

First comprehensive study on ichthyofaunal diversity of River Kurram Khyber Pakhtunkhwa Pakistan

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Abstract

Highlighting the economic, ecological, and medical significance of fish species as well as their role as a cheap and rich source of animal protein and their remarkable diversity among vertebrates, the present study aimed to explore the fish diversity of the River Kurram, Khyber Pakhtunkhwa, Pakistan, from September 2019 to September 2022. Fish specimens were collected from 14 different sites with the help of local fishermen using cast nets. The collected specimens were washed and preserved in 90% ethanol for further observation. A total of 1,902 specimens were collected and identified, belonging to six orders, eight families, 22 genera, and 35 species. Among the recorded orders, Cypriniformes was the most diverse represented by 19 species, followed by Siluriformes represented by 6 species, Perciformes represented by 3 species, Salmoniformes represented by 2 species, and Channiformes also represented by 2 species, while Mastacembeliformes was the least diverse, represented by only one species. In terms of family-wise diversity, Cyprinidae was the most diverse family, with 19 species, whereas Mastacembelidae was the least diverse, represented by only a single species, *Mastacembelus armatus*. Regarding species abundance, the most abundant species was *Schizothorax plagiostomus*, with 241 specimens (12.7% of the total collection), followed by *Garra gotyla* (139 specimens, 7.3%), *Barilius pakistanicus* (128 specimens, 6.7%), and *Tor putitora* (122 specimens, 6.4%). Conversely, *Cyprinus watsoni* and *Schistura shadwalensis* were the rarest species, each represented by only 11 specimens (0.58% of the total collection). In terms of site-wise distribution, *Schizothorax plagiostomus* was the most widely distributed species, collected from nearly all study sites except for a few locations in the upper region of the river.

Keywords: Ichthyofauna, River Kurram, Khyber Pakhtunkhwa

Introduction

Fish can be defined as a cold-blooded vertebrate that adapts to live in water, respire through gills, and has limbs in the form of fins (Iqbal & Lubna, 2023; Malabarba & Malabarba, 2020). Ichthyofauna represent an essential component of the aquatic ecosystem and are highly valued for their economic, social, and aesthetic importance (N'Zi et al., 2015). Similarly, the Food and Agriculture Organization (FAO) reported that fish produce 91.3 million tons of food of which 79.7 tons are produced by marine water and 11.6 tons by freshwater fish. Out of 91.3 million tons, 86% are consumed by humans and the remaining is utilized as a health supplement for a human being as a food source for livestock and aquaculture (Lynch & MacMillan, 2020). Medically, fish is a healthy food, providing macro and micronutrients, polyunsaturated fatty acid, and rich quality animal proteins making it more reasonable than other animal proteins. As compared to terrestrial animals, fish's body is rich in some minerals like Iodine, Selenium, Zinc, Calcium and micronutrients like vitamin A, and vitamin D, which are essential to prevent chronic diseases like hypertension, coronary heart disease, diabetes type-2, obesity, and cancer (Mohanty et al., 2019). Moreover, fishes are environmental indicators and they show the physical, chemical, and biological status of water bodies in both fresh and marine ecosystems (Whitfield & Elliott, 2002). A fish database (fishbase) recorded more than 34000 species of Fish which are the most abundant group of vertebrates that are different from one another by size, shape, color, habits, and habitat (Tedesco et al., 2017). In 2010 about 32000 fish species were reported of which 16764 belong to marine water, 15170 belong to freshwater, and 180 species were from brackish water. Moreover each year 100-150 new marine species are being added to ichthyofauna (Eschmeyer & Polack, 2010). According to (Dawson, 2012) freshwater occupies less than 1% of the aquatic environment and represents 48% of fish fauna about 13000 fish species out of 27000 while marine water occupies 99% aquatic environment and represents about 14000 fish species. Geographically freshwater fishes have a different population in different regions, out of 13000 species and 2513 genera Neotropical region is the more abundant region representing 4,035 species (705 genera) followed by the tropical region 2,938 (390 genera), oriental represents 2,345 (440 genera), in the Palearctic 1,844 (380 genera), Nearctic 1,411 (298 genera) while Australian represent very least population 261 (94 genera) Levêque et al., 2008). The distribution of fish in freshwater is affected by different ecological features like stream gradient, rainfall, water chemistry, temperature, and

latitude (Reis et al., 2016). Moreover, in the recent decade fish diversity is badly affected by different aquatic pollution, especially heavy metals and pesticides (Ullah et al., 2022; Habib et al., 2024; Naz et al., 2022). The present study is aimed to explore the fish diversity of River Kurram, Khyber Pakhtunkhwa Pakistan from September 2019 to September 2022.

