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Original Research Article

Fish Diversity in River Panjkora, District Dir Lower, Khyber Pakhtunkhwa, Pakistan

Masood Shah[1]*, Kinza Ejaz[2], Linta Noor[3], Nadeem Jamal[4], Amir Muaawia[4], Anbareen[5], Abul Hassan Khan[6], Muhammad Afzal[2], Muhammad Usman[7]

[1]Department of Zoology, Shaheed Benazir Bhutto University, Dir Upper KPK, Pakistan
[2]Department of Zoology, The Islamia University of Bahawalpur, Punjab Pakistan
[3]Department of Fisheries and Aquaculture, Abdul Wali Khan University Mardan, KPK Pakistan
[4]Department of Zoology, Abdul Wali Khan University Mardan, KPK Pakistan
[5]Department of Zoology, University of Peshawar, KPK Pakistan
[6]Department of Zoology, Wildlife and Fisheries, University of Agriculture Faisalabad, Punjab Pakistan
[7]Department of Zoology, University of Malakand Dir, KPK Pakistan

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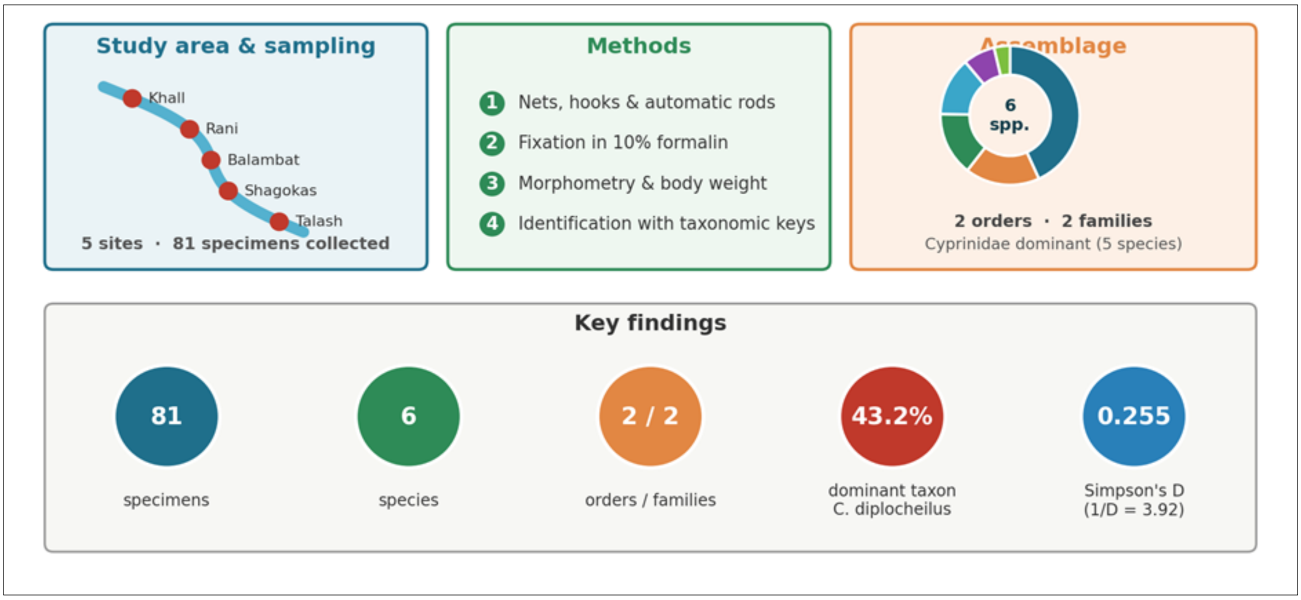
***Corresponding author:** Masood Shah
Department of Zoology, Shaheed Benazir Bhutto University, Dir Upper KPK, Pakistan

Abstract



A fish may be defined as a poikilothermic, aquatic chordate whose appendages, when present, are developed as fins, whose chief respiratory organs are gills and whose body is usually covered with scales. The present study was undertaken to document the fish diversity of River Panjkora in District Dir Lower, Khyber Pakhtunkhwa, Pakistan. Samples were collected from March to August 2024 using gill nets, cast nets, hooks and automatic rods at five sites along the river, namely Talash, Shagokas, Balambat, Rani and Khall. A total of 81 specimens were captured and identified, representing six species distributed across two orders (Cypriniformes and Perciformes) and two families (Cyprinidae and Channidae). Cyprinidae was the richest family, comprising five species Schizothorax esocinus, Puntius ticto, Tor macrolepis, Carassius auratus and Crossocheilus diplocheilus whereas Channidae was represented by a single species, Channa gachua. Crossocheilus diplocheilus was the most abundant taxon (35 individuals; 43.20%), while Carassius auratus was the least abundant (3 individuals; 3.70%). Morphometric measurements and fin formulae were recorded for every species; the smallest species was Puntius ticto (total length 8.2 cm) and the largest was Tor macrolepis (total length 19.5 cm). Simpson's index of dominance was 0.255 and the reciprocal Simpson's index was 3.92, indicating a moderately diverse assemblage

dominated by cyprinids. Fishes were identified using standard taxonomic keys, including Fishes of the Punjab (Mirza and Sandhu, 2007) and the Urdu key of Mirza (1990). The findings indicate that the river can potentially harbour additional species and could serve as a resource for conserving threatened taxa. Regular monitoring of the fish fauna, periodic assessment of water quality, stocking of native fish and control of illegal fishing are recommended to safeguard the ichthyofauna.

Keywords: Fish diversity; River Panjkora; Dir Lower; Cyprinidae; Simpson's index; morphometry; freshwater fishes.

1. INTRODUCTION

Recognizing their great diversity, a fish can be defined as a poikilothermic, aquatic chordate with appendages (when present) developed as fins, whose chief respiratory organs are gills and whose body is usually covered with scales (Berra, 2001), or more simply as an aquatic vertebrate with gills and with limbs in the shape of fins (Nelson, 2006; Ather *et al.,* 2026: Ijaz *et al.,* 2024). Fishes are therefore cold-blooded animals, typically possessing a backbone, gills and fins rather than pentadactyl limbs, and are primarily dependent on water as the medium in which they live. Fishes constitute the largest group of vertebrates found in fresh and salt water bodies. More than 25,000 species of fish account for roughly 50% of the vertebrate population (Delsuc *et al.,* 2006), and because around 100 new species are described each year, the final total may well exceed 30,000 (Takezaki *et al.,* 2003). Bony teleost's predominate over the cartilaginous and elasmobranch fishes, which number just over 800 species. Fishes display enormous diversity in both their morphology and the habitats they occupy.

