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Ornamental Fishes and Their Habitat in Adda Holé and Kempu Holé, Western Ghats of Karnataka

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Abstract: ***The Western Ghats of the Indian subcontinent is one of the 25 biodiversity hotspots of the world and is well known for high endemism, especially with the fishes. Numerous hills serve as watershed for the entire region of Western Ghats which give rise to streams of different size and length that combine to form tributaries of a larger water body. The present study aims to understand the availability of fishes present in the Adda holé river, which is one of the tributaries of river Kempu holé (Gundia river) in Gundia region of Sakleshpur. A checklist of fishes present in study area has been prepared and an assessment was made on the habitat of these fishes. 24 species of fishes have been identified, of which 4 are endangered. The habitat study reveals the presence of fishes in a given area based on their preference for substrate types - sand, fine sand, rock, gravel and cobble substrates while also indicating their distribution in Adda holé and Kempu holé region of Gundia basin which is very important from their conservation perspective.***

Keywords: Western Ghats, Adda holé, Kempu holé, habitat, endemism, behavior, conservation

1. Introduction

About 60% of Western Ghats lies in Karnataka, which is located on the Western Coast of the Indian Peninsula and towards the Western edge of the Deccan Plateau. The Western Ghats is considered as the green belt, by virtue of its position along the tropic of cancer, it comprises of tropical evergreen rain forests and it is an exceptional hotspot of freshwater fish diversity and endemism in peninsular India (Kottelat and Whitten, 1996; Dahanukar et al. 2004). The Western Ghats is gifted with perennial streams, which are pristine habitats, a unique biological regions and 'hotspots' of fish diversity. The Central and Southern Western Ghats of India have high freshwater fish diversity and endemism (Bhat, 2004; Molur, Smith, Daniels and Darwall 2011; Raghavan, Prasad, Ali, Anvar and Pereira, 2009). Bapurao et al (2010) described 58 fishes from the river Koyna lying in the Northern Western Ghats, out of which 22 species were endemic. The rivers and streams are shaped by the interaction between the topography, geology, soils, climate and vegetation of the region in which they are located. The rivers of this geographical area differ in their unique streamline characteristics like low velocity, moderate temperature, moderate water content, small size and terrain. The varied climate and diverse topography create a wide array of habitats that support unique set of plants and animals (Bhat, 2003). Habitat is one of the most important criteria for fish survival as it provides for the medium in which fish may flourish or even perish under unfavourable circumstances. The slope of the landscape and volume of water combine to exert energy on the stream channel, creating structures that are important for fish habitat, such as meanders, pools, riffles, overhanging banks and gravel substrates of appropriate sizes (Thompson, 2004). Streams evolve over time and the form of the channel tends to balance the energy flow that is characteristic of the system, so that the channel is relatively stable even though it may be altered by flood flows (Mount, 1995). Type of sediment also plays an important role in existence of fishes in a given area. Sediment, from a fishery standpoint, is defined as fine inorganic waterborne material below a certain specified diameter (Everest et al. 1987). With the growing threat to the freshwater fishes and habitats in the form of anthropological activities and growing economy, it is necessary to understand the existing diversity of fishes in their habitats in order to conserve them.

2. Materials and Methods

2.1 Study area

Adda holé river in Kabbinale forest and Kempu holé river in Kombar forest range was selected to carry out the study. The area falls under Hassan District, Sakleshpur range with an area of 6072.9 Ha. Adda holé river is located along the NH48 main road. The river is formed by the merger of two smaller rivers viz Shishila holé, a precipitation from Shishila region on the western side and another river which is a precipitation from Kumarahalli and Mugilagiri hill region. Both of these rivers combine to form the Adda holé which flows downwards in the pristine and untouched forest for about 8.6 Kms till it crossess path with the NH48 main road and merges with the Kempu holé river. The Adda holé is also directly fed by many small creeks (Fig.1) along its entire stretch until it merges with Kempu holé river. Throughout the year, the undisturbed minimum ecological flow of the river sustains all the ecosystem functions of this habitat. Different types of habitat have been observed and assessed as per the methods described by Pusey et al (1993).