Martial and methods

Study area

The river Kurram is a large river that originated from Kohe e surfed (Speen Gher) in Paktia province of Afghanistan and entered into district Kurram formally known as Kurram agency, then entering to the district Bannu at the north-western side, rapid flow to the Lakki Marwat at the south (Ali et al., 2018). Water sources of the river are rainfall which mostly occurs in monsoons in summer, melting snow in winter, and drainage from the surrounding areas (Rahman et al., 2022). Their water is the main source of irrigation of lower Kurram, Bannu, and Lakkimarwat and plays very important role in their agriculture (Zafar et al., 2017). The total length of the river is 240 KM but its width and water depth are variable in different areas, water flow also decreases down the river from top to bottom, temperature in summer remains pleasant from 17C⁰ to 31 C⁰ while in winter it goes below the freezing point depend upon from sea level (Ali et al., 2022).

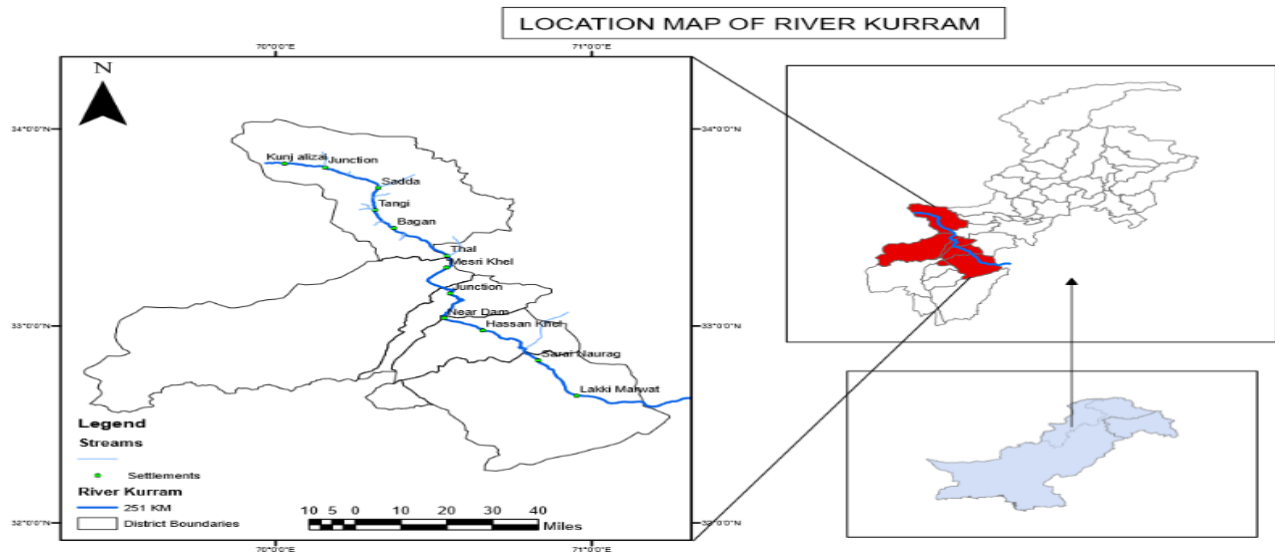


Figure 1. Study area map showing the collection sites of River Kurram.

Fish collections

Fish samples were collected from 14 different sites of River Kurram from September 2019 to September 2022 with the help of local fishermen. Different fishing gears including simple hooks, rods, and different types of nets like cast nets and hand nets.

