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ICHTHYOFAUNAL DIVERSITY OF RIVER PANJKORA, DISTRICT DIR LOWER, KHYBER PAKHTUNKHWA

Z. Hasan[1*], S. Ullah[1], S. B. Rasheed[1], A. Kakar[2] and N.Ali[1]

[1]Department of Zoology, University of Peshawar, Pakistan
[2]Department of Zoology, University of Balochistan, Quetta, Pakistan
[*]Corresponding Author's Email: zaigham@upesh.edu.pk

ABSTRACT

The study was conducted to determine the fish diversity in River Panjkora, Dir Lower from April to September 2012. A total of 781 individuals of fish representing 25 species, belonging to five families were caught during the study period. The fish fauna in the river was dominated by species belonging to the family Cyprinidae (49.93%) followed by Nemacheilidae (27.52%). Families Channidae, Sisoridae and Mastacembelidae constituted 10.88%, 10.37% and 1.28% respectively. Most dominant species were *Crossocheilusdiplocheilus*(15.492%) followed by *Garragotyla* (15.1%) and *Cyprinuscarpio* (8.194%). These species were abundant especially during the months of May and July. *Ctenopharyngodonidella* (Family: Cyprinidae), *Triplophysamicrops* (Family: Nemacheilidae)and*Schisturamacrolepis* (Family: Nemacheilidae) were the least existing species with 0.128%, 0.512% and 1.152% abundance respectively. Physico-chemical parameters of water were also monitored, mean values of which were as follows; temperature (21.275°C), pH (7.325), dissolved Oxygen (8.975mg/L), electric conductivity (201.675µs/cm), total dissolved solid (127.912 mg/L), total suspended solid (129.857 mg/L), total hardness (118.75mg/l), free CO_2(4.3 mg/L), turbidity (1.34NTU), salinity (0.0075 mg/L), Ca hardness (77.5mg/L), Mg hardness(43.25mg/L), Sodium(5.1mg/L), Potassium(2.825mg/L), total alkalinity (98mg/L), Chloride (15.93mg/L) and nitrates (0.035mg/L). Over all Simpson's diversity value (1-D= 0.92031) and Simpson's Reciprocal index value (1/D= 12.54936) indicates that River Panjkora is quite diverse concerning fish species richness and evenness.

Key words: River Panjkora, Physico-chemical parameters, fish diversity.

INTRODUCTION

Aquatic life has been serving man since pre-historic time. Fish, which is one of the most important components of aquatic communities, of course, has been in front line in serving human being. As such fish provides innumerable services, butits prior importance is that it has been a staple item in the diet of many people (Essetchi *et al.,* 2003). The tragic moment that we are faced with is that, on one hand, population is growing explosively and on the other hand, anthropogenic activities are greatly damaging biodiversity- where remedy lies for food shortage. Regular monitoring of the biodiversity changes should be planed as they might govern the trend of development in near future.

A number of factors are contributing in fall of fisheries and fishing communities such as over exploitation, introduction of exotic species, pollutants e.g. domestic sewages, industrial effluents, agricultural run offs and siltationetc. Habitat loss and changes due to damming and water diversions also contribute in declining the aquatic biodiversity, both in freshwater and marine environments (Jalal *et al.,* 2012). Many of the fish species are facing threats because of deterioration in their natural aquatic ecosystems. The greatest threatsare due to environmental distortion resulting from a swiftly increasing human population along the river basins (Peter, 1994).

Information about the presence of a fish species at certain place and time, distribution and compositionisbeneficial to scrutinize causesaffecting fish community structure (Belliard and B"Oet, 1997; Galactos *et al.,* 2004). Fish diversity, distribution, composition of populations and characteristics of fisheries depend on many factors such as water systems, size of the river system, availability of food, breeding area, depth and speed of water, topography, geographic location of the river basin and physicochemical factors of water (Haris, 1995). A considerable amount of information about freshwater fishes and water quality from small rivers, lakes, reservoirs and coastal water in Pakistan is present but data concerning fish diversity and water quality of river Panjkora does not exist yet.