The Kempu holé river is an extension of the Yettina holé river which is formed of drainage from the ranges - Yettina holé, Kadumane holé, Keri holé and Hongada halla catchment. The Yettina holé river originates at an altitude of 950 meters in Sakleshpura taluk of Hassan district. Yettina holé catchment extends from 12 44'N to 12 58'N Latitude and 75 37'E to 75 47'E longitude and encompasses a total area of 179.68 km2 (Ramachandra et al 2015).

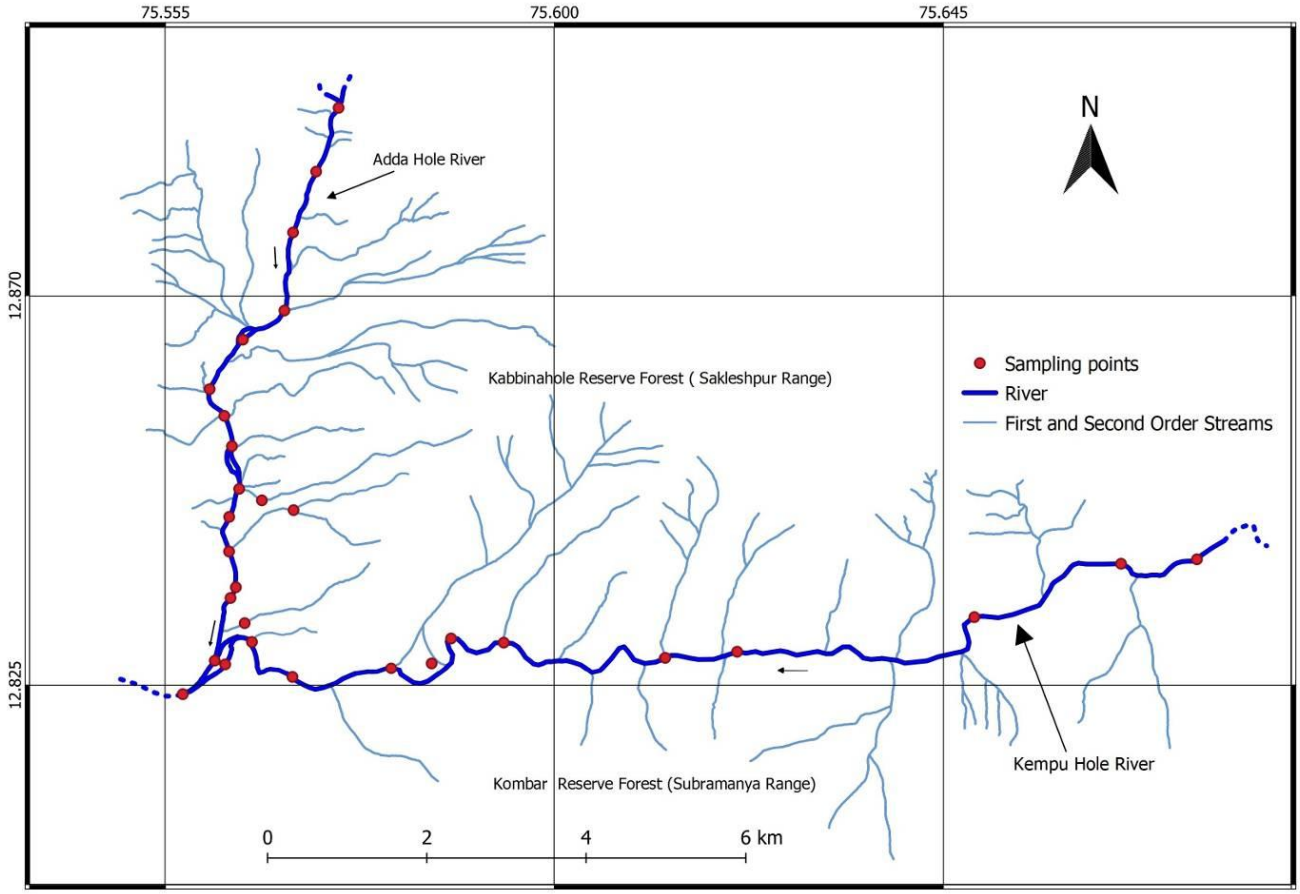


Figure 1: Map showing the location of *Adda holé* river and *Kempu holé* river along with their tributaries.