Morphological identification and morphometry

The collected samples were shifted to the laboratory of the zoology department at Islamia College Peshawar for morphological identification with the help of different standard fish identification keys (Jayram, 1999; Talwar & Jhingran, 1991). Specimens were identified based on external morphological features such as body shape, position of mouth, position of fins, number and types of fin rays, types and numbers of lateral line scales, number and length of barbels and their position, pattern of the body color and measurement of various morphometric variables (Mirza & Sandhu, 2007; Mirza, 1990).

Table 1. Details of collection sites, GPS location and mean annual temperature.

Site Number	Name	Latitude	Longitude	Mean Annual Temp. C°
01	Kunj alizai	33°49'27.48"N	70° 1'40.73"E	15
02	Gubad shah	33°55'22.84"N	70° 8'14.92"E	17
03	Junction	33°48'23.02"N	70° 9'23.12"E	16
04	Sadda	33°42'6.61"N	70°19'27.78"E	18
05	Tangi	33°35'21.51"N	70°18'50.25"E	19
06	Bagan	33°29'44.75"N	70°22'29.28"E	20
07	Thal	33°21'27.07"N	70°32'31.87"E	21
08	Mesri khel	33°17'44.61"N	70°32'24.25"E	22
09	Junction	33° 9'57.82"N	70°33'2.65"E	23
10	Near dam	33° 2'22.17"N	70°32'1.38"E	23
11	Hassan khel	32°58'38.27"N	70°39'16.79"E	23
12	Sarai naurag	32°49'32.35"N	70°49'49.58"E	24
13	Lakki marwat	32°38'48.33"N	70°57'6.14"E	24
14	Junction	32°37'26.12"N	71°21'50.11"E	24

The details of the collecting sites from where fish specimens were collected, their GPS coordinates, and the average annual temperature is mentioned in Table 1. Kunj Alazai, Qubad Shah, Junction, Sadda, Tangi, Bagan, Thal, Mesri Khel, Junction, Near Dam, Hassan Khel, Sarai naurang, Lakki Marwat and Junction. The average annual temperature was maximum in the junction and Lakki Marwat, where the temperature was recorded 24 C°. In comparison, the minimum temperature was recorded in Kunj Alizai at about 15 C°, then the continuous increase from Kunj Alizai to Lakki Marwat.

Table 2. Details of fish species collected from River Kurram Khyber Pakhtunkhwa Pakistan

Sr. No.	Order	Family	Species
1.	Cypriniformes	Cyprinidae	<i>Carassius auratus</i>
2.			<i>Cyprinus Carpio</i>
3.			<i>Barilius modestus</i>
4.			<i>Barilius vagra</i>
5.			<i>Barilius pakistanicus</i>
6.			<i>Cyprinus watsoni</i>
7.			<i>Puntius ticto</i>
8.			<i>Puntius sophore</i>
9.			<i>Schizothorax plagiostomus</i>
10.			<i>Schizothorax Labiatus</i>
11.			<i>Schistura alepidote</i>
12.			<i>Schistura shadwalensis</i>
13.			<i>Schistura prashari</i>
14.			<i>Tor putitora</i>
15.			<i>Cirrhinus mrigala</i>
16.			<i>Crossocheilus diplocheilus</i>
17.			<i>Garra gotyla</i>
18.		Nemacheilidae	<i>Triplophysa naziri</i>
19.			<i>Triplophysa choprai</i>
20.			<i>Acanthocobitis botia</i>
21.	Siluriformes	Sisoridae	<i>Glyptothorax stocki</i>
22.			<i>Glyptosternon reticulatum</i>
23.			<i>Glyptothorax punjabensis</i>
24.			<i>Glyptothorax naziri</i>
25.			<i>Glyptothorax kashmirensis</i>
26.			<i>Ompak pabda</i>
27.		Ailiidae	<i>Mystus bleekeri</i>
28.	Chenniforms	Chennidae	<i>Channa gachua</i>
29.			<i>Channa punctate</i>
30.	Salmoniforms	Salmonidae	<i>Oncorhynchus mykiss</i>
31.			<i>Salmo trutta</i>
32.	Mastacembeliforms	Mastacembelidae	<i>Mastacembelus armatus</i>
33.	Perciform	Cichlidae	<i>Oreochromis aureus</i>
34.			<i>Oreochromus niloticus</i>
35.			<i>Oreochromis mozabica</i>

