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## Journal of Threatened Taxa

Building evidence for conservation globally

[www.threatenedtaxa.org](http://www.threatenedtaxa.org)

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

### COMMUNICATION

#### FRESHWATER FISHES OF CAUVERY WILDLIFE SANCTUARY, WESTERN GHATS OF KARNATAKA, INDIA

Naren Sreenivasan, Neethi Mahesh & Rajeev Raghavan

26 January 2021 | Vol. 13 | No. 1 | Pages: 17470–17476

DOI: 10.11609/jott.6778.13.1.17470-17476



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## INTRODUCTION

The Cauvery River basin (81,155km<sup>2</sup>) is India's fourth largest, and also the largest river system draining the southern part of peninsular India. The Cauvery River originates from the Brahmagiri Hills of the Western Ghats mountain ranges, and flows for a distance of 770km through the states of Karnataka (41%), Tamil Nadu (56%), and Kerala (3%) (Chidambaram et al. 2018), finally draining into the Bay of Bengal. Physiographically, the river is surrounded by the Western Ghats (in the west) and Eastern Ghats mountain ranges (in the east and south) and the Tungabhadra and Pennar River systems in the north (Chidambaram et al. 2018). Cauvery is one of the few rivers in the peninsular Indian region known to receive rain from both the north-east and south-west monsoons (Raj 1941), and also the most exploited river in the country in terms of water abstraction (95%) (Chidambaram et al. 2018).

Ichthyological studies in the Cauvery dates back to Jerdon (1849) who described several species from the main course of Cauvery River as well as various tributaries including Bhavani and Kabini. Subsequently, major exploratory studies (and subsequent compilations) on either the main river, or its tributaries were undertaken by Day (1867a,b), Hora (1942), Chacko et al. (1954), Rajan (1955), Jayaram (1981), Jayaram et al. (1982), and Raghunathan (1989). Though no recent studies have been carried out to understand the fish diversity of the entire river system, available estimates suggest that anywhere between 95 (Froese & Pauly 2019) and 142 species inhabit the Cauvery River basin (Jayaram 1981; Jayaram et al. 1982). This number could even be greater given the recent taxonomic and nomenclatural changes, as well as new species descriptions from the river system during the last 10 years.

The Cauvery Wildlife Sanctuary (1027.51km<sup>2</sup>) (henceforth Cauvery WS) is an IUCN category IV protected area situated in the Chamarajanagara, Mandya, and Ramnagara districts of Karnataka State. River Cauvery, on which the sanctuary is named drains the protected area, and forms the interstate boundary between Tamil Nadu and Karnataka states. Two major tributaries, Arkavathi and Shimsha also join Cauvery inside the limits of the sanctuary. Apart from its mammal and bird diversity, Cauvery WS is also known to support diverse aquatic fauna including crocodiles, otters and freshwater fish as documented by the "Management of Cauvery Wildlife Sanctuary". Of particular importance is the Mahseer (*Tor* spp.), a group of large-bodied cyprinid fishes endemic to tropical Asia, that once attracted

anglers from around the world to the famous Cauvery fishing camps, managed by the Wildlife Association of South India, and Jungle Lodges and Resorts (see Pinder & Raghavan 2013; Pinder et al. 2015).

Except for information on 22 species of large mammals, 10 species of reptiles, and 41 species of birds provided in official government documents (Management of Cauvery Wildlife Sanctuary), there are no organized checklists of the biodiversity of Cauvery WS. Recently, the Indian Grey Wolf (Kaggere 2020), and the Ratel/honey badger (Gubbi et al. 2014) were also recorded from the sanctuary. Recent interest in underwater photography led to the first report of the freshwater Jellyfish *Limnocnida indica* from the Cauvery WS (N. Sreenivasan, pers. comm. 5 August 2020), extending its known range within the river system, from previous records in Coorg and the Hemavathi reservoir (Manna et al. 2005). The biodiversity status of the Cauvery WS documented in government records is however considered an underestimate as anecdotal reports document the presence of 280 species of birds inside the sanctuary (Chandra 2014). Although Cauvery WS is mentioned in a number of papers relating to freshwater fish conservation (for e.g., Pinder & Raghavan 2013, Pinder et al. 2015, 2020), there is very little information available on the diversity of freshwater fish species inhabiting this protected area. Except for a study by Shenoy et al. (2003) who observed the occurrence of 18 species of fishes within a 5km stretch of the river Cauvery inside the sanctuary between Bheemeshwari (12.305°N & 77.285°E) and Muttatthi (12.306°N & 77.311°E), there have been no attempts to understand the fish fauna of this protected area.