Biological diversity is the variety of living forms, the ecological roles they perform and the genetic diversity they contain (Wilson, 1988). Fishes exhibit extraordinary diversity in their morphology, in the habitats they occupy and, in their biology, (Froese and Pauly, 1998). Their remarkable diversity and their strong influence on the distribution and abundance of other aquatic organisms make fishes key indicators of ecosystem quality (Moyle and Leidy, 1992); consequently, the health of fish populations generally predicts the health of aquatic ecosystems (Beverton, 1992). Biodiversity has attracted worldwide attention because of its implications for conservation and land-management strategy, and the increasing decline in biodiversity has alarmed the global conservation community (Wilson, 1988; Nielsen, 1995). Approximately 20% of the world's freshwater fishes are currently either endangered or extinct (Postel, 2002). The identification and characterization of existing species has been described as an essential part of the conservation process and has received considerable attention in the scientific literature. Fish species composition and relative abundance may change with seasonal variation (Pires *et al.,* 1999; Horpila *et al.,* 2000).

Numerically, valid scientific descriptions exist for approximately 27,977 living species of fishes in 515 families and 62 orders (Nelson, 2006). Of these, 108 are jawless fishes, 970 are cartilaginous fishes, and the remaining 26,000 or more are bony fishes. When broken down by major habitat, about 41% of species live in fresh water, 58% in the sea, and 1% move between fresh water and the sea during their life cycle (Cohen, 1970). Geographically, the highest diversities occur in the tropics: the Indo-West Pacific has the highest diversity for a marine area, whereas South America, Africa and Southeast Asia contain the most freshwater fishes (Berra, 2001; Lévêque *et al.,* 2008; Qasim *et al.,* 2025). Body length varies more than a thousand-fold, from tiny Indonesian and reef-dwelling minnows maturing at 7–8 mm to the whale shark, Rhincodon typus, at 12 m or more (Helfman *et al.,* 2009).

The length–weight relationship is widely applied in fisheries management because it provides information on stock condition (Bagenal and Tesch, 1978). It is used to predict weight from length and to compare associated parameters between fish groups in space and time, and can be extended to estimate fish condition, assuming that a heavier fish of a given length is in better condition (Kamaruddin *et al.,* 2012).

The open ocean beyond the continental shelf covers nearly two-thirds of the Earth's surface, and some 2,500 species of fish are distributed there vertically from the surface waters to the greatest depths. Marine fishes show clear zonation into epipelagic, mesopelagic and bathypelagic assemblages, the last inhabiting depths where no daylight penetrates (Marshall, 1965). Estuarine fishes, like other estuarine animals, are mainly euryhaline forms that can tolerate the unstable, variable salinities of river mouths; groups such as herrings, sprats, eels and salmonids add greatly to estuarine diversity (Bigelow and Schroeder, 1953).

Although fresh waters occupy only a small fraction of the aquatic habitat, they contain a disproportionately large number of fishes. Recent estimates place around 44,000 of the world's described species in freshwater ecosystems, even though these occupy only about 0.8% of the Earth's surface (Reaka-Kudla, 1997). It is now estimated that there are over 12,000 primary freshwater species together with a further 2,680 brackish or diadromous species (Froese and Pauly, 2004). Endemism is unusually high in some habitats; for example, an estimated 1,800 fish species are endemic to the Amazon River basin (Darwall and Revenga, 2001).

About one thousand fish species occur in the marine and fresh waters of Pakistan. Nearly 180 species are reported from Pakistan's freshwater resources, including loaches, carps and catfishes, and 28 species are recognized as inhabiting cold waters, most of the snow trout's being confined to the Trans-Himalayan region of the Indus system. The freshwater fish fauna of Pakistan comprises 179 species belonging to 82 genera, 26 families, 10 orders, 5 superorder's and 3 cohorts (Mirza and Bhatti, 1999). Famous game fishes such as mahseer and the schizothoracines are becoming rare owing to over-fishing and the loss of spawning grounds inundated by reservoirs such as Tarbela and Ghazi Barotha. A considerable number of species have also been reported from the tributaries of the region; the cyprinids are typically the most dominant family in terms of population dynamics.

Fishes occupy essentially all aquatic habitats that retain liquid water throughout the year, including thermal and alkaline springs, hypersaline lakes, sunless caves, anoxic swamps, temporary ponds, torrential rivers, wave-swept coasts and high-altitude and high-latitude environments. Their habitats differ greatly in physical features such as pH, salinity, temperature, oxygen content and light, as well as in the space available (Helfman *et al.,* 2009). Nature offers a great diversity of organisms used as food by fishes; bony fishes may be herbivorous, carnivorous or detritivores. The amount of food consumed is directly related to body size, metabolic state and environmental temperature: smaller fishes generally have higher metabolic rates and eat more relative to their size, and because fishes are cold-blooded, warm-water species generally require more food than cold-water species of the same size (Elton, 1927).

The ancestral fishes were presumably small and fusiform, and many modern fishes retain this streamlined shape built around an axial notochord that is largely replaced by vertebral elements (Parsons *et al.,* 2003). Body shape and locomotory behavior in fishes are strongly constrained by the density of water and the drag it exerts, rather than by gravity, because gas bladders or lipid-containing structures render most fishes neutrally buoyant (Videler *et al.,* 1999). The body is usually covered with overlapping scales or denticles overlain by an epithelium; because most scales persist for life, they can record events in an individual's life history, such as reduced growth during winter or the breeding season (Govoni *et al.,* 2004).

Reproduction in fishes shows great diversity and many features not seen in other vertebrates, encompassing variation in sexuality, spawning, parental care and gametogenesis. Reproductive strategies represent adaptations to the many aquatic environments that fishes occupy. Mating systems range from polyandry documented, for example, in an anemonefish through polygyny, the most common form, to monogamy, in which fish live in pairs and mate exclusively; strongly pairing species include many butterflyfishes and anemonefishes, and in some butterflyfishes, pairs may remain together for several years and probably mate for life (Moyer and Sawyers, 1973; Reese, 1975).

During courtship, individuals frequently change from their normal counter shaded patterns to bolder, contrasting colors, and in many species the existing coloration intensifies or the head darkens relative to the rest of the body. Sound production during courtship, usually by the male, occurs in many families and is often accompanied by exaggerated or rapid swimming, erection of the fins and jumping out of the water (Fine *et al.,* 1977; Lugli *et al.,* 1997; Johnston and Johnson, 2000; Lobel, 2001; Johnston and Phillips, 2003). In external fertilizers, spawning behavior often involves rapid swimming, quivering, vibrating, fin-spreading and enfolding of the female by the male, and the elaborate courtship displays serve as species-isolating mechanisms, since females may reject males of the wrong species after viewing their displays (Keenleyside, 1979; Shapiro *et al.,* 1994; Ather *et al.,* 2025).

