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BIODIVERSITY AND ECOLOGICAL DYNAMICS OF INDIGENOUS FISH SPECIES IN THE AQUATIC ECOSYSTEMS OF DISTRICT SWABI, KHYBER PAKHTUNKHWA, PAKISTAN

Ashfaq Ahmad[1]*, Huma Bahri[2], Sidra Batool[3], Rehmat Elahi[4] , Shahrukh Khan[5], Mamona faraz[6]

[1*]Department of Zoology, Abdul Wali Khan University, Mardan 23200, Pakistan, Email; Ashfaqbio@outlook.com, https://orcid.org/0000-0003-2556-9263
[2]Department of Zoology, Abdul Wali Khan University, Mardan 23200, Pakistan, Email; humabahri76@gmail.com
[3]Department of Zoology, Abdul Wali Khan University, Mardan 23200, Pakistan, Email; sidraicp1214@gmail.com
[4]Department of Zoology, Abdul Wali Khan University, Mardan 23200, Pakistan, Email; shahrukhjan025@gmail.com
[5]Department of Zoology, Islamia College University Peshawar, KP/ Department of Fisheries, Government of Khyber Pakhtunkhwa, Pakistan, Email; sahibrehmat819@gmail.com5
[6]Department of Zoology, Abdul Wali Khan University, Mardan 23200, Pakistan, Email; mamonafaraz@gmail.com

***Corresponding Author:** Ashfaq Ahmad
[*]Department of Zoology, Abdul Wali Khan University, Mardan 23200, Pakistan, Email; Ashfaqbio@outlook.com/Ashfaqameer55@gmail.com https://orcid.org/0000-0003-2556-9263

Abstract:
The current study aimed to investigate the diversity and distribution of freshwater fish in the districts of Sawabi, located in the northwest of Khyber Pakhtunkhwa province, Pakistan. Sawabi is home to numerous streams and rivers between the Indus and Kabul rivers, making it an important area for fishing and farming. A total of 350 fish samples were collected from February to November 2021. Eight species were identified in Sawabi, including *Oreochromis niloticus, Catla catla, Carassius gibelio, Tilapia sparmanii, Mystus seenghala, Cyprinus carpio, Rutilus rutilus, Tor tor, Hypopthalmichthys molitrix,* and *Dorosoma cepedianum*. The results suggest that overfishing and water pollution are major factors affecting the survival and expansion of fish species in the area. To improve the fish populations in the rivers and streams, proper stocking and regulations to control overfishing and pollution are needed. The study found that the Cyprinidae family was the most dominant, with ten species identified in the experimental area. However, the number of Tilapia sparmanii and Hypopthalmichthys molitrix was found to be low due to pollution, toxic heavy metals, and other environmental factors that affect breeding and other activities of fish.

Graphical abstract.

Keywords: Fish Fauna, Biodiversity, District Sawabi, Khyber Pakhtunkhwa.

1. Introduction

Fish are poikilothermic aquatic chordates with scales covering their gills, fins, and bodies[1]. Fish does have a pleasant flavor and is easier to digest[2]. Fish are poikilothermic creatures that breathe via their gills and swim with their fins[1]. They reside in the waters and rely on it for oxygen, nutrition, breeding, and habitat [3]. Fish can be found in practically any sort of water habitats, from polar waters to thermal baths [4, 5]. Fish could also withstand a broad range of salinity levels[6]. Fish are a much more diversified and numerous group of vertebrates, occupying nearly each water cycle habitat [7]. Their environment was diverse in terms of form, coloration, & scale [8]. The first step in understanding an area's hydrological ecology is to examine its fisheries [9]. Additional benefit of researching fish biodiversity is that it could inspire suggestions for new producing species for cultural norms and human nutrition [10].

Freshwater fish are a vital component of aquatic ecosystems, providing food and income for local communities and serving as indicators of water quality and ecosystem health [11]. However, human activities such as overfishing and pollution are putting increasing pressure on these populations [12]. Sawabi and Swabi are districts located in the northwest of the Khyber Pakhtunkhwa province in Pakistan. These areas are characterized by numerous streams and rivers that are of great importance for fishing and farming. The main streams and rivers in Sawabi and Swabi, previous literature and studies have identified several significant water bodies. Some of the notable watercourses in the region include the Kabul River, Bara River, Swat River, and various smaller streams and tributaries. When considering the fish fauna in Sawabi, it is important to mention the local species that hold significant weight in terms of size and ecological importance. Previous studies have identified certain

