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RECENT ICHTHYOFAUNAL COLLECTIONS FROM THE VALAPATTANAM RIVER BASIN, KERALA, INDIA

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ABSTRACT

The objective of the study was to document the fish species from Valapattanam river in Kerala. The duration of the study was four years (from June 2017 to July 2021) and the fishes were collected using various fishing gears from 15 sites draining the Valapattanam river system. A total of 51 fish species belonging to 42 genera, 25 families and eleven orders were collected during the present study. Order Cypriniformes dominated with maximum number of species encountered (Sps=21) followed by Anabantiformes (Sps=7) while the most speciose family was Cyprinidae (Sps=13). Among the collected fishes, one species is Endangered (EN), two are Vulnerable (VU), three Near Threatened (NT), 34 Least Concern (LC), three Not Evaluated (NE) and two are Data Deficient (DD) as per the IUCN Red List of threatened Species. Twenty-two species recorded during the study are endemic to the Western Ghats (WG).

1. INTRODUCTION

The Western Ghats is one of the hotspots of biodiversity in the world endowed with rare, endemic and threatened species of flora and fauna (Hanson *et al*., 2009). Rivers and streams of the Western Ghats are exceptionally biodiverse with high levels of endemism (Kottelat & Whitten, 1996), (Dahanukar *et al.,* 2011). The freshwater fish fauna is one of the most important, threatened and endemic taxonomic groups of the Western Ghats that contribute critical ecological role in aquatic ecosystems (Holmlund & Hammer, 2009)

With over 300 species, almost 65% are endemic and the endemism is just not restricted to the species level, as there is at least 1 family and 19 genera of fish that are unique to Western Ghats region (Raghavan, 2019).

The history of Indian freshwater fish fauna goes back to (Bloch, 1795) with the description of *Cirrhinus cirrhosu*s and L*abeo fimbriatus* from the erstwhile Malabar, followed by the description of *Wallago attu* from the same region by (Bloch & Schneider, 1801). Over the next century (1800–1900), several naturalists including Georges Cuvier (1828–1831), Achilles Valenciennes (1840–1847), Thomas Jerdon (1849), Albert Günther (1864) and Francis Day (1865–1889) enhanced the knowledge of freshwater fishes of erstwhile Malabar District and Cochin State. Further investigations on the freshwater fish fauna of India, especially in the Western Ghats, were initiated by (Hora, 1921, 1937, 1941, 1949 & 1983) and (Hora & Misra, 1938). Since then, there have been many investigations on the freshwater fish fauna of the region. Several new fish species have been described and their taxonomic and systematic studies are an active area of research.

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The Valapattanam river is one of the west-flowing rivers in the Western Ghats region of Kerala, India. It originates from the Brahmagiri Reserve Forest in Karnataka state at an altitude of 900- 1350m above mean sea level and drains into the Arabian Sea at Azheekkal estuary (Harikumar *et al.,* 2014) . The length of main stream is 110 km and the main tributaries of the river are Irikkurpuzha Srikandapurampuzha, Bavalipuzha, Venipuzha and Aralampuzha. Notable fish species such as *Channa diplogramma* (Day 1865), *Glyptothorax malabarensis* (Gopi 2010), *Dario urops* (Britz et al. 2012) were described from Valapattanam river. In the current study an attempt has been made to prepare a comprehensive list of fishes in the Valapattanam river.

2. MATERIALS AND METHODS

Survey and Sample Collection

Fishes were collected from the river during June 2017 to July 2021. Fifteen sampling stations were selected for the current study (Table 1 and Figure 1). Fishing operations and sample collections were made using various nets like cast net, scoop nets and gill nets of varying mesh size. Traditional fishing techniques like bamboo cage traps and sieving by cloth were also used in suitable areas. Only a minimum number of fish were collected for identification and the rest were released back into the stream immediately after capture. Fish specimens obtained were fixed in 5% formaldehyde. For DNA barcoding, fin clips of every species were preserved in 100% ethanol.

