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RESEARCH ARTICLE

FISH DIVERSITY OF TUNGABHADRA RIVER IN HARIHAR TALUK, DAVANAGERE DISTRICT, KARNATAKA, INDIA

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ABSTRACT

The present paper was attempted to study the fish diversity in Tungabhadra River at Harihar Taluk, Davanagere District, Karnataka. The study was conducted for a period of three months from December 2022 to February 2023. The investigation was carried out to study the distribution and characteristics of the collected fish species and to determine the water quality parameters in the study area. The results revealed that the presence of 31 fish species belongs to 05 order and 10 families were reported in the study area. The Order Cypriniformes was dominant (14 species) followed by Siluriformes (9 species), Perciformes (6 species), Osteoglossiformes (1 species) and Synbranchiformes (1species).Hence,the study of water quality parameters and fish diversity cautions for proper utilization fisheries, monitoring, conservation and management of natural resources policies of aquatic environments in the region.

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INTRODUCTION

In developing countries such as India, Bangladesh, Myanmar and Nepal, fish constitutes one of the main food items of sustenance for many people. According to Fish Base about 34,800 different type of fish species had been described as of February 2022 which is more than the combined total of all other vertebrate species like: Mammals, Amphibians, Reptiles and Birds. These are vertebrate animals (Phylum Chordata). Fish diversity is roughly divided equally between marine (oceanic) and freshwater ecosystem of the world. The world over 21,723 are living species of fish of which 8,411 are of freshwater and 11,650 marine species. In India region alone of 2,500 species, 930 are freshwater inhabitants and 1,570 are marine. Fish make a major contribution to their ecosystem providing essential nutrients that support the whole ecosystem. Fish are excellent recyclers of the nutrients that algae and other bottom-level species need to survive that in turn support the remainder of the ecosystem. India is the second major largest fish producing country through aquaculture in the world after China. Fish diversity represents the fish's faunal verity, occurrence, distribution, abundance and conservation fish species and it also prop up the commercial fisheries in riverine ecosystems. Fish constituted about 10% of total exports from India and almost 20% of agriculture exports during 2017-18.

The fisheries and aquaculture production contribute around 1% to India's GDP and over 5% to the agricultural GDP. More than 25% of world dietary protein is provided by the fish. Fish is a low-fat high-quality protein**.** Fishes are an excellent to be consider as sources of high amount of proteins content and an important food source for human-beings with supplying proteins and it also provides essential amino acids, long-chain omega-3 fatty acids, vitamins A, B2 and D and various other nutrient required for nourishment and growth of man which are important in the daily life. Fish species are not only an important indicator of ecological health of an aquatic ecosystem and abundance but also maintain a balance in the food chain by consuming plankton, small animals and form food for many animals. This balance in the food chain may be affected due to pollution in aquatic system. This adverse effect of anthropogenic activities has resulted in degrading water quality of stream and riverine ecosystem. The river system has been largely influenced by human activities such as agriculture, mining, discharge of sewage from towns and cities along the stretch of the river. The major industrial activities on the Tungabhadra River System are Harihar Polyfibre Industries and Sugar Industries at Davanagere District and Mining Activities at Hospet. It has been believed that fishes and their rich diversity and dominance in the river indicates the cleanliness of water. In addition, to this important biological resource are under threats of extinction to the fish diversity due to the construction of dams, which block the spawning migrations and introduction of exotic species.

Therefore, knowing the status of fish fauna is indispensable to prevent the loss of particular species. Knowledge of available information and the biological characters of fish species provide the first-hand information for further conservation aspects. However, the present study about the fish diversity in Tungabhadra River of Karnataka is lacking. Hence, the present investigation was aimed to encounter the fish diversity in selected sites of Tungabhadra River system at Harihar Taluk, Davanagere district of Karnataka and to sustain the fishery resource to suggest water quality status.

