, Bhawsar A, Vyas V. Assessment of Fish assemblage and distribution in Barna Stream Network in Narmada basin (Central India). International Journal of Advanced Research (IJAR). 2014; 2(1):888-897.
23. Vyas V, Vishwakarma KS. Fish Diversity in two Tributaries of River Narmada, Central India. Journal of Chemical Biological and Physical Sciences. 2013a; 3(4):2722-2730.
24. Vyas V, Vishwakarma KS. Species diversity and assemblage of fish fauna of Sip River: A tributary of Narmada River. Journal of Research in Biology. 2013b; 3(5):1003-1008.
25. Vyas V, Vishwakarma KS. Study on Ichthyofaunal Diversity of Jamner River: A Tributary of Narmada River. International Journal of Theoretical & Applied Sciences. 2013c; 5(2):50-55.
26. Vyas V, Bara S, Parashar V, Damde D, Tuli RP. Temporal variation in fish biodiversity of River Narmada in Hoshangabad Region. Fishing Chimes. 2006; 27:49-53.
27. Vyas V, Damde D, Parashar V. Fish diversity of Narmada in submergence area of Indra Sagar Reservair. Journal of Inland Fish Soc India. 2009; 41(2):18-25.