Species identification and taxonomy

Taxonomic keys with illustrations made by (Nelson *et al.,* 2016) , (Tan & Armbruster, 2018) and Fricke *et al.,* 2021) were used for the classification, identification and nomenclature of fishes. Conservation status of fishes identified up to species level were obtained from (IUCN, 2020). Specimens with taxonomic ambiguity were preserved for future DNA barcoding studies. Voucher specimens were made for each species and were deposited at the Biodiversity and Molecular biology Lab, Dept. of Zoology, Kannur University Campus, Wayanad Kerala. Some species from the collections were closely resembled the known species and whose specific status could not be confirmed due to a few marked differences in morphology were labelled with cf.(confusion). Voucher specimens with confusing identity have not been deposited in the lab at Kannur University campus as further studies on them are in progress,

3. RESULTS AND DISCUSSION

A total of 51 freshwater fishes belonging to 42 genera, 25 families and eleven orders were obtained during the current study (Image 1-36). Among the families, Cyprinidae dominated with 13 species followed by Channidae and Gobidae with four species, Danionidae, Cichlidae, and Nemacheilidae with three species each, Mastacembelidae and Aplocheilidae with two species and the remaining 17 families with one species each. Of these, 22 species were endemic to the Western Ghats. Three species *Oreochromis mossambicus, Poecilia reticulata and Pangasianodon hypophthalmus* were exotic to the country. Species level identification was not possible in 5 instances as the specimens showed substantial differences in morphology from that of their congeners reported earlier from the region (Table 2 & Figure 2).

The conservation status of the species collected revealed that one species was of Endangered category, two species were Vulnerable, three species were Near Threatened, 34 of Least Concern, two of Data Deficient and three were of Not Evaluated category (Figure 3).

Morphological variants encountered during the study

***Aplocheilus* species:** Several distinct *Aplocheilus* species were collected during the course of the study. Of the collected specimens, most of them were *Aplocheilus lineatus* (Valenciennes, 1846). The colour pattern of the specimens collected from different locations do not match with that of the *A. lineatus* described earlier, however, all specimens are considered as *A. lineatus* in this checklist. Careful examination of the specimens and their molecular genetic characterization could reveal whether the specimens comprise of cryptic species.

Schismatogobius* cf. *Deraniyagalai: The specimen collected from Eruvassi (S4) shows marked differences from the descriptions made in the original publication describing the species. Molecular genetic studies and detailed morphological characterization to make comparison with the type specimen or the topotypic materials and their congeners would reveal the exact identity of the species. Until then we retain the specimen collected as *Schismatogobius* cf. *deraniyagalai.*

Garra* cf. *Mullya: The morphology of specimen collected from, Kotoorvayal (S2), Valakkai (S3) and Karimbam (S8) shows marked differences with that of the original description. Molecular genetic studies

and detailed morphological characterization comparing the type specimen or the topotypic material and congeners would reveal the exact identity of the species. Until then we retain the specimens collected as *Garra* cf. *Mullya.*

Dawkinsia cf. Assimilis: The specimen collected from Karimbam (S8) shows marked differences from the descriptions made in the original publication describing the species. Molecular genetic studies and detailed morphological characterization comparing the type specimen or the topotypic material and congeners would reveal the exact identity of the species. Until then we retain the specimens collected as *Dawkinsia cf. Assimilis.*

Channa cf. Gachua: The morphology of specimen collected from Kotoorvayal (S2) and Edakkom (S12), shows marked differences with that of the original description. Molecular genetic studies and detailed morphological characterization comparing the type specimen or the topotypic material and congeners would reveal the exact identity of the species. Until then we retain the specimens collected as *Channa cf. gachua.*

4. DISCUSSION

In the current study to list out the freshwater fishes of Valapattanam river, a total of 51 species belonging to eleven orders, 25 families and 42 genera were described. Until now the most comprehensive survey of freshwater fishes from the river basin was of from the Aralam river by (Shaji & Palot, 2020) who recorded 45 fish species. The collections are of conservation significance that one endangered, two Vulnerable and three Near Threatened species were recorded from the streams adjacent to human-inhabited areas. Proper management plans should be choked out like setting quotas for fishing or imposing localized bans for fishing during the breeding season of these fishes to conserve them.

Three species of invasive fishes (*Oreochromis mossambicus, Pangasianodon hypophthalmus* and *Poecilia reticulata*) were collected during the study. According to (Pimental, 2002) the invasive fishes may alter the aquatic ecology by changing the water quality and may cause the extinction of native fish by predation and resource competition. The matter of invasive species is of a special concern, since the aquaculture promotion agencies (both governmental and non-governmental) in the district that comprises the study area promote culture of non-native aquaculture candidate species like *Pangasianodon hypophthalmus*, *Osphronemus gorami*, *Oreochromis niloticus*, *Pygocentrus nattereri* etc. In addition, there are several ornamental fish traders who keep several exotic species for sale. These fishes may escape into the natural water bodies and, in turn, pose a great risk to the native species. Managing the aquaculture of non-native species through legislation and enforcing strict licensing for aquarium or pet shops should be given top priority. Otherwise, these practices could destroy the rich freshwater fish biodiversity of the river system.