As part of a larger project aimed at conservation and management of freshwater fishes of Cauvery WS, especially the Hump-backed Mahseer, we carried out a rapid survey of the ichthyofauna in February 2015, followed up by opportunistic visits until the end of 2019. This contribution provides the results of these surveys in the form of a preliminary checklist of the freshwater fish fauna of Cauvery WS with notes on their threats and conservation needs.

## METHODS

Initial part of the surveys were conducted from 3–14 February 2015. Follow-up visits were undertaken during different seasons as recently as December 2019 in the stretch of the Cauvery River between Shivanasamudram falls (11.294°N & 77.169°E) and Makedattu (12.261°N

& 77.448°E) within Cauvery WS. A rapid assessment approach (Abd et al. 2009) with minor modifications as was carried out for other sites in the Western Ghats (see Baby et al. 2010) was used to maximize efforts and minimize costs. Three types of fishing gears were used. A bottom-weighted gill net (15m X 1.7m, 1-inch mesh size) was used to capture small fish, cast nets (3m diameter, 3-inch mesh size), and rod and line (plant-based bait and lures) were used to target fish larger than 30cm SL. All sampling was conducted between 06.00hr & 18.00hr. In the post-monsoon months, fish were caught opportunistically in river-side pools, formed as the water level receded. All fish caught were photographed live and released within the shortest possible time after their capture, adhering to the permissions provided by the Karnataka State Forest Department. Family level taxonomy primarily follow Nelson et al. (2016), while species level identification was carried out following Jayaram (1999) supported by relevant updated taxonomic papers on specific genera. Species that could not be identified accurately were mentioned as 'cf.' or 'sp.'. All species names adhere to the Catalog of Fishes (Fricke et al. 2020) unless otherwise mentioned. Personal interviews and focus group discussions were carried out with staff of the Karnataka Forest Department (KFD), Jungle Lodges and Resorts Private Limited (JLR), and members of the Wildlife Association of South India (WASI) to understand threats to freshwater fishes, and related conservation issues in the study area.

## RESULTS AND DISCUSSION

Fifty-eight species of freshwater fish belonging to 18 families and 44 genera were recorded from the 37km stretch between Shivanasamudram falls and Mekedattu inside Cauvery WS (Table 1). Order Cypriniformes dominated with 30 species (51.7%) under two families (Cyprinidae and Danionidae), followed by Siluriformes with 10 species (17.2%) under six families (Table 1). Close to 25% (15 species) of the fish species that occur within the study area are endemic to the Western Ghats region, of which eight are endemic to the Cauvery River system (including Bhavani, Moyar, and Kabini tributaries). Nine species of non-native fish including those that are exotic and introduced from other biogeographic regions of the country were also recorded (Table 1). Some of the species were found only in specific areas in the Cauvery WS, *Silonia childreni* was once reported from throughout the study area but is now only restricted to the Mekedattu gorge. *Tor* spp. are found in deep pools

and rapids across the study area but were observed to migrate between pools and rapids in large schools either in response to time of day (09.00–10.00 hr and 17.00–18.00 hr), or change in water level (moving to deeper pools as water recedes). *Pterygoplichthys* sp. and *Clarias gariepinus* was only noticed close to the confluence of the Arkavathi River and the Shimsha River.

