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Cover: *Euphaea pseudodispar* shot at Kalindi River, Thirunelly, Wayanad district, Kerala. © Muneer P.K.

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COMMUNICATION

Freshwater fishes of the Chimmony Wildlife Sanctuary, Western Ghats, India

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Abstract: The fish diversity of Chimmony Wildlife Sanctuary in the Western Ghats of Kerala was studied between January 2018 and December 2020. The ichthyofauna comprised of 40 species belonging to 11 Orders, 17 Families, and 29 genera, of which 35% are endemic to the Western Ghats region, and two are endemic to the state of Kerala. Cyprinids were the most dominant family, represented by 19 species belonging to three genera, followed by family Channidae (3 species) and loaches belonging to the family Nemacheilidae (3 species). Of the 40 species, one (*Mesonemachelius herrei*) belonged to the 'Critically Endangered' (CR), one species is listed as 'Vulnerable' (VU), and four 'Near Threatened' (NT) category and on the IUCN Red List. Results are presented in the form of a primary checklist of the freshwater fish fauna of the Chimmony Wildlife Sanctuary, together with remarks on their threats and conservation requirements.

Keywords: Checklist, diversity, endemic species, ichthyofauna, Kerala.

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Author contributions: Both of the authors were involved in field survey, documentation, literature review and manuscript preparation, editing and finalizing the manuscript.

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INTRODUCTION

India's Western Ghats mountain ranges feature a high level of ecological variety and endemicity in terrestrial fauna, and are listed as a global biodiversity hotspot (Myers et al. 2000). Around 320 species belonging to 11 orders, 35 families, and 112 genera are known from this region, of which more than 60% are endemic (Dahanukar & Raghavan 2013). The Chimmony Wildlife Sanctuary (Chimmony WS) covering a catchment area of 85.06 km^2 is an IUCN category IV protected area located on the western slopes of the Nelliyampathi Hills in Thrissur district of Kerala, India (IUCN 2020). This protected area falls between 10.38° & 10.48° N and 76.43° & 76.55° E (Figure 1). The sanctuary, which is bordered on the east by the Parambikulam Wildlife Sanctuary and on the west by the Peechi-Vazhani Wildlife Sanctuary, was established as a wildlife sanctuary in August 1984.

The vegetation of Chimmony WS comprises a mix of evergreen, damp teak, and wet mixed deciduous trees and except the watershed area, the whole area is considered as a core zone of the sanctuary (Thomas et al. 2000a). The Chimmony Dam on the Chimmony River provides means of subsistence fishing from the reservoir, specially permitted to tribal communities. Much research has been conducted on the fish fauna of Kerala's wildlife sanctuaries and reserved forests, including the Aralam WS (Shaji et al. 1995), Neyyar WS, Idukki WS (Thomas et al. 2000b), Parambikulam WS (Biju et al. 1999), Karimpuzha WS (Baby et al. 2010), Periyar Tiger Reserve (Radhakrishnan & Kurup 2010), and Achankovil Reserve Forest (Baby et al. 2011). Thampy et al. (2021) recorded a total of 136 fish species belonging to 13 orders, 29 families and 69 genera from the upper-catchment of Kabini River in Wayanad, an indication of high diversity of upper catchment areas of Kerala Rivers.

The only previous study of ichthyodiversity and fishery resources of Chimmony WS is that of Thomas et al. (2000a), conducted by visiting two sites within the sanctuary. A thorough exploratory study of the protected area's freshwater habitats covering all seasons would reveal a more comprehensive assessment of fish diversity and abundance in the area, and this was the aim of the present study. Identification of major threats to fish fauna and providing suggestions on suitable conservation strategies were the other main objectives.