5. CONCLUSION

The true diversity of freshwater fishes of this river could be underestimated due to lack of detailed taxonomic studies, and systematic long term field surveys. Fish fauna in this region is threatened primarily by water pollution due to soil mining, rock mining, agricultural run-offs, industrial effluents and also by invasive species. Though we studied several streams in the region during the survey, records of more species are expected and further taxonomic studies are essential for calculating the true diversity of fishes in this region. The present study would help to formulate the necessary conservation strategies to protect the faunal diversity in the Valapattanam river basin. Moreover, the study area experienced two consecutive floods in the years 2018 and 2019 and the present work may help to set a foundation for detailed studies on the impacts of flood on the freshwater fish diversity and distribution.

6. CONFLICT OF INTEREST

Authors have declared that there is no conflict of interests regarding the publication of this article.

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TABLE 1. Details of sampling stations for the fish species recorded

No.	Sampling Station	Latitude N	Longitude E	Altitude (m)
1	Chempanthotty	12°05'26.3"	75°29'39.7"	100
2	Kottoorvayal	12°03'54.3"	75°31'11.8"	100
3	Valakkai	12°02'30.5"	75°26'59.0"	100
4	Eruvassi	12°04'34.3"	75°33'34.7"	100
5	Kottiyoor	11°52'38.8"	75°51'43.9"	200
6	Paisakkari	12°04'34.3"	75°33'34.7"	100
7	Sreekanadapuram river	12°02'46.5"	75°30'28.7"	100
8	Karimbam	12°02'33.8"	75°23'07.7"	100
9	Irikkur river	11°59'05.0"	75°33'11.7"	100
10	Peravoor	11°53'39.9"	75°43'55.0"	100
11	Kudiyanmala	12°08'28.4"	75°33'07.1"	400
12	Edakkom	12°08'21.5"	75°22'44.9"	100
13	Keezhallur	11°53'53.5"	75°31'38.7"	100
14	Kannavam	11°50'45.6"	75°39'28.5"	100
15	Vallithode	12°01'46.1"	75°42'48.8"	100

TABLE 2. Details of collections of freshwater fishes from Valapattanam river.

Sl No.	Order/ Family/ Subfamily/Species	Distribution	[a]Red List status	[b]Endemism
	Order: Anguilliformes			
	Family: Anguillidae			
1	*Anguilla bicolor* McClelland 1844	S2	NT	
	Order: Beloniformes			
	Family: Belonidae			
2	*Xenentodon cancila* (Hamilton, 1822)	S1,S2,S3,S6,S7	LC	
	Order: Cypriniformes			
	Family: Balitoridae			
3	*Bhavania australis* (Jerdon, 1849)	S5	LC	WG
	Family: Cobitidae			
4	*Lepidocephalichthys thermalis* (Valenciennes 1846)	S3	LC	
	Family: Cyprinidae			
5	*Dawkinsia lepida* (Day 1868)	S3,S4	VU	WG
6	Dawkinsia cf. assimilis	S8		
7	*Dawkinsia filamentosa* (Valenciennes 1844)	S12	LC	WG
8	*Haludaria fasciata* (Jerdon, 1849)	S2, S11, S12, S14	LC	WG
9	*Pethia punctata* (Day, 1865)	S8	LC	WG
10	*Puntius machecola* (Valenciennes,1844)	S2, S3,S8	DD	
11	*Puntius vittatus* Day, 1865	S8	LC	
12	*Systomus sarana* (Hamilton 1822)	S6, S7	LC	WG
13	*Garra mullya* (Sykes 1839)	S1,S9	LC	WG

