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Freshwater fish fauna of the Ashambu Hills landscape, southern Western Ghats, India, with notes on some range extensions

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Abstract: A systematic, updated checklist of freshwater fish species of the west-flowing drainages of the Ashambu (Agasthyamala) Hills landscape in the southern Western Ghats of Kerala, India is provided, with notes on occurrence, status and ecology of endemic and threatened species. The checklist incorporates information from a review of taxonomic, exploratory and ecological literature concerning the area. A total of 103 species have been reported from the landscape, with 25 endemic to the Western Ghats. Range extension of four species, viz. *Garra mcclellandi, G. hughi, Hypselobarbus jerdoni* and *Puntius mahecola* is reported from the Ashambu Hills landscape.

Keywords: Ashambu Hills, endemics, fish diversity, *Garra*, *Puntius*, *Hypselobarbus*, range extension, threatened species, Western Ghats.

INTRODUCTION

The Western Ghats mountain range extends along the west coast of India and is crisscrossed with streams, which form the headwaters of several major rivers providing water to the plains of peninsular India. The Ghats represent a globally critical ecosystem and biodiversity hotspot (Myers et al. 2000). Freshwater fish diversity is very high, with around 288 species and a high rate of endemism (>50%) (Daniels 2002; Dahanukar 2004). The southern Western Ghats that comprise the Ashambu (Agasthyamala) Hills landscape in Kerala form a biogeographically unique ecoregion (Nair 1991). As with several other taxa, this region is very rich in fish species diversity and endemism (Bossuyt et al. 2004).

The west flowing rivers south of the Shenkottah/Ariyankavu pass have not been extensively surveyed for fish diversity. Most surveys to date have been conducted either in easily accessible sites or in limited localities along individual rivers. In this paper we provide a systematic, updated checklist of freshwater fishes across five important rivers of Kollam and Thiruvananthapuram districts of Kerala, namely, Kallada, Ithikkara, Vamanapuram, Karamana and Neyyar, based on the available literature, secondary data and field-sampling along these rivers in the Ashambu Hills landscape. Habitat preferences and anthropogenic threats have been listed for each species included in the checklist, along with ecological and threat information. This can facilitate the identification of conservation priorities for freshwater fish diversity in the region.

MATERIALS AND METHODS

The Kerala part of the Ashambu Hills covers the region southward from the Shenkottah/Ariyankavu Pass with three wildlife sanctuaries (WLS) and two reserve forests (RF) and is contiguous with the Kalakad-Mundanthurai Tiger Reserve (KMTR) to the east, in Tamil Nadu (Fig. 1). The Kallada, Ithikkara, Vamanapuram, Karamana and Neyyar are the main rivers in this landscape, that, with the exception of Ithikkara (origin at 240m), originate at elevations above 1500m from wildlife sanctuaries or semi-protected reserve forests (Basak et al. 1995). These rivers proceed westward to meet the Arabian Sea, passing through a land-use gradient with midland areas dominated by rubber plantations and a lowland matrix of coconut/mixed-garden/paddy cultivation and rural to semi-urban/urban areas. The study was conducted from May 2009 to June 2010.

A preliminary checklist of fish species was prepared based on an exhaustive review of published literature, field guides, ecological studies, short notes and reports, taxonomic assessments and previous checklists from here and neighbouring regions (Silas 1951; Menon 1987; Jayaram 1981, 1991, 2010; Pethiyagoda 1994; Devi et al. 1996, 2005; Tekriwal & Rao 1999; Sheeba 1999; Arunachalam 2000; Biju et al. 2000; Martin et al. 2000; Cherian et al. 2001; Daniels 2002; Bhat 2003, 2004; Easa & Shaji 2003; Dahanukar et al. 2004; Thomas 2004; Raagam & Devi 2004; Pethiyagoda & Kottelat 2005a; Raghavan et al. 2007, 2008; Johnson & Arunachalam 2009; Eschemeyer & Fong 2010). This checklist includes 103 fish species belonging to 53 genera and 24 families (Table 1). Taxonomic treatment is based on Eschmeyer & Fong (2010) and Jayaram (2010).

