



Ichthyodiversity of Periyar Tiger Reserve, Kerala, India

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Abstract: Previous checklists of fishes from the Periyar Tiger Reserve, Kerala merely included species from Periyar Lake and adjoining streams. To fill this lacuna, we conducted a comprehensive survey, across 10 diverse aquatic habitats within Periyar Tiger Reserve, revealing the occurrence of 54 species belonging to six orders and 19 families; an addition of 17 species to the previous lists. Twenty-four species found in this reserve were listed under different threat categories. Forty-six species were found only in less than four sampling sites of which 18 species were encountered in single location each. Nine species were very common, 10 common, 17 moderate, 12 rare and six very rare in their relative abundance. Twenty-two species are endemic to the Western Ghats of which six species are found only in the Periyar Tiger Reserve. The Periyar river-stream system had more number of fish species (36, 67%) than Pamba river-stream system. Among the different sampling sites, Azhutha had both the highest number of fish species (30) and the highest number of threatened fish species (14). The highest number of low abundant fish species (very rare/rare) was observed at Mlappara (7). Considering the restricted distribution, number of endemic fishes and threat status, it is necessary to implement urgent management plans for the conservation of freshwater fish fauna of Periyar Tiger Reserve.

Keywords: Conservation, distribution, endemism, fish diversity, Periyar Tiger Reserve, spatial variation, threats.

INTRODUCTION

The Western Ghats of India along with Sri Lanka is considered as one of the biodiversity hotspots of the world (Mittermeier et al. 1998; Myers et al. 2000). The Periyar Tiger Reserve (PTR), one of the biodiversity rich areas in southern Western Ghats from where the Periyar River originates, supports a varied aquatic biota endowed with many endemic and threatened fish species (Silas 1950, 1952; Zacharias et al. 1996; Kurup et al. 2004). Earliest studies on the fish fauna of the PTR dates back to 1948 when Chacko (1948) listed 35 species from the Periyar Lake, including the critically endangered Small Scaled Schizothoracin *Lepidopygopsis typus*. Later Menon & Remadevi (1995) described *Hypselobarbus kurali* from streams adjoining the Periyar Lake while Menon & Jacob (1996) described *Crossocheilus periyarensis* and rediscovered the cyprinid, *Puntius ophicephalus* from Periyar River, raising the total number of fish species to 38. Arun et al. (1996) added six more species to the fish fauna of Periyar Lake, including two exotic fishes, viz. *Cyprinus carpio carpio* and *Oreochromis mossambicus*, and four indigenous species, viz. *Garra maclellandi*, *Bhavana australis*, *Mesonoemacheilus guentheri* and *Travancoria jonesi*. Additional checklist of species from PTR were prepared by Zacharias et al. (1996) and Arun (1998) who reported 35 and 27 species respectively. Recently Gopi (2001) described a new cyprinid, *Garra periyarensis* from the upstreams of Periyar, and Kurup & Radhakrishnan (2005) described a new balitorid, *Nemacheilus periyarensis* from Periyar Lake.

Majority of studies on fish distribution within PTR have been restricted to the streams of Periyar River and Lake, and have overlooked the species of Pamba River and its main tributary, Azhutha a part of which are located



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inside the boundary of PTR. The present paper provides an updated checklist of the fish fauna of PTR including the Periyar Lake as well as Periyar and Pamba rivers. The paper also provides information on the distribution, relative abundance, threat status and endemism of the various species encountered during the study.

MATERIALS AND METHODS

Study Area

The study was undertaken in the Periyar Tiger Reserve (9°18'-9°41'N & 76°55'-77°25'E; Fig. 1), which covers an area of 777km², of tropical evergreen, semi-evergreen and moist deciduous forests. The elevation in PTR ranges from 800 to 2019 m with the highest point at Vellimala. The Periyar Lake, which was formed as a result of the construction of the Mullaperiyar Dam, has a total area of 26km² and a maximum depth of 46m at the highest water level. Along with River Periyar, the River Pamba and its main tributary, Azhutha also drain the Reserve. Ten locations, representing the different

aquatic habitats of the entire geographical area of PTR and located at least 5km apart were selected for study. These included Pamba (9°25.2'N & 76°58.2'E), Azhutha (9°25'N & 77°4'E), Pachakkanam (9°27.5'N & 77°8.4'E), Vallakkadavu (9°36.3'N & 77°4.6'E), Periyar Lake (9°34.3'N & 77°10.4'E), Mullayar (9°32'N & 77°13'E), Thannikkudy (9°30'N & 77°15.4'E), Ummikuppanthodu (9°28.4'N & 77°14.5'E), Mlappara (9°28.6'N & 77°16.7'E) and Moolavaigae (9°21.4'N & 77°16.3'E).