MATERIALS AND METHODS

Based on elevation gradients and topographical variations of the habitat, sampling was carried out from 23 sampling sites of Chimmony WS (Fig. 1; Table 1). To understand the seasonal variation, sampling was carried out during pre-monsoon, monsoon, and post monsoon periods from January 2018 to December 2020. Gillnets, cast nets, and scoop nets with different mesh sizes were operated for catching fish from all sampling sites. Personal expertise of tribal fishermen was utilised in fishing gear selection and sample collection methodology. All the fish caught were identified and photographed live. Specimens collected through a detailed survey of the reservoir's

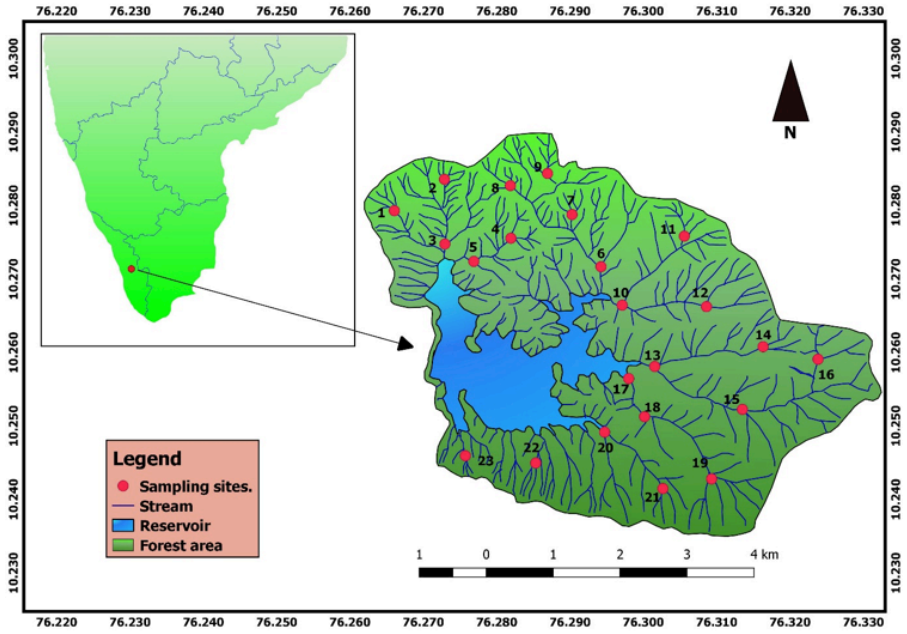

Figure 1. Map of Chimmony Wildlife Sanctuary. Red markings denote different sampling stations in the study area.

Table 1. Sampling sites, their co-ordinates, and elevation.

	Sampling sites	Longitude (°E)	Latitude (°N)	Elevation (m)
1	Cheenikuzhi	76.2716	10.2805	550
2	Ponmudi	76.2817	10.2824	444
3	Virakuthodu	76.2758	10.2743	90
4	Nellipara	76.2836	10.2751	168
5	Mukkomkodal	76.2818	10.2732	165
6	Kodakallu	76.2954	10.2716	142
7	Thekkallu	76.2948	10.2753	322
8	Vedivachankallu	76.2858	10.2818	527
9	Mangalamkavu	76.2918	10.283	566
10	Anaporu	76.3005	10.2702	118
11	Moongamadu	76.3057	10.2748	435
12	Vellimudi	76.3117	10.2701	419
13	Mulapara	76.3041	10.2614	157
14	Muramadukuthu	76.3145	10.2622	669
15	Chaurala	76.315	10.2539	333
16	Karimadakallu	76.3247	10.2619	752
17	Payampara	76.3021	10.2556	121
18	Karandanpara	76.3044	10.2535	239
19	Pundimudi	76.3122	10.2452	404
20	Kallichembara	76.2951	10.2532	80
21	Pandipetti	76.3041	10.245	429
22	Poomala	76.2927	10.2508	297
23	Ettakombanmala	76.2811	10.2519	232

tribal fishery were supplemented. Fish samples were fixed in 5% formaldehyde, and those for genetic analysis were directly fixed in 99% ethanol. Fish identification was confirmed using the available literature (Jayaram 1981, 1999). Voucher specimens were deposited in the Department of Fisheries Resource Management, Kerala University of Fisheries and Ocean studies, Kochi, Kerala, India. Checklist of fishes collected during the present study was prepared following Nelson et al. (2016) and Fricke et al. (2021). Personal interviews and discussions with focus groups including field staff of the Kerala State Forest and Wildlife Department and tribal fishermen were conducted to understand the changes that took place in the habitat and abundance of fishes. Views of tribal fishermen regarding the present threats to the system were recorded to understand the status of diversity of the wildlife sanctuary.