Fish diseases are important because parasites can reduce fish quality and marketability, diminish size and, in some cases, be transmitted to humans through the food chain. Nematodes in particular infect many aquaculture and wild fishes, commonly attacking the intestine, liver and body cavity, and their larvae may cause blockage of organs; a heavy invasion of gut nematodes may partially or wholly destroy the intestine, stiffening it, slowing peristalsis and hampering digestion (Cheng, 1964; Dar *et al.,* 2015). Visible signs of infection include hemorrhaging, cyst formation, external lumps or nodules, inflammation and necrosis, and juvenile fish are often affected more severely than adults.

Fishes worldwide suffer from a variety of parasitic diseases that cause mortality directly or indirectly (Lerssutthichawal, 1999). Helminth parasites of fish belong chiefly to the trematodes, cestodes, acanthocephalans and nematodes, and most complete their life cycles through intermediate hosts, frequently piscivorous birds (Bychovskaya-Pavlovskaya, 1962; Khanum *et al.,* 2008; Haidri *et al.,* 2026). The characteristics of the water body in which the fish live influence the parasitic fauna and help to determine the parasite community (Wisniewski, 1958; Haidri *et al.,* 2026). Because the intensity of parasitic activity increases when intermediate hosts are involved, helminth parasites can cause considerable damage to fish, either causing disease directly or rendering fish susceptible to other diseases.

As a source of food, fishes are among the most important groups of vertebrates. Fish provides the world's prime source of high-quality protein, and over one billion people rely on it as their primary source of animal protein (Hamilton, 1971). Fishes also have considerable medicinal value: cold-water species such as cod, salmon, mackerel and sardines contain oils that reduce the tendency of blood to clot and help lower blood cholesterol, and dietary studies have linked fish consumption with reduced coronary heart disease (Kromhout *et al.,* 1985). Fish oils are used to supplement vitamins A and D, and in many countries larvivorous fishes serve as biological control agents against mosquitoes (WHO, 1981).

Economically and industrially, fish oils are used in the manufacture of paints, margarine and soap; fish skins are important in the leather industry; and fish scales are used in decoration. Skin from cod, haddock and hake is used to make glue, and fish flour manufactured from sharks and other elasmobranchs is used to fortify cereal foods with high-quality protein (Russell and Yonge, 1936; Anson, 1955). Investment in, and knowledge of, the economic importance of fishes their life history, habitats, physiology, diseases and control is therefore of direct benefit to society.

The present study was therefore undertaken with the following specific objectives:

- To explore the fish diversity of River Panjkora in District Dir Lower.
- To determine the factors influencing fish diversity in River Panjkora.
- To contribute to the development of fisheries resources, increase fish production and improve nutritional levels.

2. MATERIALS AND METHODS

2.1 Study area

The present study was carried out in District Dir Lower, Khyber Pakhtunkhwa, Pakistan, which lies between 34°37′ and 35°07′ N and 71°31′ and 72°14′ E, at about 823 m (2,700 ft) above sea level with a mean annual rainfall of approximately 1,468 mm. River Panjkora originates in Kohistan (Dir Upper), flows southward through the middle of both Upper and Lower Dir, and joins River Swat behind Totakan in District Malakand at Sharbatti (Bosaaq Bridge). The river takes its name from its five principal tributaries, which join it at four places: the Barawal Stream at Chukiatan, the Gwaldi Stream at Sheringal, the Dobando Stream at Akhagram, and the Nurhund and Usherai Dara Streams at Darora (Fig. 1). The district is divided into seven tehsils Timergara, Balambat, Lalqila, Adenzai, Munda, Khal and Samarbagh. Sampling for this study was conducted at five sites along the river within Tehsil Timergara: Talash, Shagokas, Balambat, Rani and Khall.

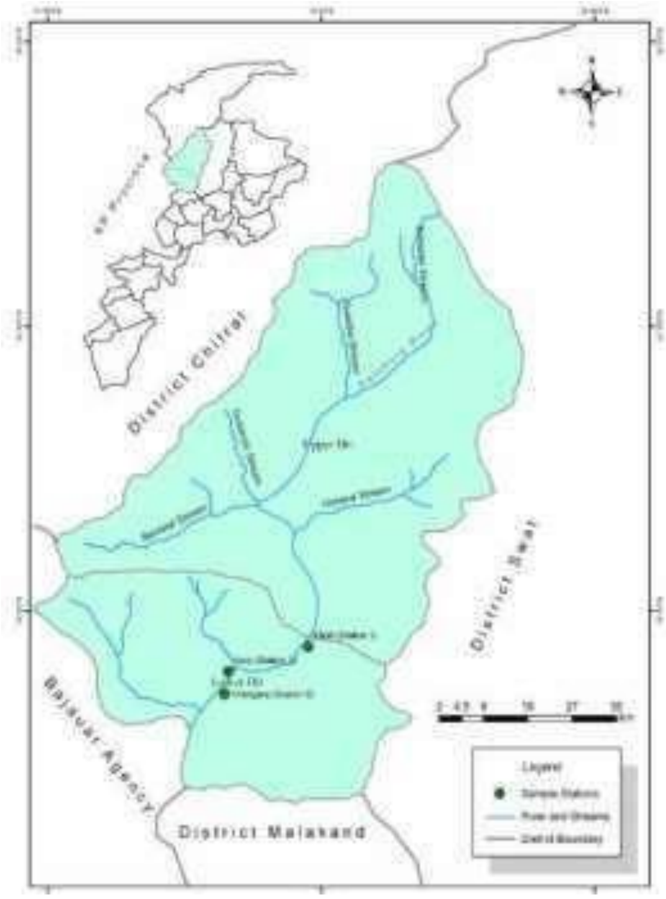


Figure 1: Map showing the location of the study area along River Panjkora, District Dir Lower, with sampling stations

2.2 Study design

The overall workflow of the study from site selection and field collection through preservation, morphometry, identification and data analysis is summarized in the scheme shown in Figure 2.

