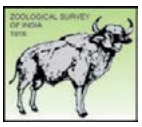
ISSN (Online) : 2581-8686
ISSN (Print) : 0375-1511

Rec. zool. Surv. India: Vol. 123(iS2)/583-600, 2023
DOI: 10.26515/rzsi/v123/iS2/2023/172549



A Study on Ichthyofaunal Diversity of Yerla River Northern Western Ghat, Maharashtra, India

Angha V. Bhoi-Kamble* and Suresh M. Kumbar

Department of Zoology,
Arts, Commerce and Science College Palus, Dist. Sangli (MS), 416 310

Abstract

The freshwater fish fauna of Yerla River, Sangli district was studied between 2021 to 2022. It is aimed at making a comprehensive checklist and to find out real anthropogenic threats to the fish fauna of Yerla River. A total of 58 species belonging to 7 orders, 19 families and 40 genera were recorded. Order Cypriniformes were the most dominant one and represents 33 species followed by Siluriformes (13 species), Anabantiformes (4 species), Cichliformes (3 species), Beloniformes (2 species), Synbranchiformes (2 species) and Gobiiformes (1 species). Among these, 17 species are endemic from the Western Ghats and 4 species endemic from the Krishna River System. As per IUCN's Red list of Threatened Species, 41 species assessed as least concern; 3 species as near threatened; 2 species as vulnerable; 4 species as endangered; 4 species as Data Deficient and the conservation status of one species *Pethia sanjaymoluri* has not yet been assessed. The fish fauna of the river is threatened due to alien species and some anthropogenic activities like releasing of agricultural effluents, domestic organic wastes and non-degradable plastic materials owing to tourism activities. Since, this small study area hosts 17 endemic and 6 threatened species. Therefore, Yerla River will be the most suitable habitat for conservation of endemic and threatened species.

Keywords: *fish diversity, endemics, threats, conservation, Yerla River*

Introduction

The Western Ghats of India is one of the eight 'hotspots' of biological diversity in the world (Myers *et al.*, 2000), with a high level of endemism, encompasses 320 species belonging to 11 orders, 35 families and 112 genera (Dahanukar and Raghavan, 2013a). Krishna is one of the major perennial River in Western region of Maharashtra. The important tributaries of the river Krishna are Wenna, Urmodi, Tarli, Koyna, Yerla, Warana, Panchaganga, Ghataprabha, Malaprabha, Bhima, Tungabhadra and Musi (Das *et al.*, 2017). In recent years, much interest has developed in the study of phylogeny and taxonomy of the freshwater fishes as a whole (Jayaram, 2009). Much of information has been accumulated in the fields of diversity, density, threats and conservations of freshwater fish fauna of Krishna River system (Arunachalam, 2002; Kharat *et al.*, 2003; Dahanukar *et al.*, 2004; Chandanshive *et al.*, 2007; Sarwade and Khillare, 2010; Jadhav *et al.*, 2011; Kharat *et al.*, 2012; Dahanukar *et al.*, 2012; Kumbar *et al.*, 2021). Earlier studies on the fish fauna of Satara district was carried out by Annandale (1919) reported 18 species in Yenna River at Medha in Satara. Silas (1953) studied the fish fauna of Mahabaleshwar and Wai in Satara district and recorded 14 species, later Kharat *et al.* (2012) has given updated checklist of fish fauna of Krishna River at Wai and Dhom reservoir and reported presence of 51 species. Jadhav *et al.* (2011) reported 58 species of fish in Koyna River. However, Kumbar and Lad (2014) have recorded 13 species of catfish in the Krishna River, Sangli district. Recently, Kumbar *et al.*, 2021 have reported 73 species of fish from the Krishna River in Sangli District. Some reviews have highlighted paucity of data on the fish fauna of the Western Ghats Rivers (Kharat *et al.*, 2003; Dahanukar

*Author for correspondence : anghabhoi@gmail.com
Article Received on: 10.04.2023
Accepted on: 17.06.2023

et al., 2011; Kharat *et al.*, 2012; Dahanukar *et al.*, 2012). Yerla River is one of the major tributary of Krishna River, there is no report on diversity and density of freshwater fish fauna. Therefore, the present study is undertaken to make comprehensive checklist of fish fauna of Yerla tributary of the Krishna River, Western Maharashtra.