REVIEW OF LITERATURE

- The studies on the fish diversity of the Tungabhadra River have been undertaken by many researchers. According to the Survey of Fisheries in the Tungabhadra River, the first study on the fish diversity of Tungabhadra River was carried out by Chacko et al., (1948): Who reported more than 89 species after a comprehensive study in a stretch of the Tungabhadra River. A survey of the fluvial fisheries of the Tungabhadra River with special reference to the breeding and nursery areas of the major food fishes has been conducted.
- According to the research study by Gangadhara et al., (2015): The fish species were collected from selected stations along the stretch of Tunga, Bhadra and Tungabhadra Rivers. The multimeric Index of Biotic Integrity (IBI) method was used to integrate the data from individual, population assemblage and ecosystem levels are transformed into a single numerical indicator and quality rating for water. A total of 34, 42 and 48 fish species have been recorded in Tunga, Bhadra and Tungabhadra rivers, respectively. The species belong to the order Cypriniforms was found to be most dominant followed by the order Siluriformes, Perciformes, Osteoglossiformes, Synbranchiformes, Beloniformes and Cyprinodontiformes.
- The fish diversity indicates the health condition of aquatic ecosystem and represents the balanced ecosystem. The present study was conducted for a period of one year by Shivaraju et al., (2018): In Durgadahalli Lake which is in the north-east of Tumakuru district. The present report on fish diversity is of its first kind in Durgadahalli lake. A total of 10 species of fishes belonging to 09 genera, 03 families and 02 orders were recorded from the lake. The order Cypriniformes (80%) was found to be dominant followed by Perciformes (20%) among fish assemblage. All the fish species recorded were of commercial importance.
- According to the research study by Narasimh et al., (2016), fish study of the Seeta River in Udupi district, Karnataka, Western Ghat, an attempt has been made to understand the diversity of freshwater fishes in Seta river. A total number of 20 species belonging to 11 different families was identified from 05 different stations of the river. The study provides an overall view of all such information to understand the availability of the fishes in the Seeta river.
- According to the research study on fish diversity has been conducted in the year 2022 by Bhushan et al., who reported 76 species fishes that are naturally occurring in Tungabhadra reservoir. The present data may serve as baseline information for any future studies as it will allow fisheries specialists & administrators to evaluate the impact of future culture enhancements on reservoir fisheries production and its yield.
- The fish diversity and abundance of three lentic water bodies (Sogane Tank, Navule Tank and Tunga Reservoir) were studied by Naik et al., (2015):In this study, Sogane tank hold up 16 fish species related to 05 orders, 08 families and 11 genera. While,Navule tank supported 13 fish species belonging to 03 orders, 06 families and 12 genera. However, Tunga reservoir exibits 32 fish species belonging to 06 orders, 11 families and 18 genera. Cyprinidae was found to be dominant among all the water ecosystems.

AIM OF THE STUDY

- To study the diversity of the fish species in the study area.
- To study the distribution, characteristics and IUCN status of the collected fish species.
- To determine the water quality parameters of the study area.
- To evaluate the threats to the fish and to suggest strategies for conservation of natural resource.

MATERIALS AND METHODS

Study Area: The river Tungabhadra is a river in southern India, which starts and flow through the state of Karnataka during most of its course before flowing along the border between Karnataka, Telangana and Andra Pradesh. For about 15˚ 53′ 19.31" N latitude to 78˚09′ 51.45"E longitude (Figure 1). The Tungabhadra River is originated by the confluence of two small seasonal Rivers Tunga and Bhadra. The river take birth in the vicinity of Varaha Paravatha at Gangamoola, Mudigere Taluk of Chikkamagalore District. Both the river joins at Koodli Sangama near Shimoga District**.** Then it is named as TUNGABHADRA after the confluence the mightily Tungabhadra River flows through Honnali and Harihar Taluks of Davanagere District. Then it flows through Harapanahalli, Hoovina-Hadagali, Hagaribommanhalli, Hospet and Sriuguppa taluk of Bellary District. It runs for about 531km (330 miles) and covers the catchment area of the river is 69,552 sq km till it joins river Krishna near Gundimalla village in Jogulamba Gadwai district of Telangana and at Sangamaleshwaram in Andra Pradesh.

