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Freshwater fish fauna of Hiranyakeshi River, the northern Western Ghats, India

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Abstract: The freshwater fish fauna of Hiranyakeshi River, a tributary of the Krishna River System, originating in the Western Ghats of Maharashtra, was studied for a period of three years from 2013–2016. We reported 57 species belonging to seven orders, 17 families and 42 genera. Cypriniformes was the most species rich order followed by Siluriformes, while Cyprinidae was the most predominant family. At least 21 freshwater fish species found in Hiranyakeshi River are endemic to river systems originating from the Western Ghats, while nine species are endemic to the Krishna River system. The true diversity of freshwater fishes in this region, however, is still obscure because of lack of detailed taxonomic studies in this region. Of the total species, at least 11 are in the threatened and near threatened categories of the IUCN Red List and Hiranyakeshi River holds a good population of most of these species. The fish fauna in this region, however, is threatened by several stressors including invasive fishing practices, water impediment due to upcoming dams, invasive introduced species and water pollution due to agricultural runoffs and industrial effluents.

Keywords: Amboli, Krishna River System, *Pterocryptis*, *Oreichthys*, *Monopterus*.

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INTRODUCTION

The Western Ghats of India, together with Sri Lanka, is considered as one of the major biodiversity hotspots of the world (Myers et al. 2000). Currently, 320 species of freshwater fishes under 11 orders, 35 families and 112 genera are known from the Western Ghats, of which 66% are endemic to this zoogeographical region (Dahanukar & Raghavan 2013). This rich diversity of fishes is under threat due to several anthropogenic stressors (Dahanukar et al. 2011) and about 47% of the endemic fishes in this region are under threatened and near threatened categories (Dahanukar & Raghavan 2013). A major hindrance in the conservation action in this area is the lack of base line data on species diversity and distribution. As compared to the southern Western Ghats, the northern region is relatively less studied for its fish diversity (Dahanukar et al. 2011). This is especially true for several upstream tributaries of the Krishna River System, where virtually no information exists. One such river is the Hiranyakeshi River that originates in the Western Ghats of southern Maharashtra.

The river Hiranyakeshi originates at about 840m near Amboli (15.954^{0}N & 74.027^{0}E), in Sindhudurg District, Maharashtra State, India (Fig. 1). It is surrounded by tropical evergreen and moist deciduous forest in the upstream and agricultural lands, which are mainly under cultivation of rice and sugarcane, in the down streams (Image 1). It flows eastwards about 90km and merges with Ghataprabha, which ultimately drains in the Krishna River system. Detailed documentation of the fish fauna of this river is not available. Although Jayaram (1995), while examining the fish fauna of tributaries of Krishna River system, mentions collection sites from Ghataprabha River he did not sample the fish fauna from its upstream. Further, Kalwar & Kelkar (1956) shows the Hiranyakeshi River in their map; however, they make no comment on whether fishes were collected from this river. Nevertheless, it is important to note that a species of barb *Pethia longicauda* as described from this river recently (Katwate et al. 2014) indicates that there is a need for systematic documentation of fish fauna of this river. We refrain from citing one recent publication from a predatory journal following the journal policy (see Raghavan et al. 2015); however, it is essential to note that this publication only reports seven species and is a gross underestimation of fish fauna of this region (see Results and Discussion section below).

In the current study we provide a checklist of freshwater fish fauna of Hiranyakeshi River based on a study conducted over a period of three years from 2013 till 2016.

MATERIALS AND METHODS

Fish collection was done from June 2013 till May 2016 at 14 different localities spread out on approximately 60km stretch of the Hiranyakeshi River (Fig. 1). Fishes were collected using cast net, gill net, drag net and scoop net with the help of local fishermen. Local market at Ajara (16.119^{0}N & 74.211^{0}E) was also visited to examine species that were missed out on surveys. A limited number of specimens of each species were collected and preserved in 4% formaldehyde. Collected fish specimens are deposited in the museum collection of Bombay Natural History Society (BNHS), Mumbai; and the Wildlife Information Liaison Development (WILD) Society, Coimbatore. Some taxonomically unambiguous fish species were not collected because of different logistic reasons. Further, a few species could be identified only at the genus level as they show marked difference from known species. These species are not deposited in the museum collection as further studies on them are in progress. Fish identification was confirmed using available literature (Menon 1987; 1992; Talwar & Jhingran 1991; Jayaram 1991; 2010; Jayaram & Dhas 2000; Jayaram & Sanyal 2003; Katwate et. al. 2014; Knight & Kumar 2015). Current taxonomic status mainly follows Eschmeyer et al. (2016). Threat status of the fish was obtained from IUCN (2016) and is provided for only indigenous species which could be identified at species level and is not provided for introduced, transplanted and species whose species identification could not be confirmed. Endemism was assessed at Western Ghats assessment region (for definition see Molur et al. 2011) and at Krishna River system.