Although the waters of Cauvery WS (including the stretch of the river that was the focus of the present study) is world renowned for its mahseer populations (see Pinder & Raghavan 2013; Pinder et al. 2015), there remains several knowledge gaps. The mahseer population of this river is comprised of several distinct 'morphotypes' of which, the 'blue-fin', 'orange-fin' or the 'hump-backed' (see also Pinder et al. 2015) and a 'black-fin' are the most frequently encountered. While the humpbacked mahseer is now known as *Tor remadevii* (see Pinder et al. 2018), there still remains ambiguities and confusions on the identity of the various morphotypes of mahseer present in the Cauvery, including the fact whether they constitute one, or more distinct species. Studies in this direction are ongoing.

Majority of the fish species that occur in the study area are assessed as 'Least Concern' on the IUCN Red List of Threatened Species (IUCN 2020), however, eight species found in the study area are threatened including two that has been assessed as 'Critically Endangered', four as 'Endangered' and two as 'Vulnerable'. Fifteen of these species are endemic to the Western Ghats region, of these 15 species, eight have a restricted range, and occur only in the Cauvery River system.

The actual fish diversity of the Cauvery WS is no doubt higher than what has been recorded in the present study, as there are additional species mentioned in Shenoy et al. (2003) as well as those recorded by recreational anglers (identified through social media and personal photographs). Over the last 10 years, several new species have been described from the tributaries of Cauvery (*Dario neela*, *Laubuka latens*, *L. trevori*, *Ompok karunkodu*, *Pethia nigripinna*) and so there are also possibilities of several undescribed species occurring in the waters of the Cauvery WS. Only a comprehensive exploratory survey of the freshwater habitats inside the protected area in various seasons could unravel the true diversity of fishes of this protected area.

The study area has been the site of a 40-year-old fishery initiated by WASI, and later carried forward by collaboration between KFD, JLR, and WASI. Consequently, the area was awarded forest department protection under the umbrella of the Cauvery WS. As a result, many direct threats to fishes such as

Table 1. Freshwater fishes recorded from the Cauvery Wildlife Sanctuary, Karnataka.

Order/Family	Species	IUCN status
<b>Beloniformes</b>		
Adrianichthyidae	<i>Oryzias carnaticus</i> (Jerdon, 1849)	Least Concern
Belonidae	<i>Hyporhamphus xanthopterus</i> (Valenciennes, 1847)	Vulnerable
	<i>Xenentodon cancila</i> (Hamilton, 1822)	Least Concern
<b>Cypriniformes</b>		
Cyprinidae	<i>Barbodes carnaticus</i> (Jerdon, 1849)	Least Concern
	<i>Gibelion catla</i> (Hamilton, 1822) †	
	<i>Cirrhinus mrigala</i> (Hamilton, 1822) †	
	<i>Ctenopharyngodon idella</i> (Valenciennes, 1844) †	
	<i>Cyprinus carpio</i> Linnaeus, 1758 †	
	<i>Dawkinsia arulius</i> (Jerdon, 1849) <sup>CWE</sup>	Endangered
	<i>Dawkinsia rubrotinctus</i> (Jerdon, 1849) <sup>CWE</sup>	Status not assessed
	<i>Garra mullya</i> (Sykes, 1839)	Least Concern
	<i>Garra stenorhynchus</i> (Jerdon, 1849) <sup>WGE</sup>	Least Concern
	<i>Hypselobarbus dubius</i> (Day, 1867) <sup>CWE</sup>	Endangered
	<i>Hypselobarbus micropogon</i> (Valenciennes, 1842) <sup>CWE</sup>	Endangered
	<i>Kantaka brevidorsalis</i> (Day, 1873) <sup>CWE</sup>	Least Concern
	<i>Labeo dyocheilus</i> (McClelland, 1839)	Least Concern
	<i>Labeo kontius</i> (Jerdon, 1849) <sup>CWE</sup>	Least Concern
	<i>Labeo nigriscens</i> (Day, 1870) <sup>WGE</sup>	Least Concern
	<i>Labeo rohita</i> (Hamilton, 1822) †	
	<i>Osteochilichthys nashii</i> (Day, 1869)	Least Concern
	<i>Pethia conchoni</i> (Hamilton, 1822)	Least Concern
	<i>Puntius sophore</i> (Hamilton, 1822)	Least Concern
	<i>Systomus sarana</i> (Hamilton, 1822)	Least Concern
	<i>Tor remadevii</i> Kurup & Radhakrishnan, 2011 <sup>CWE</sup>	Critically Endangered
	<i>Tor</i> sp.	---
Danionidae	<i>Amblypharyngodon microlepis</i> (Bleeker, 1853)	Least Concern
	<i>Devario malabaricus</i> (Jerdon, 1849)	Least Concern
	<i>Esomus thermoicos</i> (Valenciennes, 1842)	Least Concern
	<i>Opsarius bendelisis</i> (Hamilton, 1807)	Least Concern
	<i>Opsarius gatensis</i> (Valenciennes, 1844) <sup>WGE</sup>	Least Concern
	<i>Rasbora caverii</i> (Jerdon, 1849) <sup>WGE</sup>	Least Concern