fish species that are particularly large or have high ecological significance in these rivers. These species contribute to the overall biodiversity and play a crucial role in the aquatic ecosystem of the region. These water bodies serve as vital habitats for a diverse range of fish species. The current study aimed to fill this knowledge gap by conducting a comprehensive survey of freshwater fish in Sawabi. A total of 350 fish samples were collected from February to November 2021, and the results provide valuable insights into the species present, their distribution, and the factors affecting their populations. Understanding the diversity and distribution of fish in Sawabi is crucial for developing effective conservation and management strategies to ensure the sustainable use of these resources for the benefit of local communities and the environment [13]. However, it is worth noting that the frequency of fish species has been observed to decrease in recent years due to pollution. Pollution from various sources, such as industrial waste, agricultural runoff, and improper waste disposal, can have detrimental effects on water quality and the survival of fish populations. This pollution can lead to habitat degradation, reduced oxygen levels, and the accumulation of harmful substances, all of which contribute to the decline in fish numbers.

2. Methods and Materials:

In this study, we aimed to investigate the diversity and distribution of freshwater fish in the district Sawabi, located in the northwest of Khyber Pakhtunkhwa province, Pakistan. The district is home to numerous streams and rivers between the Indus and Kabul rivers, making it an important area for fishing and farming. To collect fish samples, we employed a variety of methods including hooking of multiple lengths, cast nets, automatic rods, gill nets, drag nets, hooking nets, and hand nets. These methods were used to collect fish from eight different locations in Sawabi. The study was conducted over a period of nine months, from February to November 2021, with ten collections conducted every month. The collected fish were preserved in 10% formalin for larger specimens and 5% formalin for smaller ones. Some were also preserved in 70% ethanol.

The fish were dissected to collect parasites, which were then fixed in alcohol-formol-acetic acid and identified using standard keys. The prevalence rate of parasites was calculated using the formula: (number of parasite-infected fish x 100) / total number of fish analyzed. In addition to parasite analysis, physical parameters of the water were also measured, including temperature, pH, water velocity, TSS, and TDS. Using standard fish identification keys, seven species were recognized in the Islamia college university Peshawar laboratory, ten species were identified using standard identification keys and morphometric criteria. Statistical analysis was done using Korean Statistic 9 software. All measurements were made with a calibrated compound microscope and are in millimeters. This allowed us to have a detailed understanding of the fish species present in the area, their distribution and the factors affecting their populations, which is crucial for developing effective conservation and management strategies to ensure the sustainable use of these resources for the benefit of Human.

3. Collected Data

S. No	Fish specie	Total length	Fork length	Standard length	Snout length	Pre-pectoral length	Pre-pelvic length	Pre-dorsal length	Pre-anal length
A1	*Oreochromis niloticus*	14.5 cm	Nil	11cm	1.2cm	3.1cm	3.4cm	3.2cm	7.2cm
F1	*Catla catla*	36cm	31cm	29cm	2.6cm	8.5cm	14.5cm	14.5cm	22cm
A3	*Carassius gibelio*	16.7cm	15.2cm	12.7cm	1.2cm	3.4cm	5.8cm	6.6cm	9cm
E2	*Tilapia sparmanii*	34cm	Nil	28cm	3.2cm	9cm	9.5cm	8cm	19cm
A6	*Mystus seenghala*	34cm	29cm	28.5cm	2.5cm	8cm	15.8cm	12.5cm	22cm
F2	*Cyprinus carpio*	31cm	27.5cm	25cm	2.1cm	6.5cm	12cm	11.5cm	17.5cm
F4	*Rutilis rutilis*	32cm	27.5cm	25cm	1.9cm	5.6cm	13.5cm	12.5cm	20.6cm
G1	*Tor tor*	37cm	32cm	30cm	1.3cm	6cm	15cm	12.2cm	23.5cm
H5	*Hypopthalmichthys molitrix*	33cm	27.5cm	28.5cm	2cm	7cm	11.5cm	13cm	18cm
dirty	*Dorosoma cepedianum*	20.3cm	18cm	16.5cm	1.3cm	4.5cm	7.3cm	8.5cm	11.3cm