RESULTS

A total of 40 fish species belonging to 10 orders, 17 families, and 26 genera were recorded from the Chimmony WS, with results presented in Table 2. Order Cypriniformes dominated with 19 species (47 %) under three families (Cyprinidae, Nemacheilidae, Cobitidae), followed by Siluriformes (10%) and Anabantiformes (10%) with four species each. IUCN status and population trend of species recorded are shown in Table 2. A majority of fish species found in the study region are classified as 'Least Concern' (IUCN 2020) as per IUCN Red List of Threatened Species. However, one species *Mesonemachelius herrei* has been listed as 'Critically Endangered' (CR), one species is listed as 'Vulnerable' (VU), and four as 'Near Threatened' (NT). Additionally, one species was listed as 'Data deficient' (DD) (Figure 2), and two species *Oreochromis niloticus* and *Gibelion catla* were exotic. According to the IUCN Red List, the population trend for *Mesonoemacheilus herrei, Aplocheilus lineatus,* and *Clarias dussumieri* is known to be decreasing, while the population trend for an additional 11 species are stable. The population trend for the other species recorded from the wildlife sanctuary is currently not known (Figure 3). Species richness of the study area was inversely proportional to the elevation of the sampling site. *Garra mullya* was recorded from all the sampling sites, but loaches and *Gara mullya* were the only fish species recorded from habitats situated at an elevation above 700 m (Figure 4). Out of the 40 species, 36 were recorded from the elevation below 300 m. *Dawkinsia filamentosa, Channa gachua, Garra mullya, Devario malabaricus, Haludaria melanampyx, Rasbora dandia, Mesonoemacheilus triangularis, Mystus armatus, and Ompok malabaricus* were distributed throughout the Chimmony WS other than high elevation sites.

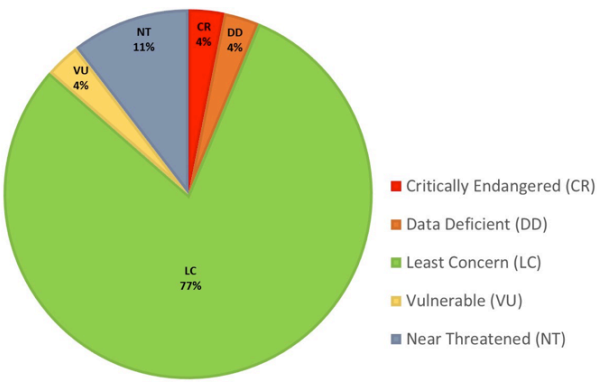

Figure 2. IUCN Red List threat status of fish collected from Chimmony Wildlife Sanctuary.

Table 2: List of fish collected from Chimmony Wildlife Sanctuary and their IUCN status, population trend and distribution at different sampling sites.