RESULTS AND DISCUSSION

A total of 57 species belonging to seven orders, 17 families and 42 genera were recorded from Hiranyakeshi River during the current study. Cypriniformes was the most predominant order with four families, 24 genera and 35 species, followed by Siluriformes with three families, five genera and eight species. Cyprinidae was the most predominant family with 28 species belonging to 18 genera. Out of the total 57 species, 22 are endemic to Western Ghats assessment region and nine species are endemic to Krishna River system. Species level identification was not possible in four cases as the

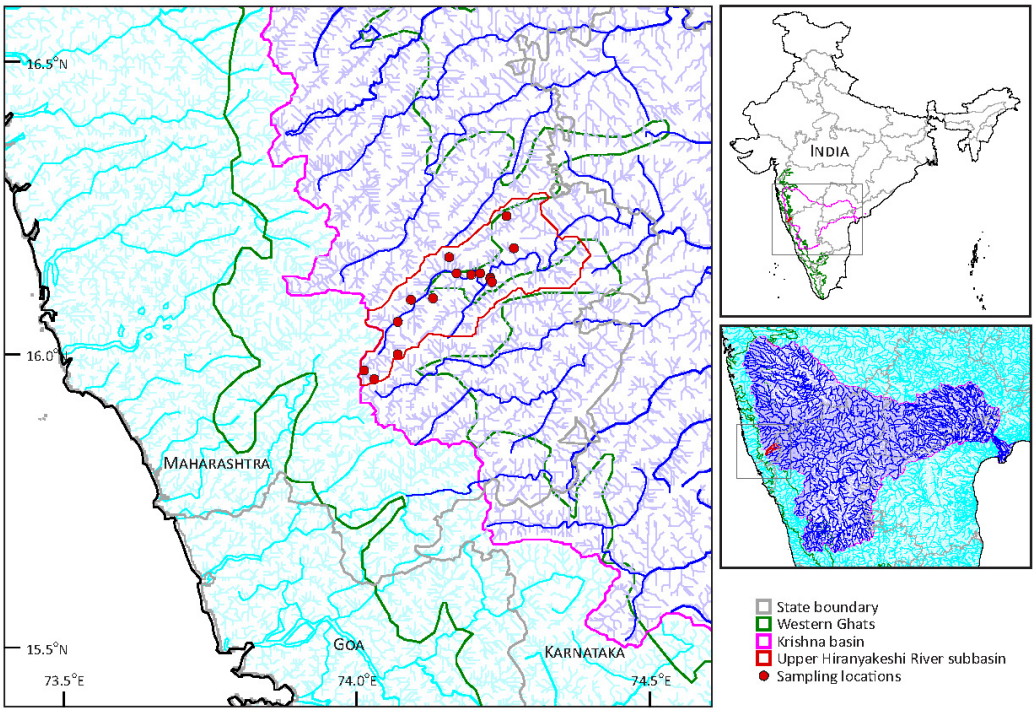

Figure 1. Sampling locations along the Hiranyakeshi River.

specimens showed substantial differences from their congeners. We recorded four invasive introduced species and two transplanted species from Hiranyakeshi River. Among the 47 indigenous species identified at species level, five species are endangered (EN), two species are Vulnerable (VU), five species are Near Threatened (NT), 28 are Least Concern (LC), three are Data Deficient (DD) and four are not evaluated. We have identified two taxa, namely *Osteobrama cotio peninsularis* and *Systomus sarana subnasutus*, at their subspecies level pending further taxonomic reviews.