Fish Sampling

Sampling was carried out in the selected locations of PTR in three seasons (pre monsoon from February to May, monsoon from June to September and post monsoon from October to January) for a period of two years (May 2004-August 2006). Fishing was carried out, using a variety of gears including cast nets (16mm, 18mm, 22mm), gill nets (32mm, 38mm, 64mm, 78mm, 110mm), drag net (4mm), scoop nets and other local contrivances. Visual observations were also carried out if the water was clear, to understand the distribution of fish species. Uniformity in catch per unit effort (number/hour)

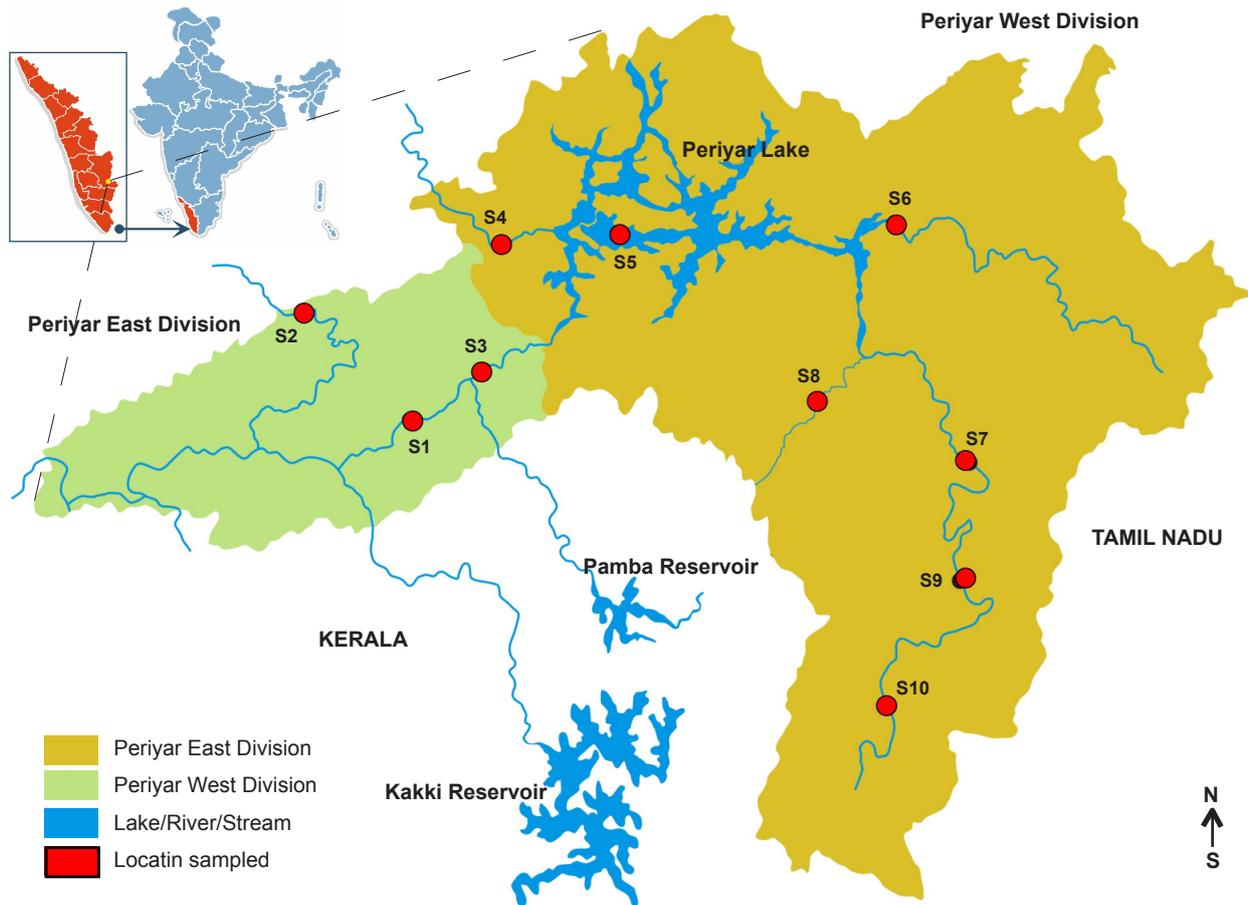


Figure 1. Map of Periyar Tiger Reserve showing the locations sampled for fishes during the period of study. S1 - Pamba; S2 - Azhutha; S3 - Pachakkanam; S4 - Vallakkadavu; S5 - Periyar Lake; S6 - Mullayar; S7 - Thannikkudy; S8 - Ummikuppanthodu; S9 - Mlappara; S10 - Moolavaigae

was maintained in sampling following Bhat (2003) from which the relative abundance of different species were assigned as very common, common, moderately found, rare and very rare (Thomas et al. 2002). Under the same sampling effort we classify records of 5 or less than 5 individuals of a species as 'very rare', 5-20 as 'rare', 20-50 as 'moderate', 50-100 as 'common' and more than 100 as 'very common'. This classification is not based on any standard methodology or literature.

Fishes were identified following Day (1878), Talwar & Jhingran (1991) and Jayaram (1981, 1999). The threat status of each species was assigned following Dahanukar et al. (2004). The endemism of fish species was determined following Gopalakrishnan & Ponniah (2000), Gopi (2000) and Shaji et al. (2000).

RESULTS

Fish fauna and distribution

A total of 54 fish species belonging to six orders and 19 families were recorded from various study sites. The list of fish species and details of their threat status, relative abundance, endemism and distribution at different sampling sites are given in Table 1. The family Cyprinidae dominated with a numerical strength of 23 species (43%), followed by Balitoridae with eight (15%) species. Four exotic species, viz. *Oreochromis mossambicus*, *Cyprinus carpio carpio*, *Poecilia reticulata* and *Clarias gariepinus* were also recorded.