Order/Family	Species	IUCN status
	<i>Rasbora dandia</i> (Valenciennes, 1844)	Status not assessed
	<i>Salmostoma boopis</i> (Day, 1874)	Least Concern
<b>Mugiliformes</b>		
Mugilidae	<i>Rhinomugil corsula</i> (Hamilton, 1822)	Least Concern
<b>Osteoglossiformes</b>		
Notopteridae	<i>Notopterus synura</i> (Bloch & Schneider, 1801)	Status not assessed
<b>Incertae sedis under Ovalenteria</b>		
Ambassidae	<i>Chanda nama</i> Hamilton, 1822	Least Concern
	<i>Parambassis ranga</i> (Hamilton, 1822)	Least Concern
<b>Anabantiformes</b>		
Badidae	<i>Badis badis</i> (Hamilton, 1822)	Least Concern
Channidae	<i>Channa gachua</i> (Hamilton, 1822)	Least Concern
	<i>Channa marulius</i> (Hamilton, 1822)	Least Concern
	<i>Channa pseudomarulius</i> (Günther, 1861) <sup>WGE</sup>	Status not assessed
	<i>Channa striata</i> (Bloch, 1793)	Least Concern
<b>Cichliformes</b>		
Cichlidae	<i>Etilapia suratensis</i> (Bloch, 1790)	Least Concern
	<i>Oreochromis mossambicus</i> (Peters, 1852) †	
	<i>Oreochromis niloticus</i> (Linnaeus, 1758) †	
<b>Gobiiformes</b>		
Gobiidae	<i>Awaous</i> sp.	
	<i>Glossogobius giuris</i> (Hamilton, 1822)	Least Concern
<b>Siluriformes</b>		
Bagridae	<i>Hemibagrus punctatus</i> (Jerdon, 1849) <sup>CWE</sup>	Critically Endangered
	<i>Mystus seengtee</i> (Sykes, 1839)	Least Concern
	<i>Mystus vittatus</i> (Bloch, 1794)	Least Concern
	<i>Sperata seenghala</i> (Sykes, 1839) <sup>WGE</sup>	Least Concern
Clariidae	<i>Clarias gariepinus</i> (Burchell, 1822) †	
Loricariidae	<i>Pterygoplichthys</i> sp. †	
Pangasiidae	<i>Pangasius</i> sp.	
Siluridae	<i>Ompok bimaculatus</i> (Bloch, 1794)	Least Concern
	<i>Wallago attu</i> (Bloch & Schneider, 1801)	Vulnerable
Schilbeidae	<i>Silonia childreni</i> (Sykes, 1839)	Endangered
<b>Synbranchiformes</b>		
Mastacembelidae	<i>Mastacembelus malabaricus</i> (Jerdon, 1849) <sup>WGE</sup>	Status not assessed

†—Non-native (transplanted or introduced) | WGE—endemic to Western Ghats  
| CWE—endemic to Cauvery River.