2.2 Sampling

The sampling was done during 2016-2018 between August to May months at multiple intervals. The *Adda holé* river was surveyed upstream to downstream for 8.6 Kms in distance and the *Kempu holé* river was surveyed upstream to downstream for about 15.5 Kms (Fig. 1). The survey was also extended to the point where the river *Adda holé* merges with the larger *Kempu holé* river.

Fish sampling was done at each site fortnightly. Different types of fishing nets such as dip nets, cast nets, drag nets and sienne nets were used according to the type of fish and the area *viz* narrow, rocky, shallow, with extensive tree rooting and in weedy waters. Cast nets were preferably used since they have been widely used for other studies in the Western Ghats and are known to be suitable for sampling different fish guilds in hill-stream sections (Abraham & Kelkar, 2012; Bhat, 2004). The fishes were collected, examined and identified by following the keys prescribed by Jayaram (1999, 2010) and Talwar & Jinghran (1991). After identification the fishes were photographed and were released back into the river. The habitat was assessed using the methods followed by Pusey *et al*., (1993). The predominant substrate in the study sites were assessed by following the methodology carried out by Bain and Stevenson (1999) and Sarkar and Bain (2007). Different types of substrates were observed and were classified as fine sand (0.8mm or lesser), sand (0.8-4.1mm), gravel (4-75mm), cobble (74-305mm), boulder (256mm or bigger), bedrock (largest & immovable substrate). The leaf litter (20-60mm) was also taken into account as it was found to be a favorable locale for many fishes.

View of *Adda Holé*

View of *Kempu Holé*

3. Results and Discussion

A total of 24 species under 14 families, 8 orders and 22 general were recorded from the Adda holé and Kempu holé river (Table – 1). Of these, the threat status of 4 species is assessed as Endangered, 1 Near Threatened, 17 Least Concern and 1 is Data Deficient and the status of 2 species are Not Evaluated as they are recently described. Of the 24 species recorded, 4 are abundant, 5 are common, 11 are moderate and 4 are rare in the study area (Table – 2). Among 8 Orders, Cypriniformes (50%) being dominant followed by Perciformes (17%), Siluriformes (13%), while Anguliformes, Beloniformes, Cyprinodontiformes, Synbranchiformes, Tetrodontiformes were all 4% each as shown in Fig-1. Order Cypriniformes is dominant in the study area and family Cyprinidae showed a significant diversity. Anandhi et al (2013) reported that Cyprinidae family is dominant in rivers and streams of Western Ghats. Out of 24 endemic species identified, 4 species viz E.canarensis, M.irulu, P.lapillicola and C.imitator have a restricted range and were found to be having a very narrow range of distribution and hence are endemic to Western Ghats. The endemics having a narrow range of distribution are mostly associated with the Western Streams which emphasizes the importance and high conservation values of stream habitats of the Western Ghats (Chandran et al, 2007). Abraham et al (2011) have reported a list of 103 species with 25 endemics from five important rivers of Kerala. Britz and Kotellat 1999 had reported C.imitator from the Indian subcontinent, Western Ghats of Karnataka region but the loacation was reported to be obscure. Vijayakrishnan et al (2022) reported M.irulu from Netravathi river system. P. Lapillicola has been found and studied in Kumaradara River, Southern Western Ghats of Karnataka by Britz et al (2012). The presence of S.boopis, A.bengalensis, M.armatus, M.petrubanarescui, Pseudolaguvia sp. C.imitator & Mystus sp. are seen to be a remarkable findings in the Adda holé region of Gundia basin when it comes to their distribution in Central Western Ghats of Karnataka region.