The objective of the current study was to evaluate and gather data regarding water quality and fish diversity in River Panjkora District Dir Lower, Khyber Pakhtunkhwa. It was aimed to provide more and up to date information about the river and to set this as a tool for planning conservation of aquatic environments in the region because of the various economically valuable and commercially important indigenous fishes inhabiting the river.

MATERIALS AND METHODS

Sampling area: Dir Lower is a district in Khyber Pakhtunkhwa, Pakistan, which is, situated at 34º, 37′ to 35º, 07′ North and 71º, 31′ to 72º, 14′ East. It is about 823 meters(2700 feet) above sea level. Annual rainfall recorded is about 1468.8mm in December and 253.7mm during March. Origin of River Panjkora is in Kohistan, Dir (Upper). It flows southward and passes almost through the middleofboth the Districtsi.e. Upper and Lower Dir. It joins River Swat behind Totakan, District Malakandat Sharbatti (BosaaqBridge). PanjkoraRiver is named so because of its five main tributaries which join the River at four places; Barawal Stream meets at Chukiatan, Gwaldi Stream joins at Sheringal, Dobando Stream falls in it at Akhagram whereas Nurhund Stream and Usherai Dara Stream join it at Darora(Fig. 1).

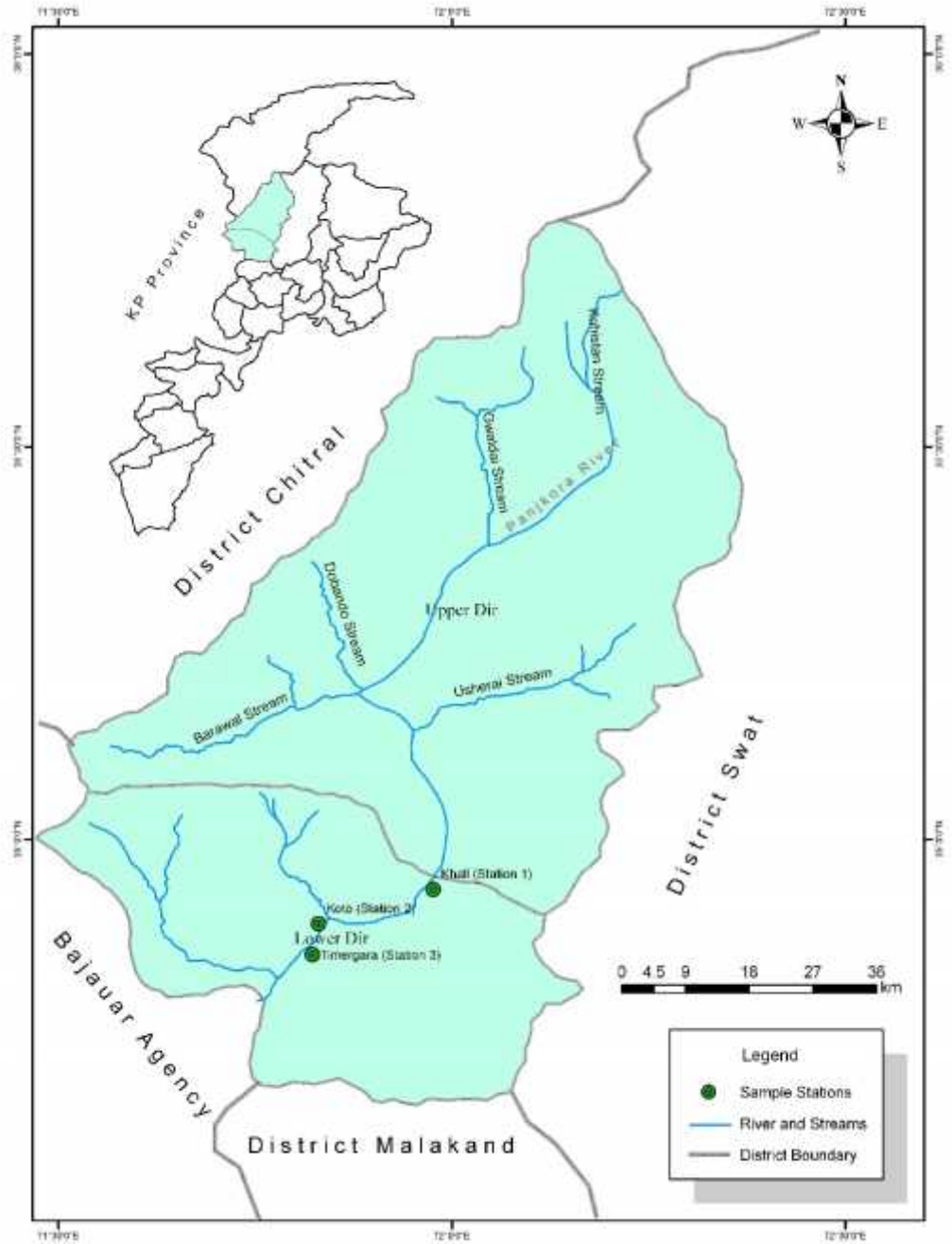


Fig. 1. Map showing location of study area along river Panjkora, District Dir Lower

Sampling was carried out in River Panjkora from April through September 2012. Sampling was done by dividing the study area into three zones with a distance of 20 km between Zone 1 and Zone 2 and 7 km between Zone 2 and Zone 3. Zone 1 was located at the upstream near mouth of the river after entering the District and at this location the agricultural run offs and domestic wastes fall into the river. Zone 2 was characterized by more transparent water as another tributary falls into the river at this location. Zone 3 was located further downstream of River Panjkora and is the dumping site for city wastes. Stratified random sampling method was used for collecting water samples from the river.

