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A survey of fish biodiversity of River Barawal, District Dir Upper, Khyber-Pakhtunkhwa, Pakistan

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Abstract

Based on the importance and crucial role in biosphere, studying fish is a debatable issue. Biodiversity refers to the number of different species living in an ecosystem. The current research survey was undertaken to study fish diversity of River Barawal District Dir Upper Khyber Pakhtunkhwa, Pakistan from April to September 2016. Fish samples were collected using cast nets, scoop net, hooks, rods and mesh cloth. Identification of the collected samples was performed studying various morphometric measurements and meristic counts. During this study seven different fish species were collected belonging to two orders; Siluriformes and Cypriniformes and three families; Sissoridae, Nemacheilidae and Cyprinidae. Family Sissoridae was the dominant family represented by 3 species viz; *Glyptothorax stocki, Glyptothorax naziri* and *Glyptosternon reticulatum*. Family Nemacheilidae represented by two species i.e. *Schistura curtistigma* and *Triplophysa microps* while Cyprinidae was represented by two species *Racoma labiate* and *Crossocheilus diplocheilus*. If the water quality and maintenance of this river is properly monitored, it can harbor large number of fish species.

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Introduction

A total number of different species of fish inhabiting in an area is called Ichthyodiversity of that area (Shinde *et al.*, 2009). Icthyodiversity is a sub group of biodiversity. Its variation depends on the morphological and physiological factors, molecular and genetic variations among fish and biotic and abiotic factors of the aquatic ecosystems (Burton *et al.*, 1992). In a water body, there are various types of factors and interactions of various ecological variables, e.g. amount of water, river size, adjoining tributaries, depth of the river, water flow speed, vegetation, channel morphology, etc (Welcomme, 1985). There is a direct relation between Ichthyodiversity and health of aquatic ecology; more abundance of the fish species shows good ecological health and vice versa (Hamzah, 2007).

Fish body size and morphology are greatly variable. Some fish are extremely small while some are extremely large in their size. Adult gobies have been reported of about 8mm only whereas a Chondrichthyes, *Rhincodon typus* gain a body length up to 12m. Moreover, morphological and anatomical features also play a crucial role in species identification. Among these, fins, barbels, soft fins rays or spines, sound production, eyes, bio-luminous organs, scales, electric organs and venom production are the most important ones (Nelson, 1994). Studies about diversity, composition of species and its distribution are crucial to analyse the factors regulating fish community (Galactos *et al.*, 2004).

Biodiversity has a vital role in producing commercial products obtained from fisheries sector (Dulvy *et al.*, 2000; Hilborn *et al.*, 2003). The combined production of fisheries from capture and aquaculture globally support food, better livelihood, employment and economy of nations (Shah *et al.*, 2018) as world is constantly using it as food resources (Akhter *et al.*, 2015). Fish show extremely large diversity, including various species from variety of conditions. Abundance of fish greatly relies on the availability of other aquatic organisms, which share a key role and have various characteristics of the aquatic life. The abundance and distribution of fish has been described by many researchers in different water bodies (Ishaq *et al.*, 2014). Fish is one of the most diverse group among vertebrates (Devashash *et al.*, 2006). Inhabiting almost all the aquatic habitats, there are about 28,000 living species of fish are known. Moreover, 27,000 species belong to Osteichthyes, 108 to Agnathans and 970 to Chondrichthyes (Ali and Narejo, 2009).

In Pakistan, large numbers of research studies have been carried out on Ichthyodiversity from time to time (Rafique *et al.*, 2003) comprising of 193 fish species (Rafique and Khan, 2012). These studies provide basic information about fish diversity. However, certain deficiencies are present as complete knowledge about fish importance and its conservation is not available in these studies (Rafique and Khan, 2012). Recently valuable work conducted by various researchers like Ishaq *et al.* (2014) who collected 18 species from River Swat, KPK. In addition, Muhammad *et al.* (2014) reported 11 species from River Panjkora, Dir Upper, KPK. Moreover, Khan and Hasan (2014) reported 21 species from District Karak, KPK. Khattak *et al.* (2015) studied fish fauna of River Kabul and identified 24 species.