Study Station and Duration: For the present investigation the Harihar station (Fig. 2) were selected based on the human activities, urbanization and industrial activities. During the period of December 2022 to February 2023, the fish samples were collected at regular intervals of 15 days in the Harihar station for three months.

LOCATIONS

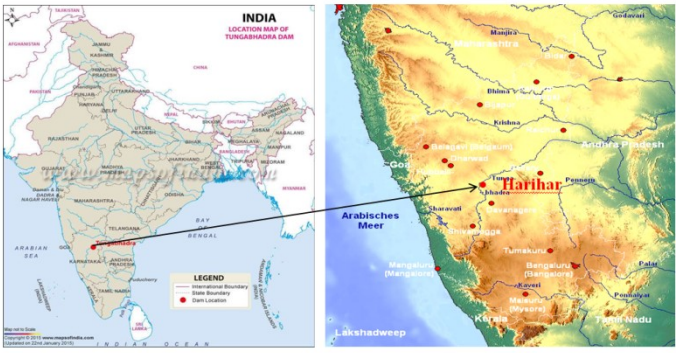

Figure 1. Map indicates location of sampling station of the River Tungabhadra in Harihar at Davanagere District

Figure 2. Showing the study area of sampling stations in Tungabhadra River at Harihar

Methodology

Fish Sampling: The fish samples were collected from selected points along the of Tungabhadra River in Harihar Taluk at Davanagere District (Fig. 2). The selected site was surveyed by walking and following guidelines of fisheries department.

The fish sampling was done monthly twice with the help of local fishermen using different methods and types of Nets: Fishing Gears, Gill Netting, Nylon Fishing Nets, Drag Nets, Bait Fishing-Casting, Spinning Fishing, Hook and line etc. The Fishing traps locally knows as Bidubale, Bale, Bisubale, Gana.

Different Types of Fishing Nets

Nylon Fishing Net

Gill Netting

Nylon Fishing Net Gill Netting: Immediately photography was made prior to preservation since formalin decolorizes the fish on long preservation. The collected fishes were preserved in 5-7% formalin solution and transported to laboratory. Fishes brought to the laboratory for identification. The Fishes brought to the laboratory were fixed in this solution in separate jars according to the size of fish species. Smaller fishes were directly placed in the formalin solution while, larger fishes were given an incision on the abdomen before they were fixed. The fishes collected, identified and labeled them with common local name of fish used in the region was labeled in each jar.

Identification of Fishes: Identification of the collected species was based on some external characteristics that metamorphose fish such as body shape, shape of their heads, length, position of mouth, nature of fish spines, location and average adult size etc. And vertical scales, fin type, color markings, colour pattern, stripes or fin spots, may also help differentiate fish when used in combination with other factors including geographic range. Identification was done based on the keys for fishes of the Indian Subcontinent (Hamilton, 1822; Linnaeus, 1758; Jerdon, 1849; Peters, 1852; Bloch & Schneider, 1801; Burchell, 1822; Bloch, 1794; Pallas, 1769; Day, 1870; Lacepede, 1800; Sykes, 1839).

Water Sample Collection for Physico-Chemical Analysis: The surface water samples were collected in polythene can from sampling station of Tungabhadra River at Harihar. Collected water samples were processed for determination of pH, colour, odour, water temperature on the spot itself. The samples were transported to the Environmental Health and Safety Research and development, Central laboratory for further parameters such as DO, Free CO_2, BOD, Total Hardness, Iron, Calcium, Sulphate, Total Suspended Solids, E-coli, Specific conductivity were analyzed other parameters using standard procedures APHA (1905) 23rd Edition.