Sampling and data analysis: Sampling was done from different locations to investigate the fish diversity in different zones. The sampling was conducted from 1st April 2012 to 30th September 2012. Different fishing gears including hooks and nets were used for collecting fish samples. The fishes were first fixed in 10% formalin solution and then for ease of processing were transferred in 70% alcohol at the laboratory. All fishes were identified using available standard taxonomic keys including Inland fishes of India and adjacent countries by Talwar and Jhingran (1991), Freshwater fishes of the Indian Region (Jayaram, 1999), Fishes of the Punjab (Mirza and Sandhu, 2007) and an Urdu key by Mirza (1990) namely*"Pakistan ki Taza Pani ki Machliyan"*. Diversity of different fish species of River Panjkora on the Shannon (H') and Simpson (D) indices was worked out according to Simpson (Simpson, 1949) and Shannon-Weiner (Odum, 1975) function.

Physico-chemical parameters such as temperature, pH, Dissolved Oxygen, Electrical Conductivity, Total Dissolved Solids, Total Suspended Solids, Total Hardness, Free CO_2, Turbidity, Salinity, Calcium hardness, Magnesium hardness, Sodium, Potassium, Total Alkalinity, Chlorine and Nitrates were observed using Water Quality Checker Meter (Horibao Ltd; Model U10, Made in Japan), pH meter (Mettler Delta 320. Halstead, C09 2DX, England, Model 320, Made in UK), Conductivity meter/ TDS meter (Model 4520, Jenway product UK), DO meter (WPA model OX20 Product UK), Flame photometer (Jenwey model, PFP7 designed and manufactured in UK), PC Multi Direct and Portable Data Logging Spectrophotometer (Darel/2010 H_2O Quality Laboratory, HACH).

