INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 8, p. 241-247, 2014

RESEARCH PAPER OPEN ACCESS

# ichthyofaunal diversity of rhound stream at district Lower Dir, Khyber Pakhtunkhwa Pakistan

**Sana Ullah[1*], Zaigham Hasan[2], Shahzad Ahmad[1], Muhammad Rauf[1] and Baber Khan[1]**

[1]*Fisheries and Aquaculture Laboratory, Department of Animal Sciences, Quaid-i-Azam University Islamabad, Pakistan*

[2]*Fisheries Lab, Department of Zoology, University of Peshawar, Pakistan*

**Key words:** Lower Dir, Fish fauna, Abundance Curve, Diversity Index.

http://dx.doi.org/10.12692/ijb/4.8.241-247 Article published on April 22, 2014

**Abstract**

The present preliminary study was undertaken to study the diversity and distribution of Ichthyofauna of Rhound stream, a tributary of river Panjkora, at District Lower Dir Khyber Pakhtunkhwa, Pakistan. Fish sampling was carried out using different types of nets, of various mesh sizes and hooks. A total of 369 fishes were collected from April through September 2013. During the study period fourteen fish species were recorded comprising of four orders including Cypriniformes, Channiformes, Siluriformes and Mastacembeliformes, and five families. Taxonomically, Cyprinidae was the richest family represented by eleven fish species including *Crossocheilus diplocheilus (17.073%), Barilius pakistanicus (16.531%), Gara gotyla (13.921%), Cyprinion watsoni (7.859%), Schizopyge esocinus (7.317%), Racoma labiata (7.317%), Cyprinus carpio (5.149%), Barilius vagra (4.607%), Barilius modestus (2.981%), Puntius sophore (2.439%)* and *Puntius ticto (0.813)*. Family Channidae, Mastacembelidae and Sisoridae were embodied to one species each, *Channa punctatus (5.691%), Mastecembelus armatus (5.42%) and Glyptothorax punjabensis (2.981%)* respectively. Present study concludes that the stream has high diversity and can harbour more diversity and greater number of fish. If proper stocking is done in future in a planned way, the stream may become the back bone of the economy of the area.

* **Corresponding Author:** Sana Ullah ✉ sunyuop@gmail.com

## Introduction

Fisheries and aquaculture is one of the most debatable issues on account of its importance in almost every sphere of life. Fish studies are as clear as bright day light on the horizon of animal research. Fish is having significance for human life in a number of ways. It is a handy sector, boosting the economy of many countries (Ahmad and Hasan, 2011). Due to its nutritional values, it is a stapled food item. Fisheries sector is also providing employment to millions of people throughout the world (Nagabhushan and Hosetti, 2010). Fish also play a crucial role in the second tropic level of the aquatic ecosystem (Dubey *et al.,* 2012).

Fish is the most ancient, abundant and diverse group of vertebrates. It has invaded almost every niche of hydrosphere. According to Nelson (2006) there is almost 28,000 known extant species. Among these species approximately 27,000 are bony fish, including 970 species of sharks, rays, and chimeras and about 108 hagfish and lampreys. Due to variation of habitat, fish has a great diversity in their shape, size and color. Biodiversity means variety of species in the ecosystem, or variety of life on earth (Lipinski and Tweed, 2003).

Fish is generally identified on the basis of Morphometric measurements. Different Morphometric measurements show different pattern of relationship among each other at different stages of life. The constant ratio is helpful in identification. Those ratios which change regularly or irregularly are not useful in identifying the species. Furthermore environmental conditions in different regions also bring some changes in different parts of the body like number of scales and vertebrae etc. (Lagler *et al.,* 1962).

Considerable studies on fish fauna from different fresh water bodies throughout Pakistan have been carried out but still no data appears in literature regarding fish diversity of Rhound Stream. It is a tributary of rive Panjkora at District Lower Dir. Although a study has been carried out on river Panjkora District Lower Dir by Hasan and Ullah (2013) but no data appear in literature concerning the ichthyic diversity of Rhound Stream. There was an urgent need to determine the current Ichthyofaunal diversity of the stream so that it could be incorporated in the expansion of conservation strategies. So a preliminary study was conducted to assess the fish species diversity, spatial variation in diversity and composition of fish assemblages in Rhound stream at district Lower Dir, Khyber Pakhtunkhwa Pakistan.