For primary data collection, 20 sampling locations were selected across the five rivers along the southern Western Ghats (Fig. 1), with uniform coverage of highland, midland and lowland areas. Sampling locations represented four broad land-use types (wildlife sanctuary/reserve forest, rubber plantation, coconut plantation/mixed-garden/paddy, semi-urban/urban area). Sites at higher elevations and coastal areas were randomly surveyed to record restricted-distribution endemics or occasional estuarine/marine species. The fish surveys and identification were carried out through non-destructive sampling by using sampling methods suited to the nature of river course, stream order, flow, presence of aquatic vegetation and local human disturbance. Visual surveys, cast nets, gill-nets and hooks and lines were used to sample fish

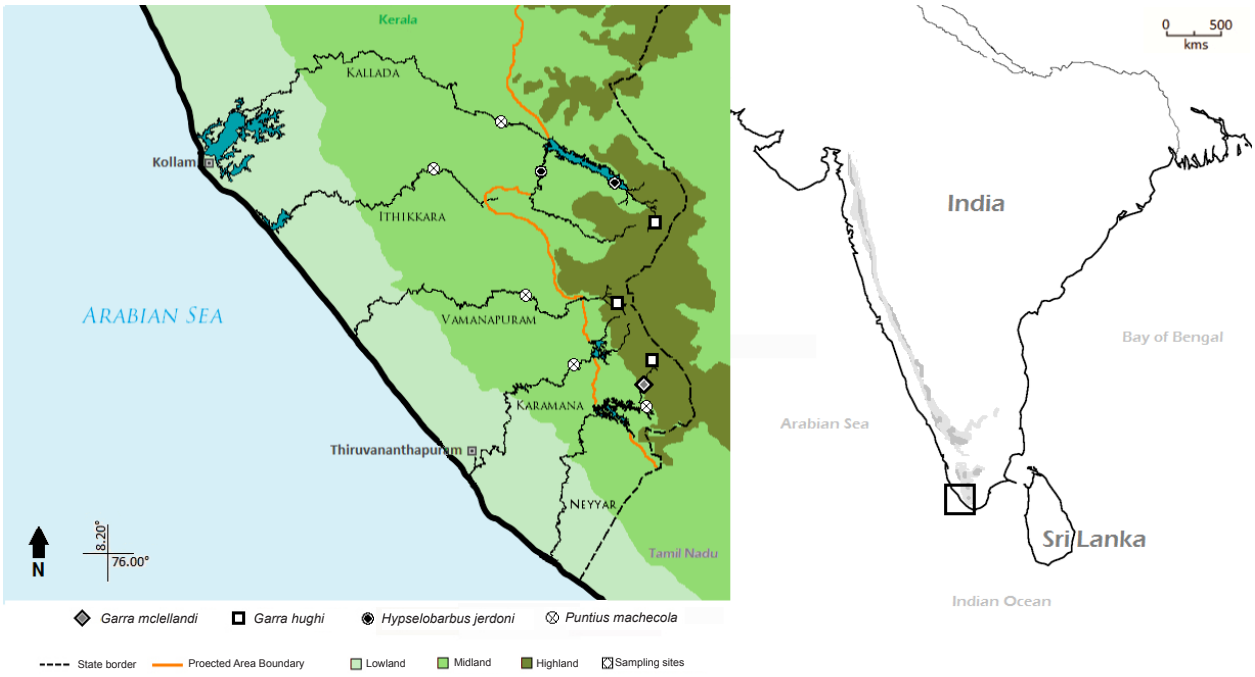

Figure 1. Map showing study area with locations indicated, where species' range extension were recorded in the Ashambu Hills (© Robin Abraham)

Table 1. An annotated checklist of freshwater fish species known from the Ashambu Hills landscape. This checklist is derived from previous literature and updated by species sampled during our study (species for which preferred habitat, elevation range and occurrence are mentioned).