RESULTS

A total of 25 species of fish belonging to 5 families and 4 orders were recorded from River Panjkora, during the study period (Table-1). The most dominant families were Cyprinidae (390 fish specimens, 49.93%) followed by Nemacheilidae (215 fish specimens, 27.52%). The representation of other families was comparatively less (<100 fish specimens,12.8%), Channidae (85 fish specimens, 10.88%) and Sisoridae (81 fish specimens, 10.37%). The least dominant family was Mastacembelidae (10 fish specimens, 1.28%).

Family Cyprinidae was represented by thirteen species (*Schizothoraxesocinus, Schizothoraxplagiostomus, Racomalabiata, Cyprinionwatsoni, Cyprinuscarpio, Tor putitora, Tor macrolepis, Bariliuspakistanicus, Bariliusvagra, Bariliusmodestus, Crossocheilusdiplocheilus, Garragotyla and Ctenopharyngodonidella*) with highest diversity index value (D= 0.24936 and H=1.65577). These species were found in all the zones. Out of these fourteen species from family Cyprinidae, *Crossocheilusdiplocheilus* was 15.5% and *Garragotyla* was 15.1% of the total specimens collected and both were highly abundant during May. *Cyprinuscarpio* was ranking third with 8.2% and was highly abundant during September (45.32%).

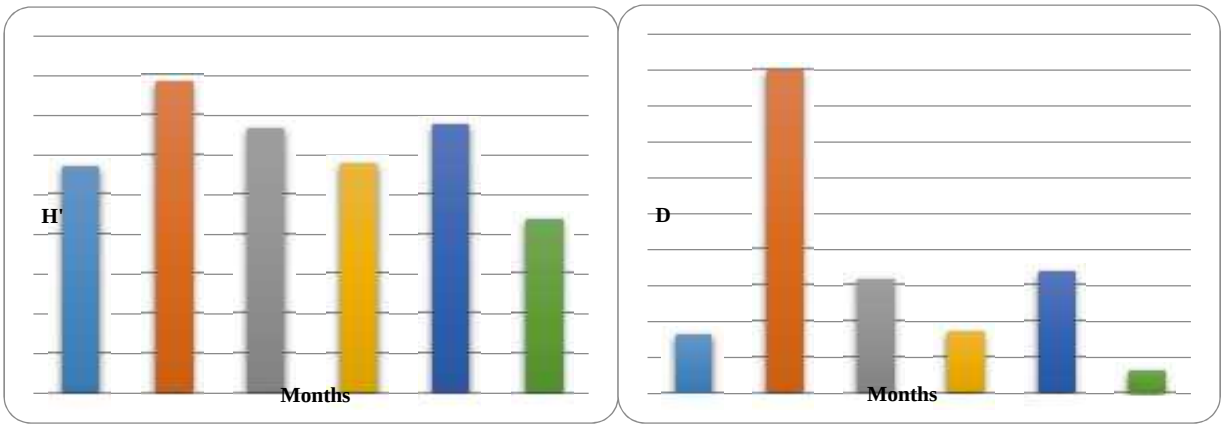
Family Nemacheilidae was the second dominant family caught during the study period which contributed 27.52% of the total fishes collected and was having a higher diversity value (D= 0.07578 and H=0.69139). The representative species of family Nemacheilidae were *Schisturaalepidota, Schisturaprashari, Schisturamacrolepis, Triplophysanaziri* and *Triplophysamicrops.* These species were caught from each zone during all months and showed high evenness.

Family Channidae was represented by two fish species, *Channagachua* and *Channapunctata*, contributed 10.88% of the total fish catch and was with total diversity value (D=0.01184 and H=0.11298). Family Sisoridae was represented by four fish species, *Glyptothoraxpunjabensis, G. stocki, G. sufii and G. naziri*, contributed 10.37% of the total catch and was with total diversity value (D=0.01075 and H=0.10538). Family Mastacembelidae was represented by a single species *Mastacembelusarmatus* and contributed 4% of the total fish catch having total diversity value (D=0.00016 and H=0.00676, Figure-2).

