DIVERSITY OF FISH FAUNA AND WATER QUALITY PARAMETERS OF MASTURA RIVER, TEHSIL DISTRICT ORAKZAI, KHYBER PAKHTUNKHWA, PAKISTAN

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ABSTRACT

Fish are ectothermic, water-living vertebrate organisms that have a backbone, gill slits, and gills used for both breathing and the osmoregulatory process. Ichthyodiversity refers to the variation in fish species on the morphological, anatomical, and genetic levels. Fishes have large and important values because they provide a high quality of vitamins, minerals, and protein for the human diet. The present study was conducted to assess the fish diversity and water quality of the Mastura River, District Orakzai, Khyber Pakhtunkhwa, Pakistan. Fish specimens and water samples were collected from March to June 2022. During the present research, approximately 137 fish specimens were collected. After identification, the results revealed the presence of 10 species belonging to three orders (Cypriniformes, Synbranchiformes, and Siluriformes) and 4 families (Cyprinidae, Nemacheilidae, Mastacembelidae, and Sisoridae). The Family Cyprinidae was the most abundant family and is represented by 9 species, including *Crossocheilus diplocheilus*, *Garragotyla*, *Bariluis vagra,* and *Racoma.labiata, Shizothoraxesocinous and Puntiusticto.* Family *Mastacembalidae Mastacembelus amratus,* Family *Siluridae* by *Glyptothorax sufii, and* Family *Nemacheilidae* by *Schistura alipidota, Triphlophys micropes.* The values of different water quality parameters during the study period ranged from a Total hardness of 180 to 120 mg/L, Free Chlorine of 1 mg/L in four months, copper with a minimum value of 0.5 mg/L, and a maximum value of 1 mg/L. Lead, Iron, and nitrites had a zero mean value, with pH ranging from a maximum of 7.9 mg/L to a minimum of 6.0 mg/L. Alkalinity is maximum at 60 mg/L and 20 mg/L. All the water quality parameters were within the optimum range for fish culture. The present study recommends that the water quality of the study area is ideal for fish culture. The fisheries department of KP should focus on introducing other cultured fish species in the area.

Keywords: Fish diversity, Mastura River, Water Quality Parameters, Khyber Pakhtunkhwa.

INTRODUCTION

The simplest definition of biological diversity is the presence of a wide variety of plants and animals (fish, amphibians, etc.) in a given area (Sufiyan, 2022). Life on Earth and biodiversity are used interchangeably (Iyiola *et al*., 2022; Segolsson and Storesund, 2022). According to Cammerino *et al*. (2024) studies on biodiversity analysis are essential nowadays for maintaining environmental quality and preserving ecosystems. Diversity is composed of two components: a population and a wealth of various animal classes in a certain area. Native fish populations may suffer as a result of invasive species. The management and control of invasive species is essential to the aquatic ecosystem's integrity. Keeping an eye out for invasive species, spotting them early, implementing measures to prevent their introduction or spread, and developing strategies for their removal or survival might all be part of this (Tao *et al*., 2023). Fish species conservation relies on the restoration and maintenance of their essential habitats. This means preserving wetlands, rivers, lakes, mangroves, coral reefs, and other aquatic habitats that serve as breeding, feeding, and migratory grounds for various fish species (Prakasam and Saravanan, 2023).

Among vertebrates, fish are the oldest and most prevalent. Out of almost 40,000 vertebrate species, 21,723 species are members of the superclass Pisces (Jayaram, 2012). Depending on their habitat, fish vary greatly in size, shape, and coloring. The range of species found in the environment, or the diversity of life on Earth, is known as biodiversity (Lipinski *et al*., 2003). Fish is an excellent aquatic food, providing high-quality protein as well as a wide variety of minerals, including phosphorus, magnesium, iron, zinc, and iodine, along with other essential nutrients such as vitamins A, B, and D, all of which are beneficial to human health. The majority of fish diversity typically inhabits freshwater lakes and rivers (Alachew, 2018). Fish flesh is the most delicious food, has easy digestion, and is important for growth (Ali *et al*., 2022; Tripathi, 2024). Additionally, fish are vital for the second trophic level of the aquatic ecosystem and are a valuable source of food, medicine, and economic value (Dubey *et al*., 2012).