Material and Methods

Yerla is a tributary of the Krishna River, originated near Manjarwadi village, (17.86° N, 74.27° E) on Solakhnath hill, about of 29 km north of Vaduj village. It is more than 120 km in length (Figure 1). Yerla River is flowing through Mol, Diskal, Lalgun, Khatav, Vaduj, Nimsod and Chitali villages in the Khatav tahsil. This river joins left side of Krishna River near Bramhanal village. There are two earthen dams near Ner and Yeralwadi near Banpuri village and many small concrete bandh along with the tributary. Yerla river flows around the year and it provides the food and shelter for many aquatic organisms including the fish fauna. Fish species were collected from 12 sampling sites during 2021-2022. Location of each sampling site was documented by using global positioning system (Table 1). The samples were collected by using cast net, gill nets, hand nets, hooks and line. The collected samples were categorized according to the categories defined by Dahanukar *et al.,* 2012 as abundant (76-100 % of total catch), common (51-75 % of total catch), moderate (26-50 % of total catch) and rare (1-25 % of total catch). The collected fishes were preserved in 4% formalin solution. The samples were identified and labeled by using the available literature (Menon, 1987, 1992, Talwar and Jhingran, 1991; Jayaram and Das, 2000; Jayaram and Sanyal, 2003; Jayaram, 1991, 2006, 2010). All identified specimens were deposited at the Department of Zoology, Arts, Commerce and Science College Palus, Sangli District, Maharashtra with accession numbers from ZID 01 to 58. Taxonomic status as per Fricke *et al.*, 2023.

Statistical analysis

For statistical analysis Shannon diversity index were calculated.

Shannon index (Shannon and Weaver, 1949): A diversity index, taking into account the number of individuals as well as number of taxa, varies from 0 for communities with only a single taxon to high values for communities with many taxa, each with few individuals:

$$H = -\sum_{i} \frac{ni}{n} ln \frac{ni}{n}$$

where, *ni* is number of individuals of '*i*' taxon and *n* is total number of individuals.

Result and Discussion

A total of 58 species of fishes, belonging to 7 orders, 19 families and 40 genera were recorded in the table 2. Order Cypriniformes were the most dominant one and represents 57% followed by Siluriformes 22%, Anabantiformes 7%, Cichliformes 5%, Beloniformes 4%, Synbranchiformes 3%, Gobiiformes 2% (Figure 2). Among these, 17 species are endemic to the Western Ghats and 4 species endemic to the Krishna River system (Images 1-58). As per IUCN Red list of Threatened Species 41 (76%) species are assessed as least concern, 2 (4%) species *Mystus malabaricus* and *Ompok bimaculatus* as Near Threatened, 2 (4%) species *Wallago attu* and *Gagata itchkeea* as vulnerable, 4 (7%) species *Botia striata, Hypselobarbus curmuca, Puntius fraseri* and *Bangana nukta* as Endangered, 4 (7%) species *Pachypterus khavalchor, Puntius amphibius, Osteobrama peninsularis* and *Hypselobarbus dobsoni* as Data Deficient and the conservation status of one species *Pethia sanjaymoluri* has not yet been assessed. Among 58 fish collected from the Yerla river, 13 species were found common, 5 abundant, 24 moderate and 16 rare (Table 3). High Shannon diversity index showed considerable variation and ranged from 3.00 – 3.41 indicates a strong relationship with overall species richness. The highest fish diversity was recorded from S3 (Wakeshwar) and S9 (Andhali) sampling site i.e., 3.41. The lowest diversity was recorded from S6 (Tupewadi) sampling site (3.00) respectively.

The fish fauna of Yerla River is threatened by anthropogenic activities such as releasing or dumping of agriculture effluents, industrial sewage and domestic organic wastes in some stretch of the river bed at the vicinity of Ner, Turchi and Bramhanal villages. Similarly, over-exploitation of fish using different sizes of gill-nets and unscientific practicing for fish catch could also be a threat to the fish species of the genera like, *Labeo, Cirrhinus, Opsarius, Salmostoma, Hypselobarbus, Mystus, Puntius* etc. We recorded eight introduced species i.e., four transplanted viz., *Cirrhinus mrigala, Labeo rohita, Labeo catla, Labeo calbasu* and four invasive species viz., *Oreochromis mossambicus, Cyprinus carpio, Clarias gariepinus* and *Ctenopharyngodon idella* from

various sites of Yerla River. Presence of these transplanted and invasive exotic species is potential threats to most of the indigenous fish species (Kharat *et al.*, 2003; Raghavan *et al.*, 2008; Knight 2010; Kumbar *et al.*, 2021). Studies on Krishna River in Sangli and adjacent areas have recorded several alien species (Jayaram 1995), but Jadhav *et al.*, 2011 could not record any alien species from Koyna River, a tributary of Krishna River. Nevertheless, Yerla River harbours 15 endemic and 4 endangered species. The population of Endangered and Endemic *Botia striata* and *Puntius fraseri* is declining drastically in the study area due to pollution, over fishing for consumption and the competition created by introduced carps such as *Cirrhinus mrigala, Labeo rohita, Labeo catla* (Ghate *et al.*, 2002; Kharat *et al.*, 2003; Dahanukar *et al.*, 2012). Similarly, *Hypselobarbus curmuca* collected moderate to less number and is assessed as Endangered (Dahanukar and Raghavan, 2013b).