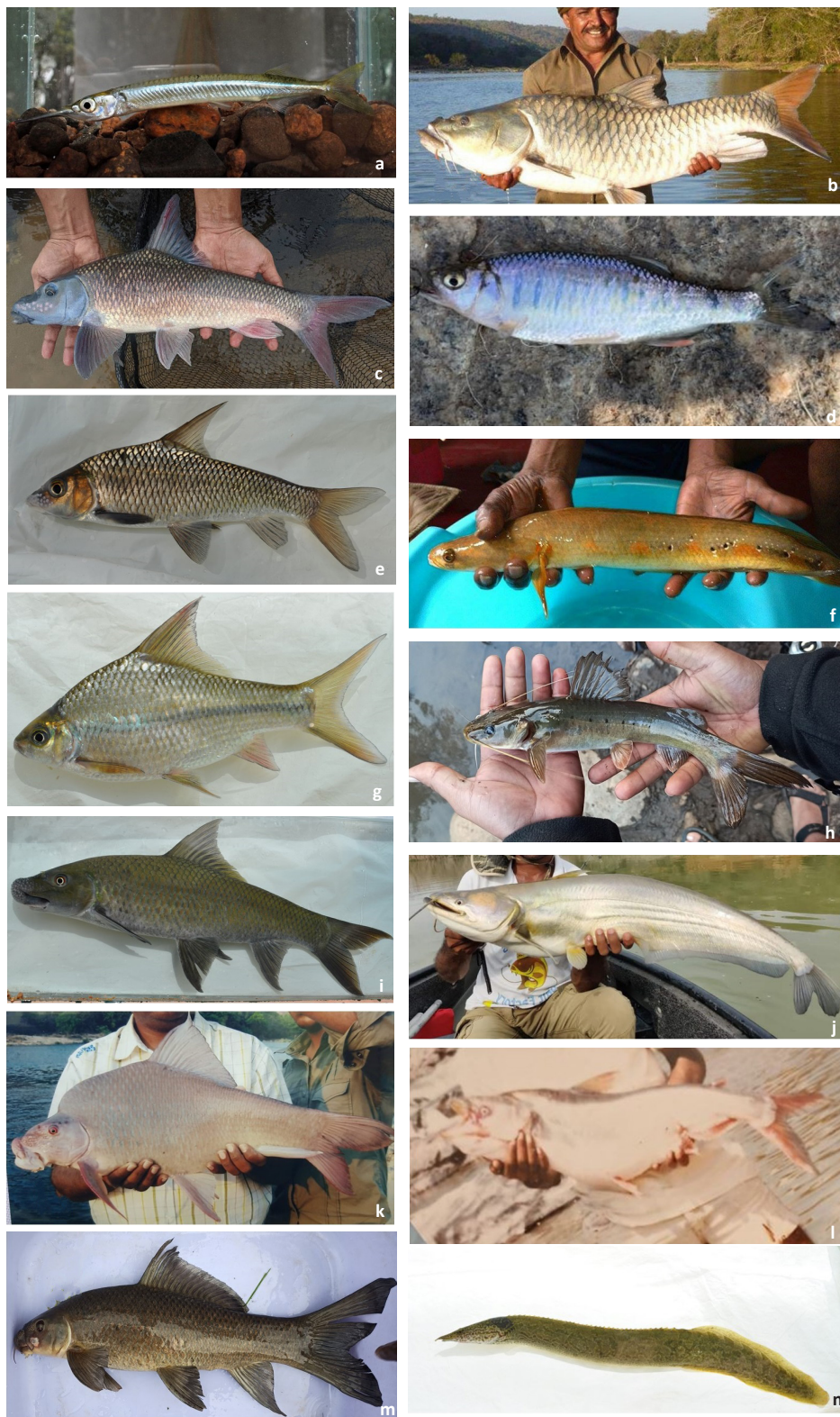


Image 1. List of endemic and high conservation value species found in the Cauvery Wildlife Sanctuary.