Order/family	Scientific name	Authority	IUCN Red List status	Sampling sites	Elevation range	Population trend	Voucher no.
Anabantiformes							
Anabantidae	*Anabas testudineus*	Bloch, 1792	LC	10,17,20	80–120	Stable	KUFOS.FV.2019.1002
Channidae	*Channa gachua*	Hamilton, 1822	LC	3,4,5,6,7,10,12,13 ,15,18,20,22,23	80–450	Unknown	KUFOS.FV.2019.1007
	Channa striata	Bloch, 1793	LC	17,20	80–120	Stable	KUFOS.FV.2019.1009
	Channa pseudomarulius	Hamilton, 1822	LC	20	80	Unknown	KUFOS.FV.2019.1008
Anguilliformes							
Anguillidae	*Anguilla bengalensis*	Gray, 1831	NT	5,10,17,18	80–240	Unknown	KUFOS.FV.2019.1003
	Anguilla bicolor	McClelland, 1844	NT	5,13,22	150–310	Unknown	KUFOS.FV.2019.1004
Beloniformes							
Belonidae	*Xenentodon cancila*	Hamilton, 1822	LC	17,20	80–120	Unknown	KUFOS.FV.2019.1040
Cichliformes							
Cichlidae	*Pseudetroplus maculatus*	Bloch, 1795	LC	10,13,17,20	80–160	Stable	KUFOS.FV.2019.1033
	Oreochromis niloticus *	Linnaeus, 1758		17	120	Unknown	KUFOS.FV.2019.1029
Clupeiformes							
Clupeidae	*Dayella malabarica*	Day, 1873	LC	10,13,17,20	80–150	Unknown	KUFOS.FV.2019.1013
Cypriniformes							
Cobitidae	*Lepidocephalichthys thermalis*	Valenciennes, 1846	LC	3,5,6,10,13, 17,18,20	80–250	Stable	KUFOS.FV.2019.1021
Cyprinidae	*Amblypharyngodon melettinus*	Valenciennes, 1844	LC	10,13,17,20	80–150	Unknown	KUFOS.FV.2019.1001
	Gibelion catla *	Hamilton, 1822		17	120	Unknown	KUFOS.FV.2019.1020
	Cyprinus carpio	Linnaeus, 1758	VU	13	150	Unknown	KUFOS.FV.2019.1010
	Labeo dussumieri	Valenciennes, 1842	LC	10,20	80–120	Unknown	KUFOS.FV.2019.1018
	Dawkinsia filamentosa	Valenciennes, 1844	LC	3,5,6,10,13,17, 18,20,22,23	80–165	Unknown	KUFOS.FV.2019.1012
	Devario malabaricus	Jerdon, 1849	LC	3,5,6,7,10,12, 13, 15,17,18,20, 22,23	80–450	Stable	KUFOS.FV.2019.1014
	Garra mullya	Sykes, 1839	LC	1,2,3,4,5,6,7,8, 9,10, 11,12,13,14,15, 16,17,18, 19,20,21,22,23	80–750	Stable	KUFOS.FV.2019.1015
	Hypselobarbus kurali	Menon & Rema Devi, 1995	LC	17	120	Unknown	KUFOS.FV.2019.1019
	Haludaria melanampyx	Jerdon, 1849	LC	3,5,6,7,10,12,13, 15,17,18,20,22,23	80–420	Unknown	KUFOS.FV.2019.1017
	Pethia punctata	Day, 1865	LC	3,5,6,10,13,17, 20,22	80–150	Stable	KUFOS.FV.2019.1032
	Puntius mahecola	Valenciennes, 1844	DD	5,6,10,13,18, 20,22	80–150	Unknown	KUFOS.FV.2019.1035
	Puntius parrah	Day, 1865	LC	10,13,17,20	80–150	Unknown	KUFOS.FV.2019.1036
	Puntius vittatus	Day, 1865	LC	3,10,13,17,20	80–150	Unknown	KUFOS.FV.2019.1037

	Rasbora dandia	Valenciennes, 1844	LC	3,5,6,7,10,12,13, 15,17,18,20,22,23	80–420	Stable	KUFOS.FV.2019.1038
	Systomus sarana	Hamilton, 1822	LC	3,5,6,10,13,17,18, 20, 22,23	80–300	Unknown	KUFOS.FV.2019.1039
Nemacheilidae	*Mesonoemacheilus herrei*	Nalbant & Banarescu, 1982	CR	11,12,14,15,16,19	400–750	Decreasing	KUFOS.FV.2019.1023
	Mesonoemacheilus triangularis	Day, 1865	LC	1,2,4,7,8,9,11,12, 14, 15,16, 18,19,20, 21	80–750	Stable	KUFOS.FV.2019.1024
	Mesonoemacheilus guentheri	Day, 1865	LC	1,2,4,9,11,12,14, 15, 16,19,21	150–750	Stable	KUFOS.FV.2019.1025
Cyprinodontiformes							
Aplocheilidae	*Aplocheilus lineatus*	Valenciennes, 1846	LC	5,10,17,18,20	80–160	Decreasing	KUFOS.FV.2019.1006
Gobiformes	*Aplocheilius blockii*	Arnold, 1911	LC	5,17,18	80–160	Unknown	KUFOS.FV.2019.1005
Gobidae	*Glossogobius giuris*	Hamilton, 1822	LC	3,5,10,17,18,20	80–230	Unknown	KUFOS.FV.2019.1016
Oxudercidae	*Pseudogobiopsis oligactis*	Bleeker, 1875	LC	10,13,17,20	80–160	Unknown	KUFOS.FV.2019.1034
Incertae sedis under Ovalenteria							
Ambassidae	*Parambassis dayi*	Bleeker, 1874	LC	3,5,10,17,18,20	80–160	Stable	KUFOS.FV.2019.1030
	Parambassis thomassi	Day, 1870	LC	3,5,6,10,13,17,18, 20,22	80–150	Unknown	KUFOS.FV.2019.1031
Siluriformes							
Bagridae	*Mystus armatus*	Day, 1865	LC	3,5,6,10,13,15, 17,18, 20,22,23	80–350	Unknown	KUFOS.FV.2019.1026
	Mystus malabaricus	Jerdon, 1849	NT	3,13,17,20,22	80–160	Unknown	KUFOS.FV.2019.1027
Clariidae	*Clarias dussumieri*	Valenciennes, 1840	NT	10,13,17,20	80–150	Decreasing	KUFOS.FV.2019.1011
Siluridae	*Ompok malabaricus*	Valenciennes, 1840	LC	3,4,5,6,10,12,13, 15,17, 18,20,22,23	80–420	Unknown	KUFOS.FV.2019.1028
Synbranchiformes							
Mastacembelidae	*Mastacembelus armatus*	Lacepede, 1800	LC	5,10,17,18	120–250	Stable	KUFOS.FV.2019.1022