Collected fish specimens belong to six orders, eight families, 22 genera and 35 species. The most diverse order was cypriniforms followed by suliriform, Perciform, Salmoniforms and Chenniforms, while the less diverse order was Mastacembeliforms representing only one species. In family wise diversity more diverse family was Cyprinidae represented by 19 species followed by Sisoridae, Cichilidae, Salmonidae, Chennidae, and Nemacheilidae, and less diverse was Mastacembelidae representing only one species. In species-wise distribution the most abundant species was *Schizothorax plageostomus* in almost all study area sites. Table 4 shows the percentage of the total fish population presented by each species. During collection, the more abundant species was *Schizothorax palgiostomus*, representing 241 specimens and 12.7% of the total collected specimens, followed by *Garra gotyla* 139 specimens and 7.3%, *Barilius pakistanikus* 128 specimens and 6.7%, and *Tor Putitora* 122 specimens and 6.4%. On the other hand, the specimens of *Cyprinus watsoni* and *schistura shadwalensis* were observed rarest in number each 11 specimens with 0.58% of the total specimens, there low numbers may be due to some ecological pressure or habitat non-suitability. Among the collecting sites, more specimens and species were collected from the junction of River Kurram and River Kabul. During collection, from site 14 total 231 specimens were collected, which belonged to 33 species which show more population and diversity, while the site1 show the very little number of specimens, which belonged to only two species which show low population and less diversity.

Table 3 summarizes the numbers of specimens, species diversity, species richness, Shannon Diversity index and Simpson diversity index among all 12 collection sites. Sites 1 and 3 show very low species diversity and richness, with very few species communities, while from site 4 onward, a very noticeable increase was observed both in the diversity index and species communities. Among all sites, species diversity was more uniform among sites 7 and 14, and their reason may be due to habitat suitability for species.

Table 3. Diversity index of collected fish species.

Site No.	Numbers of specimens	Species richness	Shannon Diversity Index	Simpson Diversity Index
Site 1	36	2	0.4	0.24
Site 2	34	2	0.58	0.40
Site 3	27	3	0.89	0.54
Site 4	40	9	1.9	0.85
Site 5	66	17	2.4	0.88
Site 6	100	21	2.5	0.91
Site 7	77	22	2.7	0.94
Site 8	109	29	2.9	0.94

Site 9	123	29	3.0	0.94
Site 10	110	27	3.0	0.93
Site 11	114	27	3.0	0.94
Site 12	105	29	3.0	0.94
Site 13	213	26	3.0	0.94
Site 14	231	26	3.0	0.94

Discussion

The current study aims to determine the ichthyofauna of the River Kurram, Khyber Pakhtunkhwa, Pakistan. A total of 1902 fish specimens were collected from 12 selected sites: Kunj Alizai, Gubad Shah, Junction, Sadda, Tangi, Bagan, Thal, Mesri Khel, Junction, near Dam, S Hassan Khel, Sarai Naurag, Lakki Marwat, and Junction between River Kurram and Kabul by local fishermen using cast nets of size 2-3 to 3-5mm. Sites show noticeable temperature variation between 15 C⁰ to 24C⁰ annually, which greatly influences the ichthyofauna, Kunjalizai to sadda temperature very low even in winter temperature down to freezing point and summer it increases to 20 C⁰, due to low average temperature upper sites have very low species diversity as compared to the lower region sites possessing more average temperature, More species diversity and population in the lower Kurram may be due to low ecological pressure, less anthropogenic activates and more habitat suitability. The collected fish specimens belong to six orders, eight families, 22 genera, and 35 species. The most diverse order was cypriniforms, represented by 20 species, followed by Siluriformes, represented 7 species, Perciform representing 3 species, Salmoniforms representing 2 species and Chenniforms representing 2 species, while the less diverse order was Mastacembeliforms, representing only one species. Similarly, mirza et al (1993) reported 13 fish species from River Kurram and its tributaries in which cyprinidae representing 7 species like aspidoporia morar, barilius pakistanicus, garra gotyla, crossocheleius diplocheilus, schizothorax plagiostomus, racoma labiate, schizocypris brucei, while nemacheilidae representing two species and sisoridae representing 4 species. Like River Kurram other major water bodies of Khyber Pakhtunkhwa also possess the same diversity of fish with little variation like Wahab & yousafzai, (2017a & 2017b) documented 10 species of family cyprinidae and 5 species of family sisoridae from River Panjkora. Similarly, Ahmad et al (2014) recorded 14 species in which 6 species belong to family cyrinidae, 2 species to channidae while mastacembelifdae, Salmonidae and sisoridae was represented by single spices from River panjkora Dir Upper region, ullah et al (2014) documented 16 species from Konhaye stream a major tributary of Panjkora in which 11 species belong to