Hill streams of Hiranyakeshi River (Image 1b–d) have a good diversity and abundance of loaches of the family Balitoridae, Cobitidae and Nemachilidae. Recently, Kumkar et al. (2016) confirmed the presence of *Balitora laticauda* from Hiranyakeshi River based on genetic analysis. We found *Balitora laticauda* (Image 2a) to be abundant upstream and in the main river stretches with torrential waters and rocky habitat with boulders and crevices (Image 1b & c). *Balitora laticauda* was found only in clear water stretches where there was no or very low organic or inorganic pollution. In family Nemachilidae we found two species, one belonging to genus *Paracanthocobitis* (Image 2c) and another to genus *Schistura*, which were markedly different from their known congeners. Although we recorded both *Schistura denisoni* and *Schistura* sp. from Hiranyakeshi River they were never found coexisting in the same habitats. *Schistura denisoni* was restricted to down streams and main river channel, while *Schistura* sp. was mainly found in the upstream regions. *Nemachilichthys ruppelli* from Hiranyakeshi River had minor morphological variations from the topotypic *N. ruppelli* collected from Mula-Mutha River of Pune; however, it was genetically similar (for more detailed analysis see Keskar et al. 2015).

Oreichthys duospilus is a recently described species from Western Ghats of Karnataka (Knight & Kumar 2015). We provide the first range extension of *Oreichthys duospilus* (Image 2e) from Maharashtra. We found this species to be rare and it was normally found either as singe or small group of two or three individuals in larger shoals of *Pethia longicauda*.

We found good population of the cyprinid fish *Schismatorhynchus nukta* (Image 2q), which is endemic to peninsular India. Currently this species is categorized under EN due to rapid decline in its numbers and threats to its populations and habitat (Dahanukar 2011a). This fish is caught by local fisherman and sold in the local market of Ajara.

Arunachalam et al. (2000) gave the first report of *Pterocryptis wyanaadensis* from Maharashtra; however, because they have not provided voucher specimen details or a photographic record it is difficult to validate their report. We provide the first authentic report of the species from Maharashtra with photographic evidence (Image 2k) backed up with a voucher specimen (Table

Image 1. Available habitats in the Hiranyakeshi River arranged a–h from upstream to downstream areas. © Unmesh Katwate

1). We found a good population of *P. wyanaadensis* in the upper stretches of Hiranyakeshi River. Discussion with local people made us aware of a major threat to the species in the form of a unique fishing activity in this region. Based on the information from the locals, after the monsoon season is over *P. wyanaadensis* normally takes shelter in burrows and holes in the upstreams of the Hiranyakeshi River where it stays in large numbers. Individuals stay in such burrows and holes till they mature and are ready to lay eggs in the next monsoon season. With the onset of monsoon they leave the burrows and holes in large numbers and breed in the streams. Some local fisherman make a trap on the mouth of such burrows and holes before the onset of monsoon and catch a large number of mature individuals before they lay eggs. As this species has a high market value, the fishing pressure on the species has increased in the recent years. Therefore, public awareness is essential for conservation of this species.

Clarias dussumieri is endemic to the Western Ghats and is known from Goa, Karnataka, Kerala and Tamil Nadu states (Abraham 2011). To our knowledge there

Table 1. List of freshwater fish fauna of Hiranyakeshi River.