LC—Least Concern | NT—Near Threatened | CR—Critically Endangered | DD—Data Deficient | VU—Vulnerable | *—Exotic.

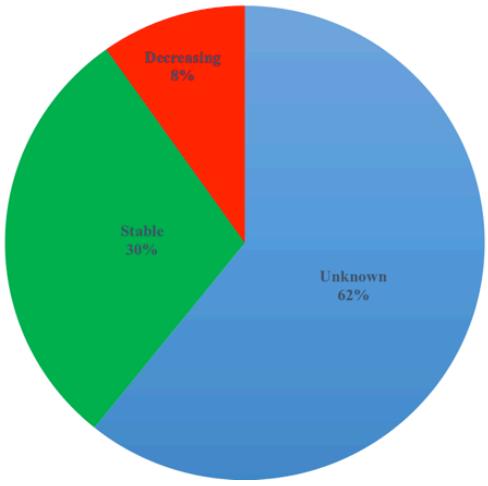

Figure 3. IUCN Red List population trend of fish collected from Chimmony Wildlife Sanctuary.

DISCUSSION

Results of the present study revealed the existence of 40 species within the Chimmony WS (Table 2). Thomas et al. (2000a) examined the fish diversity of Chimmony and Peechi WS, and recorded 37 species, with Chimmony WS harbouring 34 species belonging to 15 families, whereas Peechi Wildlife Sanctuary had 33 species belonging to 15 families. Their research was conducted by visiting only two sites within Chimmony WS. The present study carried out a thorough exploratory survey of the protected area's freshwater habitats over multiple seasons to better assess fish diversity and abundance, and our findings indicate that the ichthyo-diversity of Chimmony WS is somewhat greater than previously reported.