cyprinidae, 2 species to channidae, while nemacheilidae, sisoridae and mastacembelidae represented by single species.

Different authors documented fish diversity in River Swat in different years and from different regions but family cyprinidae was recorded the dominant family in river like Akhtar et al 2014 reported 14 species from River Swat, Yousafzai et al (2013) documented 38 species from river Swat at Charsadda region, in which 20 species belong to cyprinidae, 4 species to nemacheilidae, 6 species to sisoridae, 2 species to schilbeidae and channidae while mastacembelidae, belonidae and chandidae represented by single species. Another study conducted by Akhtar et al 2014 on River Swat reported 18 species, 14 belong to cyprinidae, 3 belonged to sisoridae and mastacembelidae represented by single species. River Kabul a large River based on their water and catchment area also show similarity in diversity, Khattak et al 2015 recorded 24 species at the Nowshera region in which family cyprinidae was the most abundant representing 14 species, Channidae, bagridae and siluridae represented by two species, while nemacheilidae, mastacembelidae, schilbeidae and sisoridae represented by single species. Thus, family cyprinidae is the most abundant species in River Kurram. But also in all major rivers of Khyber Pakhtunkhwa, its mean species of cyprinidae show more adaptation to environmental conditions. In species abundance we found *Schizothorax plagiostomus* is the more abundant species in the study areas as compared to other species of family cyprinidae, *Schizothorax plagiostomus*, representing 241 specimens and 12.7% of the total collected specimens, followed by *Garra gotta* 139 specimens and 7.3%, various *pakistanicus* 128 specimens and 6.7%, and *Tor Putitora* 122 specimens and 6.4%. On the other hand, the specimens of *Cyprinus watsoni* and *Schistura shadwalensis* were observed as rarest in number each 11 specimens with 0.58% of the total specimens, their low numbers may be due to some ecological pressure or habitat non-suitability. Similarly, Haseeb & Yousafzai, 2023 also recorded *Schizothorax plagiostomus* as a most abundant species from all major Rivers (Panjkora, Swat, Kabul and Kurram) of Khyber Pakhtunkhwa.

Conclusion

It is the first comprehensive study on the Ichthyofauna of River Kurram and results of the current study report a total of 35 species belonged to 6 orders, 8th families, 22 genus and 35 species. Current study also concluded that upper portion of the river is very suitable for cold water fish's e, g trout due to low temperature while lower portion is very suitable for carps rearing due to moderate temperate temperature.

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Table 4: Location-wise collection from River Kurram Khyber Pakhtunkhwa Pakistan

Species Name	Site1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site10	Site11	Site 12	Site 13	Site14	Total	Percentage
<i>Carassius auratus</i>	-	-	-	-	-	-	-	2	2	5	4	4	13	17	47	2.48%
<i>Cyprinus Carpio</i>	-	-	-	-	-	-	-	-	-	-	3	9	21	23	56	2.95%
<i>Barilius modestus</i>	-	-	-	-	-	-	3	3	2	7	12	17	12	21	77	4.06%
<i>Barilius vagra</i>	-	-	-	-	3	3	7	12	15	17	21	27	12	9	126	6.64%
<i>Barilius pakistanicus</i>	-	-	-	-	2	5	7	12	11	19	23	17	21	11	128	6.75%
<i>Cyprinus watsoni</i>	-	-	-	-	-	-	-	1	-	3	2	5	-	-	11	0.58%
<i>Puntius ticto</i>	-	-	-	-	-	-	7	3	4	1	6	4	-	-	25	1.31%
<i>Puntius sophore</i>	-	-	-	-	-	3	7	8	12	1	-	-	-	-	31	1.63%
<i>Schizothorax plagiostomus</i>	-	-	7	13	21	23	17	19	27	31	22	17	15	29	241	12.71%
<i>Schizothorax Labiatus</i>	-	-	-	-	-	-	-	3	1	9	2	11	5	7	38	2.00%
<i>Schistura shadwalensis</i>	-	-	-	3	2	2	-	-	2	-	-	2	-	-	11	0.58%
<i>Schistura alepidote</i>	-	-	-	-	-	-	-	2	3	5	-	3	7	5	25	1.31%