RESULT AND DISCUSSION

In the present investigation the different species diversity of fish was encountered in Tungabhadra River near Harihar has given in the Table 1. During the study a total of 31 species of freshwater fishes belonging to 05 order and 10 families were reported from the sampling site. The Order Cypriniformes was dominant (14 species) followed by Siluriformes (9 species), Perciformes (6 species), Osteoglossiformes (1 species) and Synbranchiformes (1species). The order of dominance and percentage composition of species is given in the Table 1. (Fig 1 & 2). The fish diversity of Tungabhadra River comprises 10 families namely; Notopteridae, Cyprinidae, Bagridae, Siluridae, Sisoridas. Clariidae, Mastacembelidae, Cichlidae, Gobiidae, Channidae. During the study, number of families, dominance and percentage composition of species in the given Table 1. (Fig 3 & 4). Out of 31 fish species found in Tungabhadra River, 14 species belong to the family cyprinidae and also called as common carp group. The family Cyprinidae was represented by the carps: *Labeo rohita, Gibelion catla, Cirrhinus mrigala, Labeo calbasu, Labeo Fimbriatus, Pethia ticto, puntius pulchellus, Cirrhinus reba, Osteobrama Vigrosii, Systomus sarana, Hypselobarbus kolus, Garra stenorhynchus, Cyprinus carpio and Hypophthalmichthys molitrix.* The family Cichlidae was represented by 2 species: *Etroplus maculatus* and *Oreochromis mossambica.*

Among the catfishes: The family Bagridae was represented by 5 species: *Rita gogra, Mystus cavasius, Mystus vittstus, Sperata aor, Sperata seenghala*. The Family Siluridae was represented by 2 species: *Ompok bimaculatus* and *Wallago attu*. The family Sisoridas was represented by 1 species: *Bagarius yareli*. The family claridae was represented by 1 species: *Clarias garipinus*. Among the Snakehead fishes:

The family Channidae was represented by 3 species: *Channa maraulius, Channa striatua* and *Channa Orientalis*. The family Mastacembelidae was represented by 1 species: *Mastacembelus armatnus*. The family Gobidae was represented by 1 species: *Glossogobius giuris.* Among the family feather back fishes the family Notopteridae was represented by 1 species: *Notopterus notopterus*. As far as diversity status (IUCN Red- list 2018) is concerned, out of 31 fish species, 23 fish species are categorized into Least concern (LC), 01 Vulnerable (Vu), 01 Critically Endangered (CE), 01 Endangered (End), 03 Near Threatened (NT), 01 Rare (RR), 01 Not Evaluated (NE) respectively given the Table 1 (Fig.5).

Note

- **Least concern (LC):** A taxon is in the least concern category when it has been evaluated and does not qualify for any of the threatened category.
- **Vulnerable (Vu):** A taxon is vulnerable when it is not critically endangered, but it is facing high risk of extinction in the wild in the near future.
- **Critically Endangered (CE):** A taxon is critically endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (End):** A taxon is endangered when it is not critically evaluated / assessed, but it is facing a very high risk of extinction in the near future.
- **Near Threatened (NT):** A taxon is near threatened category when it is not – Critically Endangered or Endangered but is facing a very High Risk of Extinction in the Near Future.
- **Not Evaluated (NE):** A taxon is not evaluated when it has not yet been assessed against the criteria.
- **Rare (RR):** It is not being cultured presently.

Water Quality Parameters: The details of the physical and biological features, as observed and have been appended in the following format. The Physico-chemical variations of the water of the Tungabhadra River is given in Table 2. The air temperature recorded at the site on the day of sampling stood at 28.1^0C and of water, it was 26.7^0C. Colour and odour of the Medium imparted slight turbidity and its was odourless. Turbidity value 3.03 NTU indicates that the medium. The pH values recorded in the present instance being 7.32 appears normal to sustain the aquatic life inhabiting the system. Dissolved Oxygen (DO) is an important indicator of water quality.