In the present study *Opsarius bendelisis, Bangana nukta, Heteropneustes fossilis* and *Gagata itchkeea* (Image 9, 33, 44 and 48) were recorded very less in number. Further, the important Western Ghats and Krishna River endemic species *Pachypterus khavalchor, Osteobrama neilli, Pethia sanjaymoluri, Rohtee ogilbii* have been collected at various sites of the study areas. Possible threats o the fishes of Yerla River are over fishing, recreational activities and pollution of the river. Four species *Pachypterus khavalchor, Puntius amphibius, Osteobrama peninsularis* and *Hypselobarbus dobsoni* assessed as Data Deficient due to lack of substantial information. *Anabas testudineus* (Image 51), a climbing perch of amphibious species was recorded in Bramhanal site (S12). It is widely distributed from India and China across to Cambodia. However, *A. testudineus* is assessed as Least Concern due to its wide distributional range.

Though, the threat of anthropogenic stressors are lesser in its impact compare to other rivers of the district or the tributaries of Krishna River, the presence of eight transplanted, three alien or exotic fish species could be the major threats for indigenous fish species of the Yerla river. However, this fauna was threatened due to directly releasing of industrial and agricultural effluents, domestic organic wastes and non-degradable plastic materials, mostly single use plastics. If the present trend is continued, the adverse conditions might lead to the loss of habitat and fish fauna of Yerla River, which are richly diver at present. Therefore, it is essential to convey awareness in local fishers and people for reducing the deposition of various pollutants and protection of food fishes. The collected data will be helpful for the other researchers in perceiving the aquatic life in Yerla River. It is therefore essential to conserve and protect endemic and threatened species found in the Yerla River.

Table 1: Details of the sampling sites of Yerla River

Site Code	Sampling Sites	GPS Locations
S1	Ner Dam	17°44'50.4"N 74°18'24.9"E
S2	Khatgun	17°42'04.2"N 74°20'47.0"E
S3	Wakeshwar	17°36'09.0"N 74°25'14.1"E
S4	Yeralwadi Dam	17°32'03.5"N 74°29'10.7"E
S5	Chitali	17°25'14.3"N 74°29'45.7"E
S6	Tupewadi	17°20'38.8"N 74°28'28.2"E
S7	Vadiye-Raibag	17°16'50.9"N 74°25'57.3"E
S8	Rampur	17°10'42.4"N 74°25'50.3"E
S9	Andhali	17°08'06.7"N 74°28'55.9"E
S10	Turchi	17°04'08.7"N 74°33'15.7"E
S11	Nandre	16°57'19.3"N 74°32'31.4"E
S12	Bramhanal	16°56'25.8"N 74°30'38.4"E

Table 2: The representative orders, families, genera and species of Yerla River

Order	Families	Genera	Species
Anabantiformes	2	2	4
Beloniformes	2	2	2
Cichliformes	2	3	3
Cypriniformes	5	21	33
Gobiiformes	1	1	1
Siluriformes	6	9	13
Synbranchiformes	1	2	2
Total	**19**	**40**	**58**

Table 3: Checklist of freshwater fishes collected from the Yerla River, Maharashtra, Southern India

Sr. No.	Order	Family	Species	Status	WRE	KRE	IUCN Status
1	Beloniformes	Belonidae (Needle fish)	*Xenentodon cancila* (Hamilton, 1822)	R	-	-	LC
2		Hemiramphidae (Half beaks)	*Hyporhamphus limbatus* (Valenciennes, 1847)	R	-	-	LC
3	Cypriniformes	Botiidae (Pointface loaches)	*Botia striata* (Rao, 1920)	M	+	+	EN
4		Danionidae (Danios)	*Amblypharyngodon mola* (Hamilton,1822)	M	-	-	LC
5			*Devario malabaricus* (Jerdon, 1849)	M	-	-	LC
6			*Salmostoma balookee* (Sykes, 1839)	C	-	-	LC
7			*Salmostoma boopis* (Day, 1874)	A	+	-	LC
8			*Salmostoma novacula* (Valenciennes, 1838)	M	+	-	LC
9			*Opsarius bendelisis* (Hamilton, 1807)	R	-	-	LC
10			*Cirrhinus mrigala* (Hamilton, 1822)	M	-	-	LC
11			*Cirrhinus reba* (Hamilton, 1822)	M	-	-	LC

Sr. No.	Order	Family	Species	Status	WRE	KRE	IUCN Status
13			*Cyprinus carpio* Linnaeus, 1758	M	-	-	-
14			*Garra mullya* (Sykes, 1839)	A	-	-	LC
15			*Gymnostomus ariza* (Hamilton, 1807)	R	-	-	LC
16			*Hypselobarbus curmuca* (Hamilton, 1807)	M	-	-	EN
17			*Hypselobarbus dobsoni* (Day, 1876)	R	-	-	DD
18			*Labeo boggut* (Sykes, 1839)	R	-	-	LC
19			*Labeo calbasu* (Hamilton, 1822)	M	-	-	LC
20			*Labeo catla* (Hamilton, 1822)	A	-	-	LC
21		Cyprinidae (Minnows and Carps)	*Labeo porcellus* (Heckel, 1844)	R	+	-	LC
22			*Labeo rohita* (Hamilton, 1822)	A	-	-	LC
23			*Osteobrama neilli* (Day, 1873)	R	+	+	LC
24			*Osteobrama peninsularis* (Silas, 1952)	M	+	-	DD
25			*Osteobrama vigorsii* (Sykes, 1839)	C	-	-	LC
26			*Pethia sanjaymoluri* Katwate, Jadhav, Kumar, Raghavan & Dahanukar, 2016	M	+	+	NE
27			*Puntius amphibius* (Valenciennes, 1842)	M	+	-	DD
28			*Puntius fraseri* (Hora & Misra, 1938)	R	+	-	EN
29			*Puntius sophore* (Hamilton, 1822)	C	-	-	LC