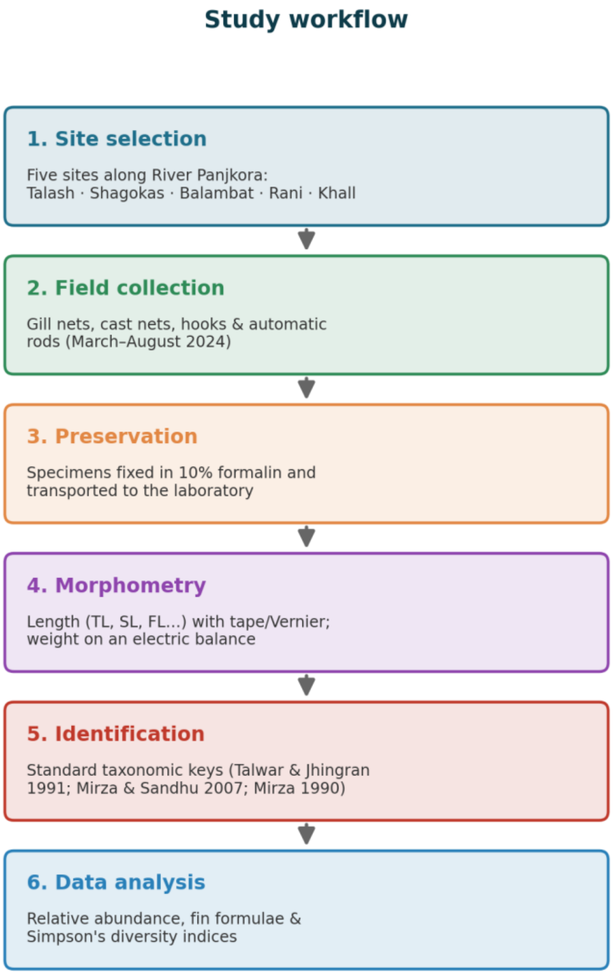


Figure 2: Scheme outlining the sequential workflow followed during the study

2.3 Sample collection and preservation

Fishes were collected randomly from the five sites of River Panjkora between March and August 2024 using gill nets, cast nets, hooks and automatic rods, so as to sample fish diversity across the different zones of the river. The largest catches were obtained with nets. Collected specimens were fixed in 10% formalin in the field and transported to the laboratory of the Department of Zoology, Government Girls Degree College Timergara, Dir Lower, for measurement and identification.

2.4 Measurements and weighing of fishes

Morphometric measurements were taken with a measuring tape, a steel scale and Vernier calipers. Total length, standard length (from the snout to the base of the caudal peduncle), fork length, head length, body depth, body width, pre-dorsal and post-dorsal lengths, eye diameter, snout length and the number of lateral-line scales were recorded for each specimen. Body weight was determined using an electronic balance. Fin formulae (dorsal, pectoral, ventral, anal and caudal fins, together with lateral-line scale counts) were also recorded for each species.

2.5 Identification

All fishes were identified using available standard taxonomic keys, including Inland Fishes of India and Adjacent Countries (Talwar and Jhingran, 1991), Freshwater Fishes of the Indian Region (Jayaram, 1999), Fishes of the Punjab (Mirza and Sandhu, 2007) and the Urdu key by Mirza (1990), Pakistan ki Taza Pani ki Machliyan.

2.6 Diversity analysis

Species diversity was quantified using Simpson's index, which accounts for both the number of species present and the relative abundance of each species. Simpson's dominance index was calculated as $\mathbf{D = \Sigma\ n(n - 1) / N(N - 1)}$, where n is the number of individuals of a given species and N is the total number of individuals of all species. From this, Simpson's index of diversity ($1 - D$) and Simpson's reciprocal index ($1/D$) were derived. For D, values approach 0 as diversity increases and 1 as diversity decreases; for $1 - D$ and $1/D$, larger values indicate greater diversity.

3. RESULTS

The study was conducted to determine the fish diversity of River Panjkora, District Dir Lower, from

March to August 2024. A total of 81 specimens were collected, representing six species belonging to six genera, four subfamilies, two families and two orders. The family Cyprinidae was represented by five species and was the most dominant family in the assemblage, while the family Channidae was represented by a single species. Cypriniformes was the richest order. Morphometric measurements were recorded for every species; the smallest species was Puntius ticto (total length 8.2 cm) and the largest was Tor macrolepis (total length 19.5 cm). Variation in the availability of fishes was recorded among the different sites, and relative abundance and diversity indices were determined. The six species recorded were Crossocheilus diplocheilus, Schizothorax esocinus, Puntius ticto, Tor macrolepis, Carassius auratus and Channa gachua.

3.1 Species composition and site distribution

The species recorded at each of the five sampling sites are listed in Table 1. Crossocheilus diplocheilus and Tor macrolepis were the most widely distributed species, whereas Carassius auratus was restricted to Shagokas and Balambat. Rani supported the greatest number of species (five), followed by Khall (four).

Table 1: Species collected from different sites of River Panjkora at Tehsil Timergara, Dir Lower

No.	Site	Species collected
1	Talash	Crossocheilus diplocheilus; Tor macrolepis
2	Shagokas	Carassius auratus; Crossocheilus diplocheilus; Tor macrolepis
3	Balambat	Tor macrolepis; Carassius auratus; Crossocheilus diplocheilus
4	Rani	Channa gachua; Schizothorax esocinus; Crossocheilus diplocheilus; Tor macrolepis; Puntius ticto
5	Khall	Channa gachua; Schizothorax esocinus; Tor macrolepis; Puntius ticto

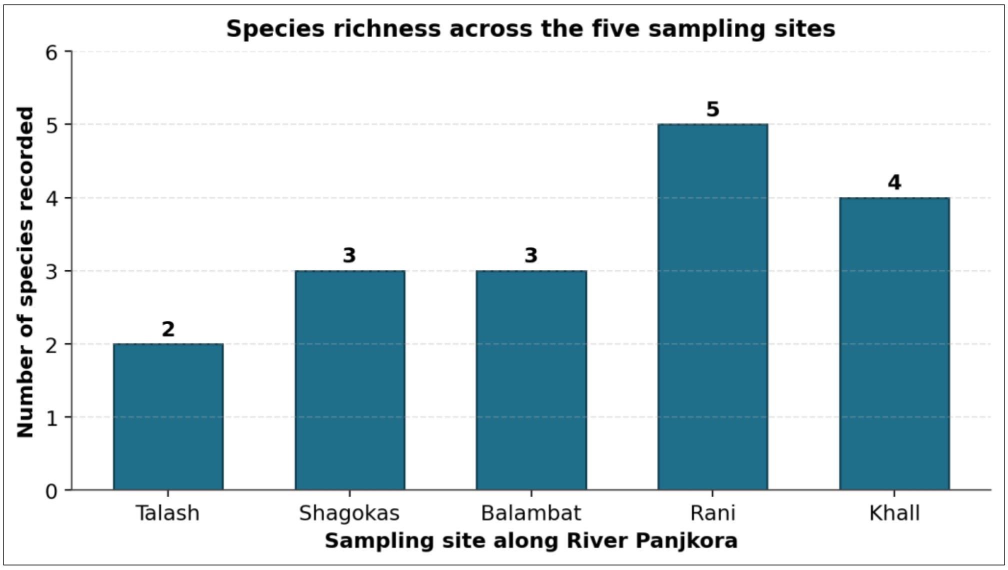


Figure 3: Number of fish species recorded at each of the five sampling sites

3.2 Abundance and percentage composition

The total abundance and percentage composition of the captured species are given in Table 2 and illustrated in Figures 4 and 5. Crossocheilus diplocheilus was overwhelmingly dominant, accounting for 35 of the 81 individuals (43.20%), followed by Tor macrolepis (14; 17.28%) and Schizothorax esocinus (12; 14.81%). Carassius auratus was the least abundant species, represented by only three individuals (3.70%).