A good production of water should have dissolved oxygen concentration more than 5.00 mg/l and the DO ranged 5.5 mg/l in the Tungabhadra River. The Total Hardness was 57 mg/l and Alkalinity ranged 51 mg/l. The total hardness and alkalinity both the value is moderate. In the present study carried out some other parameters such as Nitrate (2.97mg/l), Calcium (12.8mg/l), Potassium –(1.6mg/l), Magnesium (6.07mg/l), Chloride (60.17mg/l) Sulphate (11.36mg/l, Fluoride(0.19mg/l), BOD (2.2mg/l), COD (8.0mg/l), Specific Conductivity (362s/cm), Total Suspended solids is 6mg/l and total dissolved solid ranged 245mg/l. The faecal coliform count is between the desirable limit of 500 and maximum permissible limit of 2,500 mpn (Most Probable Number) per 100ml. Total coliform-1700 mpn/100ml, fecal coliform-120mpn/100mland E-coli value is 11 mpn/100ml.

Table 1. Systematic list of the fish species recorded from the Tungabhadra River at Harihar, Davanagere District, Karnataka State

Sl No.	Scientific Name	English Name	Local Name	IUCN Status	Size attains (mm)
	Superclass: Gnathostomata Class: Actinopterygii Subclass: Neopterygii Division: Teleostei I. Order: Osteoglossiformes I. Family: NOTOPTERIDAE				
1.	Notopterusnotopterus	Gray Featherback	Chamari, PappariChappalimeenu	LC	210
	II. Order: Cypriniformes II. Family: CYPRINIDAE				
2.	Labeorohita	Rohu	Rohu	RR	2000
3.	Gibelioncalta	Calta	Katla, Doddagende	VU	1820
4.	Cirrhinusmrigala	Mrigal	Mrigala	LC	990
5.	Labeo calbasu	Calbasu	Kagemeenu, keddallu	CR	920
6.	Labeofimbriatus	Fimbriatus	Kem-meenu	LC	460
7.	Osteobramavigorsii	Bheema Osteobrama	Parkemeenu	LC	230
8.	Puntius pulchellus	Pulchellus	Harige, Hullugende	LC	780
9.	Systomussarana	Olive Barb	Gende, Kijan	LC	300
10.	Hypselobarbuskolus	Kolus	Kolacha	LC	300
11.	Cirrhinus reba	Reba	Arjameenu	LC	300
12.	Cyprinus carpio	Common Carp	Gowri	LC	1200
13.	Hypophthalmichthys molitrix	Silvercarp	Belligende	LC	825
14.	Garrastenorhynchus	Nilgiris	Kallumattu	LC	155
15.	Pethiaticto	Ticto Barb	Bud-pakke	LC	100
	III. Order: Siluriformes III. Family: BAGRIDAE				
16.	Rita gogra	Deccan Rita	Kantaka	LC	260
17.	Mystuscavasius	Gangetic Mystus	Misegirlu	LC	400
18.	Mystusvittatus	Striped Dwarf Catfish	Girlu	LC	200
19.	Hemibagrusmaydelli	Krishna Mystus	Haddumeenu	LC	1800
20.	Sperataaor	Giant River Catfish	Thoragimeenu	LC	1500
	IV.Family: SILURIDAE				
21.	Ompokbimaculatus	Butterfish	Godle	NT	450
22.	Wallago attu	Freshwater Shark	Balemeenu	NT	2400
	V. Family: SISORIDAS				
23.	Bagariusyareli	Goonch	Kuldi, Kurudimeenu	End	23,000
	VI. Family: CLARIDAE				
24.	Clarias garipinus	African Catfish	Ane-meenu	LC	1770
	IV.Order: Synbranchiformes **VII. Family: MASTACEMBELIDAE**				
25.	Mastacembelusarmatnus	Spiny Eel	Havumeenu	LC	900
	V. Order: Perciformes **VIII. Family: CICHLIDAE**				
26.	Etroplus maculatus	Orange Chromid	Alapimeenu, Belli	LC	76
27.	Oreochromis mossambica	Tilapia	Tilapia	NT	380
	IX. Family: GOBIIDAE				
28.	Glossogobiusgiuris	Tank Goby	Bhangi-sidda	LC	230
	X. Family:CHANNIDAE				
29.	Channa marulius	Murrel, GaintSnake-Head	Avulumeenu	LC	1830
30.	Channa orientalis	Asiatic Snake-Head	Mottu, Hole – Korava	NE	330
31.	Channa striatus	Stripped Snake-Head	Kuchhu, Kandu	LC	920

LC - Least concern, Vu - Vulnerable,CE - Critically Endangered,End- Endangered, NT - Near Threatened,NE -Not Evaluated, RR - Rare.