Sr. No.	Order	Family	Species	Status	WRE	KRE	IUCN Status
30			*Pethia ticto* (Hamilton, 1822)	M	-	-	LC
31			*Rasbora dandia* (Valenciennes, 1844)	M	-	-	LC
32			*Rohtee ogilbii* (Sykes, 1839)	M	+	+	LC
33			*Bangana nukta* (Sykes, 1841)	R	-	-	EN
34			*Systomus sarana* (Hamilton, 1822)	C	-	-	LC
35		Nemacheilidae (Brook loaches)	*Paracanthocobitis mooreh* (Sykes, 1839)	R	-	-	LC
		Xenocyprididae	*Ctenopharyngodon idella* (Valenciennes, 1844)	M	-	-	-
36	Siluriformes	Bagridae (Bagrid catishes)	*Mystus cavasius* (Hamilton, 1822)	M	-	-	LC
37			*Mystus malabaricus* (Jerdon, 1849)	M	+	-	NT
38			*Mystus seengtee* (Skyes, 1839)	M	+	-	LC
39			*Sperata aor* (Hamilton, 1822)	M	-	-	LC
40			*Sperata seenghala* (Sykes, 1839)	M	-	-	LC
41			*Rita gogra* (Sykes, 1839)	R	+	-	LC
42			*Rita kuturnee* (Sykes, 1839)	C	+	-	LC
43		Clariidae (Airbreathing catfishes)	*Clarias gariepinus*	R	+	-	-
44		Heteropneustidae (Stinging catfish)	*Heteropneustes fossilis* (Bloch, 1794)	R	-	-	LC
45		Horabagridae	*Pachypterus khavalchor* (Kulkarni, 1952)	A	+	-	DD

Sr. No.	Order	Family	Species	Status	WRE	KRE	IUCN Status
46		Siluridae (Sheat fishes)	*Ompok bimaculatus* (Bloch, 1794)	C	-	-	NT
47			*Wallago attu* (Bloch & Schneider, 1801)	C	-	-	VU
48		Sisoridae (Sisorid catfishes)	*Gagata itchkeea* (Sykes, 1839)	R	+	-	VU
49	Cichliformes	Ambassidae (Asiatic glassfishes)	*Chanda nama* (Hamilton, 1822)	C	-	-	LC
50			*Parambassis ranga* (Hamilton, 1822)	C	-	-	LC
51		Cichlidae (Cichlids)	*Oreochromis mossambicus* (Peters, 1852)	C	-	-	-
52	Anabantiformes	Anabantidae (Climbing gouramies)	*Anabas testudineus* (Bloch, 1972)	R	-	-	LC
53		Channidae (Snakeheads)	*Channa marulius* (Hamilton, 1822)	M	-	-	LC
54			*Channa punctata* (Bloch, 1793)	M	-	-	LC
55			*Channa striata* (Bloch, 1793)	M	-	-	LC
56	Gobiiformes	Gobiidae (Gobies)	*Glossogobius giuris* (Hamilton, 1822)	C	-	-	LC
57	Synbranchiformes	Mastacembelidae (Spiny eels)	*Mastacembelus armatus* (Lacepède, 1800)	C	-	-	LC
58			*Macrognathus puncalus* (Hamilton, 1822)	C	-	-	LC

Note: A – Abundant, C – Common, M – Moderate, R – Rare, EN – Endangered, NT – Near Threatened, LC – Least Concern, NE – Not Evaluated, DD – Data Deficient, VU – Vulnerable

Table 4: Summary of variation in fish species abundance, Shannon index.

Study sites	Sampling sites											
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Species	38	30	35	33	30	23	33	28	40	25	30	40
Individual	166	100	129	183	120	91	150	117	175	94	125	179
Shannon Index	3.14	3.25	3.41	3.07	3.29	3.00	3.34	3.16	3.41	3.07	3.21	3.36