Fish specie	Head length	Head width	Mouth cleft	Eye diameter	Interorbital length	Dorsal fin rays	Pectoral fin rays	Pelvic fin rays	Anal fin rays
Oreochromis niloticus	3.4cm	1.6cm	1cm	0.8cm	1.1cm	26	12	7	13
Catla catla	10cm	4.8cm	4.5cm	1cm	4.5cm	16	18	9	8
Carassius gibelio	3.8cm	2.7cm	1.2cm	0.8cm	1.5cm	18	16	8	6
Tilapia sparrmanii	9cm	4.4cm	4.5cm	1.7cm	3.5cm	29	13	5	12
Mystus seenghala	9cm	3.8cm	3.3cm	0.9cm	1.8cm	8	8	7	10
Cyprinus carpio	7cm	4cm	2.7cm	1cm	2.7cm	20	12	9	7
Rutilis rutilis	7cm	4.5cm	2.2cm	1.4cm	4cm	14	16	9	7
Tor tor	6cm	4.3cm	2cm	1.2cm	2.8cm	13	16	8	6
Hypopthalmichthys molitrix	7.7cm	4cm	3.3cm	1.5cm	3.2cm	8	8	16	13
Dorosoma cepedianum	4.5cm	2.1cm	1.7cm	0.7cm	2cm	9	17	7	14

Fish name	Genus	Family	Order	Class	Phylum
Oreochromis niloticus	Oreochromis	Cichlidae	Perciformes	Actinopterygii	Chordata
Catla catla	Catla	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Carassius gibelio	Carassius	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Tilapia sparmanii	Tilapia	Cichlidae	Perciformes	Actinopterygii	Chordata
Mystus seenghala	mystus	Bagridae	Siluriformes	Actinopterygii	Chordata
Cyprinus carpio	Cyprinus	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Rutilus rutilis	Rutilus	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Tor tor	Tor	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Hypopthalmichthys molitrix	Hypopthalmichthys	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Dorosoma cepedianum	Dorosoma	Clupeidae	Clupieformes	Actinopterygii	Chordata