## Materials and methods

*Study Area*

District Lower Dir is situated with Longitudes and Latitudes of 34°, 37′ to 35°, 07′ North and 71°, 31′ to 72°, 14′ East respectively with approximate 2700 feet (820 meter) above mean sea level experiencing an annual rain fall of 1468.8mm and 253.7mm during December and March respectively. District Dir is bounded by District Chitral to the Northern Side, by Bajaur and Afghanistan to the Western side, by District Malakand to the Southern side and by District Swat to Eastern side. River Panjkora originates from Kohistan, District Dir (Upper) and flow southward dividing District Dir Upper and Lower into two halves. River Panjkora joins river Swat at Bosaq pull, Sharbatti (behind Totakan, District Malakand). The name Panjkora is because of the main five tributaries that fall in the river at four different places at District Dir Upper (Gwaldi Stream at Sheringal, Barawal Stream at Chukiatan, Usherai Dara Stream and Nurhund Stream at Darora and Dobando Stream at Akhagram) while two tributaries fall in the river at two different places in District Lower Dir (Konhaye Stream at Koto and Round Stream at Thrai Bypass). Figure 1 is showing the study area and tributaries of river Panjkora.

*Fish sampling*

The fish collection was done twice a month, on every 15$^{th}$ and 30$^{th}$ of the month with the help of hand nets, cast nets, Patti nets and simple hooks. The samples were fixed in 10 percent buffered commercial grade formalin directly or after intraperitonial injection of

10 percent formalin (in case of specimens larger than 15 cm) and were then transferred into 70% alcohol. All possible efforts were made in order to collect maximum number of species. Identification was made after consulting several standard keys and literature such as Fishes of the Punjab (Mirza and Sandhu, 2007), Freshwater fishes of the Indian Region (Jayaram, 1999), Inland fishes of India and adjacent countries (Talwar and Jhingran, 1991) and Pakistan ki Taza Pani ke Machliyan (Mirza, 1990).

*Data analysis*

The data of occurrence and abundance of various species was used to calculate the Species richness (S), Shannon diversity index (H′), Simpson diversity index (D), and Simpson's Evenness Index ($E_{1/D}$) (Magurran, 2004). All statistical analysis was performed using Microsoft Excel 2010. Arc GIS 9.3 Platform was used for preparing the map of the study area.

**Results**

*Fish Species Recorded*

The present study confirms the occurrence of 14 species belonging to 4 order, 4 family and 11 genera, given in the checklist (Table 1). The Morphometric measurements of some of the selected specimens and their distinguishing characters (Fin formula) are given in Table 2 and Table 3 respectively.

**Table 1.** Recorded Fish fauna of Rhound Stream District Lower Dir.

| S. No | Order | Family | Genus and Species | Local names |
|---|---|---|---|---|
| 1 | Cypriniformes | Cyprinidae | *Schizopyge esocinus* | Ranth/ Aasala |
| 2 | | | *Racoma labiata* | Kanesatt |
| 3 | | | *Cyprinion watsoni* | Sabzug |
| 4 | | | *Cyprinus carpio* (Exotic) | China kub |
| 5 | | | *Barilius pakistanicus* | Pepal |
| 6 | | | *Barilius vagra* | Pepal |
| 7 | | | *Barilius modestus* | Pepal |
| 8 | | | *Crossocheilus diplocheilus* | Butten |
| 9 | | | *Gara gotyla* | Kanesatt |
| 10 | | | *Puntius ticto* | Paplait |
| 11 | | | *Puctius sophore* | Paplait |
| 12 | Channiformes | Channidae | *Channa punctatus* | Asle Katasarre |
| 13 | Siluriformes | Sisoridae | *Glyptothorax punjabensis* | Sulamanne |
| 14 | Mastacembeliformes | Mastacembelidae | *Mastacemelus armatus* | Bam/ Marmahay |