Pakistan has the largest canal system, comprising approximately five main canals and numerous smaller rivers, as well as lakes. Along with more than 225 wetlands, just 19 of which are designated as Ramsar sites, it also has a sizable number of cool mountain stream flows in different parts of Pakistan. Approximately 780,000 hectares make up Pakistan, which accounts for 9.7% (73% of freshwater and 26.06% of coastal wetland regions) of the nation's total wetland area (IUCN, 1989). In KPK, fish production was 694.377 metric tonnes of fish worth R.s 29.649 million in 1998–99, compared to 752.036 metric tonnes worth R.s 12.798 million in 1997–98 (KP Fisheries Statistics, 2000).

The particular study area was selected because little work has been carried out here regarding the fish diversity of that particular area; hardly any data is available about the fish diversity of the area of Mastura River, District Orakzai, Khyber Pakhtunkhwa, mostly in mountain areas, and we are working to find new species with respect to the study area.

MATERIALS AND METHODS

EXPERIMENTAL AREA

This research was carried out in the area of Mastura River, District Orakzai, Khyber Pakhtunkhwa, mostly in mountain areas (Fig.1). This valley, the second smallest after Bajaur Agency, is nestled between mountain ranges that reach heights of 6,000 to 7,000 feet (2,100 m). Its borders are defined by: Kurram Agency (West), Khyber (North), Kohat District (south), and Peshawar (east). The Orakzai Agency is characterized by rugged, mountainous terrain, crisscrossed by a network of dry watercourses, particularly in the southwest. The Mastura River and Khanki Toi River are the two primary streams, flowing eastward from their origins in the western hills. Mastura River originates from Upper Dabori Central and Lower stream water that comes from hills and plains area, which makes Mastura River, and at last meets with Barrah River of District Khyber at Mamaria point. Mastura River is mostly used for irrigation purposes, and half of the land is irrigated through this River.