Therefore, the current study was performed with aim to:

- Study the Ichthyofauna, its abundance and distribution in River Barawal.
- Find out the commercial fish species of the respective river.
- Make aware the people about significance of fish and disadvantages of illegal fishing.

Materials and methods

Sampling Site

River Barawal is flowing through Barawal Bandi, District Dir Upper KPK, Pakistan with latitude and longitude of 35.0894 North and 71.7642 East. River Barawal is originated from Binshai Dara.

It is joined by Shahi stream at Shaltalo, Nusrat Dara stream at Shahi Kot, Bindara stream at Jhon Batai, Shingaray stream at Barawal Bandai and Hatan Dara stream at Sundrawal.

Sample Collection

Fish samples were collected from April to September 2016 from three different sites (Hichkalay, Surbaat and Sundrawal) from River Barawal. This was performed using cast nets, scoop net, hooks, rods and mesh cloth. No illegal means were adopted during sampling. The samples were washed properly and placed in 5% formalin.

Preservation

The samples were then brought to the Fisheries and Aquaculture Lab, Department of Zoology, University of Peshawar KPK, Pakistan. For long term preservation 10% formalin was used. Smaller specimens were taken directly into the sampling jars while the larger ones were injected with formalin into the abdomen before fixation.

Laboratory Work

In laboratory, identification of the collected samples was performed studying various morphometric measurements and meristic counts (Table 3) with the help of some taxonomic and identification keys like Fishes of the Punjab (Mirza and Sandhu, 2007), Freshwater fishes of the Indian Regions (Jayaram, 1999) and Inland fishes of the India and adjacent countries (Talwar and Jhingran, 1991). Various types of equipments and instruments were used i.e. Vernier calliper, scale, light microscope, dissection microscope, counting needle, magnifying glass, forceps, surgical gloves, petri dishes and beakers.