**Table 2.** Morphometric measurements (cm) of some of the recorded fish specimens.

| S. No | Fish Species | T.L | F.L | S.L | H.L | E.D | P.O.L | B.D |
|---|---|---|---|---|---|---|---|---|
| 1 | *Racoma labiata* | 14.0 | 13.2 | 12 | 3.6 | 0.5 | 6.6 | 2.6 |
| 2 | *Channa punctata* | 16.5 | 13.5 | 5.0 | 3.0 | 0.6 | 15.1 | 3.0 |
| 3 | *Channa gachua* | 15.9 | 14.1 | 4.1 | 2.5 | 0.5 | 16 | 3.0 |
| 4 | *Cyprinion watsoni* | 13.7 | 11 | 12.8 | 2.5 | 0.8 | 1.5 | 4.0 |
| 5 | *Cyprinius carpio* | 16.0 | 13 | 12 | 3.0 | 0.6 | 1.9 | 4.3 |
| 6 | *Barilius pakistanicus* | 7.6 | 6.5 | 5.8 | 1.2 | 0.4 | 7.0 | 1.2 |
| 7 | *Barilius vagra* | 12.4 | 11.2 | 10.2 | 2.5 | 0.6 | 11.6 | 2.0 |
| 8 | *Barilius modestus* | 10.9 | 9.7 | 9.2 | 1.8 | 0.5 | 10.2 | 2.0 |
| 9 | *Schistura macrolepis* | 9.5 | 9.1 | 7.5 | 2 | 0.1 | 0.8 | 1.5 |
| 10 | *Mastacembelus armatus* | 23.5 | 21 | 3.9 | 2.4 | 0.2 | 22.6 | 2.0 |
| 11 | *Glyptothorax punjabensis* | 12.2 | 8.8 | 8.4 | 2.5 | 0.2 | 8.5 | 1.5 |
| 12 | *Crossocheilus diplocheilus* | 12 | 11 | 8.5 | 1.5 | 0.5 | 11 | 2.2 |
| 13 | *Garra gotyla* | 13.9 | 12.4 | 12.5 | 2.6 | 0.4 | 12.7 | 3.0 |
| 14 | *Punctius ticto* | 10.7 | 8.6 | 11.4 | 2.0 | 0.4 | 4.7 | 1.9 |
| 15 | *Punctius sophore* | 13.1 | 10.9 | 12.1 | 2.2 | 0.7 | 5.9 | 2.2 |
| 16 | *Schizothorax esocinus* | 23.6 | 22.8 | 19.5 | 4.0 | 0.8 | 0.3 | 4.0 |

T.L = Total Length, F.L= Fork Length, S.L = Standard Length, H.L = Head Length, E.D = Eye Diameter, P.O.L = Post Orbital Length and B.D = Body Depth.

*Biological Diversity Indices*

Numerically the order Cypriniformes was the richest order represented by 85.91% (317 Specimens). The order Channiformes was embodied by 5.691% (21 Specimens), Mastacembeliformes by 5.42% (20 Specimens) and Siluriformes by 2.98% (11 Specimens) of the total collected individuals. Taxonomically, the most abundant family was Cyprinidae represented by 8 genera and 11 species. On the other hand, 3 families viz. Channidae, Mastacembelidae and Sisoridae, each were represented by one genus as well as one species only. The rank- abundance curve drawn for these 14 fish species collected from the stream is shown in Figure 2. The curve illustrates that the fish fauna is rich but the curve has relatively steep slope portraying low evenness in the recorded species. Table 4 consist upon data concerning the month wise diversity, percentage, specie richness, Margalef's ($D_{mg}$), Minhinick's ($D_{mn}$) and Shannon-Weiner's diversity indices.