Fish species diversity is correlated with habitat complexity (Gorman and Karr, 1978; Schlosser, 1982) of depth, flow and substrate types. The influence of these habitat attributes : on the structure and function of fish assemblages in streams has been studied in detail at different latitudes (Leveque, 1997). Of the 24 species identified in Adda holé and Kempu holé, 21 species were commonly found to inhabit the pool water system, 21 were found in flow water system, 19 in run, 4 in riffle, 3 in cascade, 1 in fall and 1 in rapids (Table - 3a & 3b). This indicates that fishes in the study area are more common in shallow water system in comparison with other systems. The substrate also plays a very important role when it comes to finding the fishes in a stream. The fishes are accustomed to commonly aggregate and thrive in a particular substrate type depending upon the water current, food availability, cover, avoiding predators etc which is detailed under Table-4 and Figure-3. The substrate-wise availabilty of the fishes have been assessed and it is found that a maximum of 18% species are always found to be in gravel region, 17% in cobble, 17% in rock region, 16% in sand, 16% in fine sand region, 13% in leaf litters and 2% in bedrock region and 1% in boulder regions (Table-4 & Fig. 3). Habitat features have been identified as major determinants in distribution and abundance of fishes from earlier times (Shelford, 1911). In addition, the presence of evergreen and semi evergreen forests also have a positive influence on fish species richness, endemics, endangered and data deficient species and has a negative influence on the lower risk categories. Earlier studies by Chandran et al (2007) have revealed that the composition and distribution of fish species have strong association with the kind of terrestrial landscape elements. The perennial streams with their catchments clad in evergreen to semi-evergreen forests and higher levels of plant endemism are the habitats for rich and endemic fish fauna. In the present study, it is established that the abundance of fishes in the pristine untouched Adda holé is much higher when compared to that of Kempu holé river which is subjected to a lot of anthropological activities such as construction of highway alongside the river, vehicular movement, construction of dams and water logging. It was found that the Adda holé with its numerous tributaries in the region plays a very important role in in-situ conservation of endemic ornamental fishes of the region.

Photographs of different stream types:

Run

Riffle

Pool

Flow

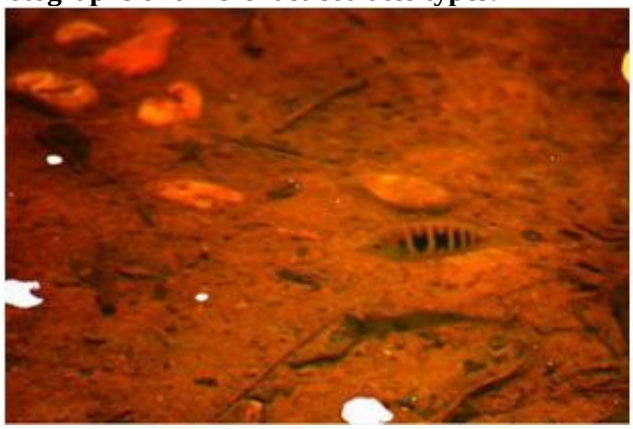
Cascades

Falls

Rapids

Torrential

Photographs of different substrates types:



Sand

Fine sand

Rocky

Cobble

Boulder

Bedrock

Leaf litter

Table 1: Order and family wise classification and IUCN status of fishes in *Adda holé* and *Kempu holé* river