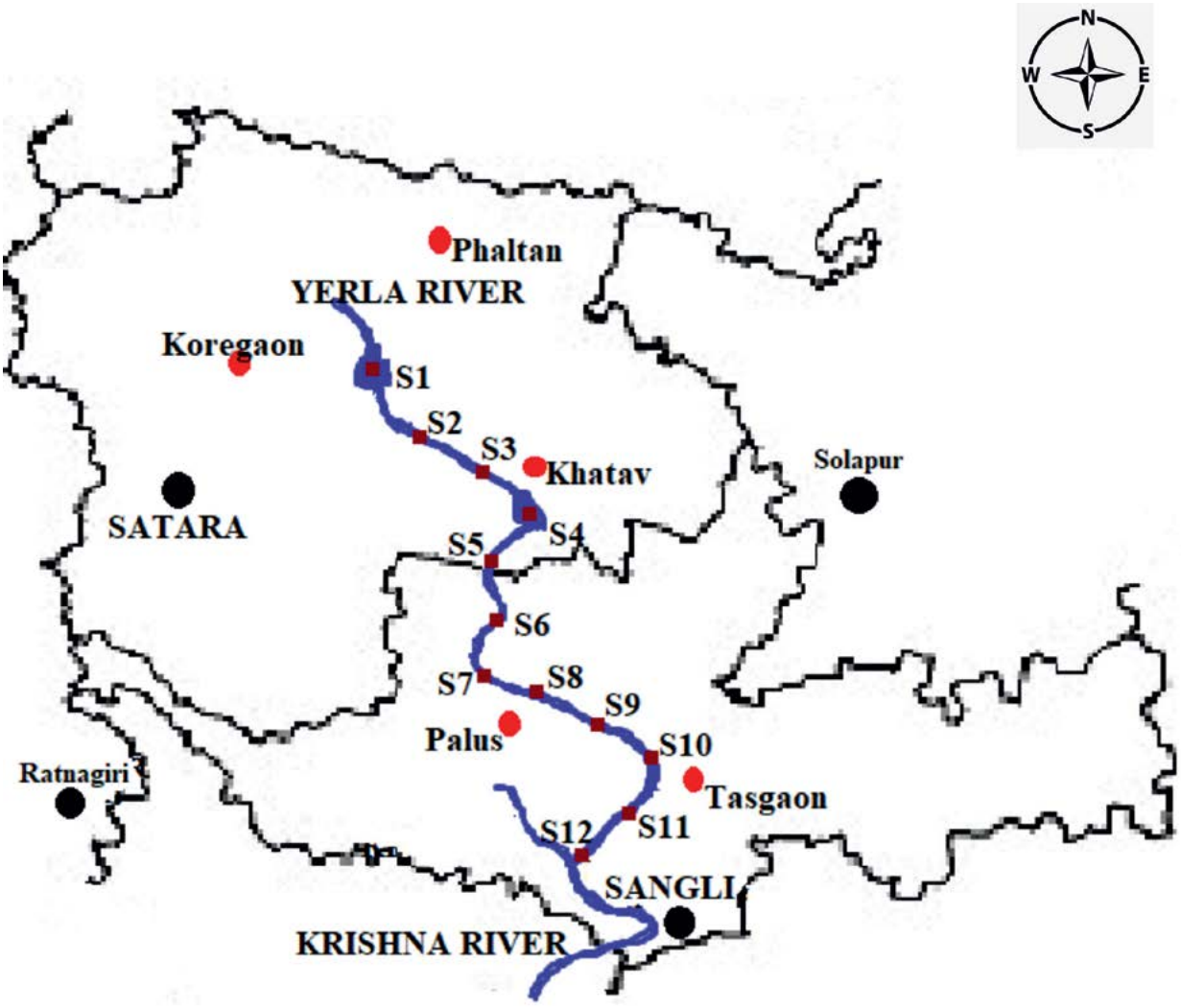


Fig. 1 Study area map showing different sampling sites on Yerla river

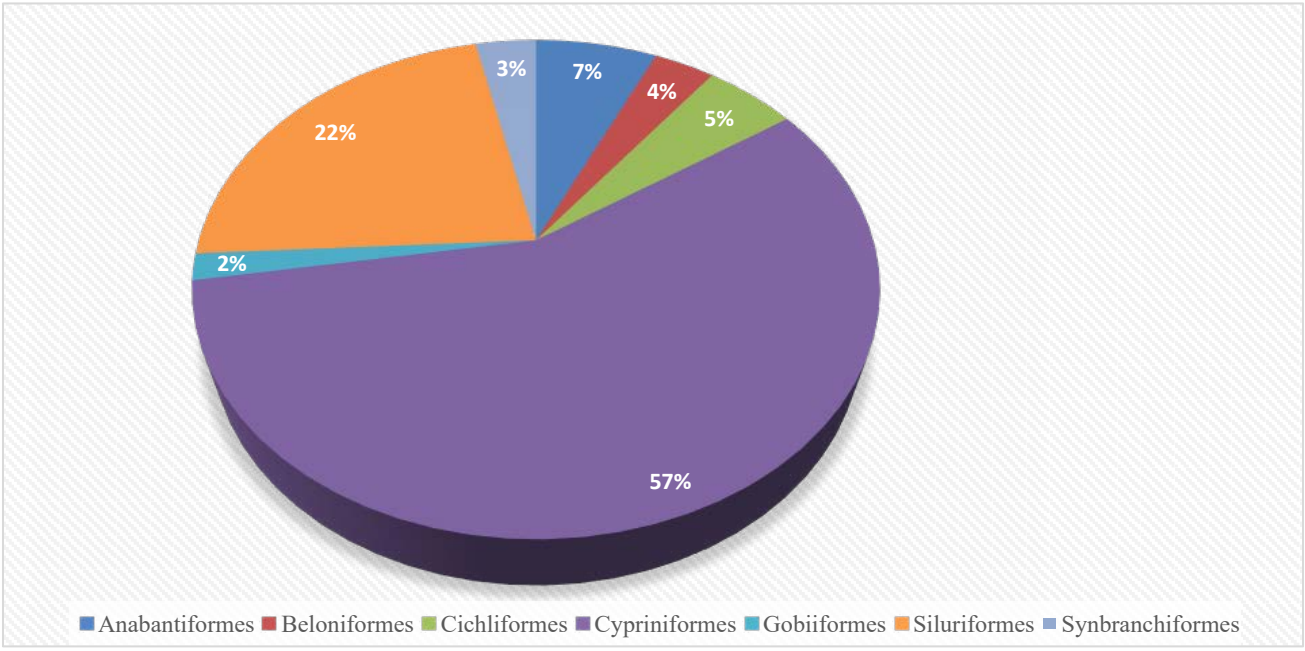


Figure 2 Percentage composition of orders

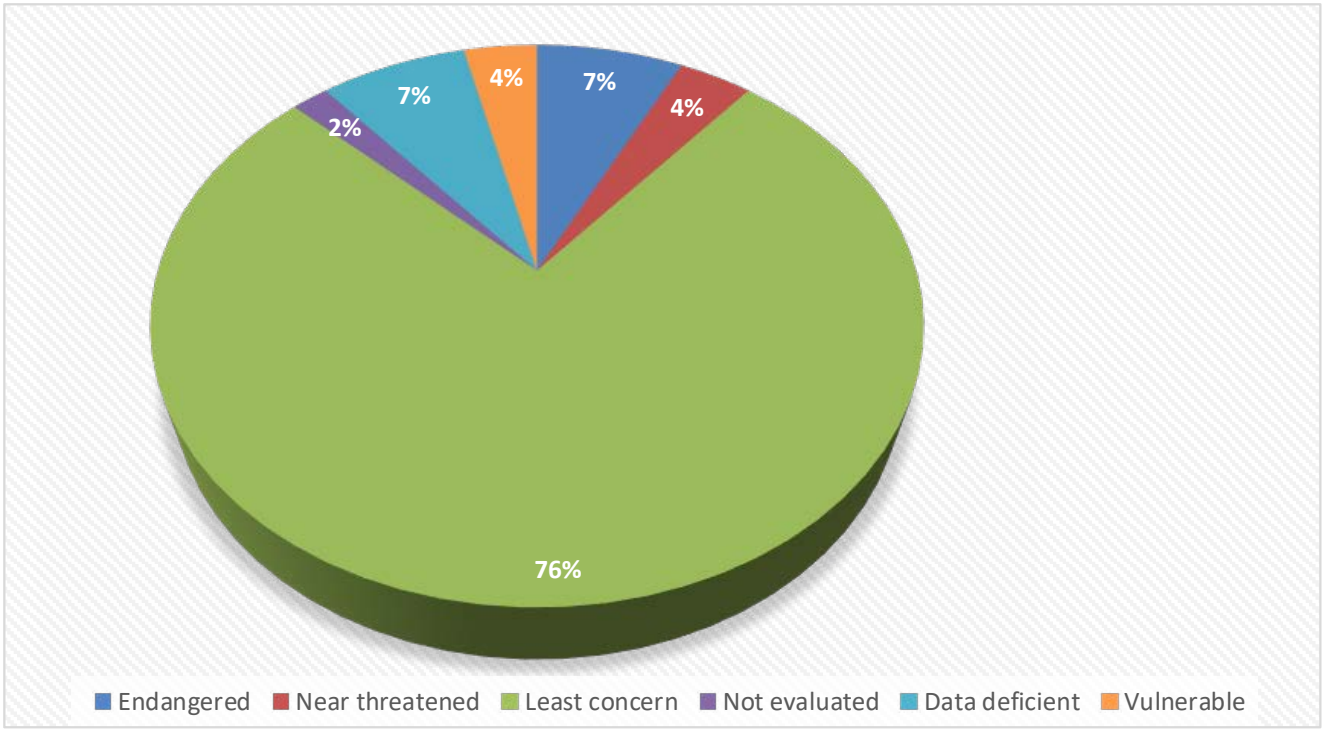


Figure 3 Percentage composition of conservation status (IUCN) of fish fauna

Image 1. *Xenentodon cancila*

Image 2. *Hyporhamphus limbatus*

Image 3. *Botia striata*

Image 4. *Amblyphryngodon mola*

Image 5. *Devario malabaricus*

Image 6. *Salmostoma balookee*

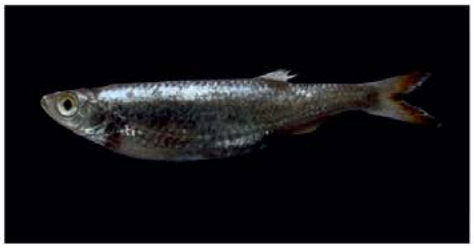


Image 7. *Salmostoma boopis*

Image 8. *Salmostoma novacula*

Image 9. *Opsarius bendelisis*

Image 10. *Cirrhinus mrigala*

Image 11. *Cirrhinus reba*

Image 12. *Ctenopharyngodon idella*

Image 13. *Cyprinus carpio*

Image 14. *Garra mullya*

Image 15. *Gymnostomus ariza*

Image 16. *Hypselobarbus curmuca*

Image 17. *Hypselobarbus dobsoni*

Image 18. *Labeo boggut*

Image 19. *Labeo calbasu*

Image 20. *Labeo catla*

Image 21. *Labeo porcellus*

Image 22. *Labeo rohita*

Image 23. *Osteobrama neilli*

Image 24. *Osteobrama peninsularis*

Image 25. *Osteobrama vigorsii*

Image 26. *Pethia sanjaymoluri*

Image 27. *Puntius amphibius*

Image 28. *Puntius fraseri*

Image 29. *Puntius sophore*

Image 30. *Pethia ticto*

Image 31. *Rasbora dandia*

Image 32. *Rohtee ogilbii*

Image 33. *Bangana nukta*