A comparative statement of the results of studies on

Image 1. *Amblypharyngodon melettinus*

Image 2. *Anguilla bicolor*

Image 3. *Aplochelius lineatus*

Image 4. *Channa gachua*

Image 5. *Clarias dussumieri*

Image 6. *Dawkinsia filamentosa*

Image 7. *Devario malabaricus*

Image 8. *Garra mullya*

Image 9. *Haludaria melanampyx*

Image 10. *Hypselobarbus kurali*

Image 11. *Lepidocephalichthys thermalis*

Image 12. *Mastacembelus armatus*

Image 14. *Mesonoemacheilus triangularis*

Image 13. *Mesonoemacheilus guentheri*

Image 16. *Pethia punctata*

Image 15. *Mystus armatus*

Image 17. *Pseudetroplus maculatus*

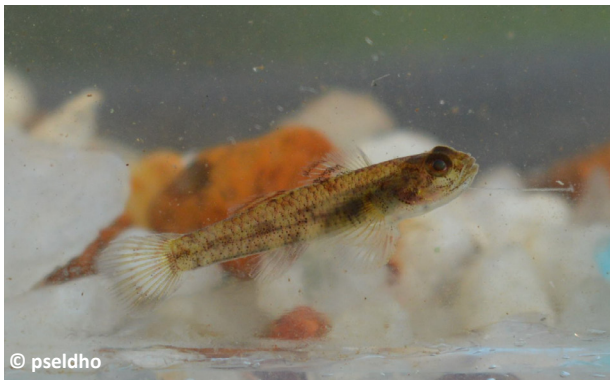

Image 18. *Pseudogobiopsis oligactis*

Image 20. *Puntius vittatus*

Image 22. *Systomus sarana*

Image 19. *Puntius mahecola*

Image 21. *Puntius parrah*

Image 23. *Rasbora dandia*

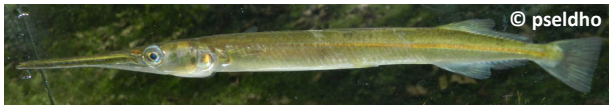

Image 24. *Xenentodon cancila*

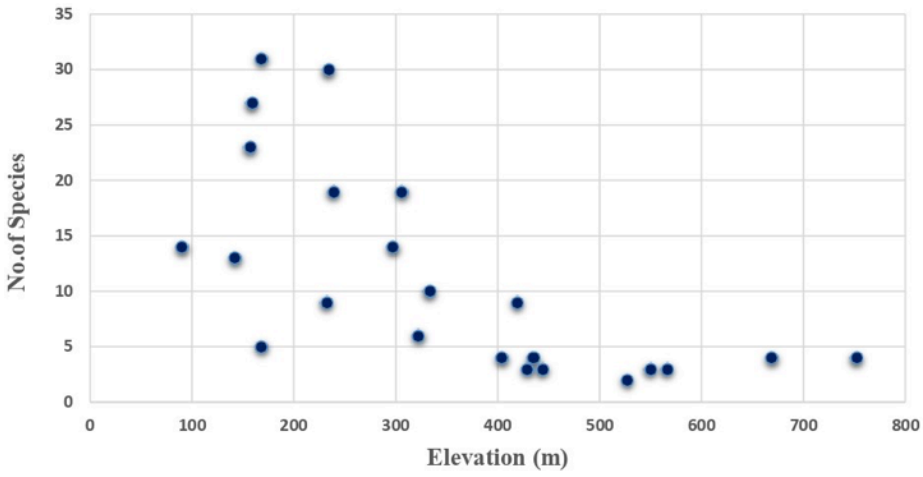

Figure 4. Elevation based fish species richness in Chimmony Wildlife Sanctuary.

Table 3. Studies on fish fauna of Kerala's wildlife sanctuaries and reserved forests.

Area of study	Number of species recorded	Author
Aralam Wildlife Sanctuary	33	Shaji et al. 1995
Neyyar Wildlife Sanctuary	38	Thomas et al. 2000b
Parambikulam Wildlife Sanctuary	40	Biju et al. 1999
Idukki Wildlife Sanctuary	40	Thomas et al. 2000b
Karimpuzha Wildlife Sanctuary	43	Baby et al. 2010
Achankovil Reserve Forest	46	Baby et al. 2011
Periyar Tiger Reserve	54	Radhakrishnan & Kurup 2010
Chimmony Wildlife Sanctuary	40	Present study

fish fauna of Kerala's wildlife sanctuaries and reserved forests is presented in Table 3. The results of the present study are in agreement with findings of the earlier studies conducted on the fish fauna of Kerala's wildlife sanctuaries and reserved forests. Baby et al. (2010), Radhakrishnan & Kurup (2010), and Baby et al. (2011) recorded higher numbers of species than the present study. This indicates that topography habitats, elevation of sites and differences in hydrological parameters and vegetation play major roles in the distribution and abundance of fish in the upper reaches of the river.

Present study collected information on the habitat, ichthyofauna and fishery of the Chimmony WS, and the compiled results of responses indicate that illegal fishing methods practiced in the area will have harmful effects on habitat and ichthyofauna diversity. The Kerala State Forest Department has banned fishing inside the sanctuary's limits, but illegal fishing in the upper reaches of the river is still prevalent and destructive fishing practices pose a major threat to the sanctuary's fish diversity. Indiscriminate capture of adult individuals during their yearly spawning migration (locally known as 'Ootha') is another illegal practice that has drastic effects on the fish population. Stream bank alteration and loss of riparian vegetation due to human-induced disturbance and local firewood collection resulted in deterioration of habitat. Most protected area staff working with the forest department were not familiar with freshwater habitats, ichthyofaunal diversity and the concept of conservation of fishery resources. Preliminary training of forest staff on ichthyofaunal diversity, sustainable fisheries and informed habitat management is needed. Comprehensive multi-disciplinary research, outreach and capacity building of the diversity, distribution, ecology, and threats to fish and other aquatic species inhabiting in the Chimmony WS is also highly recommended.

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