**Table 3.** Diagnostic Characters of Ichthyofauna of Konhaye stream District Lower Dir (Mirza and Sandhu, 2007).

| S.No | Species | D | P | V | A | C | L.L |
|---|---|---|---|---|---|---|---|
| 1 | *Schizopyge esocinus* | 4/8 | 20 | 10 | 3/5 | 19 | 95-98 |
| 2 | *Racoma labiata* | 4/8 | 20 | 11 | 3/5 | 19 | 110 |
| 3 | *Cyprinion watsoni* | 3/9-10 | 15 | 8 | 2/7 | 19 | 33-36 |
| 4 | *Cyprinus carpio* | 3/17 | 15 | 9 | 3/5 | 19 | 36-38 |
| 5 | *Barilius pakistanicus* | 2/7 | 15 | 9 | 2/10 | 19 | 42-44 |
| 6 | *Barilius vagra* | 2/7 | 15-16 | 9 | 2/10 | 19 | 42-44 |
| 7 | *Barilius modestus* | 2/7 | 15-16 | 9 | 2/10 | 19 | 42-44 |
| 8 | *Crossocheilus diplocheilus* | 3/8 | 15 | 9 | 2/5 | 19 | 38 |
| 9 | *Gara gotyla* | 2/8 | 15 | 8 | 2/5 | 19 | 30 |
| 10 | *Puntius ticto* | 3/8-9 | 15 | 1/8 | 3/5 | 19 | 23-26 |
| 11 | *Puctius sophore* | 3/8-9 | 17 | 1/8 | 3/5 | 19 | 23-26 |
| 12 | *Channa punctatus* | 29-32 | 17 | 6 | 21-23 | 12 | 37-40 |
| 13 | *Glyptothorax punjabensis* | 1/6 | 1/8 | 6 | 3/9 | 18 | - |
| 14 | *Mastacemelus armatus* | 32-39/74-90 | 23 | - | 3/75-88 | - | - |

D=Dorsal fins, P=Pelvic fins, V=Ventral fins, A=Anal fins, C=Caudal fins, L.L=Lateral Line Scales.

**Table 4.** Month wise numerical and fish species abundance and diversity indices.

| S.No | Species | April | May | June | July | Aug | Sep | Total |
|---|---|---|---|---|---|---|---|---|
| 1 | *Mastacembelus armatus* | 4 | 4 | 6 | 2 | 1 | 3 | 20 |
| 2 | *Cyprinion watsoni* | 7 | 9 | 4 | 5 | 4 | 0 | 29 |
| 3 | *Garra gotyla* | 10 | 20 | 13 | 4 | 3 | 1 | 51 |
| 4 | *Chrossocheilus diplocheilus* | 13 | 27 | 5 | 8 | 7 | 3 | 63 |
| 5 | *Schizopyge esocinus* | 2 | 6 | 2 | 9 | 5 | 3 | 27 |
| 6 | *Cyprinus carpio* | 8 | 2 | 3 | 4 | 1 | 1 | 19 |
| 7 | *Puntius sophore* | 4 | 2 | 1 | 0 | 0 | 2 | 9 |
| 8 | *Puntius ticto* | 0 | 0 | 1 | 0 | 2 | 0 | 3 |
| 9 | *Barrilius pakistanicus* | 17 | 11 | 8 | 16 | 2 | 7 | 61 |
| 10 | *Barrilius vagra* | 0 | 2 | 0 | 9 | 5 | 1 | 17 |
| 11 | *Barrilius modestus* | 2 | 3 | 4 | 0 | 2 | 0 | 11 |
| 12 | *Channa punctata* | 5 | 0 | 0 | 9 | 5 | 2 | 21 |
| 13 | *Racoma labiata* | 2 | 5 | 4 | 7 | 8 | 1 | 27 |
| 14 | *Glyptothorax punjabensis* | 0 | 0 | 2 | 3 | 5 | 1 | 11 |
| | Total | 74 | 91 | 53 | 76 | 50 | 25 | 369 |
| | Month wise Percentage | 20.054 | 24.661 | 14.363 | 20.6 | 13.55 | 6.775 | 100 |
| | Margalef's Index ($D_{mg}$) | 2.3234 | 2.216 | 2.771 | 2.31 | 3.067 | 3.107 | 2.199 |
| | Menhinick's Index ($D_{mn}$) | 1.279 | 1.153 | 1.648 | 1.26 | 1.839 | 2.2 | 0.729 |
| | Shannon's Weiner's Index (H′) | -0.465 | -0.498 | -0.402 | -0.47 | -0.39 | -0.26 | -2.49 |

Month wise Percentage = fish caught in month/ Total fish caught, $D_{mn} = S/\sqrt{N}$, $D_{mg} = S\text{-}1/\ln N$.