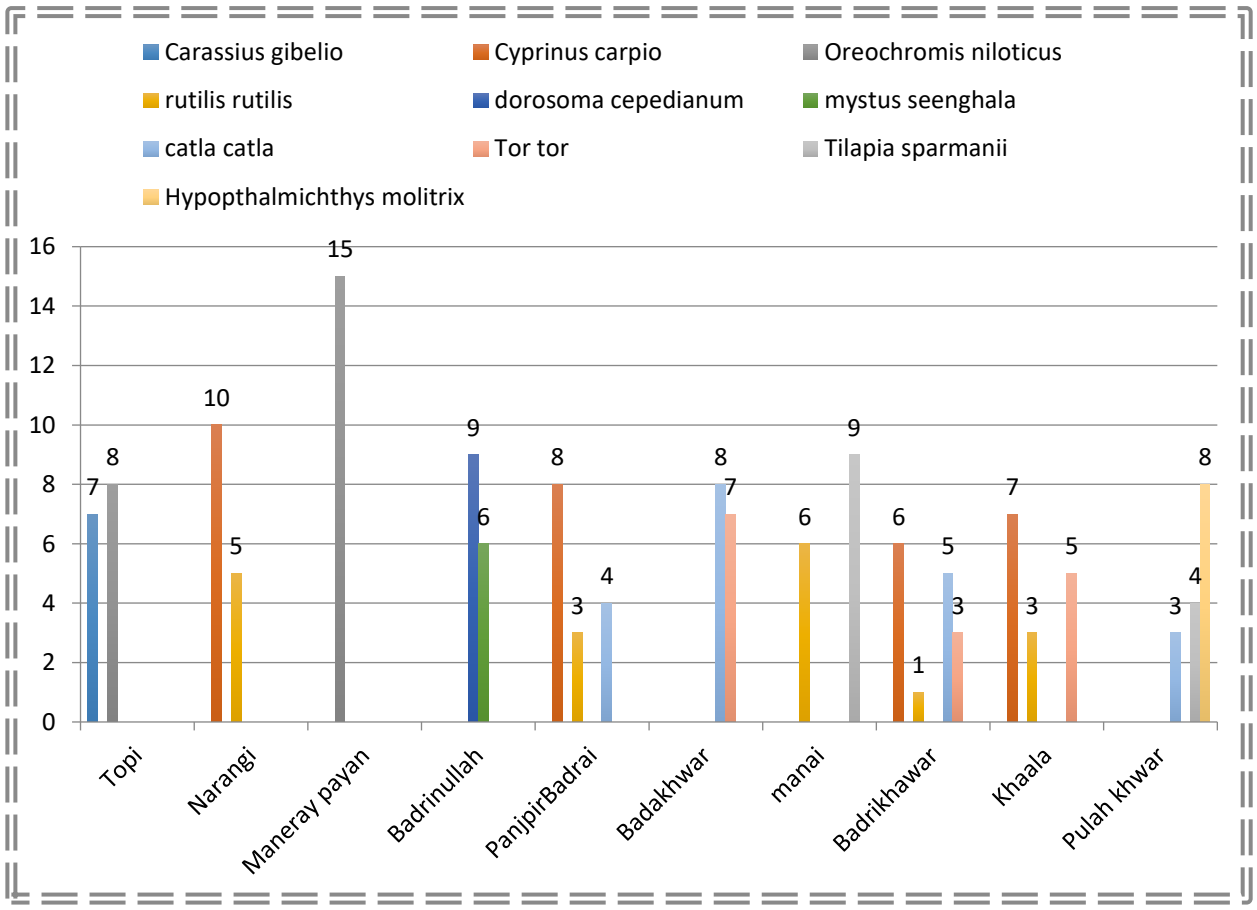

Figure. 1 shows the presence and number of fish species in different streams and rivers of district Swabi.

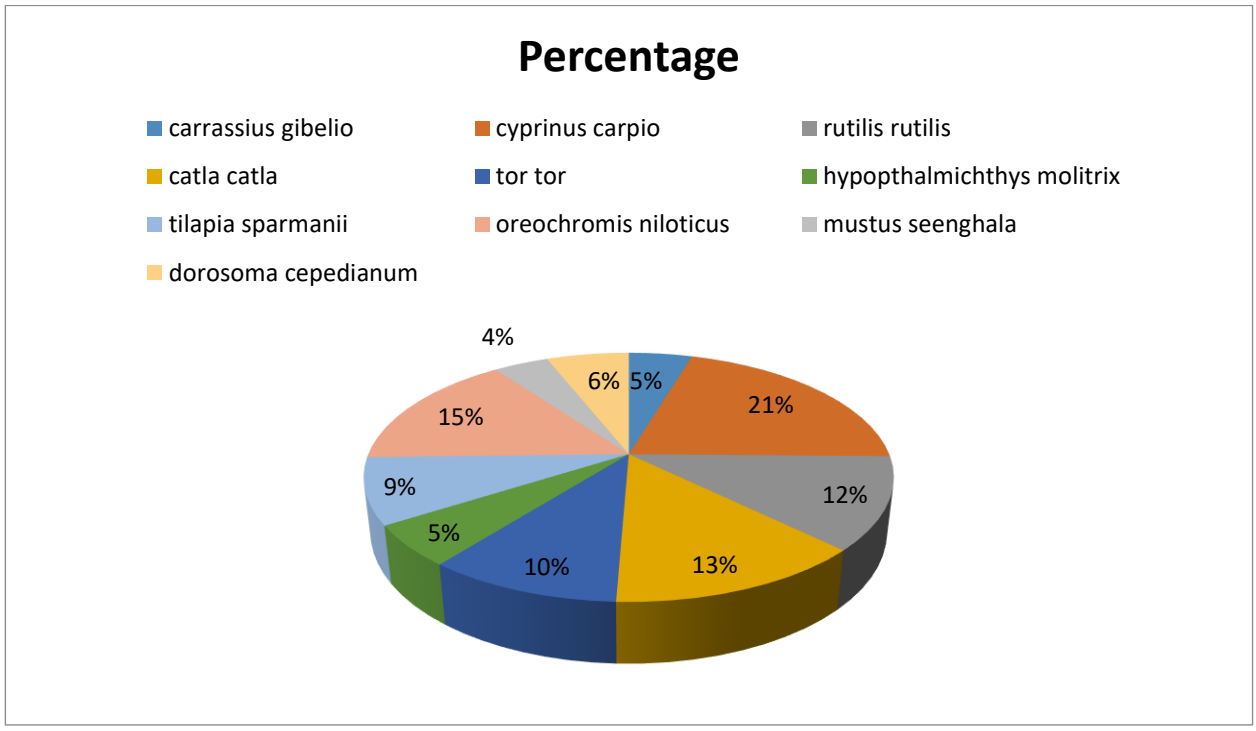

Figure. 2 shows the Biodiversity percentage of different fish species in district Swabi.