Puntius fasciatus and *Devario aequipinnatus* were found distributed in nine study sites. Six species, viz. *Hypselobarbus kurali*, *Tor khudree*, *Rasbora daniconius*, *Puntius filamentosus*, *Garra mullya* and *Barilius gatensis* were found in 5-8 locations. Forty-six species were observed in less than four locations of which 18 species were encountered only from single locations each. The highest number of fish species were encountered in Azhutha (30, 56%), followed by Pamba (23, 43%), and Periyar Lake (20, 54%).

Threat status and relative abundance

Twenty-four species (45%) found in PTR were listed as threatened. *Lepidopygopsis typus* has been listed as Critically Endangered while 13 other species were Endangered and 10 were Vulnerable in their threat status (Fig. 2). Nine (17%) species were found to be very common, 10 (19%) species were common, 17 (31%) species were moderately found, 12 (22%) species were rare and 6 (11%) species were very rare in their relative abundance. Species such as *Lepidopygopsis typus*, *Crossocheilus periyarensis*, *Travancoria jonesi*, *Nemacheilus periyarensis*, *Hypselobarbus periyarensis* and *Puntius denisonii* were found to be 'very rare' inside the PTR.

Endemism

Twenty-two (41%) species were found to be endemic to the Western Ghats of which six species were strictly endemic to the Periyar Tiger Reserve. These included four species of cyprinids, viz. *Hypselobarbus periyarensis*, *Lepidopygopsis typus*, *Crossocheilus periyarensis* and *Garra periyarensis* and two species of Balitorids *Nemacheilus periyarensis* and *N. menoni*. Figure 3 shows nature of endemism of fish species encountered in the PTR.

DISCUSSION

The present study revealed that the Periyar Lake and the river stream within the PTR harbour rich and diverse fish fauna. Seventeen fish species were found to be new additions to the PTR. This was attributed to the fact that, the field surveys were carried out in the Periyar Lake and its associated streams as well as Pamba River and its main tributary – Azhutha. Nevertheless, the present study also revealed the disappearance of some fish species in recent years from the lake-stream system. Of the 35 fish species reported by Chacko (1948) in Periyar Lake and connected streams, cyprinids such as *Puntius melanostigma* (currently valid as *P. mahecola*), *P. arulius*,