**Table 5.** Showing diversity indices (Shannon-Weiner's Index and Simpson's Index).

| | Shannon-Weiner's Index | | | Simpson's Index | | |
|---|---|---|---|---|---|---|
| Species | Pi | Log2(Pi) | Pi(Log2(Pi)) | n | n-1 | n(n-1) |
| *Mastacembelus armatus* | 0.054 | -4.206 | -0.228 | 20 | 19 | 380 |
| *Cyprinion watsoni* | 0.078 | -3.67 | -0.288 | 29 | 28 | 812 |
| *Garra gotyla* | 0.138 | -2.86 | -0.395 | 51 | 50 | 2550 |
| *Chrossocheilus diplocheilus* | 0.171 | -2.55 | -0.435 | 63 | 62 | 3906 |
| *Schizopyge esocinus* | 0.073 | -3.773 | -0.276 | 27 | 26 | 702 |
| *Cyprinus carpio* | 0.0515 | -4.280 | -0.221 | 19 | 18 | 342 |
| *Puntius sophore* | 0.024 | -5.358 | -0.131 | 9 | 8 | 72 |
| *Puntius ticto* | 0.008 | -6.943 | -0.056 | 3 | 2 | 6 |
| *Barrilius pakistanicus* | 0.165 | -2.597 | -0.43 | 61 | 60 | 3660 |
| *Barrilius vagra* | 0.046 | -4.44046 | -0.205 | 17 | 16 | 272 |
| *Barrilius modestus* | 0.030 | -5.06855 | -0.151 | 11 | 10 | 110 |
| *Channa punctata* | 0.0571 | -4.136 | -0.235 | 21 | 20 | 420 |
| *Racoma labiata* | 0.073 | -3.773 | -0.276 | 27 | 26 | 702 |
| *Glyptothorax punjabensis* | 0.030 | -5.068 | -0.151 | 11 | 10 | 110 |
| | | | H′ = 3.478 | N=369 | | ∑n(n-1) = 14044 |
| N (N-1) = 135792 | D = 0.897 | | 1/D = 1.115 | | | $E_{1/D}$ = 0.068 |

Pi = Relative Abundance (n/N), Pi (Log2 (Pi)) = Species Diversity, H′ = Shannon-Weiner's Index, n = number of individual species, N=Total number of individuals, D=Simpson's Biodiversity Index, D = 1 - (∑ n(n-1)/N(N-1)), 1/D = Simpson's Reciprocal Index, (Simpson's Evenness) $E_{1/D}$ = (1/D)/S (S=Species Richness).

*Numerical Findings*

It was further observed that numerically *Crossocheilus diplocheilus* (17.073%), *Barilius pakistanicus* (16.531%) and *Gara gotyla* (13.821%), were the most abundant fish species. Similarly other species viz. *Cyprinion watsoni, Racoma labiata, Schizopyge esocinus, Channa punctata, Mastacembelus armatus, Barilius vagra, Puntius sophore, Glyptothorax punjabensis, Barrilius modestus* and *Puntius ticto* were 7.859%, 7.317%, 7.317%, 5.691%, 5.42%, 4.607%, 2.439%, 2.981%, 2.981%, and 0.813% abundant respectively. The peculiar feature of the abundance data was the increasing number of an introduced fish, C*yprinus carpio*, which formed 5.149% (19 specimens) of the total caught fishes. Species richness indices were found out through Margalef's Index and Menhinick's Index and were 5.91 and 19.21 respectively. Different diversity indices calculated are given in Table 5.