Image 34. *Systomus sarana*

Image 35. *Paracanthocobitis mooreh*

Image 36. *Mystus cavasius*

Image 37. *Mystus malabaricus*

Image 38. *Mystus seengtee*

Image 39. *Sperata aor*

Image 40. *Sperata seenghala*

Image 41. *Rita gogra*

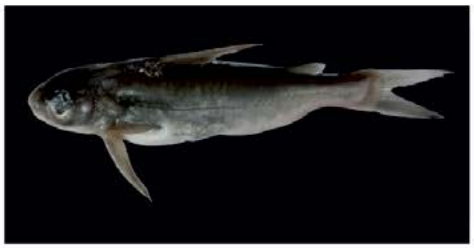


Image 42. *Rita kuturnee*

Image 43. *Clarias gariepinus*

Image 44. *Heteropneustes fossilis*

Image 45. *Pachypterus khavalchor*

Image 46. *Ompok bimaculatus*

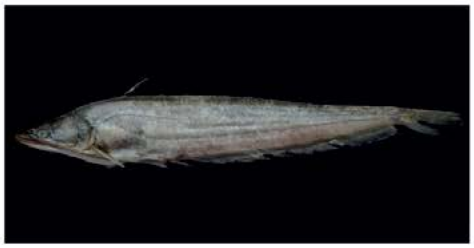


Image 47. *Wallago attu*

Image 48. *Gagata itchkeea*

Image 49. *Chanda nama*

Image 50. *Parambassis ranga*

Image 51. *Anabas testudineus*

Image 52. *Channa marulius*

Image 53. *Channa punctata*

Image 54. *Channa striata*

Image 55. *Oreochromis mossambicus*

Image 56. *Glossogobius giuris*

Image 57. *Mastacembalus armatus*

Image 58. *Macrognathus pancalus*

Acknowledgements

We are grateful to the Management and Principal, Arts, Commerce and Science College, Palus, District Sangli for providing infrastructural facilities. We also thankful to Dr. Neelesh Dahanukar, Department of Life Sciences, Shiv-Nadar University, Delhi NCR for the identification and encouragement. First author thanks to Department of Zoology, Balwant College, Vita for providing necessary facilities. Also, thanks to Government of Maharashtra for providing financial assistance through MAHAJYOTI fellowship. Thanks to DBT Star College Scheme for partial financial support.