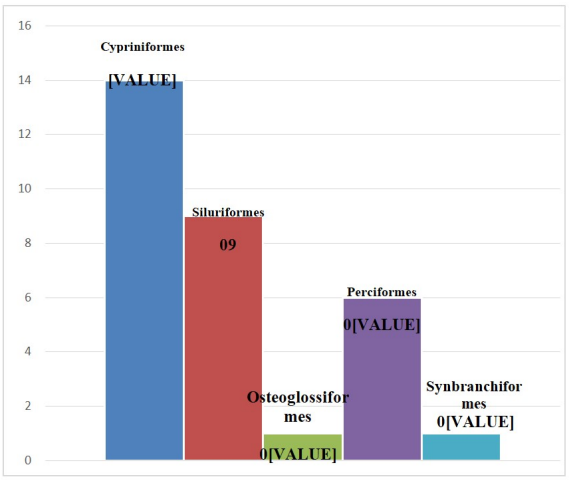

Fig. 1. Order wise fish species composition number of Tungabhadra River

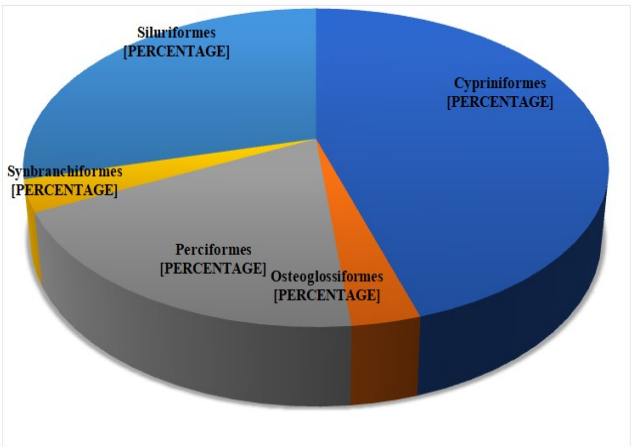

Fig. 2. Order wise fish species composition percentage of Tungabhadra River. Tungabhadra River