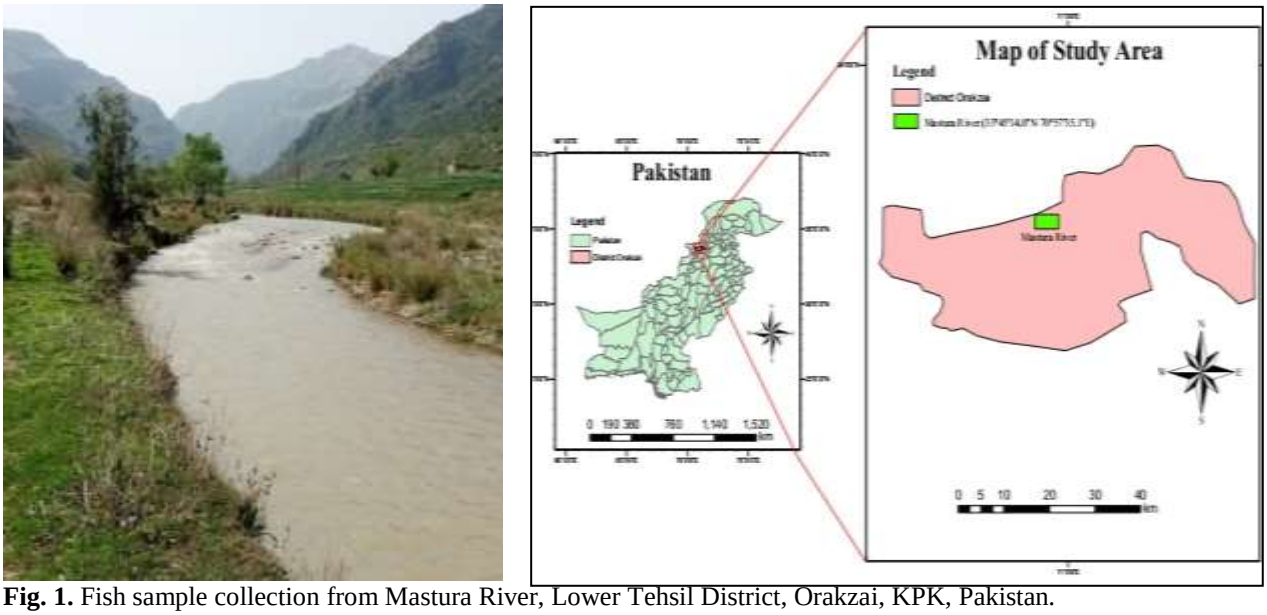

Fig. 1. Fish sample collection from Mastura River, Lower Tehsil District, Orakzai, KPK, Pakistan.

FISH SAMPLES COLLECTION

Fish samples were collected randomly from different zones of Mastura River, Lower Tehsil, District, Orakzai, with the help of different instruments, like fish nets, hooks, hand nets, and adapted methods of local people, also bought from local people. Sampling collection was started from 15 March to 15 June 2024 and captured a variety of fish. After the captured fish were kept in big Plastic bottles and brought to the Department of Zoology, the fisheries lab at Kohat University of Science and Technology for identification.

ANALYSIS OF WATER SAMPLES

The samples were collected from different sites of the Mastura River, of Lower Tehsil District, Orakzai. Water samples were collected from March to June 2023. Water sample collection and analysis were carried out twice in month. For Water analysis, water quality strips were used, and the average value of each water quality test was obtained. The collected sample of water was kept in the open air, and the depth water strip was completely submerged for a second, and then the strip was kept horizontally for 60 seconds in the open air. After 60 seconds, the resulting value was compared with reference values of the water strip.

PRESERVATION AND IDENTIFICATION

Formalin solutions were prepared from 9:1 or 10% Formalin and 90% distal water. Each species was put in a formalin solution to cover the whole body of the species.

After the collection and preservation, the fish were brought to the Department of Zoology, the fisheries lab at Kohat University of Science and Technology for identification. The preserved fishes were identified according to their morphological and morphometric characteristics, and each species was identified to the species level with the help of a specific systematic way and mainly Mirza and Sandhu's (2007) key for identification.

RESULTS

FISH DIVERSITY

The present study was conducted at Mastura River, District Orakzai, Khyber Pakhtunkhwa, to identify fish diversity and water Parameters. The Sample collection was conducted from March to June 2022; the duration of the sample collection was four months, and during these four months, randomly collected samples from different sites of the river, Mastura. In this duration, 130 total specimens were collected and only 10 species up to the species level, taxonomically collected samples belonging to 3 Orders, 4 Families, 10 genera, and species. 3 Oder, Cypriniformes, Synbranchiformes, Siluriformes, and 4 Family, 1 Cyprinidae family have presented the following species: C. *diplocheilus*, Garra *gotyla, Bariluis Vagra. Racoma Labiata, Shizothorax esocinus*, and *Puntius ticto.* 2, *Mastacembalidae* have *M. amratus*, 3, *Siluridae Family, Glyptothorax. Sufii* and 4. *Nemacheilidae* have *Schistura alipidota* and *Triphlophysa micropes*. The most dominant Family was Cyprinidae, which has 8 species, and the second one had only 2 species, Nemacheilidae, and Sisoridae had only one species (Table 1, Fig.2-13). All the reported data of fish were pasted with pictures along with their morphological characters and importance.

Table 1. Classification of identified fishes into Family, Genus and species.