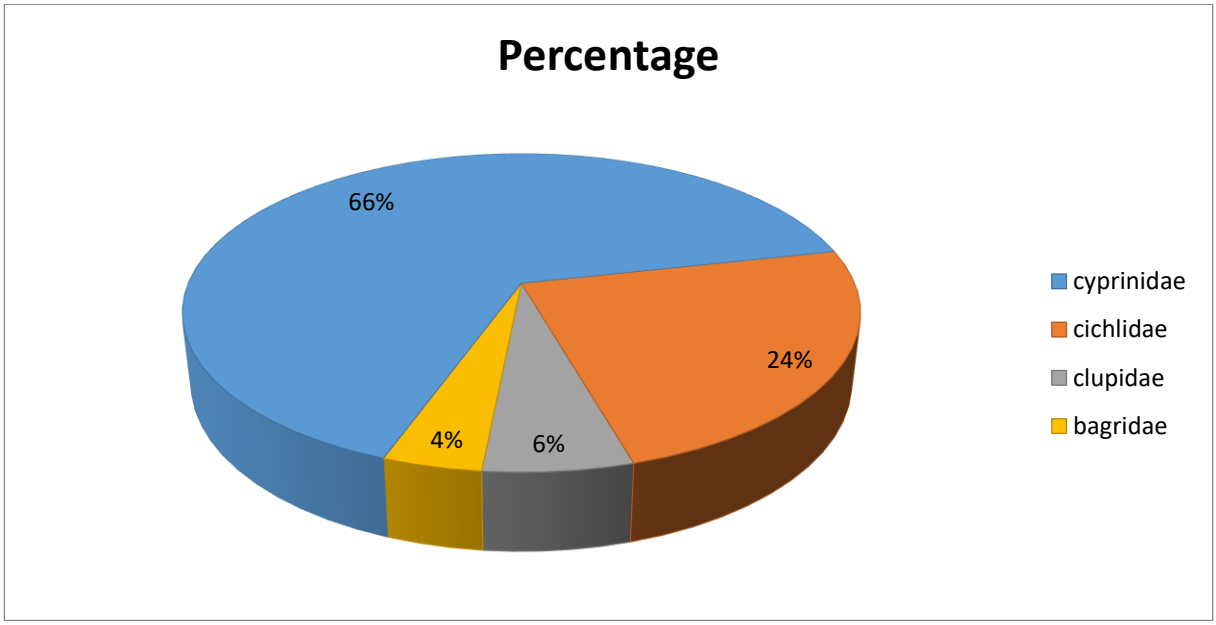

Figure. 3 shows the percentage of different fish families present in district Swabi.

Fish name	Genus	Family	Order	Class	Phylum
Oreochromis niloticus	*Oreochromis*	Cichlidae	Perciformes	Actinopterygii	Chordata
Catla catla	*Catla*	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Carassius gibelio	*Carassius*	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Tilapia sparmanii	*Tilapia*	Cichlidae	Perciformes	Actinopterygii	Chordata
Mystus seenghala	*mystus*	Bagridae	Siluriformes	Actinopterygii	Chordata
Cyprinus carpio	*Cyprinus*	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Rutilus rutilis	*Rutilus*	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Tor tor	*Tor*	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Hypopthalmichthys molitrix	*Hypopthalmichthys*	Cyprinidae	Cypriniformes	Actinopterygii	Chordata
Dorosoma cepedianum	*Dorosoma*	Clupeidae	Clupieformes	Actinopterygii	Chordata

River wise breakdown

In these table, the CLASS column comes first, followed by ORDER, FAMILY, GENUS, and SPECIES.

1. Topi khwar

S.No	CLASS	ORDER	FAMILY	GENUS	SPECIES
1	Actinopterygii	Perciformes	Cichlidae	*Oreochromis*	*niloticus*
2	Actinopterygii	Cypriniformes	Cyprinidae	*Carassius*	*gibelio*

2. Narangi khwar

S.No	CLASS	ORDER	FAMILY	GENUS	SPECIES
1	Actinopterygii	Cypriniformes	Cyprinidae	*Cyprinus*	*carpio*
2	Actinopterygii	Cypriniformes	Cyprinidae	*Rutilus*	*rutilis*

3. Manery payan

S.No	CLASS	ORDER	FAMILY	GENUS	SPECIES
1	Actinopterygii	Perciformes	Cichlidae	*Oreochromis*	*carpio*
2	Actinopterygii	Cypriniformes	Cyprinidae	*Catla*	*Catla*

4. Badri nullah

S.No	CLASS	ORDER	FAMILY	GENUS	SPECIES
1	Actinopterygii	Siluriformes	Bagridae	*mystus*	*seenghala*
2	Actinopterygii	Cypriniformes	Cyprinidae	*Hypopthalmichthys*	*molitrix*
3	Actinopterygii	Clupieformes	Clupeidae	*Dorosoma*	*cepedianum*