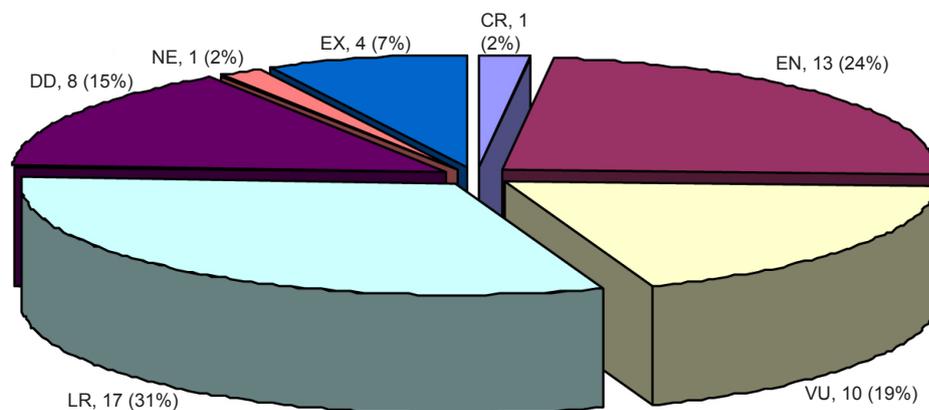


Figure 2. Threat status of fishes collected from Periyar Tiger Reserve.
 CR - Critically Endangered;
 EN - Endangered;
 VU - Vulnerable;
 LR - Low Risk;
 EX - Exotic;
 DD - Data Deficient;
 NE - Not Evaluated

Table 1. List of fishes collected from Periyar Tiger Reserve - their threat status, relative abundance, endemism and distribution at different sampling sites

	Order/Family/Species	Threat status	Relative abundance	Endemism	Distribution in study sites									
					S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
	Order: Anguilliformes													
	Family: Anguillidae													
1	<i>Anguilla bengalensis bengalensis</i>	EN	rare	EN-IS						+				
	Order: Cypriniformes													
	Family: Cyprinidae													
2	<i>Cyprinus carpio carpio</i>	EX	very common	WD					+					
3	<i>Tor khudree</i>	VU	very common	EN-IS	+	+			+	+	+		+	
4	<i>Hypseobarbus curmuca</i>	EN	moderate	EN-IS	+	+								
5	<i>Hypseobarbus kurali</i>	DD	common	EN-K			+		+	+	+		+	
6	<i>Hypseobarbus periyarensis</i>	DD	Very rare	EN-PTR							+		+	
7	<i>Puntius amphibius</i>	LR	common	EN-IS	+	+			+					
8	<i>Puntius denisonii</i>	EN	Very rare	EN-WG		+								
9	<i>Puntius fasciatus</i>	EN	very common	EN-WG	+	+	+	+	+	+	+		+	+
10	<i>Puntius filamentosus</i>	DD	very common	EN-I	+	+	+	+	+	+	+			
11	<i>Puntius ophicephalus</i>	EN	rare	EN-WG								+	+	+
12	<i>Puntius ticto</i>	LR	rare	WD		+								
13	<i>Puntius vittatus</i>	VU	moderate	EN-IS	+	+								
14	<i>Salmophasia boopis</i>	LR	common	EN-WG	+	+								
15	<i>Rasbora daniconius</i>	LR	very common	WD	+	+	+		+	+	+			
16	<i>Barilius bakeri</i>	VU	common	EN-K	+	+								
17	<i>Barilius gatensis</i>	DD	very common	EN-WG	+	+	+	+	+	+	+		+	
18	<i>Devario aequipinnatus</i>	LR	very common	WD	+	+	+	+	+	+	+	+	+	
19	<i>Devario malabaricus</i>	LR	moderate	EN-IS					+	+				
20	<i>Lepidopygopsis typus</i>	CR	Very rare	EN-PTR							+		+	+
21	<i>Crossocheilus periyarensis</i>	VU	Very rare	EN-PTR							+		+	
22	<i>Garra mullya</i>	LR	very common	EN-IS	+	+	+			+	+		+	+
23	<i>Garra periyarensis</i>	DD	rare	EN-PTR							+		+	
24	<i>Garra surendranathanii</i>	EN	rare	EN-K		+								
	Family: Balitoridae													
25	<i>Bhavana australis</i>	EN	moderate	EN-WG							+		+	+
26	<i>Travancoria jonesi</i>	EN	Very rare	EN-K									+	
27	<i>Schistura denisoni</i>	VU	moderate	EN-I							+		+	
28	<i>Mesonoemacheilus guentheri</i>	LR	moderate	EN-K	+		+				+			
29	<i>Mesonoemacheilus triangularis</i>	LR	moderate	EN-K	+	+	+							
30	<i>Nemacheilus keralensis</i>	EN	rare	EN-K									+	
31	<i>Nemacheilus menoni</i>	DD	moderate	EN-PTR							+		+	+
32	<i>Nemacheilus periyarensis</i>	NE	Very rare	EN-PTR					+		+			
	Family: Cobitidae													
33	<i>Lepidocephalus thermalis</i>	LR	moderate	EN-IS					+					
	Order: Siluriformes													
	Family: Bagridae													
34	<i>Batasio travancoria</i>	EN	moderate	EN-WG	+	+								
35	<i>Mystus armatus</i>	LR	moderate	EN-IS		+								