S. No	Oder	Family	Genus	Species	
1.	Cypriniformes	Cyprinidae Nemacheilidae	*Crossocheilus* *Garra, Racoma, Pontius, Barlius. Shizothorax,* *Schistura, Triplophysa*	*C. diplocheilus* *G. gotyla, Bariluis. Vagra. Racoma Labiata, S. esocinus, Puntius. ticto* *Schistura alipidota, Tryplophysa. Microps,*	
2.	Synbranchiformes	Matacembaladae	*Mastacembalus,*	*M. armatus*	
3.	Siluriforme	Sisoridae	*Glypthotorax*	*G.Sufii,*	

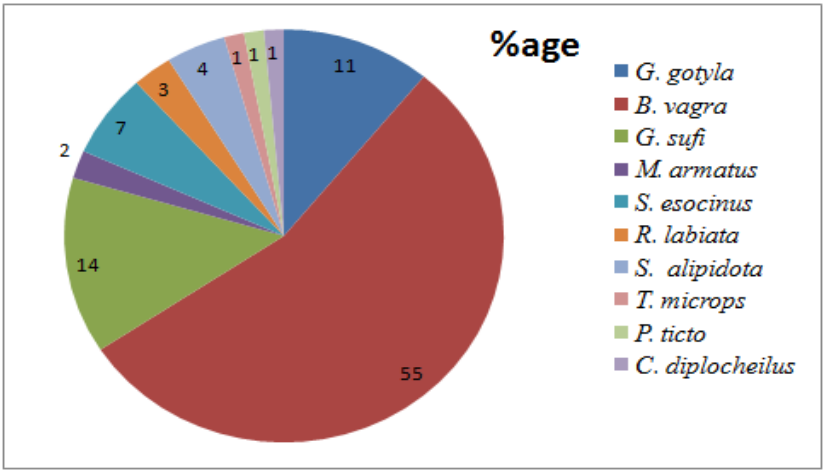

Fig. 2. Percentage of various specimens at the site of Mastura River District, Orakzai.

Fig.3. *Crossocheilus diplocheikus*

Fig.4. *Mastacembalus armatus*

Fig. 5. *Garra gotyla*

Fig. 6. *Bariluis vagra*

Fig. 7. *Triplophysa micropa*

Fig. 8. *Shizothorax esocinus*

Fig. 9. *Schistura alipidota*

Fig.10. *Racoma labiatus*

Fig.11. *Pontius ticto*

Fig.12. *Glyptothorax sufii*

Water Parameter

The present study was conducted from March to June 2022, and the total duration of sample collection and water analysis was about four months. During four months in each month, twice water quality tests were performed at different sites of the River Mastura to investigate different water parameters such as total hardness, Free Chlorine, Iron, lead, Copper, Nitrate, and Nitrite. Alkalinity and pH of Lower Tehsil, District Orakzai. The following test results were presented as the mean value for the month in Table 2, Fig. 13-18.

Table 2. The Month-Wise Mean Value of the Water Quality of River Mastura.

S. no	Water parameter	March Mean value	April Mean value	May Mean value	June Mean value	Permissible limit for fish culture By WHO
1	Total Hardness (mg/L)	180	180	180	120	120-180mg/L
2	Free Chlorine (mg/L)	1	1	1	1	5 mg/L
3	Iron (mg/L)	0	0	0	0	0.3-1.0mg/L
4	Copper (mg/L)	0.5	1	0.5	0.5	2.0mg/L
5	Lead (mg/L)	0	0	0	0	0.1 mg/L
7	Nitrate (mg/L)	10	10	10	10	0.50mg/l
8	Nitrite (mg/L)	0	0	0	0	10mg/L
9	Total Alkalinity	40	20	60	40	20-200mg/L
10	pH	7.15	6	7.9	7.2	6.5-8.5mg/L