Species	Threats	Preferred Habitat	Elevation Range	Occurrence in Rivers
Ambassidae				
Chanda nama Hamilton	HL	Ru	m	KLD
Parambassis dayi + Bleeker	HL			
Parambassis thomassi + (Day)	HL, DY, IN	Ru	m	KLD, VAM, KAR, NEY
Pseudambassis ranga (Hamilton-Buchanan)	HL	Ru	m	KLD, KAR, NEY
Anabantidae				
Anabas testudineus Bloch	HL, IN, DY			
Anguillidae				
Anguilla bengalensis Gray	HL	Ru, Pl	l,m,h	KLD, ITK, VAM, KAR, NEY
Anguilla bicolor McClelland	HL			
Aplocheilidae				
Aplocheilus lineatus (Valenciennes)	HL	Pl	l,m	KLD, ITK, VAM, KAR, NEY
Aplocheilus blockii + (Arnold)	HL	Pl	m	NEY
Bagridae				
Batasio travancorica + Hora & Law	HL, DY			
Horabagrus brachysoma + (Gunther)	HL, DY	Pl	l,m	KLD, KAR, NEY
Mystus armatus Day	HL			
Mystus bleekeri (Day)	HL	Pl	m, h	NEY
Mystus cavasius Hamilton-Buchanan	HL			
Mystus keletius (Valenciennes)	HL			
Mystus malabaricus + (Jerdon)	HL, DY	Pl	m, h	KLD, ITK, VAM, KAR, NEY
Mystus montanus Jerdon	HL			
Mystus oculatus Valenciennes	HL	Ru, Pl	m	NEY
Mystus vittatus Bloch	HL			
Balitoridae				
Bhavania australis + Jerdon	HL	Ra	h	KLD
Travancoria jonesi + Hora	HL	Ra, Ri	h	KLD, VAM
Nemacheilus denisoni + Day	HL			
Nemacheilus pulchellus + Day	HL			
Nemacheilus triangularis + Day	HL	Ra, Ru, Ri	m,h	KLD, VAM, KAR, NEY
Cobitidae				
Pangio goaensis Tilak	HL			
Lepidocephalichthys thermalis (Valenciennes)	HL	Ra, Ru, Ri	m,h	KLD
Belonidae				
Xenentodon cancilla Hamilton-Buchanan	HL, DY	Ru, Pl	l,m	KLD, ITK, VAM, KAR, NEY
Channidae				
Channa gachua Bloch & Schneider	HL, DY, IN	Ru, Pl	l,m	VAM
Channa marulius Hamilton-Buchanan	HL, DY, IN	Ru, Pl	l,m	VAM, KLD
Channa striata (Bloch)	HL, DY	Ru, Pl	l,m	KLD, ITK, VAM, KAR, NEY
Channa diplogramma +, ^ (Day)	HL, DY, OF	Ru, Pl	m	KLD
Cichlidae				
Etroplus maculatus (Bloch)	HL, DY	Ru, Pl	l,m	KLD, ITK, VAM, KAR, NEY
Etroplus suratensis (Bloch)	HL, DY	Ru, Pl	l	KLD, ITK, VAM, KAR, NEY