Fishes caught during the study (Figure, 3 a-y) was showing high abundance in the month of May with the diversity value (D=0.08976 and H=0.15682) and lowest in September with the diversity value (D = 0.0063 and H=0.08734). Over all Simpson's diversity value (1-D= 0.92031) and Simpson's Reciprocal index value (1/D= 12.54936) indicate that River Panjkora is quite diverse concerning fish species richness and evenness. Findings of this study also indicate that fish diversity of River Panjkora was high in the month of May (19 fish species and 30% abundance), followed by July (19 fish species and 13% abundance), August (18 fish species and 18% abundance), June (17 fish species and 18% abundance) and April (17 fish species and 13% abundance). September was the month with least diversity (10 fish species and 8% abundance).

Table-1: List of fish species identified from River Panjkora and their Diversity Index

Order	Family	Specie	% of Abundance	Pi	Simpson's index (D) $Pi^2 \times X$	Shannon's index (H) Pi (log Pi)×S
Cypriniformes	Cyprinidae	*Schizothoraxesocinus*	1.536	0.0153	0.00023	0.02786
		Schizothoraxplagiostomus	1.792	0.0179	0.00032	0.03131
		Racomalabiata	3.072	0.0307	0.00094	0.04648
		Cyprinionwatsoni	2.304	0.0230	0.00053	0.03774
		Cyprinuscarpio	8.194	0.0819	0.00067	0.08903
		Tor Putitora	1.792	0.0179	0.00032	0.03131
		Tor macrolepis	2.304	0.2304	0.00053	0.03774
		Bariliuspakistanicus	7.298	0.0729	0.00532	0.08297
		Bariliusvagra	3.201	0.0320	0.00102	0.04785
		Bariliusmodestus	3.201	0.0320	0.00102	0.04785
		Crossocheilusdiplocheilus	15.492	0.1549	0.02400	0.12547
		Garragotyla	15.108	0.1510	1.02282	0.12401
		Ctenopharyngodonidella	0.128	0.0012	0.00001	0.00370
	Nemacheilidae	*Schisturaalepidota*	6.530	0.0653	0.00426	0.07739
		Schisturaprashari	2.304	0.0230	0.00053	0.03774
		Schisturamacrolepis	1.152	0.0115	0.00013	0.02234
		Triplophysanaziri	1.536	0.0153	0.00023	0.02786
		Triplophysamicrops	0.512	0.0051	0.00002	0.01173
Siluriformes	Sisoridae	*Glyptothoraxpunjabensis*	5.377	0.0537	0.00289	0.06826
		Glyptothoraxstocki	0.768	0.0076	0.00005	0.01624
		Glyptothoraxsufii	1.536	0.0153	0.00023	0.02786
		Glyptothoraxnaziri	2.688	0.0268	0.00072	0.04223
Channiformes	Channidae	*Channapunctata*	3.585	0.0358	0.00128	0.05162
		Channagachua	7.298	0.0729	0.00536	0.08297
Mastacembeliformes	Mastacembelidae	*Mastacembelusarmatus*	1.280	0.0128	0.00016	0.02423
		Total	100.0	1.0	D= 0.07968	H=1.22399
Simpson's Diversity index (1-D= 0.9203707), Simpson's reciprocal index (1/D= 12.54936)						