Table 2: Total abundance and percentage of captured species at different sites of River Panjkora, Tehsil Timergara

No.	Species	Captured individuals	Percentage (%)
1	Crossocheilus diplocheilus	35	43.20
2	Tor macrolepis	14	17.28
3	Schizothorax esocinus	12	14.81
4	Puntius ticto	11	13.58
5	Channa gachua	06	7.40
6	Carassius auratus	03	3.70
	Total	**81**	**100.00**

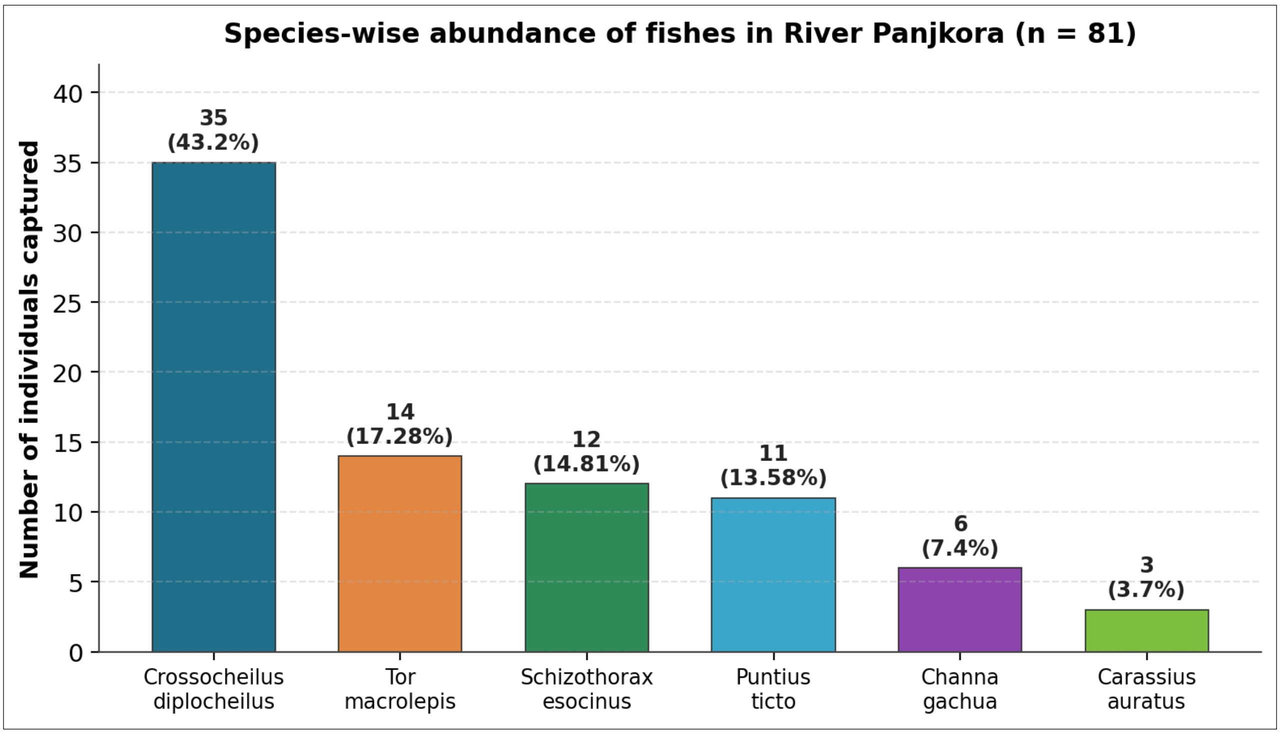


Figure 4: Species-wise abundance of fishes captured in River Panjkora (n = 81)

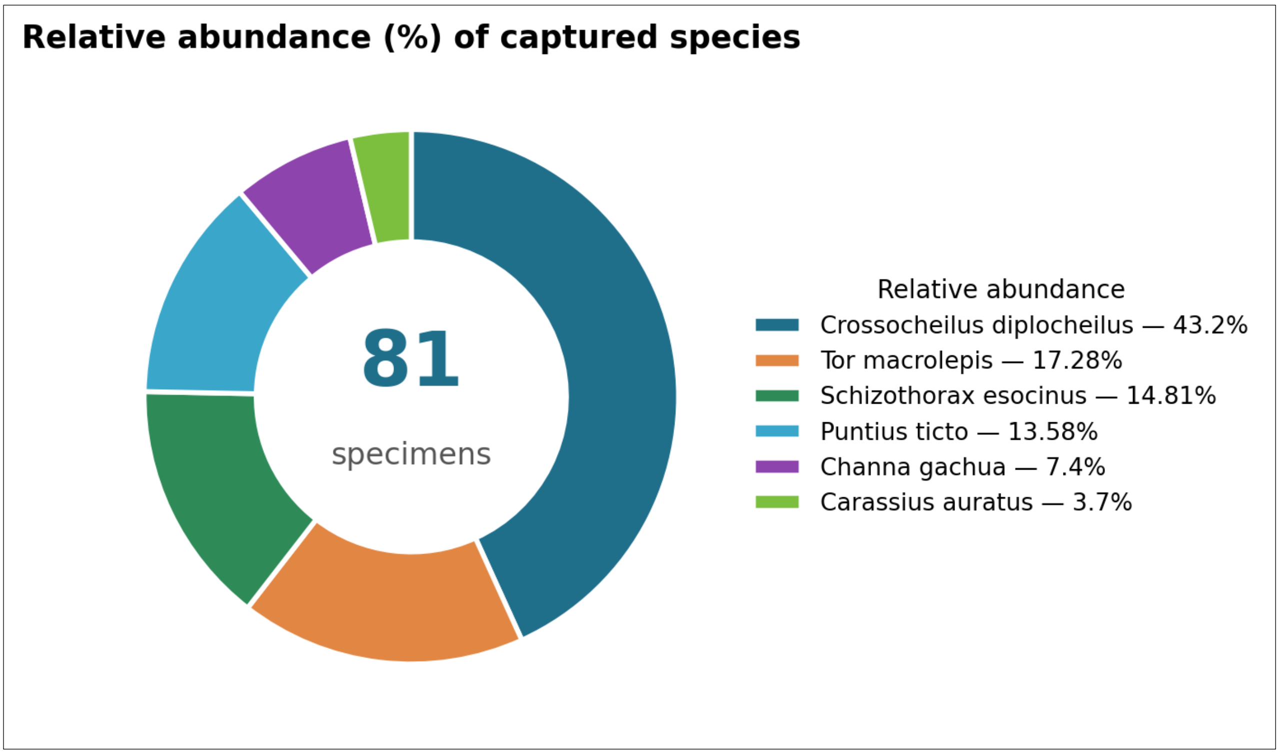


Figure 5: Relative abundance (percentage composition) of the six recorded species

3.3 Taxonomic composition

The assemblage was strongly dominated by the order Cypriniformes and the family Cyprinidae, which together accounted for five of the six species and 75 of the 81 individuals. The order Perciformes (family Channidae) contributed a single species, Channa gachua, with six individuals (Fig. 6).