14	*Garra* cf. *mullya*	S2,S3,S8		
15	*Hypselobarbus kurali* Menon & Rema Devi 1995	S2	LC	WG
16	*Osteochilichthys nashii* (Day 1869)	S5,S15	LC	WG
17	*Tor malabaricus* (Jerdon 1849)	S7	EN	WG
	Family: Danionidae			
18	*Barilius malabaricus* (Jerdon 1849)	S2, S11	NE	WG
19	*Devario malabaricus* (Jerdon 1849)	S1,S2,S10,S13	LC	WG
20	*Rasbora dandia (Valenciennes, 1844)*	S2, S3, S14	LC	
	Family: Nemacheilidae			
21	*Mesonoemacheilus triangularis* (Day 1865)	S5,S14	LC	WG
22	*Mesonoemacheilus guentheri* (Day 1867)	S5, S8	LC	WG
23	*Schistura nilgiriensis* (Menon 1987)	S5	LC	WG
	Order: Cyprinodontiformes			
	Family: Aplocheilidae			
24	*Aplochelius lineatus* (Valenciennes, 1846)	S2	LC	
25	*Aplochelius* cf.*lineatus*	S2, S3		
	Family: Poeciliidae:			
26	*Poecilia reticulata* Peters 1859	S1	NE	I
	Order: Anabantiformes			
	Family: Channidae			
27	*Channa gachua* (Hamilton, 1822)	S2	LC	
28	Channa cf. gachua	S2,S12		
29	*Channa striata* (Bloch, 1793)	S7,S9	LC	
30	*Channa pseudomarulius*(Günther 1861)	S9	LC	
	Family: Osphronemidae			

31	*Pseudosphromenus cupanus* (Cuvier, 1831)	S2, S3	LC	
	Family: Badidae			
32	*Dario urops* Britz, Ali &Philip 2012	S14	NE	WG
	Family: Pristolepididae			
33	*Pristolepis rubripinnis* Britz, Kumar &Baby 2012	S5	LC	WG
	Cichliformes			
	Family: Cichlidae			
34	*Pseudetroplus maculatus* (Bloch 1795)	S3, S4, S11	LC	
35	*Etroplus suratensis* (Bloch, 1790)	S5	LC	
36	*Oreochromis mossambicus* (Peters,1852)	S2, S13	NT	I
	Gobiiformes			
	Family:Gobiidae			
37	*Schismatogobius* cf. *deraniyagalai*	S4		
38	*Awaous grammepomus*(Bleeker 1849)	S2,S3,S7	LC	
39	*Glossogobius giuris* (Hamilton, 1822)	S2, S3, S6, S7	LC	
40	*Sicyopterus griseus* (Day 1877)	S6	LC	
	Family: Eleotridae			
41	*Eleotris fusca* (Bloch &Schneider 1801)	S3	LC	
	Order: Siluriformes			
	Family: Bagridae			
42	*Mystus montanus* (Jerdon, 1849)	S2, S14	LC	WG
	Family: Clariidae			
43	*Clarias dussumieri* Valenciennes, 1840	S2	NT	WG

	Family: Pangasiidae			
44	*Pangasianodon hypophthalmus* (Sauvage 1878)	S7		I
	Family: Siluridae			
45	*Ompok malabaricus* (Valenciennes 1840)	S2, S3	LC	WG
	Family: Sisoridae			
46	*Glyptothorax malabarensis* (Gopi 2010)	S11	DD	
	Order: Synbranchiformes:			
	Family: Mastacembelidae			
47	*Macrognathus guentheri* (Day 1865)	S2, S8	LC	WG
48	*Mastacembelus armatus* (Lacepède 1800)	S2, S8, S15	LC	
	Family: Ambassidae			
49	*Parambassis dayi* (Bleeker 1874)	S4, S5, S9	LC	WG
	Order: Syngnathiformes			
	Family: Syngnathidae			
50	*Microphis cuncalus* (Hamilton, 1822)	S3	LC	
	Order: Tetradontiformes			
	Family: Tetraodontidae			
51	*Carinotetraodon travancoricus* (Hora&Nair, 1941)	S7	VU	WG

[a]Red List categories: EN-Endangered; LC – Least Concern; NT- Near Threatened; VU – Vulnerable; DD data deficient; NE – Not Evaluated; I – Introduced. [b]Endemism: WG- Western Ghats. S1-15; Sampling stations 1-15