	Order/Family/Species	Threat status	Relative abundance	Endemism	Distribution in study sites									
					S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
	Family: Siluridae													
36	<i>Ompok bimaculatus</i>	EN	common	WD	+					+		+		
	Family: Sisoridae													
37	<i>Glyptothorax annandalei</i>	EN	rare	WD			+							
	Family: Clariidae													
38	<i>Clarias dussumieri</i>	VU	moderate	WD	+	+								
39	<i>Clarias gariepinus</i>	EX	rare	WD					+					
	Family: Heteropneustidae													
40	<i>Heteropneustes fossilis</i>	VU	rare	EN-IS	+	+			+					
	Order: Beloniformes													
	Family: Belonidae													
41	<i>Xenentodon cancila</i>	LR	common	WD	+	+								
	Order: Cyprinodontiformes													
	Family: Aplocheilidae													
42	<i>Aplocheilus lineatus</i>	DD	moderate	EN-IS			+		+					
	Family: Poeciliidae								+					
43	<i>Poecilia reticulata</i>	EX	rare	WD										
	Family: Mastacembelidae													
44	<i>Mastacembelus armatus</i>	LR	moderate	WD	+	+								
	Order: Perciformes													
	Family: Ambassidae													
45	<i>Parambassis dayi</i>	EN	common	EN-I	+	+			+					
46	<i>Parambassis thomassi</i>	VU	moderate	EN-WG		+								
	Family: Nandidae													
47	<i>Pristolepis marginata</i>	VU	moderate	EN-WG		+			+					
	Family: Cichlidae													
48	<i>Etilapia maculatus</i>	LR	common	EN-IS		+								
49	<i>Oreochromis mossambicus</i>	EX	very common	WD					+					
	Family: Gobiidae													
50	<i>Glossogobius giuris</i>	LR	common	WD	+	+								
	Family: Anabantidae													
51	<i>Anabas testudineus</i>	VU	moderate	WD	+	+								
	Family: Channidae													
52	<i>Channa gachua</i>	DD	rare	WD						+				
53	<i>Channa marulius</i>	LR	rare	WD		+								
54	<i>Channa striata</i>	LR	common	WD		+								

CR - Critically Endangered; EN - Endangered; VU - Vulnerable; LR - Low Risk; EX - Exotic; DD - Data Deficient; NE - Not Evaluated; WD - Widely Distributed; EN-IS - Endemic to Indian Subcontinent; EN-I - Endemic to India; EN-WG - Endemic to Western Ghats; EN-K - Endemic to Kerala; EN-PTR - Endemic to Periyar Tiger Reserve. Sample sites S1 to S10 as per Figure 1.

P. pinnauratus (*P. sarana*), *Barilius bendelisis* and *Garra lampta*; catfish species, *Mystus vittatus* and the feather back *Notopterus notopterus* could not be collected during the present study. Arun (1998) also had a similar observation of not recording 16 species from the list of Chacko (1948). Zacharias et al. (1996) reported 35 fish

species representing 11 families and 21 genera, of which *Nemacheilus botia* (*Acanthocobitis botia*), *N. evezardi* (*Indoreonectes evezardi*), *Barilus bendelisis* and *Garra gotyla stenorhynchus* were not represented in our study. *Garra maclellandi*, which was reported from Periyar Lake and streams (Easa & Shaji 1997), was also not