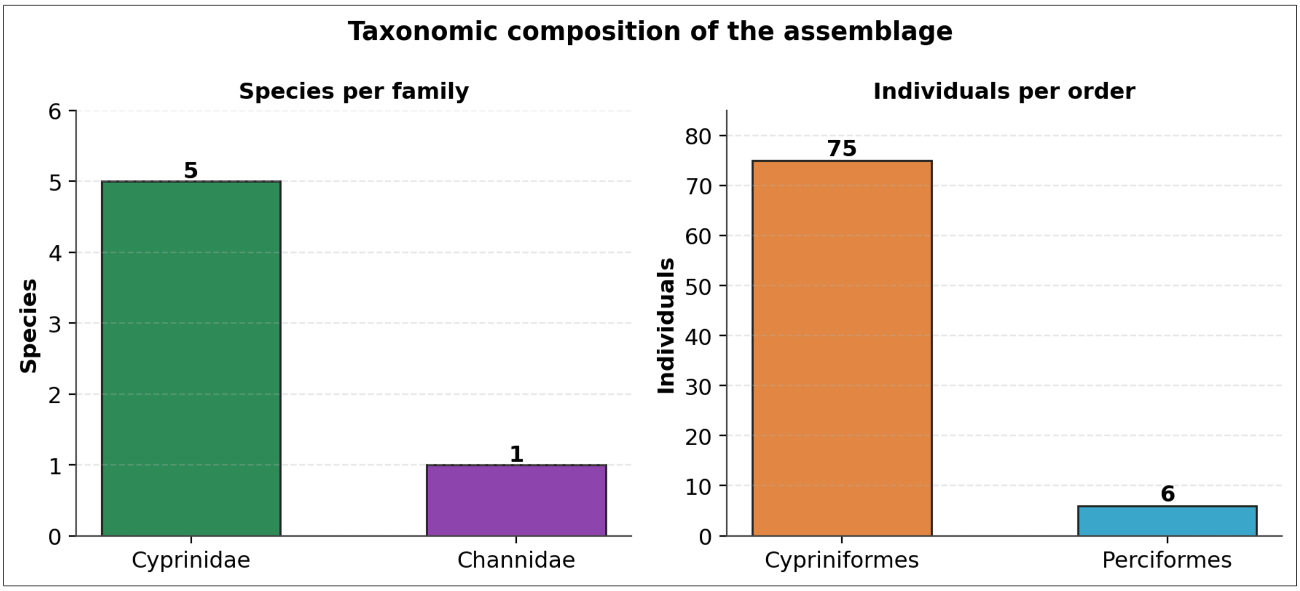


Figure 6: Taxonomic composition of the assemblage: number of species per family and number of individuals per order

3.4 Morphometric measurements

The morphometric measurements and body weights of the six recorded species are presented in Table 3.

Table 3: Morphometric measurements (cm) and body weight (g) of the recorded fish species

Species	T.L	S.L	F.L	H.L	B.D	B.W	Pr.L	Ps.L	E.D	Sn.L	L.L.S
Channa gachua	10.4	8.7	4.0	2.3	2.0	1.2	1.0	0.1	0.5	0.4	44
Schizothorax esocinus	19.0	16.0	16.3	3.0	3.0	3.5	5.0	5.2	7.0	0.6	13
Puntius ticto	8.2	6.4	7.3	1.4	1.2	2.1	2.3	1.7	0.5	0.3	20
Tor macrolepis	19.5	15.0	16.0	3.0	4.0	1.5	5.0	8.5	0.6	1.8	22
Carassius auratus	11.0	8.6	10.1	2.3	3.5	1.0	2.5	1.5	0.5	0.5	29
Crossocheilus diplocheilus	10.2	8.2	9.4	1.7	2.0	1.3	3.4	2.4	0.4	0.4	33

T.L = total length; S.L = standard length; F.L = fork length; H.L = head length; B.D = body depth; B.W = body width; Pr.L = pre-dorsal length; Ps.L = post-dorsal length; E.D = eye diameter; Sn.L = snout length; L.L.S = number of lateral-line scales.

3.5 Fin formulae

The fin formulae of the six species, together with lateral-line scale counts, are given in Table 4.

Table 4: Fin formulae of the recorded fish species

No.	Species	D	P	V	A	C	L.L
1	Tor macrolepis	2/9	9	9	1/6	18	22
2	Schizothorax esocinus	1/8	1/12	10	7	18	13
3	Carassius auratus	1/17	14	8	1/6	19	29
4	Channa gachua	30	16	17	—	12	44
5	Crossocheilus diplocheilus	1/9	13	8	7	19	33
6	Puntius ticto	1/8	9	7	7	17	19

D = dorsal fin; P = pectoral fin; V = ventral (pelvic) fin; A = anal fin; C = caudal fin; L.L = lateral-line scales.

3.6 Diversity indices

The calculation of Simpson's diversity indices is set out in Table 5. Using the abundance data (Σ n(n − 1) = 1,650 and N(N − 1) = 6,480), Simpson's dominance index was D = 0.255, giving Simpson's index of diversity (1 − D) = 0.745 and Simpson's reciprocal index (1/D) = 3.92 (Fig. 7). Because D is close to 0, the assemblage can be regarded as moderately diverse, although it is strongly dominated by a single cyprinid species. The reciprocal value of 3.92 indicates that the effective number of common species is fewer than the six species actually recorded, reflecting the uneven distribution of individuals among species.

Table 5: Simpson's diversity index computation for the River Panjkora fish assemblage

No.	Species	n	n − 1	n(n − 1)
1	Crossocheilus diplocheilus	35	34	1190
2	Tor macrolepis	14	13	182
3	Schizothorax esocinus	12	11	132
4	Puntius ticto	11	10	110
5	Channa gachua	06	5	30
6	Carassius auratus	03	2	6
	Total (N = 81)	81		Σ = 1650

$D = \Sigma n(n-1) / N(N-1) = 1650 / 6480 = 0.255$; $1 - D = 0.745$; $1/D = 3.92$.