S. No	Common Name	Scientific name	Order	Family	IUCN status
1	Indian longfin eel	*Anguilla bengalensis* (Gray, 1831)	Anguilliformes	Anguillidae	**NT**
2	Freshwater gar fish	*Xenentodon cancila* (Hamilton, 1822)	Beloniformes	Belonidae	LC
3	Jerdon's Baril	*Barilius canarensis (*Jerdon, 1849)	Cypriniformes	Cyprinidae	**EN**
4	Western Ghats loach	*Bhavania australis* (Jerdon, 1849)	Cypriniformes	Balitoridae	LC
5	Exclamation barb	*Dawkinsia filamentosa* (Valenciennes, 1844)	Cypriniformes	Cyprinidae	**EN**
6	Giant danio	*Devario aequipinnatus* (McClelland, 1839)	Cypriniformes	Cyprinidae	LC
7	Stone sucker	*Garra mullya* (Sykes, 1839)	Cypriniformes	Cyprinidae	LC
8	Melon barb	*Haludaria fasciatus* (Jerdon, 1849)	Cypriniformes	Cyprinidae	LC
9	-	*Mesonoemacheilus petrubanarescui* (Menon, 1984)	Cypriniformes	Nemacheilidae	**EN**
10	Zodiac loach	*Mesonoemacheilus triangularis* (Day, 1865)	Cypriniformes	Nemacheilidae	LC
11	Narayani barb	*Pethia setnai* (Hora, 1937)	Cypriniformes	Cyprinidae	LC
12	Blackline rasbora	*Rasbora daniconius* (Hamilton, 1822)	Cypriniformes	Cyprinidae	LC
13	Razorbelly minnow	*Salmophasia boopis* (Day, 1874)	Cypriniformes	Cyprinidae	LC
14	Denisoni loach	*Schistura denisoni* (Day, 1867)	Cypriniformes	Nemacheilidae	LC
15	Striped panchax/ Killi fish	*Aplocheilus lineatus* (Valenciennes, 1846)	Cyprinodontiformes	Aplocheilidae	LC
16	Dwarf snake-head	*Channa gachua* (Hamilton, 1822)	Perciformes	Channidae	LC
17	Canara pearlspot	*Etroplus canarensis* (Day, 1877)	Perciformes	Cichlidae	**EN**
18	Indian glassy fish	*Parambassis ranga* (Hamilton, 1822)	Perciformes	Ambassidae	LC
19	Malabar leaf fish	*Pristolepis marginata* (Jerdon, 1849)	Perciformes	Nandidae	LC
20	-	*Mystus irulu* (Vijayakrishnan and Praveenraj, 2022)	Siluriformes	Bagridae	**Not Evaluated**
21	Wynaad mystus	*Mystus montanus* (Jerdon, 1849)	Siluriformes	Bagridae	LC
22	Freshwater cat fish	*Pseudolaguvia lapillicola* (Britz, Ali & Raghavan, 2013)	Siluriformes	Sisoridae	**Not Evaluated**
23	Spiny eel	*Mastacembelus armatus* (Lacépède, 1800)	Synbranchiformes	Mastacembelidae	LC
24	Dwarf puffer	*Carinotetraodon imitator* (Britz & Kottelat, 1999)	Tetraodontiformes	Tetraodontidae	**DD**

(DD-Data Deficient, LC-Least Concern, NT-Near Threatened, VU-Vulnerable, EN-Endangered)

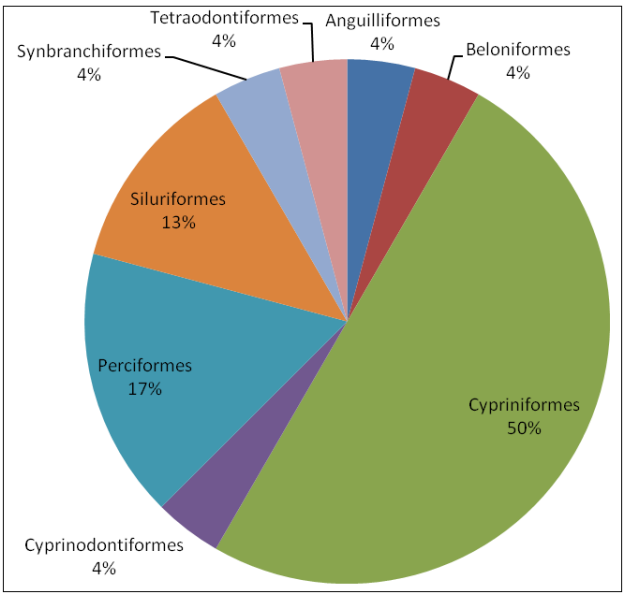


Figure 1: Order wise distribution of fishes in study area

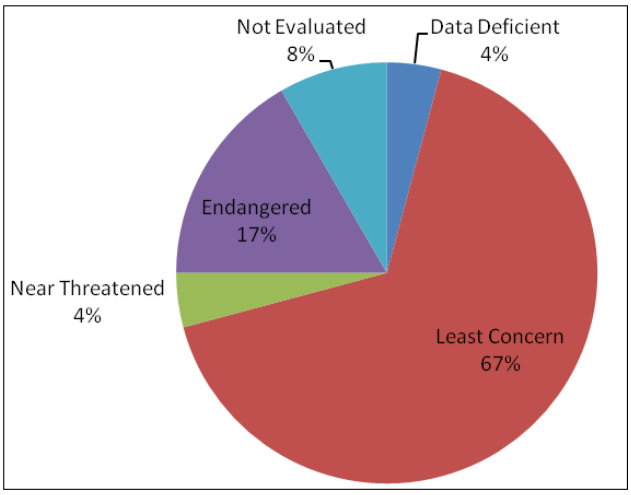


Figure 2: IUCN Threat status of fishes found in study area

Table 2: Fish availibility status in *Adda holé* and *Kempu holé*.