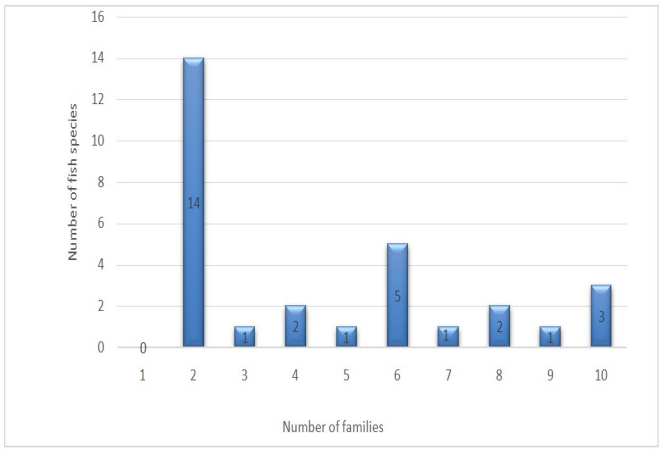

Fig. 3. Number of fish Families species composition in Tungabhadra River

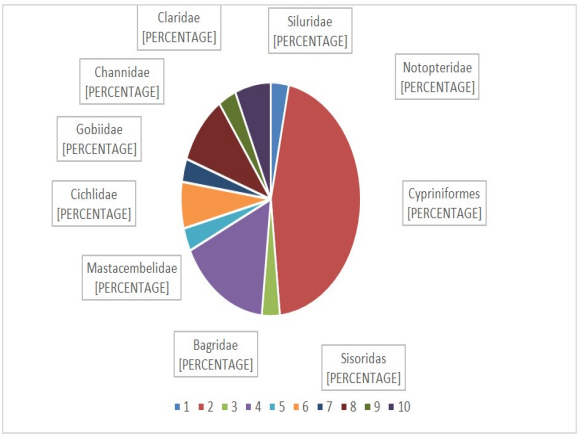

Fig.4.Percentage of fish Families species composition in Tungabhadra River

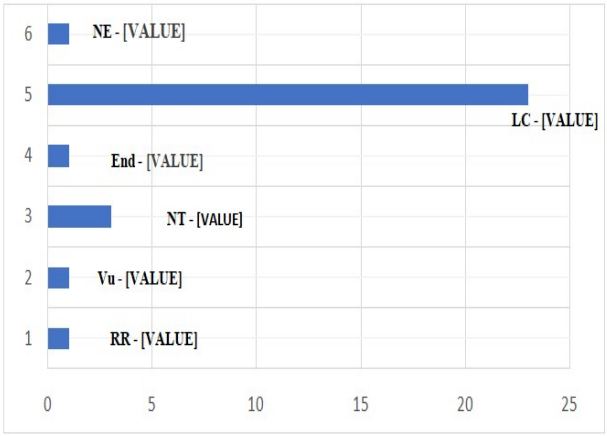

Fig. 5. Biodiversity status (IUCN- 2018) of fishes of Tungabhadra River

Table 2. Physico- chemical parameters of the water quality of Tungabhadra River at Harihar, Davanagere District, Karnataka State

Sl.no	Parameters	Unit	Test Methods	Results
1.	Colour	Hazen	ISM3025(Part 4):1983	< 1
2.	Odour	--	ISM3025(Part 5):1983	Agreeable
3.	pH	--	APHA 4500H^+ B	7.32
4.	Temperature	^{0}C	APHA 2550 B	26.7
5.	Turbidity	NTU	APHA 2130 B	3.03
6.	Dissolved Oxygen	mg/L	APHA4500-O C	5.5
7.	Dissolved Phosphate	mg/L	APHA 4500-P D	0.12
8.	Free Carbon dioxide	mg/L	APHA 4500-C O_2	BDL
9.	Free Ammonia	mg/L	APHA 4500-NH_3 F	BDL
10.	Silica (SiO_2)	mg/L	APHA 4500-SiO_2 C	BDL
11.	Total Hardness ($CaCo_3$)	mg/L	APHA 2340 C	57
12.	Total Alkalinity	mg/L	APHA 2320 B	51
13.	Nitrate (NO_3)	mg/L	APHA 4500-NO_3 E	2.97
14.	Iron (Fe)	mg/L	IS 3025 (Part 2): 2004 RA 2019	BDL
15.	Calcium (Ca)	mg/L	APHA 3500-Ca	12.8
16.	Potassium (K)	mg/L	APHA 3500-K	1.6
17.	Magnesium (Mg)	mg/L	APHA 3500 Mg B	6.07
18.	Chloride (Cl)	mg/L	APHA 4500-Cl-B	60.17
19.	Sulphate (SO_4)	mg/L	APHA 4500-SO_4^{2-}E	11.36
20.	Fluoride (F)	mg/L	APHA 4500F D	0.19
21.	BOD (3 Days @ 27^{0}C)	mg/L	APHA 5210 B	2.2
22.	COD	mg/L	APHA 5220 B	8.0
23.	Specific Conductivity	μs/cm	APHA 2510 B	362
24.	Total Suspended Solids	mg/L	APHA 2540 D	6
25.	Total Dissolved Solids	mg/L	APHA 2540 C	245
26.	Total coliform	MPN INDEX/100ml	APHA 9221 B	1700
27.	Fecal Coliform		APHA 9221 E	120
28.	E-coli		APHA 9221 F	11