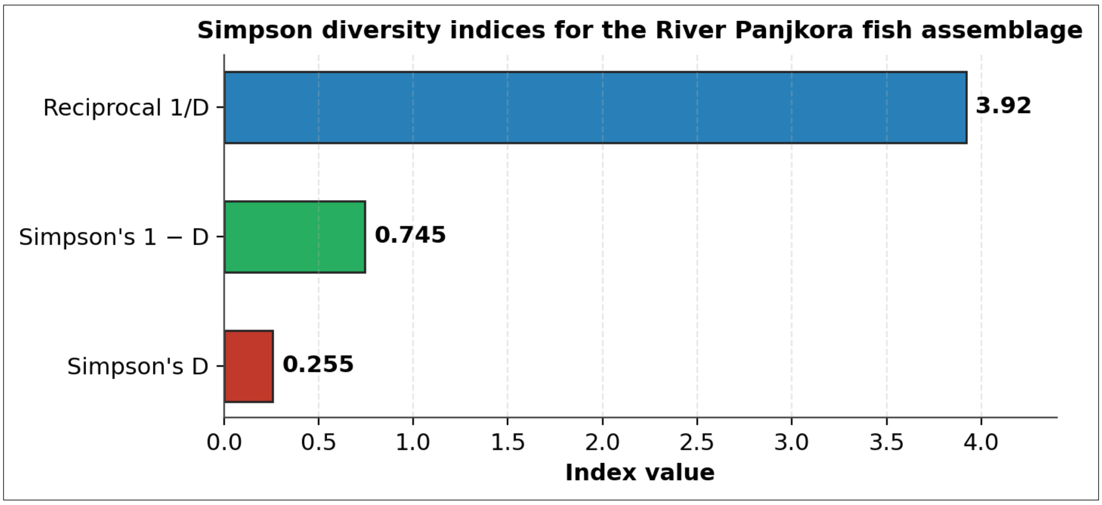


Figure 7: Simpson's diversity indices for the River Panjkora fish assemblage

3.7 Systematic accounts and general characteristics of the recorded species

The six species collected from River Panjkora at Tehsil Timergara were identified with the help of published literature and standard taxonomic keys. Their systematic positions and general characteristics are described below.

3.7.1 Schizothorax esocinus (McClelland, 1842)

Class: Actinopterygii
Subclass: Actinopteri
Cohort: Otocephala
Order: Cypriniformes
Superorder: Ostariophysi
Family: Cyprinidae
Subfamily: Schizothoracinae
Genus: Schizothorax
Species: Schizothorax esocinus
Colour: Silvery, with black spots on the dorsal and lateral surfaces.
Habitat: Mountain streams, rivers and lakes.
Size: Total length about 19 cm in the present material.
Distribution: Pakistan (Northern Areas, Khyber Pakhtunkhwa, Punjab; Indus River up to Dakhner and downstream from Attock Khurd), Azad Kashmir, Afghanistan and India.

Figure 8: Schizothorax esocinus

3.7.2 Channa gachua (Hamilton, 1822)
Class: Actinopterygii
Subclass: Actinopteri
Cohort: Percomorphaceae
Superorder: Acanthopterygii
Order: Perciformes
Family: Channidae
Subfamily: Channinae
Genus: Channa
Species: Channa gachua
Colour: Dorsal surface greenish-grey, under-surface bluish; dorsal, anal and caudal fins slate-coloured and fringed with orange; pectoral fin with a black base, transversely barred and with an orange margin.
Habitat: Freshwater streams and ponds from the plains to high elevations; also tolerant of poorly oxygenated, stagnant water.
Size: Total length about 10.4 cm in the present material.
Distribution: Pakistan (Khyber Pakhtunkhwa, Punjab, Baluchistan, Sindh), Azad Kashmir, Afghanistan, India, Nepal, Bangladesh, Sri Lanka, Iran and Myanmar.

Figure 9: Channa gachua

3.7.3 Puntius ticto (Hamilton, 1822)
Class: Actinopterygii
Subclass: Actinopteri
Cohort: Otocephala
Order: Cypriniformes
Superorder: Ostariophysi
Family: Cyprinidae
Subfamily: Barbinae
Genus: Puntius
Species: Puntius ticto
Colour: Silvery with a grey back; dorsal, pelvic and anal fins black-edged; operculum with a large blotch; body usually with two lateral spots, the anterior over the 3rd–4th and the posterior over the 18th–19th lateral-line scales. In some specimens the upper half of the dorsal fin is black.
Habitat: Rivers, streams and ponds in clear water, chiefly over a muddy substrate.
Size: Total length 8.2 cm.
Distribution: Pakistan (Khyber Pakhtunkhwa, Punjab, Sindh, Baluchistan), Azad Kashmir, Nepal, Bangladesh and India.

Figure 10: Puntius ticto

3.7.4 Tor macrolepis (Heckel, 1838)
Class: Actinopterygii
Subclass: Actinopteri
Cohort: Otocephala
Order: Cypriniformes
Superorder: Ostariophysi
Family: Cyprinidae
Subfamily: Cyprininae
Genus: Tor
Species: Tor macrolepis

Colour: Greenish above with light pink sides and a silvery-white abdomen; fins reddish-yellow.
Habitat: Rapid streams with a rocky bottom.
Size: Total length 19.5 cm; the largest species recorded in the study.
Distribution: Pakistan (Khyber Pakhtunkhwa, Punjab, Sindh, Baluchistan), Azad Kashmir and India; Indus drainage system.


Figure 11: Tor macrolepis

3.7.5 Carassius auratus (Linnaeus, 1758)
Class: Actinopterygii
Subclass: Actinopteri
Cohort: Otocephala
Superorder: Ostariophysi
Order: Cypriniformes
Family: Cyprinidae
Subfamily: Cyprininae
Genus: Carassius
Species: Carassius auratus
Colour: Highly variable, ranging through red, orange, bluish-grey, brown, yellow, white and black.
Habitat: Rivers, streams, lakes, ponds, reservoirs and virtually every freshwater habitat, from temperate to tropical environments.
Size: Total length about 11 cm in the present material.
Distribution: Native to East Asia and now widely introduced; recorded from China, Canada and the United States, among many other regions.


Figure 12: Carassius auratus

3.7.6 Crossocheilus diplocheilus (Heckel, 1838)
Class: Actinopterygii
Subclass: Actinopteri
Cohort: Otocephala
Order: Cypriniformes
Superorder: Ostariophysi
Family: Cyprinidae
Subfamily: Cyprininae
Genus: Crossocheilus
Species: Crossocheilus diplocheilus
Colour: Brownish-olive above, paler below, with fine dark speckling over the body.
Habitat: Rivers, streams, lakes and ponds.
Size: Total length about 10.2 cm; the most abundant species in the study.
Distribution: Widely distributed across South and Southeast Asia, including Pakistan, India, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Vietnam.