5. Panjpir badrai

S.No	CLASS	ORDER	FAMILY	GENUS	SPECIES
1	Actinopterygii	Perciformes	Cichlidae	*Oreochromis*	*niloticus*
2	Actinopterygii	Cypriniformes	Cyprinidae	*Catla*	*Catla*
3	Actinopterygii	Cypriniformes	Cyprinidae	*Cyprinus*	*carpio*
4	Actinopterygii	Cypriniformes	Cyprinidae	*Rutilus*	*rutilis*

6. badakhwar

S.No	CLASS	ORDER	FAMILY	GENUS	SPECIES
1	Actinopterygii	Cypriniformes	Cyprinidae	*Catla*	*Catla*
2	Actinopterygii	Cypriniformes	Cyprinidae	*Tor*	*Tor*

7. Manai

S.No	CLASS	ORDER	FAMILY	GENUS	SPECIES
1	Actinopterygii	Perciformes	Cichlidae	*Tilapia*	*sparmanii*
2	Actinopterygii	Cypriniformes	Cyprinidae	*Rutilus*	*Rutilus*

8. badri khwar

S.No	CLASS	ORDER	FAMILY	GENUS	SPECIES
1	Actinopterygii	Cypriniformes	Cyprinidae	*Catla*	*Catla*
2	Actinopterygii	Siluriformes	Bagridae	*mystus*	*Rutilus*
3	Actinopterygii	Cypriniformes	Cyprinidae	*Cyprinus*	*carpio*
4	Actinopterygii	Cypriniformes	Cyprinidae	*Rutilus*	*Cyprinus*
5	Actinopterygii	Cypriniformes	Cyprinidae	*Tor*	*tor*

9. khala khwar,

S.No	CLASS	ORDER	FAMILY	GENUS	SPECIES
1	Actinopterygii	Cypriniformes	Cyprinidae	*Catla*	*Catla*
2	Actinopterygii	Cypriniformes	Cyprinidae	*Cyprinus*	*carpio*
3	Actinopterygii	Cypriniformes	Cyprinidae	*Rutilus*	*rutilis*
4	Actinopterygii	Cypriniformes	Cyprinidae	*Tor*	*tor*

10. pullah khwar

S.No	CLASS	ORDER	FAMILY	GENUS	SPECIES
1	Actinopterygii	Cypriniformes	Cyprinidae	*Catla*	*Catla*
2	Actinopterygii	Perciformes	Cichlidae	*Tilapia*	*sparmanii*
3	Actinopterygii	Cypriniformes	Cyprinidae	*Hypopthalmichthys*	*molitrix*

S.No	**Collection River Name**	**Latitude**	**Longitude**	**Dominant Species**
1.	Topi khwar	34°04'59.1"N	72°36'18.3"E	*Oreochromis niloticus*
2.	Naranji khwar	34°14'30.1"N	72°14'56.7"E	*Cyprinus carpio*
3.	Maneri Payan khwar	34°08'28.1"N	72°29'25.1"E	*Oreochromis niloticus*
4.	Badri nullah khwar	34°08'56.7"N	72°27'19.1"E	*Dorosoma cepedianum*
5.	Panjpir badrai	34°04'51.6"N	72°28'35.0"E	*Cyprinus carpio*
6.	Badakhwar	34°08'43.9"N	72°36'44.3"E	*Catla Catla, Tor tor*
7.	Manai	34°07'06.6"N	72°36'49.5"E	*Tilapia sparmanii*
8.	Badri khwar	34°08'28.9"N	72°27'38.4"E	*Cyprinus carpio, Tor tor*
9.	Khala khwar	34°07'01.9"N	72°27'43.0"E	*Cyprinus carpio*
10.	Pullah khwar	34°06'05.4"N	72°37'34.9"E	*Hypopthalmichthys molitrix*

4. Results:

In this study, we conducted a biodiversity assessment of freshwater fish in the district of Sawabi in Pakistan. A total of 350 fish samples were collected from various locations in these districts during the study period, which lasted from February to November 2021. Using various identification keys and literature, we were able to identify 10 different species of fish, including *Oreochromis niloticus*, *Catla catla*, *Carassius gibelio*, *Tilapia sparmanii*, *Mystus seenghala*, *Cyprinus carpio*, *Rutilus rutilus*, *Tor tor*, *Hypopthalmichthys molitrix*, and *Dorosoma cepedianum*. These species were classified into four orders: Perciformes, Cypriniformes, Siluriformes, Clupeiformes, as well as four families: Cichlidae, Cyprinidae, Bagridae, Clupeidae. Our findings revealed that the Cyprinidae family was the most abundant in the streams and rivers of District Swabi, with a strong association between the occurrences of fish species in these water bodies. This could be attributed to the minimal fishing pressure and the substrate of the rivers and streams, which provide suitable conditions for nesting and rearing. Figure 8.1 shows the percentage of these species in District Swabi, Figure 8.2 the percentage of these families in District Swabi, and Table 3 lists the ten genera.