Significance of fishes

- A soup made from Notopterus fish it is reported to be given to people with measles (Viral Disease Affecting Humans).
- Rohu also plays significant role in developing eyesight and preventing night blindness. The antioxidants found in rohu helps to fight cancer.
- Retinol is a type of Vitamin A. It has been known to lower the symptoms of rheumatoid arthritis. Catla fish is good for the nervous system. Some people also believe it guards us against bowel infection.
- The Silver Carp fish were imported to the North America in the 1970s for controlling algae growth in aquaculture and municipal wastewater treatment facilities.
- *Rita gogra* is important as a rich source of protein, essential amino acids (leucine, phenylalanine, glutamic acid) and micro elements (Zn, Fe).
- *Bagarius yarrelli* are harvested heavily in different parts of its range as food fish and for ornamental trade and as sport fish (IUCN 2010). It is low in sodium, a good source of thiamin, potassium and selenium and a very good source of protein, vitamin D, Vitamin B12 and phosphorous.
- *Channa marulius*is used as medicinal properties like antilithiotic, chemo preventive, anti-oxidant and antiepileptic potential. Other folk uses include treatment of ulcers and wound healing properties, pain reliever and energy booster to include its properties as ACE- Inhibitor and neuro regenerative agent.
- The omega-3 fatty acids in tilapia fish have been linked to lower risk of heart diseases. Omega-3 fatty acids are also good for the brain. Consuming tilapia fish is good for bone health because it contains good amount of phosphorus. Tilapia fish is high in the antioxidant selenium which has many health benefits.

Expected outcome from the proposed work

- The present study enlightens the diversity, richness and their status of the fish species in the study area. It also identifies as fishes belonging to the family Cyprinidae dominate in the Tungabhadra River.

THREATS TO FISH: Fish species in freshwater habitats are under threat worldwide due to over exploitation, pollution, species invasion, dam construction, and climate change. Habitat Loss since in the 1960s, the amount of water held by dams in reservoirs has severely impacting the population levels of freshwater fish. Also, agricultural development, water treatment facilities, and raw sewage pollute fish's ecosystems. Pollution in a fish's aquatic home can come in many forms and from different sources chemicals from production plants, plastic from waste facilities, fertilizers from agriculture but the result is exactly the same: it either severely harms or kills fish. Not only does pollution affect the fish and their ecosystems, but the effects of pollution make their way back to the polluters (us) in the form of contaminated seafood. Due to the existence of degradation and loss of habitat for the fishes; many riverine fish species have become endangered. When we compare freshwater biodiversity to marine or terrestrial biodiversity, it may be noted that freshwater biodiversity deteriorated more rapidly than other (WWF, 2016). Around 35% of the world's fish stocks were overfished in 2016. About one-third of freshwater fish species are threatened with extinction; 80 species were declared extinct in 2020. Over the last few decades, the riverine ecosystem has been facing intense anthropogenic pressure. The reason behind it is the increasing demand of freshwater resources.

Probable Solutions

- Restriction the construction of dams.
- Providing incentives for farming business to reduce the use of pesticides.
- Establishment of protected wetlands areas.
- Regulation of water withdrawal for human use.
- Future prospective to understand an aquatic ecosystem, it is necessary to transcript its biodiversity.

CONCLUSION

The present study indicates that Tungabhadra River is rich in fish diversity which consists of native species, economical and rare species of fishes. Changes in fish community, directly or indirectly affect other components of the riverine ecosystem including physical, chemical and biological characteristics. Habitat loss and ecological degradation has seriously affected the fish fauna. Conservation of fish diversity assumes top most priority under changing circumstances of gradual habitat degradation. Therefore, a sustainable strategy needs to explore more fish species, utilize and save fish community of this water body. This study will provide future strategies for development and fish conservation in the Tungabhadra River. It was concluded that further studies may be done to develop techniques for fish culturing. The use of illegal methods to catch fish should be banned in this area to prevent further depletion of freshwater fish resources. The fishermen should make aware about fishing, scientific training and facilities made available to the fish farmers fishing of the spawn, larval fish and immature fish should be avoided and subsidies loan facility may be provided on large scales which may help in high yield of fish production in the Tungabhadra River.

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