Figure 13: Crossocheilus diplocheilus

4. DISCUSSION

The present study was carried out at five locations along River Panjkora Talash, Shagokas, Balambat, Rani and Khall within Tehsil Timergara. Six species were identified, belonging to six genera, four subfamilies, two families and two orders. The family Cyprinidae was represented by five species (Schizothorax esocinus, Puntius ticto, Tor macrolepis, Carassius auratus and Crossocheilus diplocheilus), while the family Channidae was represented by a single species, Channa gachua. Cyprinids thus dominated the assemblage, a pattern consistent with earlier surveys of the region, in which cyprinids are typically the most species-rich and abundant family in the hill streams of northern Pakistan.

Muhammad et al. (2014), in a preliminary survey of the fish fauna of River Panjkora at District Upper Dir, reported eleven species from various collection sites, including Racoma labiata, Schizothorax esocinus, Orinus plagiostomus, Garra gotyla, Crossocheilus diplocheilus, Barilius pakistanicus, Channa punctata, Carassius auratus, Oncorhynchus mykiss, Glyptothorax punjabensis and Gagata cenia. Several of these species, notably Schizothorax esocinus, Crossocheilus diplocheilus and Carassius auratus, were also recorded in the present study, indicating continuity in the core cyprinid fauna between the upper and lower reaches of the river.

Hasan et al. (2015) recorded 25 species from River Panjkora belonging to five families, of which many are shared with the present study, including Schizothorax esocinus, Racoma labiata, Cyprinus carpio, Schizothorax plagiostomus, Tor putitora, Barilius pakistanicus, Barilius vagra, Crossocheilus diplocheilus, Garra gotyla, Channa punctata, Channa gachua and several glyptothoracid catfishes. The considerably higher richness they reported reflects their broader spatial and temporal coverage; the comparatively modest richness recorded here is attributable to the restricted number of sites, the single sampling season and the sampling gear available.

Comparable patterns have been reported from neighbouring drainages. Khan et al. (2008) collected and identified 20 species from freshwater reservoirs in Punjab, dominated by Cyprinus carpio, Oreochromis aureus, Labeo rohita, Labeo gonius and other large cyprinids. Ishaq et al. (2014) recorded 18 species from River Swat between Madyan and Chakdara, belonging to five orders and six families, including Barilius pakistanicus, Carassius auratus, Channa gachua, Crossocheilus diplocheilus, Garra gotyla, Oncorhynchus mykiss, Puntius sophore, Schizothorax plagiostomus and Tor macrolepis a species list that overlaps substantially with the present assemblage. Ullah et al. (2014) reported eleven species from the Konhaye Stream of River Panjkora, including Schizopyge esocinus, Racoma labiata, Crossocheilus diplocheilus, Garra gotyla, Puntius ticto, Channa gachua and Mastacembelus armatus, again confirming the prevalence of cyprinids and Channa gachua in the drainage.

Hasan et al. (2013) worked on River Swat and reported fifty species, of which sixteen were edible, including Carassius auratus, Channa gachua, Channa punctata, Crossocheilus diplocheilus, Cyprinus carpio, Oncorhynchus mykiss, Racoma labiata, Schizothorax plagiostomus and Tor macrolepis. All the species recorded in the present study fall within their list, which reinforces the view that the edible fish fauna of the region forms a coherent, cyprinid-dominated community whose composition is broadly stable across nearby river systems.

Several limitations were encountered during the present research, including the climatic conditions of the study area, the short collection period, the general lack of awareness among local people regarding the importance of fish, and the authors' limited initial experience with catching techniques. On both banks of River Panjkora, fishers frequently use destructive methods such as strong electric shocks generated by portable generators and, in some places, dynamite, to capture large numbers of fish at once. The absence of proper conservation measures, the use of unsuitable collection methods and widespread over-fishing degrade water quality and river ecology and, in turn, disturb the livelihoods and the social and economic conditions of the community.

River Panjkora flows through settled, populated areas and is therefore heavily exploited and stressed by discharges of municipal and industrial effluent, agricultural run-off and domestic sewage. Industrialization and population growth have indirectly influenced the aquatic environment and, ultimately, the abundance and diversity of aquatic organisms, because the stability of a fish community depends on the availability of a suitable environment in which to live. Human activities such as habitat modification, harvesting, culture and the effects of modernization have contributed to the pollution of the water bodies that serve as fish habitat; for example, the waste products of factories and industries in the upper reaches flow into the water and adversely affect the fish fauna (Chaudhary *et al.,* 2025; Qasim *et al.,* 2026).

The maintenance of fish diversity and abundance in the natural environment can be achieved through techniques such as the implementation of strict environmental laws, annual fish stocking, regulation of harvesting, prevention of fishing during the breeding season and harvesting of only marketable-size fish. River Panjkora is under constantly increasing pressure as local people continuously use its banks for construction, agriculture, recreation and industry. It is therefore suggested that, to improve the aquatic environment and conserve the existing species giving them the opportunity to reproduce and grow in abundance the Khyber Pakhtunkhwa Fisheries Department should play an active role by enforcing strict laws against illegal fishing with chemicals and electric shocks. Regular sample-based monitoring should be carried out to evaluate species diversity and its socio-economic dimensions, because comprehensive knowledge of an ecosystem is essential for its scientific supervision, suitable management and effective conservation (Prusty *et al.,* 2007; Qasim *et al.,* 2026).

5. CONCLUSION

The present survey documented the edible ichthyodiversity of River Panjkora in District Dir Lower and recorded six species Schizothorax esocinus, Channa gachua, Puntius ticto, Tor macrolepis, Carassius auratus and Crossocheilus diplocheilus with the order Cypriniformes being the richest. The results demonstrate that the river can potentially harbour additional species and could be used as a resource for conserving threatened taxa. The current status of the edible fish fauna can be improved by monitoring the fauna regularly, assessing the water quality of the river at regular intervals, and stocking native fish. Regular fishing, and especially the capture of non-marketable-size fish, should be avoided, and conditions favoring the fish fauna and its natural distribution should be maintained.

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Conflict of Interest: The authors declare that they have no conflict of interest.

Data Availability: The data supporting the findings of this study are contained within the article. Additional details, including the preserved voucher specimens, are available from the corresponding author on reasonable request.

Ethics Statement: Sampling was conducted using conventional fishing gear in accordance with local practice. No experiments were performed on live vertebrates beyond the collection of specimens for taxonomic study, and all specimens were handled following standard collection procedures.

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