a. Shannon's Index b. Simpson's Index

Fig. 2. Monthly fish species diversityinRiver Panjkora, District Dir Lower

(a) Bariliusmodestus

(b) Bariliuspakistanicus

(c) Bariliusvagra

(d) Cyprinuscarpio

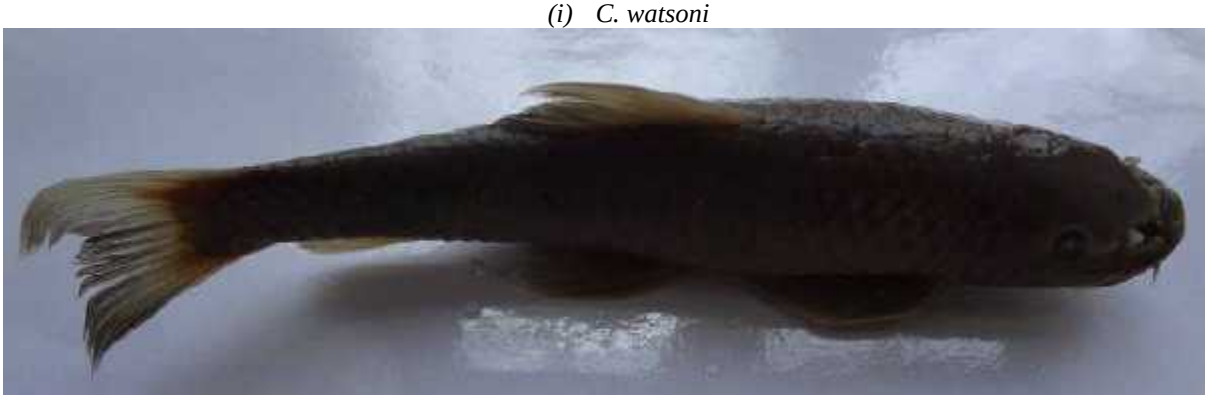
(e) C. diplocheilus

(f) C. gachua

(g) C. punctata

(h) C. idella

(i) C. watsoni



(j) G. gotyla

(k) G. naziri

(l) G. punjabensis

(m) G. stocki

(n) G. sofii

(o) M. armatus

(p) R. labieta

(q) S. plagiostomus

(r) S. alepidota

(s) S. esocinus

(t) S. macrolepis

(u) S. prashari

(v) T. macrolepis

(w) T. microps

(x) T. naziri

(y) T. putitora

Fig. 3. (a-y) Fish species collected from River Panjkora

DISCUSSION

A total of 25 commercial and non-commercial fish taxa were obtained out of which 2 were exotic fish species. Most of the species collected from River Panjkora were commonly found in the riversof adjoined areas i.e. River Swat (Hasan *et al.*, 2013). Since River Panjkora is relatively shorter and smaller than River Swat, so the species composition was not as diversified as in River Swat. Among the fishes caught, few fish species were of commercial importance like *Tor macrolepis*, *Schizothoraxplagiostomus*, *Racomalabiata*, *Mastacembelusarmatus* and *Cyprinuscarpio*. The most dominant fishes were *Crossocheilusdiplocheilus* (121 specimens, 15.5% of the total), *Garragotyla* (118 specimens, 15.1% of the total), *Cyprinuscarpio* (64 specimens, 8.2% of the total), *Channagachua* and *Bariliuspakistanicus* (57 specimens both, 7.3% of the total). The least abundant fish species was *Ctenopharyngodonidella* (only 1 specimen, 0.128%).

Overall,*Bariliusspp*.were most abundant (107 specimens, 13.7%). However, the evenness, richness and abundance of the fish speciesis mainly due to the water quality, as most of the important physicochemical parameters fall within the limits suggested by the United States Public Health Standards for surface water, 1976 but at the same time the monthly variations have influenced the fish composition in different months. The greater number of individual fish caught and diverse species composition was observed during May (234 fishes, 30%)followed byAugust (144 fishes, 18.44%) and June (139 fishes, 17.8%). According to United States Public Health the concentration of the physicochemical factors observed and recorded show that the water quality is excellent (Table-2)as the physiological functions of fishes and other aquatic organisms are affected by these parameters i.e. pH of the water affects respiration and exchange of ions with the water and under a relatively wide pH range in most aquatic biota, these vital physiological processes normally operate (McKee and Wolf, 1963). Similarly the other factors which render important functions at their own place, fall within the standard range (Table-3) showing that the water quality in the River Panjkora is suitable for the fish communities to flourish.