**Discussion**

Biological diversity plays an ample role in ecosystem pliability (Elmqvist *et al.,* 2003). Ichthyofauna of the stream was diverse (Shannon's Index = 3.477), but it is not evenly distributed (Simpson Evenness = 0.068). There are large differences in the richness amongst different species. Hasan and Ullah (2013) recorded twenty five species from river Panjkora at district Lower Dir while Muhammad (2010) provided a list eleven fish species from river Panjkora at District Dir Upper. As compare to their results it is obvious that the river is richer in Ichthyofauna as compared to the Konhaye stream. If Simpson's diversity index for river Panjkora District Lower Dir, D=0.921 (Ullah *et al.,* 2013), Konhaye stream, D=0.91 (Ullah *et al.,* 2014) and Rhound stream, D= 0.896, is compared, Rhound stream is a bit less diverse as compare to these two water bodies.

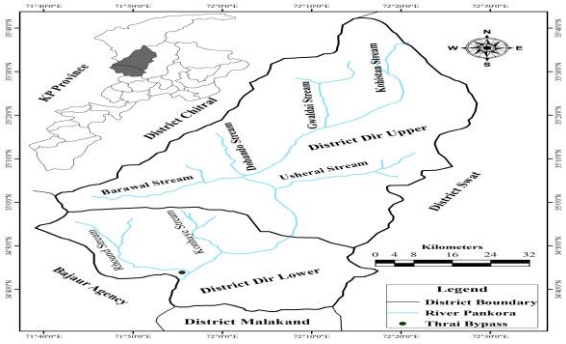


**Fig. 1.** Map showing river Panjkora and tributaries.

The natural flow regimes are key factors for controlling the fish assemblages in water bodies (Church, 2002). These factors are comprised of the magnitude, frequency, timing, duration, and rate of

change of hydrologic conditions. These all influence the ecological processes in aquatic surroundings (Poff *et al.,* 1997). These factors also affect the food resources present in the water bodies, which vary seasonally (Lancaster, 2000). So increase in the diversity of any aquatic body could therefore be correlated with changes in flow regimes, which created new environments, providing opportunity to the species found in nearby water bodies to establish there (Mirza *et al.,* 2011).

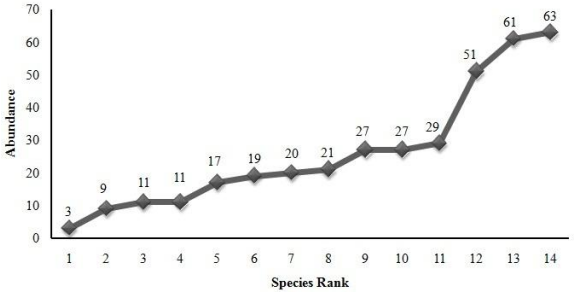


**Fig. 2.** Rank abundance curve for Ichthyofauna of the Konhaye stream.

The present study and the earlier one conducted by Ullah *et al.* (2013) on river Panjkora revealed that twelve species are embodied to both water bodies, while two species viz. *Puntius sophore* and *Puntius ticto* in the present study were missing in their study, but both these species were included in the collection of Ullah *et al.* (2014) on Konhaye stream.

If comparing with the fauna of river Panjkora at District Dir Upper (Muhammad, 2010) *Orienus plagiostomus, Carassius auratus, Gagata cenia* and *Oncorhynchus mykiss* were missing from the present study while the rest ten species were missing in his study. Hasan *et al.* (2014) reported all these species from river Swat, which is relatively more diverse than river Panjkora, Konhaye stream and Rhound stream.
The results showed that the diversity of the stream is good but the disturbance in abundance curve is clearly showing the impact of anthropogenic activities (Qadir and Malik, 2009). The results of this study also confirmed that *Cyprinus carpio*, an exotic species, has established populations in the areas, and formed a significant portion (6.566%) of the total collected specimens. Discussions with the local fishermen further revealed that the populations of a highly prized game fish in the area, *Schizopyge esocinus,* formerly known as *Schizothorax esocinus* (Hasan *et al.,* 2013), *Puntius sophore* and *Puntius ticto* have been substantially reduced. The current collections contained only 27 specimens (7.317% only), 9 specimens (2.439%) and 3 specimens (0.813%) respectively, and need instant actions to mitigate the situation. It may be due to the nasty fishing techniques such as use of chemicals and electric shocks etc. The study also showed that if proper stocking is carried in future, in a well planned manner by Khyber Pakhtunkhwa Fisheries Department, the stream can harbour more diversity and greater number of fish.