S. No	Scientific name	Status
1	*Anguilla bengalensis* (Gray, 1831)	Rare
2	*Xenentodon cancila* (Hamilton, 1822)	Moderate
3	*Barilius canarensis (*Jerdon, 1849)	Abundant
4	*Bhavania australis* (Jerdon, 1849)	Moderate
5	*Dawkinsia filamentosa* (Valenciennes, 1844)	Common
6	*Devario aequipinnatus* (McClelland, 1839)	Common
7	*Garra mullya* (Sykes, 1839)	Abundant
8	*Haludaria fasciatus* (Jerdon, 1849)	Abundant
9	*Mesonoemacheilus petrubanarescui* (Menon, 1984)	Moderate
10	*Mesonoemacheilus triangularis* (Day, 1865)	Moderate
11	*Pethia setnai* (Hora, 1937)	Moderate
12	*Rasbora daniconius* (Hamilton, 1822)	Abundant
13	*Salmophasia boopis* (Day, 1874)	Rare
14	*Schistura denisoni* (Day, 1867)	Common
15	*Aplocheilus lineatus* (Valenciennes, 1846)	Moderate
16	*Channa gachua* (Hamilton, 1822)	Common
17	*Etroplus canarensis* (Day, 1877)	Moderate
18	*Parambassis ranga* (Hamilton, 1822)	Moderate
19	*Pristolepis marginata* (Jerdon, 1849)	Common
20	*Mystus irulu* (Vijayakrishnan and Praveenraj, 2022)	Rare
21	*Mystus montanus* (Jerdon, 1849)	Moderate
22	*Pseudolaguvia lapillicola* (Britz, Ali & Raghavan, 2013)	Rare
23	*Mastacembelus armatus* (Lacépède, 1800)	Moderate
24	*Carinotetraodon imitator* (Britz & Kottelat, 1999)	Moderate

Table 3 (a): Fish distribution as per water flow regime

S. No	Scientific name	Pool	Flow	Run	Riffle	Cascade	Fall	Rapid
1	*Anguilla bengalensis (Gray, 1831)*	+	-	-	-	-	-	-
2	*Xenentodon cancila (Hamilton, 1822)*	+	+	+	-	-	-	+
3	*Barilius canarensis (Jerdon, 1849)*	+	+	+	-	-	-	-
4	*Bhavania australis (Jerdon, 1849)*	-	-	-	+	+	-	-
5	*Dawkinsia filamentosa (Valenciennes, 1844)*	+	+	+	-	-	-	-
6	*Devario aequipinniatus (McClelland, 1839)*	+	+	+	-	-	-	-
7	*Garra mullya (Sykes, 1839)*	-	-	-	+	+	+	-
8	*Haludaria fasciatus (Jerdon, 1849)*	+	+	+	-	-	-	-
9	*Mesonoemacheilus petrubanarescui (Menon, 1984)*	+	+	+	-	-	-	-
10	*Mesonoemacheilus triangularis (Day, 1865)*	+	+	+	-	-	-	-
11	*Pethia narayani (Hora, 1937)*	+	+	+	-	-	-	-
12	*Rasbora daniconius (Hamilton, 1822)*	+	+	+	-	-	-	-
13	*Salmophasia boopis (Day, 1874)*	-	+	+	+	-	-	-
14	*Schistura denisoni (Day, 1867)*	+	+	+	-	-	-	-

15	*Aplocheilus lineatus (Valenciennes, 1846)*	+	+	-	-	-	-	-
16	*Channa gachua (Hamilton, 1822)*	+	+	-	-	-	-	-
17	*Etroplus canarensis (Day, 1877)*	+	+	+	-	-	-	-
18	*Parambassis ranga (Hamilton, 1822)*	+	+	+	-	-	-	-
19	*Pristolepis marginata (Jerdon, 1849)*	+	+	+	-	-	-	-
20	*Mystus irulu (Vijayakrishnan and Praveenraj, 2022)*	+	+	+	-	-	-	-
21	*Mystus montanus (Jerdon, 1849)*	+	+	+	-	-	-	-
22	*Pseudolaguvia lapillicola (Britz, Ali & Raghavan, 2013)*	+	+	+	-	-	-	-
23	*Mastacembelus armatus (Lacépède, 1800)*	+	+	+	+	+	-	-
24	*Carinotetraodon imitator (Britz & Kottelat, 1999)*	+	+	+	-	-	-	-
	Total	21	21	19	4	3	1	1

Table 3 (b): Number of fishes assessed according to water flow regime.