Order/ Family/ *Species*	Voucher code	Red List status [a]	Endemicity [b]
Anguilliformes: Anguillidae			
Anguilla bengalensis (Gray, 1831)*		NT	
Beloniformes: Hemiramphidae			
Hyporhamphus limbatus (Valenciennes, 1847)	BNHS FWF 233	LC	
Cypriniformes: Balitoridae			
Balitora laticauda Bhoite, Jadhav & Dahanukar, 2012	BNHS FWF 199	NE	WG, K
Cobitidae			
Lepidocephalichthys thermalis (Valenciennes, 1846)	BNHS FWF 251	LC	
Cyprinidae			
Cirrhinus fulungee (Sykes, 1839)	BNHS FWF 209	LC	WG
Danio rerio (Hamilton, 1822)	BNHS FWF 253	LC	
Devario malabaricus (Jerdon, 1849)	BNHS FWF 249	LC	WG
Garra bicornuta Narayan Rao, 1920	BNHS FWF 235	NT	WG, K
Garra mullya (Sykes, 1839)	BNHS FWF 219	LC	
Hypselobarbus curmuca (Hamilton, 1807)	BNHS FWF 206	EN	WG
Hypselobarbus dobsoni (Day, 1876)	BNHS FWF 257	DD	WG, K
Bangana ariza (Hamilton, 1807)	BNHS FWF 222	LC	
Labeo calbasu (Hamilton, 1822)*			T
Labeo fimbriatus (Bloch, 1795)	BNHS FWF 221	LC	
Labeo porcellus (Heckel, 1844)	BNHS FWF 260	LC	WG, K
Labeo potail (Sykes, 1839)	BNHS FWF 204	EN	WG, K
Labeo rohita (Hamilton, 1822)	BNHS FWF 230		T
Oreichthys duospilus Knight & Kumar, 2015	BNHS FWF 267	NE	WG, K
Osteobrama cotio peninsularis Silas, 1952	BNHS FWF 241	DD	WG, K
Osteochilichthys thomassi (Day, 1877)	BNHS FWF 259	LC	WG
Parapsilorhynchus discophorus Hora, 1921	WILD-17-PIS-315	VU	WG
Pethia longicauda Katwate, Paingankar, Raghavan & Dahanukar, 2014	BNHS FWF 97	NE	WG, K
Pethia sp.***			
Puntius amphibius (Valenciennes, 1842)	BNHS FWF 245	DD	WG
Puntius sophore (Hamilton, 1822)	BNHS FWF 247	LC	
Rasbora dandia (Valenciennes, 1844)	BNHS FWF 239	NE	
Salmostoma balookee (Sykes, 1839)	BNHS FWF 211	LC	
Salmostoma boopis (Day, 1874)	BNHS FWF 240	LC	WG
Salmostoma novacula (Valenciennes, 1840)	BNHS FWF 217	LC	WG
Schismatorhynchos nukta (Sykes, 1839)	BNHS FWF 214	EN	WG
Systomus sarana subnasutus (Valenciennes, 1842)	BNHS FWF 205	LC	
Tor khudree (Sykes, 1839)	WILD-17-PIS-316	EN	
Nemacheilidae			
Indoreonectes evezardi (Day, 1872)	BNHS FWF 262	LC	
Nemachilichthys ruppelli (Sykes, 1839)	WILD-15-PIS-221	LC	WG, K
Paracanthocobitis sp.***			
*Schistura denisoni (*Day, 1867)	BNHS FWF 263	LC	
Schistura sp.***			
Cyprinodontiformes: Aplocheilidae			
Aplocheilus lineatus (Valenciennes, 1846)	WILD-17-PIS-317	LC	
Poeciliidae			
Gambusia affinis (Baird & Girard, 1853)*			I
Poecilia reticulata Peters, 1859*			I
Perciformes: Ambassidae			
Chanda nama Hamilton, 1822	BNHS FWF 225	LC	
Parambassis ranga (Hamilton, 1822)	BNHS FWF 265	LC	
Channidae			
Channa marulius (Hamilton, 1822)*		LC	
Channa gachua (Hamilton, 1822)	WILD-17-PIS-318	LC	
Cichlidae			
Oreochromis mossambicus (Peters, 1852)	BNHS FWF 223		I
Gobiidae			
Bathygobius sp.***	WILD-17-PIS-320		
Glossogobius giuris (Hamilton, 1822)*		LC	
Siluriformes: Bagridae			
Mystus bleekeri (Day, 1877)	BNHS FWF 255	LC	
Mystus malabaricus (Jerdon, 1849)	BNHS FWF 210	NT	WG
Mystus seengtee (Sykes, 1839)	BNHS FWF 212	LC	
Sperata seenghala (Sykes, 1839)*		LC	
Clariidae			
Clarias dussumieri Valenciennes, 1840	WILD-17-PIS-319	NT	WG
Clarias gariepinus (Burchell, 1822)	BNHS FWF 226		I
Siluridae			
Ompok bimaculatus (Bloch, 1794)	BNHS FWF 208	NT	
Pterocryptis wynaadensis (Day, 1873)	BNHS FWF 266	EN	WG
Synbranchiformes: Mastacembelidae			
Mastacembelus armatus (Lacepède, 1800)	BNHS FWF 232	LC	
Synbranchidae			
Monopterus indicus (Silas & Dawson, 1961)	BNHS FWF 264	VU	WG