References

Annandale, N. 1919. Bombay streams fauna: notes on fresh water fish mostly from the Satara and Poona Districts. *Records of the Indian Museum*, 16:125-138.

Arunachalam, M., Sankaranarayanan, A., Manimekalan, A., Soranam, R. and Johnson, J.A. 2002. Fish fauna of some streams and rivers in the Western Ghats of Maharashtra. *Journal of the Bombay Natural History Society*, 99(2): 337-341.

Chandanshive, E.N., Kamble, S.M. and Yadav, B.E. 2007. Fish fauna of Pavana river of Pune, Maharashtra. *Zoo's Print Journal*, 22(5): 2693-2694.

Dahanukar, N., and Raut, R. and Bhat, A. 2004. Distribution, endemism and threat status of freshwater fishes in the Western Ghats of India. *Journal of Biogeography*, 31(1): 123-136.

Dahanukar, N., Diwekar, M. and Paingankar, M. 2011. Rediscovery of threatened and Western Ghats endemic

Sisorid Catfish *Glyptothorax poonaensis* (Teleostei: Siluriformes; Sisoridae). *Journal of Threatened Taxa*, 3(7): 1885-1898.

Dahanukar, N., Paingankar, M., Raut, R.N. and Kharat, S.S. 2012. Fish fauna of Indrayani River, northern Western Ghats, India. *Journal of Threatened Taxa*, 4(1): 2310-2317.

Dahanukar, N. and Raghavan, R. 2013a. Freshwater fishes of the Western Ghats: Checklist. Min 1:6-16.