River flow regime	Species observed
Pool & Flow	3
Pool, Flow & Run	16
Riffle & Cascade	1
Flow, Run & Riffle	1
Riffle, Cascade & Fall	1
Pool, flow, Run & Rapid	1
Pool, flow, Run, Riffle, Cascade & Rapid	1

Table 4: Substrate wise availabilty of fishes

Sl. No	Scientific name	Sand	Fine sand	Rock	Gravel	Cobble	Boulder	Leaf litter	Bedrock
1	*Anguilla bengalensis (Gray, 1831)*	+	+	-	+	-	+	-	+
2	*Xenentodon cancila (Hamilton, 1822)*	+	+	+	+	+	-	+	-
3	*Barilius canarensis (Jerdon, 1849)*	+	+	+	+	+	-	+	-
4	*Bhavania australis (Jerdon, 1849)*	-	-	+	+	+	-	-	+
5	*Dawkinsia filamentosa (Valenciennes, 1844)*	+	+	+	+	+	-	+	-
6	*Devario aequipinniatus (McClelland, 1839)*	+	+	+	+	+	-	+	-
7	*Garra mullya (Sykes, 1839)*	-	-	+	+	+	+	-	+
8	*Haludaria fasciatus (Jerdon, 1849)*	+	+	+	+	+	-	+	-
9	*Mesonoemacheilus petrubanarescui (Menon, 1984)*	+	+	+	+	+	-	-	-
10	*Mesonoemacheilus triangularis (Day, 1865)*	+	+	+	+	+	-	-	-
11	*Pethia narayani (Hora, 1937)*	+	+	+	+	+	-	+	-
12	*Rasbora daniconius (Hamilton, 1822)*	+	+	+	+	+	-	+	-
13	*Salmophasia boopis (Day, 1874)*	+	+	+	+	+	-	+	-
14	*Schistura denisoni (Day, 1867)*	+	+	+	+	+	-	-	-
15	*Aplocheilus lineatus (Valenciennes, 1846)*	+	+	+	+	+	-	+	-
16	*Channa gachua (Hamilton, 1822)*	+	+	+	+	+	-	+	-
17	*Etroplus canarensis (Day, 1877)*	+	+	+	+	+	-	+	-
18	*Parambassis ranga (Hamilton, 1822)*	+	+	+	+	+	-	+	-
19	*Pristolepis marginata (Jerdon, 1849)*	+	+	+	+	+	-	+	-
20	*Mystus irulu (Vijayakrishnan and Praveenraj, 2022)*	+	+	+	+	+	-	+	-
21	*Mystus montanus (Jerdon, 1849)*	+	+	+	+	+	-	+	-
22	*Pseudolaguvia lapillicola (Britz, Ali & Raghavan, 2013)*	+	+	+	+	+	-	+	-
23	*Mastacembelus armatus (Lacépède, 1800)*	+	+	+	+	+	-	-	-
24	*Carinotetraodon imitator (Britz & Kottelat, 1999)*	+	+	+	+	+	-	+	-
	Total	22	22	23	24	23	2	17	3