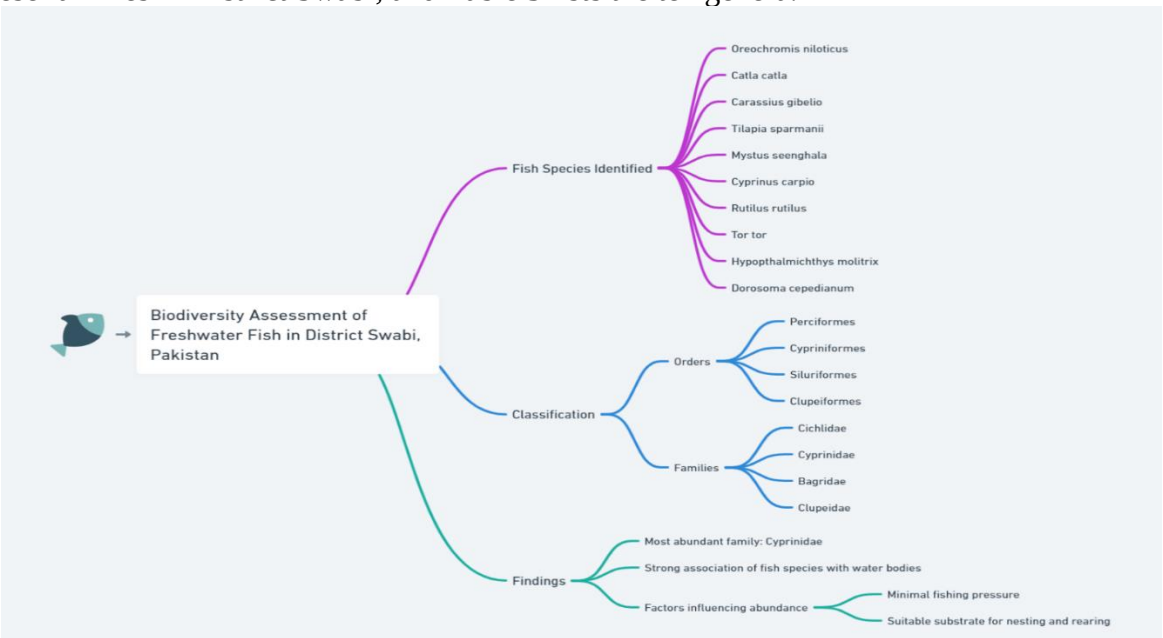

Figure. 4 Biodiversity Assessment of freshwater fish in District sawabi.

5. Discussion

In the district of Sawabi, Khyber Pakhtunkhwa, Pakistan, our research identified a diverse array of fish species, shedding light on the rich aquatic biodiversity of the region. A total of Ten distinct species were recorded during our study, each contributing to the intricate aquatic ecosystem of Sawabi.Among the identified species Oreochromis niloticus, Catla catla, Carassius gibelio, Tilapia sparmanii, Mystus seenghala, Cyprinus carpio, Rutilus rutilus, Tor tor, Hypopthalmichthys molitrix, and Dorosoma cepedianum. Exhibited a remarkable range of morphological and ecological adaptations. These adaptations reflect the unique environmental niches and conditions within Sawabi. Catla catla, commonly known as an Indian carp, is a well-known species globally and is often introduced into various aquatic systems for its economic value. Its presence in Sawabi signifies the potential for aquaculture and the local importance of this species. Catla catla (Catla): Catla is a popular freshwater fish in South Asia, including Pakistan. It is widely consumed for its delicious taste and is an important source of protein in the diet. Cyprinus carpio (Common Carp): Common carp is a versatile fish that is commonly eaten in many parts of the world, including Pakistan. It is valued for its mild flavor and can be prepared in various ways. Tilapia sparmanii (Tilapia): Tilapia is known for its mild and delicate taste. It is often farmed and consumed as a source of protein in various cuisines, including those in Pakistan. These species are part of the local diet and provide a valuable source of nutrition for the people in the region. Their presence highlights the importance of preserving the ecological balance within Sawabi's aquatic ecosystems. The identification of T. putitora, a species native to the region, is of particular ecological significance. Also known as the Himalayan mahseer, it is an iconic fish species renowned for its recreational value and ecological importance as a top predator. Oreochromis mosambicus, an exotic species, suggests potential ecological impacts and the need for further monitoring to understand its interaction with native species and habitats. Our findings underscore the need for ongoing conservation efforts in Sawabi to safeguard the diverse fish fauna. Additionally, this research provides a foundation for future studies focusing on the biology, ecology, and conservation of these fish species within the district. Understanding the dynamics of these species and their roles in the local ecosystem is crucial for the sustainable management of aquatic resources and the preservation of Sawabi's unique aquatic biodiversity.