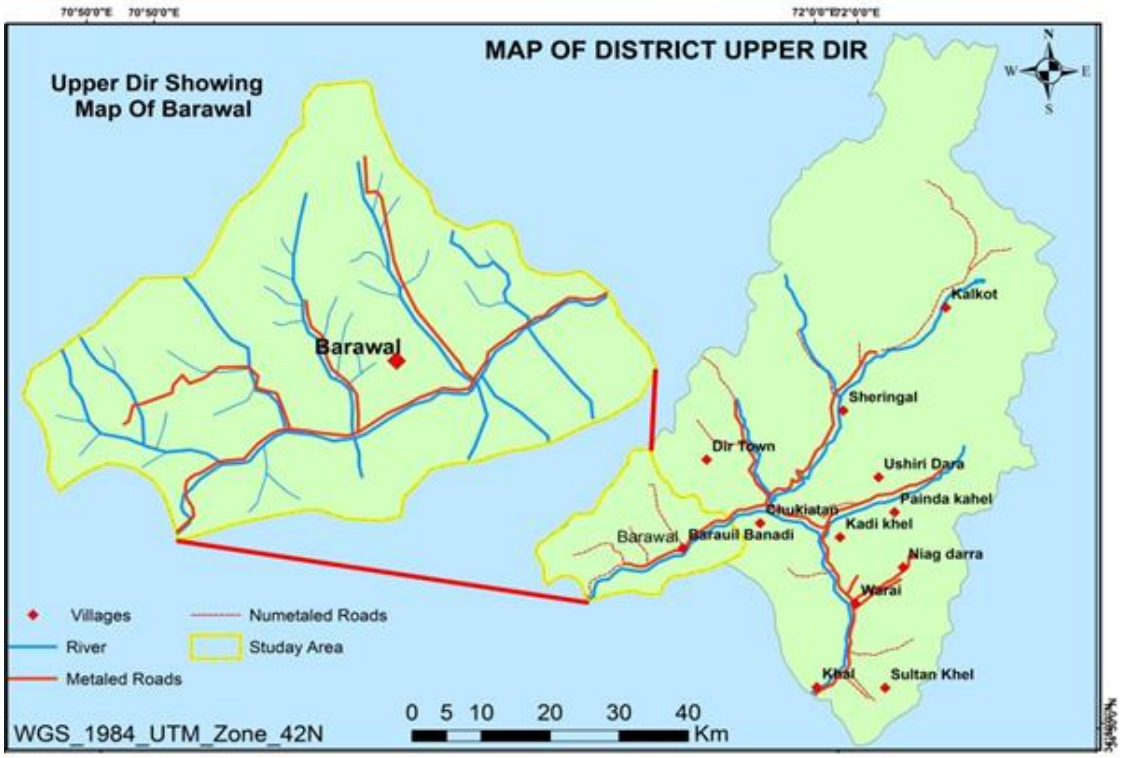


Fig. 1. Map of River Barawal District Dir Upper.

Labelling

After identification and morphometry, the collected species were placed in separate jars while mentioning all the necessary information i.e. site of collection, date of collection, name of collector, serial number, etc.

Results

During the current survey, a total of 276 fish samples were collected from River Barawal comprising seven species. These samples varied in their body size i.e. small, medium and large. The identified species were *Racoma labiata, Crossocheilus diplocheilus, Glyptosternon reticulatum, Glyptothorax naziri, Glyptothorax stocki, Schistura curtistigma* and *Triplophysa microps*. All these species belonging to two orders (Siluriformes and Cypriniformes), three families (Sissoridae, Nemacheilidae and Cyprinidae) and six Generas (*Glyptothorax, Glyptosternon, Schistura, Crossocheilus, Triplophysa and Racoma*) (Table 1).

Table 1. Total reported fish species of River Barawal, District Dir Upper.

SN	Order	Family	Genus	Species
1	Cypriniformes	Cyprinidae	Racoma	Racoma Labiata
2			Crossocheilus	Crossocheilus diplocheilus
3		Nemacheilidae	Schistura	Schistura curtistigma
4			*Triplophysa*	*Triplophysa microps*
5			Glyptothorax	Glyptothorax stocki
6	Siluriformes	Sissoridae		Glyptothorax naziri
7			*Glyptosternon*	*Glyptosternon reticulatum*

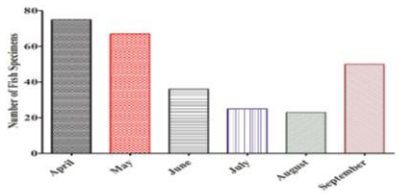
Table 2. Total number of collected specimen from three spot of River Barawal.

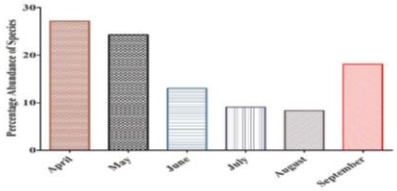
SN	Species	April	May	June	July	August	September	Total
1	*Racoma labiata*	25	18	10	5	12	20	90
2	*Crossocheilus diplocheilus*	6	8	4	2	1	5	26
3	*Glyptosternon reticulatum*	8	12	5	2	1	4	32
4	*Glyptothorax stocki*	12	6	4	6	2	5	35
5	*Glyptothorax naziri*	10	15	8	6	3	8	50
6	*Schistura curtistigma*	14	8	5	4	2	2	35
7	*Triplophysa microps*	0	0	0	0	2	6	8
	Total	75	67	36	25	23	50	276

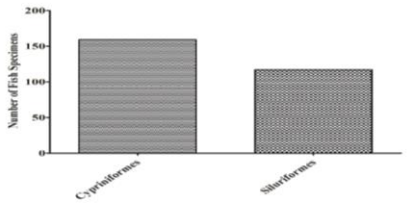
Table 3. Morphometric measurements of reported species from River Barawal.