Dahanukar, N. and Raghavan, R. 2013b. *Hypselobarbus mussullah*. The IUCN Red List of Threatened species. Downloaded on 21 December 2015.

Das, A.K., Manna, R.K., Rao, D.S.K., Jha, B.C., Naskar, M. and Sharma, A.P. 2017. Status of the River Krishna: Water quality and riverine environment in relation to fisheries. *Aquatic Ecosystem Health & Management*, 20:1-2; 160-174

Fricke, R., Eschmeyer, W.N. & R. van der Laan (eds) 2023. Eschmeyer's Catalog Of Fishes: Genera, Species, Ferences.(http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp). Downloaded on 19 January, 2023.

Ghate, H.V., Pawar, V.M. and Yadav, B.E. 2002. Note on cyprinoid fish *Schimatorhynchos* (Nukta) *nukta* (Sykes) from the Krishna drainage, Western Ghats. *Zoo's Print Journal*, 17(7):830-831.

Jadhav, B.V., Kharat, S.S., Raut, R.N., Paingankar M. and Dahanukar, N. 2011. Freshwater fish fauna of Koyna River, northern Western Ghats, India. *Journal of Threatened Taxa*, 3(1): 1449-1455.

Jayaram, K.C. 1991. Revision of the Genus *Puntius* Hamilton from the Indian Region (Pisces: Cypriniformes: Cyprinidae: Cyprininae). Occasional Paper No. 135, 178pp (Published by the Director, Zoological Survey of India, Kolkata).

Jayaram, K.C. 1995. The Krishna River System: A Bioresources Study. Occasional Paper No. 160, 167pp (Published by the Director, Zoological Survey of India, Kolkata).

Jayaram, K.C. and Das, J.J. 2000. Revision of the Genus *Labeo* from Indian Region with A Discussion on its Phylogeny and Zoogeography. Occasional Paper No. 183.143pp. (Published by the Director, Zoological Survey of India, Kolkata)

Jayaram, K.C. and Sanyal, A. 2003. A Taxonomic Revision of the fishes of the Genus *Mystus* Scopoli (Family: Bagridae) Occasional Paper No. 207, 136pp (Published by the Director, Zoological Survey of India, Kolkata).

Jayaram, K.C. 2006. *The catfishes of the Indian Region*, 383pp (Published by Narendra Publishing House, Delhi)

Jayaram, K.C. 2010. *The Freshwater Fishes of the Indian Region*. Second Edition, 616pp (Published by Narendra Publishing House, Delhi).

Kharat, S.S., Dahanukar, N., Raut, R. and Mahabaleshwarkar, M. 2003. Long term changes in freshwater fish species composition in north Western Ghats, Pune District. *Current Science*, 84(6): 816-820.

Kharat, S.S., Paingankar, M. and Dahanukar, N. 2012. Freshwater fish fauna of Krishna River at Wai, northern Western Ghats, India. *Journal of Threatened Taxa*, 4(6): 2644-2652.

Knight, J.D.M. 2010. Invasive ornamental fish: a potential threat to aquatic biodiversity in peninsular India. *Journal of Threatened Taxa,* 2(2): 700-704.

Kumbar, S.M. and Lad, S.B. 2014. Diversity, threats and conservation of catfish fauna of the Krishna River, Sangli District, Maharashtra, India. *Journal of Threatened Taxa*, 6(10):5362-5367.

Kumbar, S.M., Jadhav, S.S., Lad, S.B., Ghadage, A.B., Patil, S.S. and Shiv Shankar, C. 2021. On the freshwater fish fauna of Krishna River, Sangli District, Maharashtra, India. *Journal of Threatened Taxa*, 13(8): 19093-19101.

Menon, A.G.K. 1987. The Fauna of India and adjacent countries, Pisces, Vol.4. Teleostomi, Cobitoidea. Pt.I. Homalopteridae. Zoological Survey of India, 259 pp.

Menon, A.G.K. 1992. *Fauna of India-Pisces: Cobitidae*. 1-113(Published by the Director, Zoological Survey of India, Kolkata).

Myers, N., Mittermeier, R.A., Mittemeier, C.G., De Fonseca, G.A.B. and Kent, J. 2000. Biodiversity and hotspots for conservation priorities. *Nature*, 403:853-858. https://doi/10.1038/35002501

Raghavan, R., Prasad, G., Ali, A.P.H. and Pereira, B. 2008. Exotic fish species in a global biodiversity hotspot: Observations from river Chalakudy, part of Western Ghats, Kerala, India. *Biological Invasions*, 10(1): 37-40.

Sarwade, J.P. and Khillare, Y.K. 2010. Fish diversity of Ujani wetland, Maharashtra, India. *The Bioscan* 1: 173–179.

Silas, E.G. 1953. Notes on fishes of Mahabaleshwar and Wai (Satara Dist., Bombay State) *Journal of the Bombay Natural History Society*, 51: 579-589.

Talwar, P.K. and Jhingran, A.G. 1991. *Inland Fishes of India and adjacent countries*. Vol. I & II. Oxford & I.B.H. Publ. Co. Pvt. Ltd., New Delhi, 1158 pp.