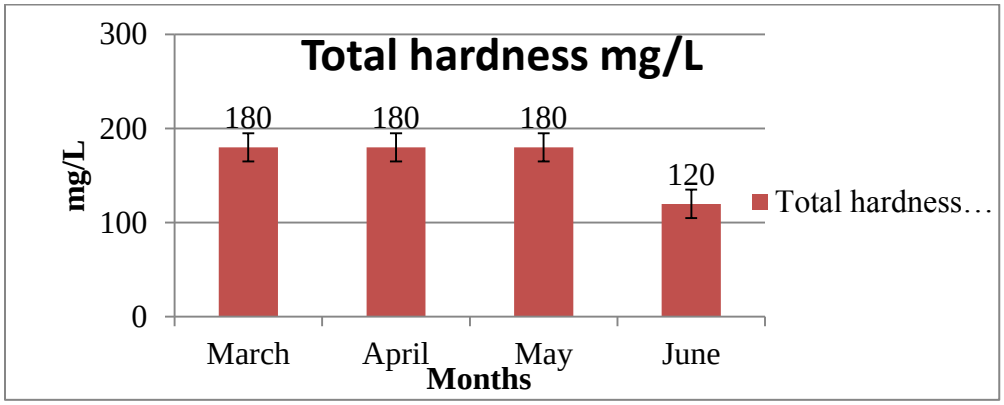

Fig. 13. Total Hardness.

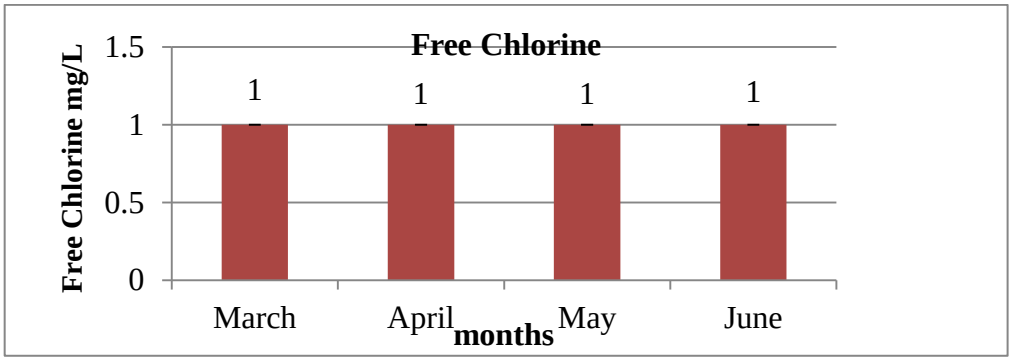

Fig. 14. Free Chlorine.

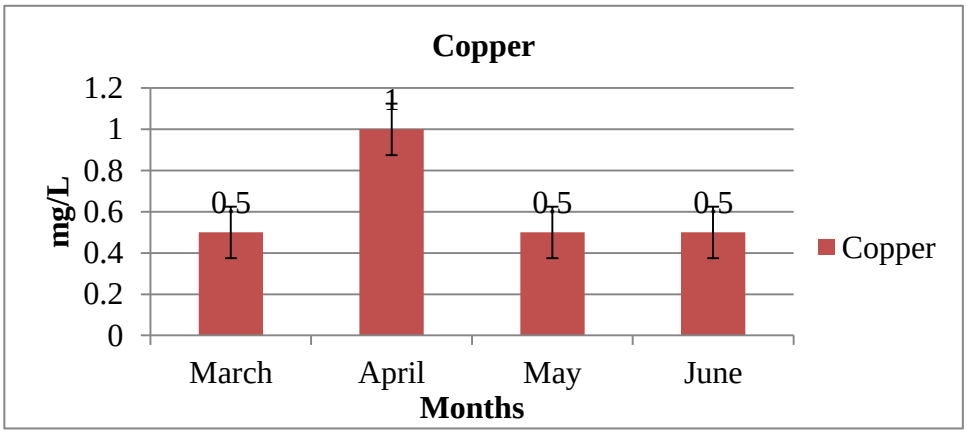

Fig. 15. Copper.