6. Conclusion

In conclusion, this study provides valuable information on the freshwater fish diversity in the district of Sawabi in KPK, Pakistan. A total of 10 fish species belonging to four orders and four families were identified using various identification keys and literature. The species of the Cyprinidae family were found to be abundant in the streams and rivers of District Swabi, which could be attributed to minimal fishing traffic and suitable substrate in the rivers and streams for nest building and rearing. The comparison of this study with previous studies in other regions of Pakistan revealed similar trends in terms of dominant fish families and species. The findings of this study can be used for conservation and management purposes, and further research can be conducted to better understand the ecology and biology of these fish species in the study area. Fishes were collected from February to November 2021 and eight species were found in the study area. Due to harsh conditions like COV-19 were the main challenges in the research work, but I still managed to identify the following fishes. The ten fishes are, *Oreochromis niloticus, Catla catla, Carassius gibelio, Tilapia sparmanii, Mystus seenghala, Cyprinus carpio, Rutilus rutilus, Tor tor, Hypopthalmichthys molitrix, and Dorosoma cepedianum*. The number of fish is decreasing daily due to water pollution, inadequate drainage systems, plastic in the water, toxic chemicals are present in water. The following steps should be taken to save the fish biodiversity of the area.

1. Illegal fishing like dynamiting and diverting the water to catch are significant threats to the fish fauna of the area.
2. People should be adequately educated about the importance of fish fauna.
3. People should be aware of the conservation of fish.
4. Deforestation should be avoided to control silting, which is a significant threat to

Fish fauna.

5. Sewages and other waste materials should be appropriately disposed of.

References

1. McGrouther, M. 2020.
2. DOLGOFF, S. 2021.
3. Graham, J.B., *Air-breathing fishes: evolution, diversity, and adaptation*. 1997: Elsevier.
4. Pörtner, H.O., L. Peck, and G. Somero, *Thermal limits and adaptation in marine Antarctic ectotherms: an integrative view.* Philos Trans R Soc Lond B Biol Sci, 2007. **362**(1488): p. 2233-58.
5. Mason, J.G., et al., *Projecting climate-driven shifts in demersal fish thermal habitat in Iceland's waters.* ICES Journal of Marine Science, 2021. **78**(10): p. 3793-3804.
6. *Why do some fish normally live in freshwater and others in saltwater? How can some fish adapt to both?* 1998.
7. Winemiller, K.O., A.A. Agostinho, and É.P. Caramaschi, *Fish ecology in tropical streams*, in *Tropical stream ecology*. 2008, Elsevier. p. 107-III.
8. Luo, M., et al., *Fish pigmentation and coloration: Molecular mechanisms and aquaculture perspectives.* Reviews in Aquaculture, 2021. **13**(4): p. 2395-2412.
9. Arias, M.E., et al., *The flood pulse as the underlying driver of vegetation in the largest wetland and fishery of the Mekong Basin.* Ambio, 2013. **42**: p. 864-876.
10. Johns, T. and B.R. Sthapit, *Biocultural diversity in the sustainability of developing-country food systems.* Food and nutrition bulletin, 2004. **25**(2): p. 143-155.
11. Alho, C.J., R.E. Reis, and P.P. Aquino, *Amazonian freshwater habitats experiencing environmental and socioeconomic threats affecting subsistence fisheries.* Ambio, 2015. **44**(5): p. 412-25.
12. Sumaila, U.R. and T.C. Tai, *End Overfishing and Increase the Resilience of the Ocean to Climate Change.* Frontiers in Marine Science, 2020. **7**.
13. Ali, U., et al., *Identification and distribution of fishes in fresh water of District Malakand, Khyber Pakhtunkhwa Pakistan.* Pure and Applied Biology, 2020. **9**: p. 2297-2304.