Species	Threats	Preferred Habitat	Elevation Range	Occurrence in Rivers
Oreochromis mossambicus (Peters)	-	Ru, Pl	l,m	NEY, KLD
Clariidae				
Clarias dussumieri [+] Valenciennes	HL, OF, IN	Pl	m	KLD, NEY
Heteropneustes fossilis Bloch	HL, DY	Pl	l,m	NEY
Clupeidae				
Dayella malabarica [+] (Day)	HL	Ru	m	KLD
Cyprinidae				
Laubuca dadyburjori [+] Menon	HL			
Salmophasia boopis [+] Day	HL, DY			
Salmophasia balookee (Sykes)	HL, DY	Ru	m	NEY
Esomus danricus Hamilton-Buchanan				
Esomus thermoicos Valenciennes				
Devario aequipinnatus (McClelland)	HL	Ru, Pl	l,m,h	KLD, ITK, VAM, KAR, NEY
Devario malabaricus [+] (Jerdon)	HL	Ru, Pl	l,m,h	KLD, ITK, VAM, KAR, NEY
Rasbora daniconius (Hamilton)	HL	Ru, Pl	l,m,h	KLD, ITK, VAM, KAR, NEY
Amblypharyngodon melettinus (Valenciennes)	HL, DY	Ru	l,m	NEY
Amblypharyngodon microlepis (Bleeker)	HL			
Barilius bakeri [+] Day	HL, EX	Ra, Ru	m, h	KLD, ITK, VAM, KAR, NEY
Barilius bendelisis Hamilton-Buchanan	HL			
Barilius gatensis [+] Valenciennes	HL			
Cyprinus carpio Linnaeus	-	Pl	m	KLD, NEY
Ctenopharyngodon idella Valenciennes	-			
Labeo dussumieri [+] Valenciennes	HL, EX			
Labeo rohita Hamilton-Buchanan	HL			
Labeo calbasu Hamilton-Buchanan	HL			
Tor malabaricus [+] (Jerdon)	HL, OF, DY, EX	Pl	m, h	KLD, VAM, KAR, NEY
Catla catla Valenciennes	-			
Cirrhinus mrigala Hamilton-Buchanan	-			
Garra mcclellandi [+, RE] (Jerdon)	HL, DY, EX	Ra, Ru	h	NEY
Garra mullya (Sykes)	HL, DY, EX	Ra, Ru, Pl, Ri	l, m, h	KLD, ITK, VAM, KAR, NEY
Garra hughi [+, RE] Silas	HL	Ra, Ru, Pl, Ri	h	KLD, VAM, NEY
Garra surendranathanii Shaji, Arun & Easa	HL			
Horalabiosa joshuai Silas	HL, EX			
Hypselobarbus curmuca [+] (Hamilton)	HL, OF, DY, EX, IN	Ru, Pl	m, h	KLD, ITK, VAM, KAR, NEY
Hypselobarbus kolus [+] (Sykes)	HL, DY	Ru, Pl	m	KLD
Hypselobarbus kurali [+] Menon & Rema Devi	HL, DY	Ru, Pl	m	KLD
Osteobrama bakeri [+] Day	HL, DY, IN	Ru, Pl	m	KLD
Puntius arulius Jerdon	HL			
Puntius bimaculatus (Bleeker)	HL, DY, IN			
Barbodes carnaticus [+] (Jerdon)	HL			
Puntius chola Hamilton-Buchanan	HL, DY, IN			
Puntius conchonius Hamilton-Buchanan	HL, DY, IN			
Puntius denisonii [+] Day	HL, DY, OF			
Puntius dorsalis (Jerdon)	HL, DY	Ru, Pl	m, h	KLD, ITK, VAM, NEY
Puntius exclamatio [+, ASH] Pethiyagoda & Kottelat	HL, EX, DY	Ru, Pl	m	KLD