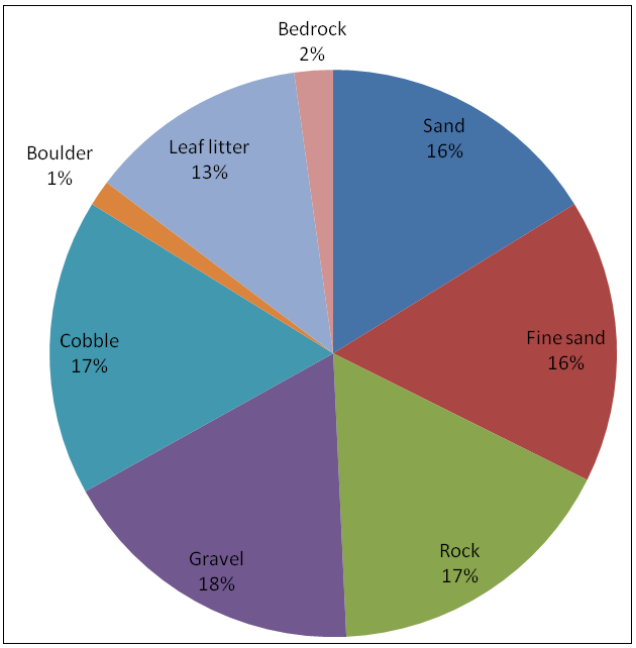


Figure 3: Substrate wise availabiltiy of fishes in percentage

Photographs:

Rasbora daniconius

Garra mullya

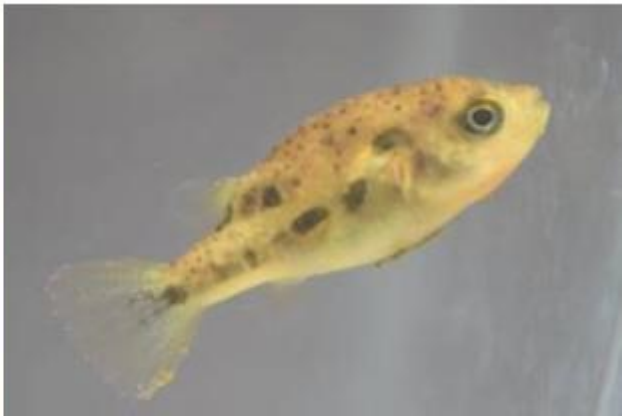
Etroplus canarensis

Xenentodon cancila (Photo credit – Vidyadhar Atkore)

Channa gachua

Parambassis ranga

Schistura denisoni



Carinotetraodon imitator

Devario aequipinnatus

Aplocheilus lineatus

Pseudolaguvia lapillicola (Photo credit – Ralf Britz)

Barilius canarensis

Anguilla benghalensis

Mastacembelus armatus

Salmophasia boopis

Mystus montanus

Mesonoemacheilus triangularis

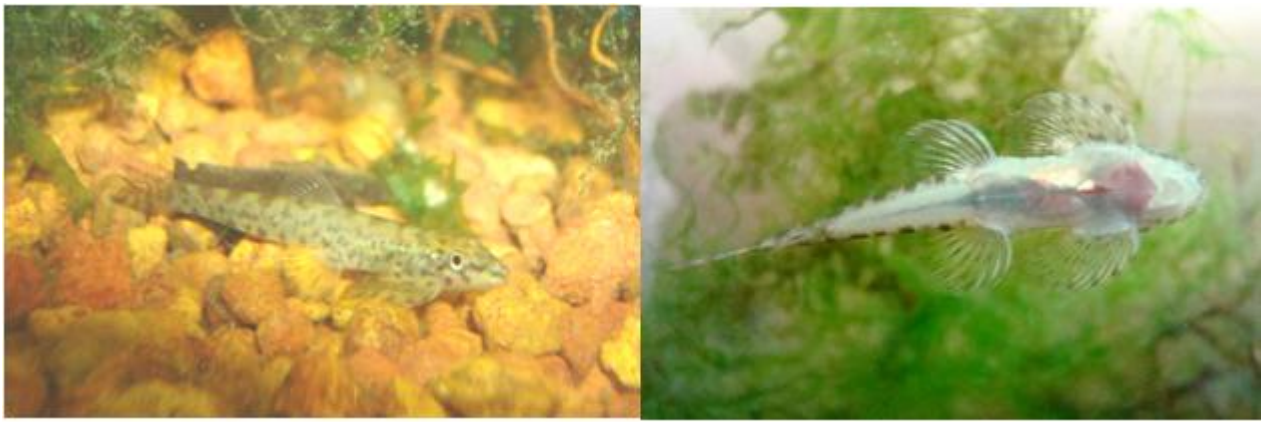
Mesonoemacheilus petrubanarescui

Pristolepis marginata

Pethia narayani

Dawkinsia filamentosa

Haludaria fasciatus



Bhavania australis

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