a— Red-tipped Halfbeak *Hyporhamphus xanthopterus* © Rahul Kumar | b—Humpback Mahseer *Tor remadevii* © WASI | c— Nilgiri Barb *Hypselobarbus dubius* © Naren Sreenivasan | d—Malabar Baril *Opsarius gatensis* © Shayan Subbaiah | e— Pink Carp *Hypselobarbus micropogon* © Naren Sreenivasan | f— False Giant Snakehead *Channa pseudomaculatus* © Derek D'souza | g— Kantaka Barb *Kantaka brevidorsalis* © Naren Sreenivasan | h—Nilgiri Mystus *Hemibagrus punctatus* © Naren Sreenivasan | i—Fringe-lipped Carp *Labeo dyocheilus* © Naren Sreenivasan | j—Mulley *Wallago attu* © Sheik Imran | k— Pig-mouth Carp *Labeo kontius* © Salik Khan | l— Silund *Silonia childreni* © Ajith Sreenivasan | m— Black Fringe-lipped Carp *Labeo nigriscens* © Naren Sreenivasan | n—Malabar Spiny Eel *Mastacembelus malabaricus* © Naren Sreenivasan.



indiscriminate and often destructive fishing practices (using dynamites) and sand mining have effectively been kept under control along most river stretches in the study site. The possible presence of a large number of African Catfish (as indicated in the focus group discussions with anglers) in the Shimsha tributary, however, is a cause for concern. It is currently not known how and when this predatory fish entered the waters of the protected area. Life history traits including an opportunistic feeding strategy and ability to establish large and persistent populations (Roshni et al. 2020) make the African Catfish an imminent threat to the native fishes of the Cauvery WS especially native catfishes with which they directly compete. The Silund *Silonia childreni* a threatened species of peninsular Indian catfish that was reported from within the study site during the 1970–80s (also see Shenoy et al. 2003) is now known to occur only in a limited stretch of the river in the Mekedattu Gorge, and close to the Karnataka-Tamil Nadu border (WASI Anglers pers. comm.). Whether the three large-bodied catfish species, viz, *Wallago attu*, *Pangassius* sp. and *S. childreni* which were known to occur in the study area until two decades ago has been potentially extirpated requires focused investigation. During the course of this study, only one specimen each of these three species was recorded, although local fishers report isolated populations in deep gorges in south-east of the Sanctuary.

The biggest threat to freshwater fishes in the area is the anthropogenic impacts to the riparian habitat that supports this large aquatic diversity. Development projects proposed in and around the study site threaten to change the dynamics of the river and its riparian vegetation, not only affecting breeding and feeding habits of many fish species, but also force key species in the sanctuary such as the Grizzled Giant Squirrel *Ratufa macroura*, Indian Marsh Crocodile *Crocodylus palustris*, and the Smooth-coated Otter *Lutrogale perspicillata* to drastically change their habitat use patterns. A comprehensive multi-year study on the diversity, distribution and threats to fishes and other aquatic wildlife in the Cauvery Wildlife Sanctuary is urgently required to strengthen future conservation action. Such an effort is currently being developed by WASI in collaboration with the State Forest Department and other relevant stakeholders.

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ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

January 2021 | Vol. 13 | No. 1 | Pages: 17455–17610

Date of Publication: 26 January 2021 (Online & Print)

DOI: 10.11609/jott.2021.13.1.17455-17610

## Communications

### Diversity and distribution of snakes in Trashigang Territorial Forest Division, eastern Bhutan

– Bal Krishna Koirala, Karma Jamtsho, Phuntsho Wangdi, Dawa Tshering, Rinchen Wangdi, Lam Norbu, Sonam Phuntsho, Sonam Lhendup & Tshering Nidup, Pp. 17455–17469

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