Species	Threats	Preferred Habitat	Elevation Range	Occurrence in Rivers
Puntius fasciatus [+] (Jerdon)	HL, DY	Ru, Pl, Ri	m, h	KLD, VAM, KAR, NEY
Puntius filamentosus (Valenciennes)	HL, DY, IN	Ru, Pl	m	KLD, ITK, VAM, KAR, NEY
Puntius undescribed [+, ASH]	HL	Ru, Pl	m	ITK
Hypselobarbus jerdoni [RE] (Day)	HL, EX, DY	Ru, Pl	m	KLD
Puntius mahecola [+, RE] (Valenciennes)	HL, IN	Ru, Pl	m	KLD, ITK, VAM, KAR, NEY
Puntius parrah Day	HL	Ru, Pl	m	KAR
Puntius narayani [+] (Hora)				
Puntius sarana subnasutus [+] Valenciennes	HL, OF, IN, DY	Ru, Pl	l, m	KLD, ITK, NEY
Puntius tambraparniei [+] Silas	HL			
Puntius ticto Hamilton-Buchanan	HL, EX, DY, IN	Ru, Pl, Ri	m	KLD, ITK, KAR, NEY
Puntius vittatus Day	HL			
Gobiidae				
Sicyopterus griseus Day	HL	Ru	l, m	KAR
Awaous gutum Hamilton-Buchanan	HL	Ru	l, m	KAR
Glossogobius giuris Hamilton-Buchanan	HL, DY, IN	Ru	l, m	KLD, ITK, VAM, KAR
Hemiramphidae				
Hyporamphus limbatus Valenciennes	HL	Ru, Pl	l	KLD
Mastacembelidae				
Mastacembelus armatus (Lacepede)	HL, OF, DY, IN	Ru, Pl, Ri	l, m, h	KLD, NEY
Macrognathus guentheri (Day)	HL, DY			
Nandidae				
Pristolepis marginata [+] Jerdon	HL, DY	Ru, Pl	l, m	KLD, NEY
Notopteridae				
Notopterus notopterus Pallas	HL			
Osphronemidae				
Pseudosphronemus cupanus (Cuvier)	HL, DY			
Siluridae				
Ompok bimaculatus (Bloch)	HL, DY	Ru, Pl	m, h	NEY
Ompok malabaricus [+] (Valenciennes)	HL, DY, EX	Ru, Pl	m, h	NEY, KLD
Wallago attu Bloch & Schneider	HL, DY, OF			
Sisoridae				
Glyptothorax annandalei Hora	HL			
Glyptothorax madraspatanus [+] Day	HL			
Synbranchidae				
Monopterus fossorius Nair	HL, OF, DY			
Microphis cuncalus Hamilton-Buchanan	HL			
Tetraodontidae				
Carinotetraodon travancoricus [+] Hora & Nair	HL, OF			

Author names in brackets indicate redescriptions. Rivers: KLD – Kallada; ITK – Ithikkara; VAM – Vamanapuram; KAR – Karamana; NEY – Neyyar. PA – Protected Area; NPA – Non-Protected Area. Elevation range: l – low (0–30 m); m – mid (30–200 m); h – high (200–1800 m). [RE] – Range extension to the Ashambu Hills Landscape; ^ - Taxonomy following new molecular study showing that the Indian species of Giant Snakehead; previously *C. micropeltes* should be treated as a distinct species *C. diplogramma* (Adamson et al. 2010). Endemism: [+] – Western Ghats; [ASH] – Ashambu Hills. Preferred Habitat: Ru – Run; Ri – Riffle; Ra – Rapid; Pl – Pool. Threats: HL – Habitat Loss; DY – Dynamite Fishing; OF – Overfishing; EX – Exotic species; IN – Industrial Pollution.

Image 1. Species whose range extensions have been recorded in the study. (Images not to scale)
a - *Garra mcclellandi*
b - *Garra hughi*
c - *Hypselobarbus jerdoni*
d - *Puntius mahecola* (male).

species. Species richness data were collected. We also opportunistically collected these data from local fishermen fishing at the same locations. Fish species were identified with the aid of taxonomic keys and field guides (Jayaram 1981, 2010; Easa & Shaji 2003). Information on threats to and ecology of species was also collected based on observation, measurements of stream-related ecological covariates and semi-structured interviews with local key-informants.

RESULTS

A checklist of 103 freshwater fish species for this region was prepared using information from available literature and our sampling. The total number of species sampled by us was 58, belonging to 35 genera and 16 families (Table 1). Of these, 25 species were endemic to the Western Ghats. Four range extensions to southern Kerala were recorded, viz. *Garra mcclellandi*, *Garra hughi*, *Puntius mahecola* and *Hypselobarbus jerdoni*. *Garra mcclellandi* was recorded in the Neyyar Wildlife Sanctuary. *Garra hughi* has been recorded in our study, from the higher elevations (above 900m) of the Shendurney Wildlife Sanctuary, Palode Reserve Forest and the Neyyar Wildlife Sanctuary (Fig. 1, Images 1–4). *Hypselobarbus jerdoni* is a new record for the Kallada River with in the Shendurney Wildlife Sanctuary and the Kulathupuzha River, a tributary of the Kallada in Kulathupuzha Reserve Forest. This now forms the southernmost record for this species. *Puntius mahecola* was collected from all five sampled rivers.