**References**

**Ahmad M, Hasan Z.** 2011. A preliminary survey of fish fauna of Changhoz Dam Karak, K.P.K. Pakistan. World Journal of Fisheries and Marine Sciences **3,** 376-378.

**Church M.** 2002. Geomorphic thresholds in riverine landscapes. Freshwater Biology **47,** 541-557. http://dx.doi.org/10.1046/j.1365-2427.2002.00919.x

**Dubey AK, Shukla SK, Verma H.** 2012. Ichthyo-Diversity of Banisagar Dam at Chhatarpur Madhya Pradesh, India. International Journal of Fisheries and Aquaculture Sciences **2(3),** 157-161.

**Elmqvist T, Folke C, Nyström M, Peterson G, Bengtsson J, Walker B, Norberg J.** 2003. Response diversity, ecosystem change, and resilience. Frontiers in Ecology and the Environment **1**, 488-494. http://dx.doi.org/10.1890/15409295(2003)001[0488:RDECAR]2.0.CO;2

**Hasan Z, Ullah S.** 2013. The Ichthyofaunal Diversity, Relative Abundance, Physico Chemical Analysis and the Estimation of Biodiversity Index of River Panjkora District Dir (Lower), Khyber Pakhtunkhwa. Proceedings 33rd Pakistan Congress of Zoology (International), PNHM, Islamabad, 218 p.

**Jayaram KC.** 1999. Freshwater Fishes of the Indian Region. Narendra Publishing House, Delhi, India.

**Lagler K, Bardach JE, Miller RR**. 1962. Ichthyology. John Willey and Sons Inc., New York USA.

**Lancaster J.** 2000. Geometric scaling of microhabitat patches and their efficacy as refugia during disturbance. Journal of Animal Ecology **69**, 442-457. http://dx.doi.org/10.1046/j.1365-2656.2000.00407.x

**Lipinski S, Tweed.** 2003. Environmental Science. Scott Foresman, Addison Wesley New York USA.

**Magurran AE.** 2004. Measuring biological diversity. Blackwell Publishing. MA 02148-5020, USA.

**Mirza MR, Sandhu IA.** 2007. Fishes of the Punjab. Polymer Publications Lahore.

**Mirza MR.** 1990. Pakistan Ki Taza Pani Ki machliyan. Polymer Publications Lahore.

**Mirza ZS, Mirza MR, Mirza MA, Sulehria AQK.** 2011. Icthyofaunal diversity of the River Jhelum, Pakistan. Biologia **57,** 23-32.

**Muhammad I.** 2010. Fish biodiversity of River Panjkora at District Upper Dir. M.Sc. thesis, Department of Zoology, University of Peshawar.

**Nagabhushan CM, Hosetti BB.** 2010. Diversity of Ichthyo-Fauna in Relation to Physico-Chemical characters of Tungabhadra Reservoir, Hospet. Wetlands, biodiversity and climate change, 1-9 p.

**Nelson JS.** 2006. Fishes of the World (4th edition). John Wiley & Sons, Inc. New York. ISBN: 978-0-471-25031-9.

**Poff NLR, Allan JD, Bain MB, Karr JR, Prestegaard KL, Richter BD, Stromberg JC.** 1997. The natural flow regime. Bioscience **47**, 769-784.

**Qadir A, Malik R**. 2009. Assessment of an index of biological integrity (IBI) to quantify the quality of two tributaries of river Chenab, Sialkot, Pakistan. Hydrobiologia **62,** 127-153. http://dx.doi.org/10.1007/s10750-008-9637-0

**Talwar PK, Jhingran AGK.** 1991. Inland fishes of India and adjacent countries. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.

**Ullah S, Hasan Z, Rasheed B.** 2013. The Ichthyofaunal diversity of River Panjkora District Lower Dir. Reviewed submitted to Sindh University Research Journal.

**Ullah S, Hasan Z, Zuberi A.** 2014. The fish fauna of Konhaye stream: A tributary of River Panjkora District Lower Dir. Submitted to Pakistan Journal of Zoology.