Figure 1. Map of study area with sampling stations

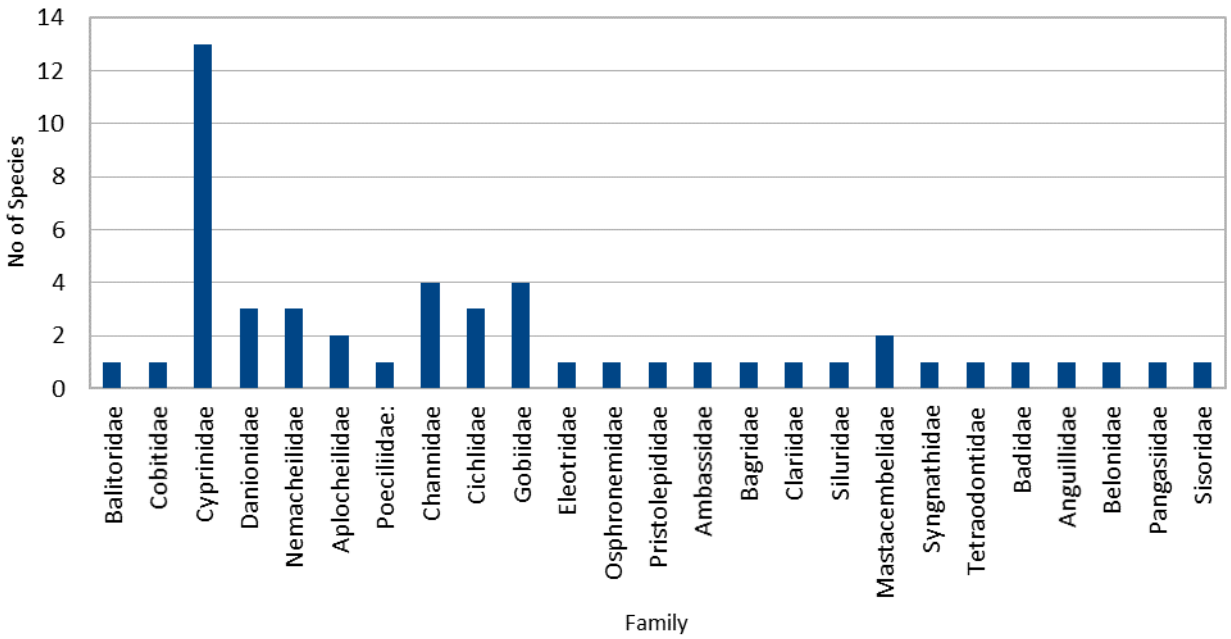

Figure 2. Family wise diversity of freshwater fishes of Valapattanam river

Figure 3. Conservation status of freshwater fishes of Valapattanam river

Image 1.*Anguilla bicolor*

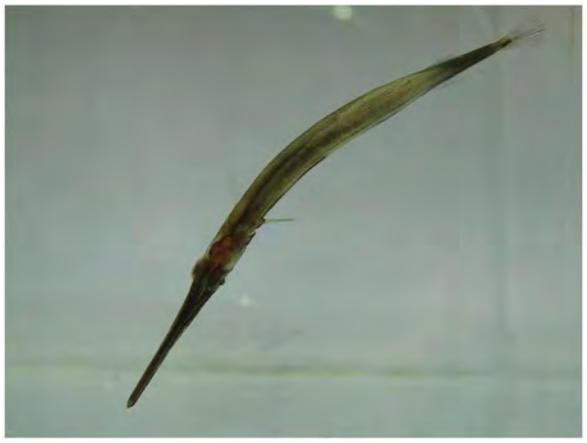

Image 2.*Xenentodon cancilla*

Image 3.*Lepidocephalichthys thermalis*

Image 4.*Dawkinsia lepida*

Image 5.*Haludaria fasciata*

Image 6.*Bhavania australis*

Image 7.*Pethia punctata*

Image 8.*Puntius machecola*

Image 9.*Puntius vittatus*

Image 10.*Garra mullya*

Image 11.*Osteochilichthys nashii*

Image 12.*Barilius malabaricus*

Image 13.*Devario malabaricus*

Image 14.*Rasbora dandia*

Image 15.*Mesonoemacheilus triangularis*

Image 16.*Mesonoemacheilus guentheri*

Image 17.*Schistura nilgiriensis*

Image 18.*Aplochelius lineatus*

Image 19.*Channa gachua*

Image 20 .*Pseudetroplus maculatus*

Image 21.*Etroplus suratensis*

Image 22.*Oreochromis mossambicus*

Image 23. *Awaous grammepomus*

Image 24.*Sicyopterus griseus*

Image 25.*Eleotris fusca*

Image 26.*Pseudosphromenus cupanus*

Image 27.*Pristolepis rubripinnis*

Image 28.*Parambassis dayi*

Image 29.*Mystus montanus*

Image 30.*Clarias dussumieri*

Image 31.*Ompok malabaricus*

Image 32.*Macrognathus guentheri*

Image 33.*Mastacembelus armatus*

Image 34.*Microphis cuncalus*

Image 35.*Systomus sarana*

Image 36.*Glossogobius giuris*

Figure 4. Showing the various images of freshwater fishes occurs in Valapattanam river