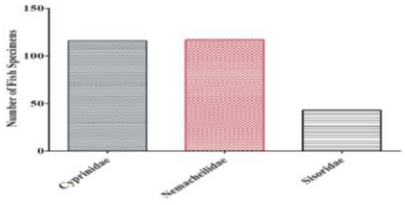
SN	Fish species	T. L	S. L	F. L	Sn. L	H. L	E. D	B. D	Cp. L
1	*Racoma labiata*	11.9	10	11	0.8	2.4	0.4	2.6	1.8
2	*Crossocheilus diplocheilus*	9.8	7.5	9.0	0.8	1.6	0.4	1.8	1.2
3	*Glyptosternon reticulatum*	10.8	9.2	-	1.6	2.4	0.2	1.7	2
4	*Glyptothorax stocki*	12	10.5	11	1.4	2.4	0.3	1.9	2
5	*Glyptothorax naziri*	11.9	9.7	10.6	1.3	2.4	0.2	1.9	1.7
6	*Schistura curtistigma*	12.4	10.2	12.2	1.3	2.2	0.3	1.8	1.4
7	*Triplophysa microps*	12.6	10.8	12	1	2.1	0.3	1.5	2.7

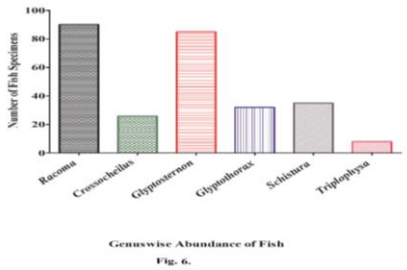
T. L = Total Length, S. L = Standard Length, F. L = Forked Length, Sn. L = Snout Length, H. L = Head Length, E. D = Eye Diameter, B. D = Body Depth, Cp. L = Caudal peduncle length











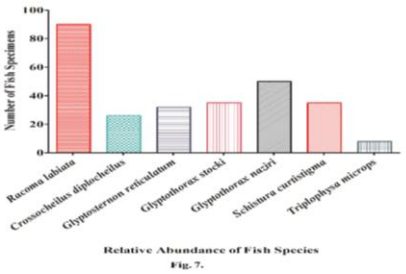


Fig. 2. Monthwise collection of the total fish specimens from May-August 2016. **Fig.** 3. Monthwise percentage abundance of total reported fish species from May-August 2016. **Fig. 4.** Orderwise diversity of the total collected fish specimens. **Fig. 5.** Familywise diversity of the total collected fish specimens. **Fig. 6.** Genuswise diversity of the total collected fish specimens. **Fig. 7.** Relative abundance of the total reported fish species from both Garhi Usmani Khel Stream and Meherdy Stream.

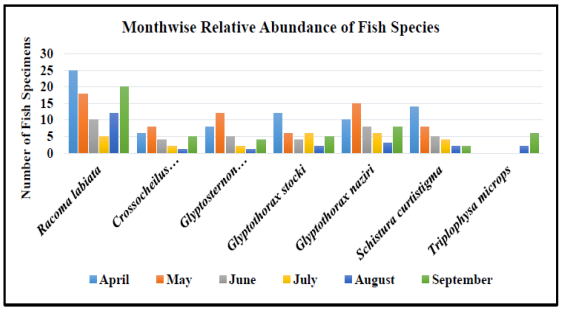


Fig. 8. Monthwise relative abundance of all the fish specimens of total reported species from May-August 2016.

Some species like *Crossocheilus diplocheilus, Glyptothorax naziri* and *Glyptothorax stocki* have no market status as they have small body size. But being a part of diversity, they play a crucial role in the food web and food chain of aquatic ecosystem. The family Sisoridae represented by three species was the leading family while Nemacheilidae and Cyprinidae were represented by two species each.

Discussion

As the present survey was preliminary, hence no enough information available about the Ichthyofauna of this site. However, a large number of studies have been carried out on the fish diversity of the water bodies of adjacent areas like Swat, Buner, Malakand, etc.