* specimens not collected.
*** specimens not submitted as further studies are in progress.
[a] IUCN catagories: LC - Least Concern; NT - Near Threatened; VU - Vulnarable; EN - Endangered; CR - Critically Endangered; DD - Data Deficient; NE - Not Evaluated.
[b] Endemicity: WG - Western Ghats; K - Krishna River System; T - Transplanted; I - Introduced

Image 2. Some fishes of the Hiranyakeshi River. © Unmesh Katwate
(a) *Balitora laticauda*, (b) *Lepidocephalichthys thermalis*, (c) *Paracanthocobitis* sp., (d) *Indoreonectes evezadi*, (e) *Oreichthys duospilus*, (f) *Garra mullya*, (g) *Pethia longicauda*, (h) *Puntius amphibius*, (i) *Rasbora dandia*, (j) *Devario malabaricus*, (k) *Pterocryptis wynaadensis* and (l) *Mystus malabaricus*.

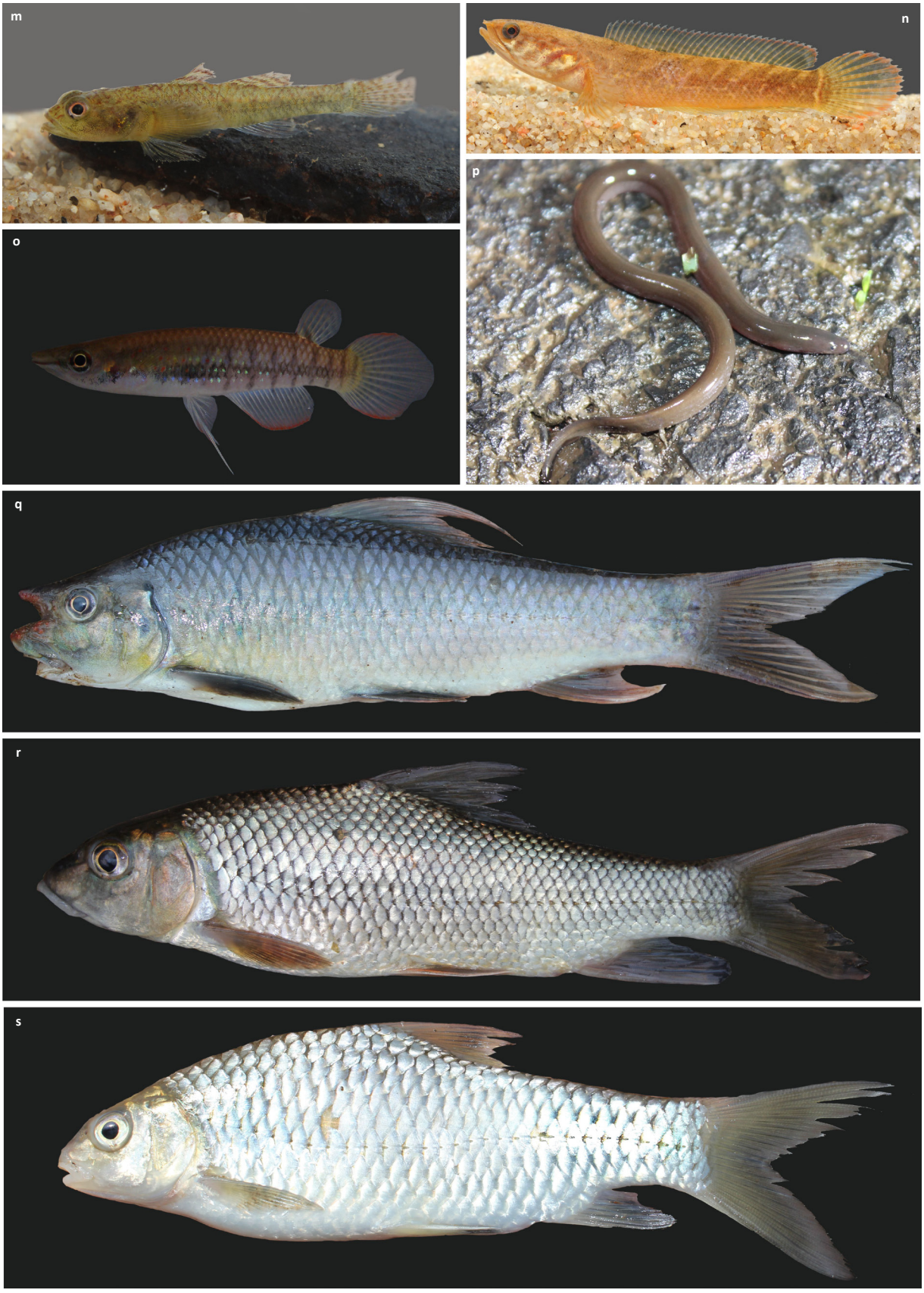

Image 2. Continued. (m) *Bathygobius* sp., (n) *Channa gachua*, (o) *Aplocheilus lineatus*, (p) *Monopterus indicus*, (q) *Schismatorhynchos nukta*, (r) *Hypselobarbus curmuca*, (s) *Hypselobarbus dobsoni*. © m,n,o,q,r,s - Unmesh Katwate; p - Swapnil Chaudhari.

is no report of this species from Maharashtra. We provide a first report of this species from Maharashtra. Our specimens match with the photographs of syntypes of *Clarias dussumieri* (Muséum National d'Histoire Naturelle, Paris, MNHN-IC-B-0686), which are available online at https://science.mnhn.fr/institution/mnhn/collection/ic/item/b-0686.

The swamp eel *Monopterus indicus* (Image 2p), currently assessed as VU (Dahanukar 2011b), has a good population in the upstreams of the Hiranyakeshi River and plateau of Amboli (Image 1a). Since Amboli receives heavy rainfall in monsoon, several *M. indicus* individuals are often seen crawling on the road. This has also led us to witness several road kills of the species.

Lack of taxonomic works and systematic revisions have rendered the diversity of gobids of the Western Ghats to be obscure. We found a member of the family Gobiidae that can be tentatively assigned to genus *Bathygobius* based on the key provided by Jayaram (2010). Further taxonomic studies are essential for clarifying generic and specific identity.

We could not collect specimens of *Anguilla bengalensis* during our survey; however, we could examine a specimen that was collected by local fishermen and deposited in Ajara College. Based on the discussion with local people, recently, there has been a large decline in the populations of *Anguilla bengalensis* in Hiranyakeshi River.