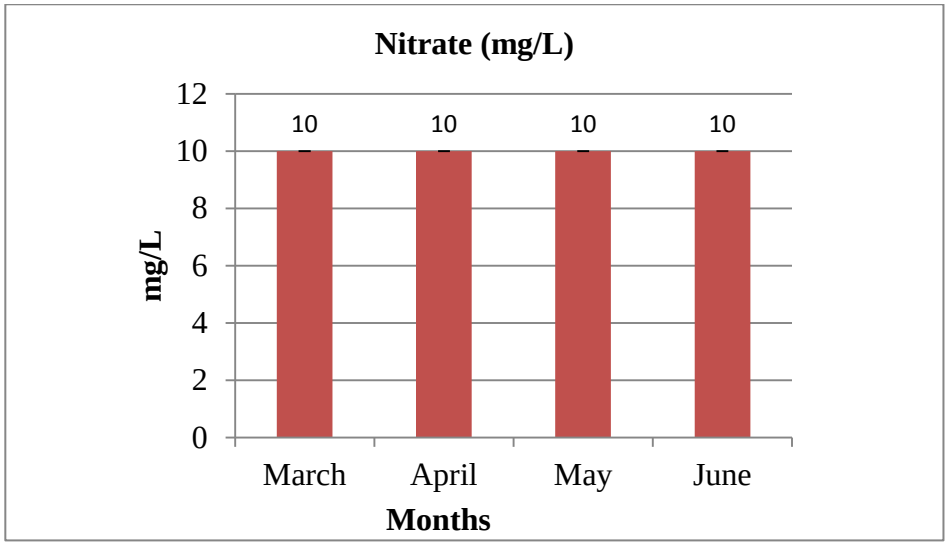

Fig. 16. Nitrate.

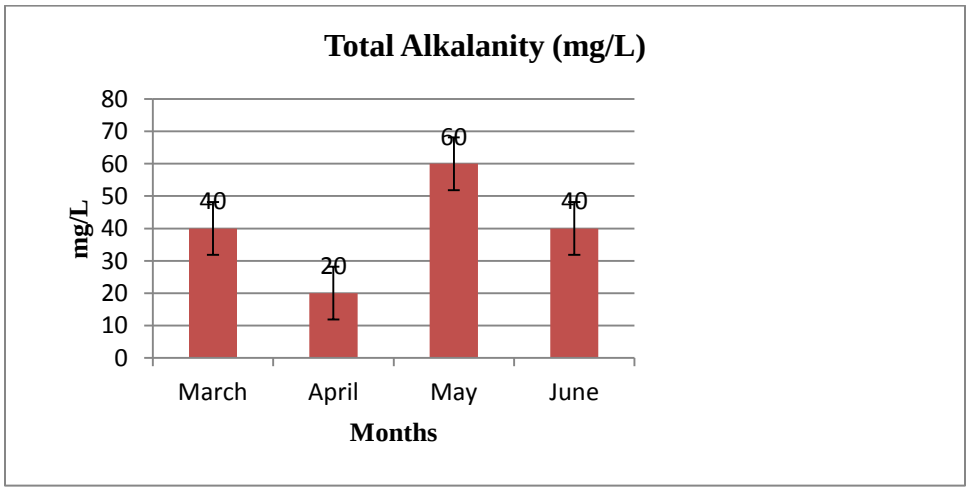

Fig. 17. Total Alkalinity.