Muhammad *et al.* (2014) reported 11 species from River Panjkora District Dir Upper KPK. While comparing both the studies only two species were common i.e. *Racoma labiata* and *Crossocheilus diplocheilus*. While *Glyptosternon reticulatum, Glyptothorax naziri, Glyptothorax stocki, Schistura curtistigma, and Triplophysa microps* were absent in their study. In addition, nine species reported in their study were missing in the current study. Similarly, Ullah *et al.* (2014) studied Ichthyofauna of Rhound Stream Dir Lower KPK and identified 14 species. Only *Racoma labiata* and *Crossocheilus diplocheilus* were common in the both the studies. The reason might be the sampling sites and duration as in the current study sampling was done for six months while in the former sampling was for eight months. Although these studies were conducted in the same district however, there could be some differences in the biotic and abiotic factors of these water bodies which led to the variation in fish fauna.

Similarly, Ishaq *et al.* (2014) reported eighteen species from River Swat. Their results showed significant similarity with the current research. Comparing both studies, only three species were common i.e. *Racoma labiata, Crossocheilus diplocheilus* and *Glyptothorax stocki* while five genera; *Racoma, Crossocheilus, Glyptothorax, Schistura* and *Triplophysa* were also common. In addition, Akhtar *et al.* (2014) identified ten species from River Barandu District Buner. There is no expressive similarity between both these studies because their results totally disagree with our results. However, few genera were common in both i.e. *Crossocheilus, Schistura* and *Triplophysa*. This difference may be due to variation in environmental factors especially water temperature because its strongly affect migration and distribution of fish species.

The current study was performed from April to September 2016 and a total of seven species were recorded. Among them, *Racoma labiata* was the most abundant species represented by 33% while the *Triplophysa microps* was the less abundant among all the species represented by 3% only. Similarly, April was the richest month (27.17%) while July was the poorest month (9.05%) (Table 2). Five fish Species like *Glyptosternon reticulatum, Glyptothorax naziri, Glyptothorax stocki, Schistura curtistigma, and Triplophysa microps* were reported for the first time in River Barawal.

It shows that these species are threatened through illegal fishing, pollution or some other sources that's why restricted to this river. If the River Barawal is properly monitored by Khyber Pakhtunkhwa Fisheries Department, this river can harbor large number of fish species. Moreover, special attention is needed for the conservation of the above five species.

The species abundance of some fish like *Crossocheilus diplocheilus* and *Triplophysa microps* was much less as compared to the others.

These species may be more prone to pollution and other factors which may cause destruction of their habitats, destroying their eggs, killing the hatchlings and larvae, damaging spawning grounds, affecting availability of food by preventing penetration of light etc. These factors have led to the decline and variation in the inland ichthyofauna (Khan *et al.*, 2012).

The relative abundance of fish species and species richness are directly related to the variations in water temperature (Koutrakis *et al.*, 2000). Species richness is mainly used in monitoring the ecological resources as it positively correlates the statistical analysis of habitat and physico-chemical parameters of water (Scott and Hall, 1997; Goteli and Colwell, 2001).

The fisheries department of Khyber Pakhtunkhwa has the authority to critically monitor the maintenance of the rivers and streams. As the respective research area is a far hilly area where proper warding is difficult that's why resulting in illegal fishing and other anthropogenic activities (Sodhi *et al.*, 2013). Certain other factors are also involved affecting the aquatic ecosystem of the mountainous regions. Important among them are dam construction, runoff from agriculture, domestic sewage, degradation of wetlands, watershed urbanization, etc. Most importantly, majority of the local fishermen use electric current/shock and dynamites for fishing that result in the killing of larvae and fries, damaging fish eggs, killing small fish and affect overall fish fauna (Shrestha, 1981).

Conclusion and recommendations

During the current, we personally analysed that the fish fauna of the River Barawal is greatly disturbed by anthropogenic activities like electric shock, use of chemicals and dynamite. Proper monitoring of water quality and maintenance of the rivers and streams should be regulated. Illegal fishing should immediately be banned.

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