Table-2: Physico-chemical parameters of River Panjkora in three different zones

Parameters	Zone 1	Zone 2	Zone 3	Mean	S.D
Temperature (°C)	21.275	23.075	24.4	22.916	1.568
pH	7.325	7.3325	7.4	7.3525	0.041
Dissolved Oxygen (mg/l)	8.975	8.878	9.06	8.971	0.091
Electric conductivity (µs/cm)	201.675	201.25	203.68	202.201	1.297
Total dissolved solid (mg/l)	127.912	126.095	132.275	128.76	3.176
Total suspended solid (mg/l)	129.857	127.1	129.56	128.839	1.513
Total hardness (mg/l)	118.75	124.75	121.25	121.583	3.013
Free CO_2 (ppm)	4.3	4.525	4.4	4.408	0.112
Turbidity (NTU)	1.34	1.82	3.14	2.1	0.932
Salinity (ppm)	0.0075	0.055	0.0525	0.038	0.026
Calcium hardness(mg/l)	77.5	77.5	77.5	77.5	0
Magnesium hardness (mg/l)	43.25	43.5	45.25	44	1.089
Sodium (mg/l)	5.1	5.225	4.897	5.074	0.165
Sodium (mg/l)	2.825	3	3.175	3	0.175
Total alkalinity (mg/l)	98	105.5	102.75	102.083	3.794
Chloride (mg/l)	15.95	16.55	15.975	16.158	0.339
Nitrate(mg/l)	0.035	0.016	0.014	0.021	0.011

Table-3: Maximum and Minimum values of Physico-chemical parameters of River Panjkora

Parameters	Maximum	Month	Minimum	Month
Temperature (°C)	30.5	July	17.4	September
pH	7.9	July	7.1	April & June
Dissolved Oxygen (mg/l)	10.4	April	8.0	July
Electric conductivity (µs/cm)	218.2	July	190.2	April
Total dissolved solid (mg/l)	139.2	July	111.1	April
Total suspended solid (mg/l)	135.3	April	120.9	May
Total hardness (mg/l)	133.0	July	100.0	June
Free CO_2 (mg/l)	4.9	May	4.2	July
Turbidity (NTU)	3.86	July	1.15	April
Salinity (mg/l)	0.11	July	0.01	May
Calcium hardness(mg/l)	81.0	July	71.0	May
Magnesium hardness (mg/l)	49.01	July	35.00	May
Sodium (mg/l)	5.9	July	4.4	April
Potassium (mg/l)	3.9	June	2.1	April
Total alkalinity (mg/l)	117.0	July	92.0	April
Chloride (mg/l)	19.7	July	11.1	April
Nitrate(mg/l)	0.09	July	0.003	May

River Panjkora flows along a settled, populated area, so it has been greatly exploited and stressed because of the discharges from municipal and industrial effluents, agricultural run offs and domestic sewages. Industrialization and increase in population has indirectly influenced the aquatic environment, ultimately affecting aquatic organisms, their abundance and diversity, because stability of fish community depends upon the availability of suitable environment to live within (Angus and Alan, 2000; Ali*et al.*, 1996). Fish population maintenance, diversity and abundance of fish species in natural environment is possible through different techniques such as implementing strict environmental laws, annual fish stocking, regulation of harvest, prevention of fishing in breeding season and harvesting of marketable size fish only.

River Panjkora is receiving a constantly increasing pressure as the local people are continuously utilizing its banks for construction, agricultural, recreational and industrial purposes. After the 2010 massive flood, according to local fishermen, the total catch has declined and about three to five fish species are missing from the river. Thus, it is suggested that to improve the aquatic environment for conserving the existing species and providing them an opportunity to reproduce and grow in abundance, Khyber

Pakhtunkhwa fisheries department should play its role by implementing strict laws against illegal fishing by chemicals and electric shocks. Regular monitoring through sampling should be carried out in order to evaluate species diversity and its socio-economic aspects because a comprehensive knowledge about an ecosystem is necessary for its scientific supervision, suitable management and conservation plans (Prusty *et al.,* 2007).

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