Sand-mining was found to be the most significant threat to the fish fauna, followed by dynamite fishing. Important, but rare indigenous food fishes such as *Tor malabaricus* were particularly threatened by dynamite fishing and the increased presence of exotic species such as *Cyprinus carpio* and *Oreochromis mossambicus* introduced in reservoirs and lowland areas. We observed niche overlap between exotic and indigenous species, and in some cases, (e.g. *Cyprinus carpio* and *Tor malabaricus*), exclusion of local species by exotic ones.

DISCUSSION

The present paper provides an updated checklist with the latest taxonomic revisions and range extensions for five river basins of the Ashambu Hills landscape. Studies in this region over the last five decades, from Silas (1951) to Thomas (2004) are restricted in scope, with incomplete coverage of rivers and streams across the elevation gradient of the Agasthyamalai ranges and a focus on particular taxonomic groups. We have made the best use of sporadic prior information on fish fauna in developing this checklist, and hope it will serve as a guide to policy makers, managers and conservationists. The range extensions that we report here underline the need for more intensive surveys across this region.

Garra mcclellandi was recorded earlier from the upper reaches of the Kaveri basin, the Nilgiris and Periyar Lake (Gopi 2000) and the current record of this species from Neyyar is the southward extension of this species. The type locality of *G. hughi* is the Anamalai Hills, with distribution including the Cardomon and Palani Hills and northern and central rivers of Kerala, and the present report confirms its presence throughout the higher reaches of southern Kerala, up to the southernmost river, Neyyar. However, *G. hughi* had been recently recorded in the Kallar River of Palode Reserve Forest (Johnson & Arunachalam 2009). According to Jayaram (2010), *Hypselobarbus jerdoni* is distributed in the Deccan along the Western Ghats down south to the Anamalai Hills, and its southern record was previously from the Chalakkudy River in Kerala (Gopi 2000). The present record confirms its presence further south to the Kallada River in the Ashambu Hills. Pethiyagoda & Kottelat (2005b) considered *Puntius mahecola* as a valid species and considered *P. amphibius* as its synonym. These authors re-described the species, with specimens collected from the Kallada River, sampled by us as well. The descriptions of the specimens collected by us were found to be in perfect taxonomic agreement with Pethiyagoda & Kottelat (2005a,b) and we record the presence of this species in all the rivers sampled by us. The earlier reports of *P. mahecola* from the Western Ghats, which were probably female specimens of *P. filamentosus,* thus remain to be critically analysed.

We identified sand-mining and dynamite fishing to be the most destructive threats to freshwater fishes of this area. These practices seem to have caused severe habitat destruction and declines of rare substrate-dwelling loach fishes, and many important native food fishes. An example of this is *Tor malabaricus*, the Malabar Mahseer, which was reported to have been facing extreme population decline across the landscape, mainly attributed to dynamite-fishing. We mostly obtained this species from within protected areas, where dynamite-fishing was absent or negligible. Pollution, dumping of acidic wastes from rubber plantations and introduction of invasive exotic food fishes into dam reservoirs and lowland river areas were the other most critical threats.

This broad-scale survey and sampling provides basic data for occurrence of fish species across the land use gradient in the region, for further targeted sampling to compare these different areas for their contribution to fish conservation, while assessing the magnitude of threats from existing practices (direct and indirect). Our paper thus provides the first step for detailed research on the freshwater fish fauna of the west-flowing rivers of the Ashambu Hills landscape, mainly with regards to taxonomic, ecological and conservation studies.

The conservation approaches suggested in this landscape include strict control over sand mining and unscientific fishing practices such as dynamiting and poisoning, the formation of river sanctuaries outside existing protected areas, construction of fish ladders in dams, in situ and ex situ conservation strategies (with the consideration that fish are also part of Indian wildlife), controlling pollution, and minimizing the threats posed by increasing numbers and diversity of exotic fish species.

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