There are several threats to the freshwater fish species in this region. As discussed earlier, the invasive fishing method for *Pterocryptis wyanaadensis* is likely to be a major threat to the species. Although we do not have information on the fishing pressure on the other species, there is an elevated fishing activity during the monsoon season when fishes, including *Tor khudree*, migrate upstream for breeding. In both the cases gravid females and mature males are the targets so increase in such fishing practices is likely to affect the fish populations adversely. Although the Hiranyakeshi River and its upstreams appear to have clean waters it is essential to note that most of the river bank has farms that mainly cultivate sugarcane. Further, in the river stretch near Amboli, farmers cultivate rice in the river itself (Image 1f). Agricultural runoff is, therefore, a potential threat to fish species. In addition, there is a sugar factory on the river bank and it has been noted that once a year large amount of effluents are released from the factory into the river channel, which affects the fishes downstream and there is a large reduction in the fish catches. There are two dams on the tributaries of Hiranyakeshi and one more is currently in construction. The construction of the new dam has not only contributed to habitat destruction, it is likely to affect migratory species, such as *Tor khudree*, in monsoon season. We also recorded four invasive introduced fish species from Hiranyakeshi River out of which *Oreochromis mossambicus* and *Gambusia affinis* are among the 100 'World's Worst Invasive Alien Species' (Lowe et al. 2000).

Hiranyakeshi River is rich with freshwater fish fauna with 57 species of fishes. Although we scanned several areas within a survey span for three years, records of more species are expected from this region. The recent description of a new species by Katwate et al. (2014) and our report of at least four species that are different from their congeners suggests that taxonomic studies are essential for deciphering the true diversity of fishes of this region. This rich diversity is, however, threatened by several anthropogenic activities and strategies to curb these stressors are essential to conserve the fish fauna of this region.

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