<i>Schistura prashari</i>	-	-	-	-	-	-	-	2	3	7	4		3	7	26	1.37%
<i>Tor putitora</i>	-	-	-	-	3	5	5	3	9	9	21	19	27	21	122	6.43%
<i>Cirrhinus mrigala</i>	-	-	-	-	-	-	-	3	-	-	-	3	5	3	14	0.73%
<i>Crossocheilus diplocheilus</i>	-	-	-	5	3	7	6	11	12	7	9	5	3	2	70	3.69%
<i>Garra gotyla</i>	-	-	-	4	6	12	14	16	12	21	12	17	12	13	139	7.33%
<i>Triplophysa naziri</i>	-	-	-	-	5	3	1	2	9	7	-	-	2	5	34	1.79%
<i>Triplophysa choprai</i>	-	-	-	-	2	1	3	5	3	-	2	-	-	-	16	0.84%
<i>Acanthocobitis botia</i>	-	-	-	-	3	3	-	5	3	-	2	-	-	-	16	0.84%
<i>Glyptothorax stocki</i>	-	-	-	-	3	5	7	18	16	10	5	3	7	5	79	4.16%
<i>Glyptosternon reticulatum</i>	-	-	-	-	-	3	4	6	11	8	6	8	7	3	56	2.95%
<i>Glyptothorax punjabensis</i>	-	-	-	-	-	1	5	7	3	1	-	3	2	5	27	1.42%
<i>Glyptothorax naziri</i>	-	-	-	-	-	3	3	5	7	3	5	3	7	5	41	2.16%
<i>Glyptothorax kashmirensis</i>	-	-	-	2	1	3	2	2	4	3	7	4	3	7	38	2.00%

<i>Ompak pabda</i>	-	-	-	-	-	3	7	4	2	3	7	9	-	-	35	1.84%
<i>Mystus bleekeri</i>	-	-	-	-	-	3	7	4	-	3	7	3	3	5	35	1.84%
<i>Channa gachua</i>	-	-	-	-	2	-	5	7	-	-	3	4	5	7	33	1.74%
<i>Channa punctate</i>	-	-	-	3	7	7	6	4	6	9	4	5	6	5	62	3.27%
<i>Oncorhynchus mykiss</i>	31	25	17	3	-	-	-	-	-	-	-	-	-	-	76	4.01%
<i>Salmo trutta</i>	5	9	3	5	-	-	-	-	-	-	-	-	-	-	22	1.16%
<i>Mastacembelus armatus</i>	-	-	-	2	3	5	2	7	17	11	16	7	5	9	84	4.43%
<i>Oreochromis aureus</i>	-	-	-	-	-	-	-	-	3	5	2	5	2	3	20	1.05%
<i>Oreochromis niloticus</i>	-	-	-	-	-	-	-	-	5	7	4	3	5	3	27	1.42%
<i>Oriochromis mozabica</i>	-	-	-	-	-	-	-	-	1	3	2	4	3	1	14	0.3%
Total	36	34	27	40	66	100	125	175	205	215	213	221	213	231	1902	100%
Percentage	1.89%	1.78%	1.41%	2.10%	3.47%	5.25%	6.57%	9.20%	10.77%	11.30%	11.19%	11.61%	11.19%	12.14%	100%	

Site1= Kunj Alizai, Site 2= Gubad shah Site 3= Junction, Site 4= Sadda, Site 5 = Tangi, Site 6= Bagan, Site7 =Thal, Site 8 = Mesri khel,
Site 9= Junction, Site 10= near dam, Site 11= Hassan khel, Site 12= Sarai naurag, Site 13=Lakki marwat, Site 14= Junction