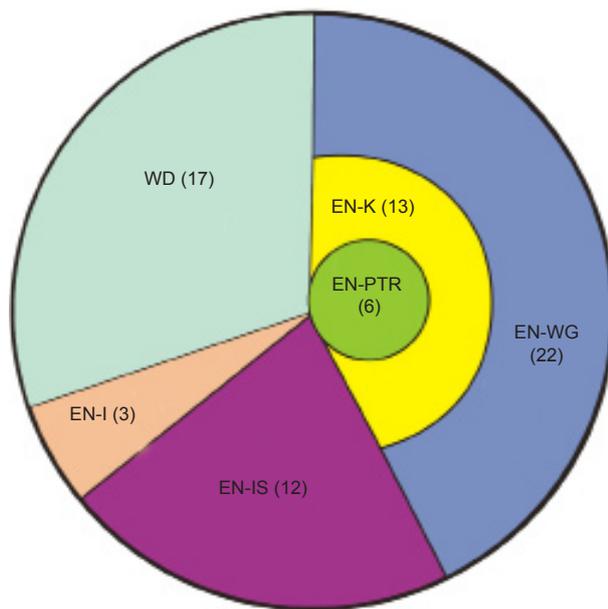


Figure 3. Endemism of fishes collected from Periyar Tiger Reserve.

WD - Widely Distributed; EN-IS - Endemic to Indian Subcontinent; EN-I - Endemic to India; EN-WG - Endemic to Western Ghats; EN-K - Endemic to Kerala; EN-PTR - Endemic to Periyar Tiger Reserve

encountered in the present study while, *G. periyarensis* which shows great similarity in body morpho-meristics with *G. maclellandi* was collected in adequate numbers. The present collection included all the 27 fishes recorded by Arun (1998) from the Periyar Lake and stream systems.

Majority (45%) of the fish fauna of PTR is threatened. Ten species of Cyprinids are threatened of which *Lepidopygopsis typus* is listed as Critically Endangered and another five species categorised as Endangered. Among other families, four out of eight balitorids and nine out of 21 species in all other families are threatened. The high rate of endemism of fish fauna in PTR, one of the richest biodiversity areas in Western Ghats is evident from the present study. Restricted distribution of fishes in PTR was also mentioned by Zacharias et al. (1996) and Arun (1999) who reported 13 (37%) and 14 (52%) species of their fish collection from PTR as endemic to Western Ghats. Large number of threatened fishes coupled with high rate of endemism emphasizes the importance of this bio-reserve with respect to fish fauna and points at the necessity of stringent protection measures for conserving its unique fish germplasm.

Thirty-six (67%) fish species were found restricted to Periyar lake-stream systems of which *Lepidocephalus thermalis* and all the four exotic fishes were found only in Periyar Lake. Ten species, viz., *Lepidopygopsis typus*, *Puntius ophicephalus*, *Crossocheilus periyarensis*, *Hypselobarbus periyarensis*, *Garra periyarensis*, *Bhavana australis*, *Travancoria jonesi*, *Nemacheilus menoni*, *N. keralensis* and *Schistura denisoni* were

observed only from upstream locations of Periyar River such as Thannikkudy, Ummikuppanthodu, Mlappara and Moolavaigae. Except *Bhavana australis*, all these species were low in abundance (rare/very rare) and except *Garra periyarensis*, all the species of this group were listed as threatened. Of the different species found restricted to Pamba and Azhutha streams, eight species, including endangered and rare *Puntius denisonii* and *Garra surendranathanii*, were found only in Azhutha Stream. Fifteen species (28%) were found distributed both in Periyar and Pamba river-stream systems which included *Tor khudree*, *Puntius fasciatus*, *Ompok bimaculatus* and *Parambassis dayi*. Besides high diversity, Azhutha also had the highest number (14) of threatened fish species observed in any location, followed by Pamba (11) and Mlappara (10). The highest number of low abundant species was observed in Mlappara (7). Azhutha and Thannkkudy had five fish species each and Periyar Lake had four species under low abundant category. The locations with highest number of threatened and low abundant fishes deserve more attention for conservation and so may be prioritised as aquatic sanctuaries or special protection zones in the management plans for conserving fish diversity of PTR.

CONCLUSION

The present study illustrates the status of PTR, as one of the richest areas of fish diversity and endemism within the Western Ghats Hotspot. The presence of a number of endemic and threatened fish species necessitates proper conservation and management actions to be developed and implemented in PTR.

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