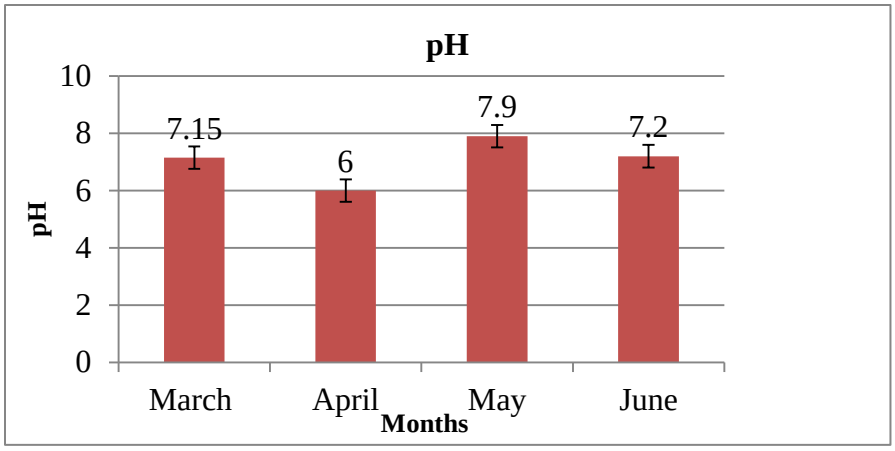

Fig. 18. pH.

DISCUSSION

The current study aims to determine the ichthyofaunal diversity and water quality of Mastura River, Tehsil Lower, District Orakzai, Khyber Pakhtunkhwa, Pakistan. In our present research studies, about 137 fish specimens were collected. After identification, the 10 species belong to three orders (*Cypriniformes*, *Synbranchiformes*, and *Siluriformes*) and 4 families (*Cyprinidae*, *Nemacheilidae*, *Mastacembelidae*, and *Sisoridae*). The Family *Cyprinidae* was the most abundant family and is represented by 9 species, including *Crossocheilus diplocheilus*, *Garragotyla*, *Bariluis vagra*, *Racoma labiata*, *Shizothorax socinous, and Puntiusticto.*

In the present research, data few commercially important species of fish were identified, like *Shizothorax socinous, R.labiatus, and G.gotyla*. Haseeb's study of the fish population in Tanda Dam identified 13 species, representing 4 orders and 5 families. The most diverse family was Cyprinidae, with 9 species recorded. The remaining 4 species were distributed among the Cobitidae, Anguillidae, Siluridae, and Belonidae families (Haseeb *et al*., 2015). The present study was conducted on the Mastura River, which identified 10 Genera and four Families. The two families, Siluridae and Cyprinidae, were common with Tanda Dam, and also Cyprinidae was prominent like Tanda Dam. Similarly, in the North Waziristan Agency, a survey of the Barganat Dam was carried out between June 2015 and March 2016. 10 species were found during the study; of these, eight belonged to the Cyprinidae family, and two to the Cypriniformes and Perciformes orders of the Cichlidae (Hameed *et al*., 2016). Fish exhibit huge variations in their morphology, habitats, and lifestyles.

From June 2009 to January 2010, seven species from two orders, two families, and five distinct genera were identified at the Changhoz Dam survey. A total of 103 were caught. Commercially, several of them are significant food fish. From Changhoz Dam, the following seven fish species were found: Barilius vagra, Barilius pakistanicus, Labeo rohita, Cyprinus carpio, Crossocheilus latius, Hypophthalmichthys molitrix, and Mastacembelus armatus (Khan and Hasan, 2011). In a related research, Shahjehan and Khan found 26 species at Baran Dam Bannuw, which is in the Karak district of NWFP, Pakistan (Shahjehan and Khan, 2000). Additionally, the sample period's seasonal change highlights how dynamic freshwater ecosystems are and how crucial timing is for biodiversity research. Future research should take into account year-round sampling to capture the entire spectrum of ecological variations, as the reproductive cycles of fish species are essential to comprehending population dynamics.

Conclusion

The current study found that the ichthyofauna population in Mastura River in District Orakzai, Khyber Pakhtunkhwa, is significant. Future ichthyologists will benefit from this study of ichthyofauna records. Maintaining the diversity of ichthyofaunal life is an essential and challenging environmental issue. The aquatic ecosystem of Mastura River in District Orakzai is severely affected by human activity and illegal fishing. Some individuals use electric current for fishing, which destroys all aquatic ecosystems.

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