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# DIVERSITY AND ABUNDANCE OF FISH FAUNA AT HEAD MARALA, CHENAB RIVER, PUNJAB, PAKISTAN

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## ABSTRACT

Marala headwork situated on River Chenab in Punjab, Pakistan was surveyed to assess the diversity and abundance of the fish fauna during the period September 2015 to June 2016. A total of five sampling sites were studied on monthly basis by using different fishing nets for assessing fish diversity. Total 1391 fish specimens belonging to 38 species, 30 genus, 14 families and 6 orders were recorded in the present study. Family Cyprinidae was found dominant with 14 fish species followed by Channidae (4 species) and Bagridae (3 Species). Fish abundance and diversity was assessed by using different diversity indices. The Shannon-Wiener diversity, Pielou's evenness and Margalef's richness indices were 2.950, 0.81 and 11.8, respectively. Present findings showed that the population of *Tor putitora* and *Nandus nandus* has declined while exotic fish species, *Cyprinus carpio, Ctenopharyngodon idella*, *Hypophthalmicthyus molitrix, Oreochromis niloticus* and *Oreochromis mossambicus* has become established. The low evenness in the river was an indication of the effects of anthropogenic activities such as habitat degradation, aquatic pollution, overfishing, damming and introduction of alien fish species. Present findings highlight the importance of instant mitigation measures for conserving fish diversity in the river.

**Keywords**: Chenab, fish fauna, freshwater, diversity, abundance.

## INTRODUCTION

The freshwater icthyo diversity of Pakistan is represented by 193 species, out of which 86 species have been identified as "species of special importance"(Rafique and Khan, 2012). River Chenab is one of the most important water body in Pakistan providing habitat for aquatic biodiversity including fishes. Number of studies has been carried out on the fish diversity of River Chenab (Mirza and Khan, 1988; Khan *et al*., 1991; Afzal *et al*., 1995; Javed *et al*., 1997; Qazi *et al*., 2000; Mirza and Javed, 2003; Altaf *et al*., 2008; Qadir *et al*., 2009; Altaf *et al*., 2011 a,b; Altaf *et al*., 2015). In a riverine ecosystem fishes plays a vital role for maintaining the ecosystem. Anthropogenic stresses are responsible for bringing the climatic changes leading to the devastating effect on the ecosystems and biodiversity (Qureshi and Ali, 2011). The present study was aimed to investigate diversity, abundance and richness of fish fauna of Head Marala situated on River Chenab, Punjab, and to suggest conservative measures for declining fish species.

## MATERIALS AND METHODS

The data was collected from September 2015 to June 2016 from Marala Headwork on monthly basis. During the study period fish samples were collected by using fishing nets of varying mesh sizes such as Cast, Drag and Drift nets, to capture as many as fish species as possible (Bhat, 2003). At the site of collection smaller fish samples were preserved in 10% formalin, while larger specimens were injected formalin intraperitonally. Later on, these samples were brought to the Fish Museum where they were shifted into 70% alcohol. On the basis of morphometric and meristics characteristics specimens were identified up to the species level by using regional fish identification keys (Mirza and Sharif, 1996; Mirza and Sandhu, 2007). The preserved specimens have been displayed at Fish Museum, Fisheries Research and Training Institute Manawan, Lahore.

## STUDY AREA

River Chenab originates from India and near Diawara village enters into district Sialkot, Punjab. In the Pakistan side total length of this river is about 960 km. There are four Headworks on this river namely; Marala Headwork, Qadirabad Headwork, Khanki Headwork and Trimmu Headwork for regulating the flow and storage of water (Siddiqi and Tahir-Kheli, 2004). Marala Headwork ($32^0$ 38′59 N, $74^0$28′05 E) is about 38.6 km away from district

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Sialkot. Fish sampling was done mainly from five sites viz Upstream and lower stream of Head Marala, Jammu Tawi, Manawar Tawi and Bajwat area (Figs. 1a-d). Sampling sites were intensvely sampled during the study period to capture as many as fish species as possible in an order to estimate the proportion to their abundance.

## STATISTICAL ANALYSIS

Fish species diversity, richness and evenness from the study area were estimated by using the following formulas. Diversity Index, H' (Shannon-Wiener, 1963). $H' = -[\Sigma P_I \text{ In } P_I]$Margalef's richness index, D (Margalef's, 1958). R = S-1/logN, Evenness index, E= (Hill, 1973) E = H'/ln(S) Where: H'= diversity Index,

$P_I$=proportion of the species relative to the total number of species, In $P_I$ natural logarithm of this proportion, D= dominance index, S= total no of species, N= total number of individuals, E= evenness index.


Fig. 1a. Location of Upstream of Marala Headwoks, River Chenab, Pakistan.


Fig. 1b. Location of Lower stream of Marala Headwoks, River Chenab.


Fig. 1c. Location of Jammu Tawi, River Chenab.


Fig. 1d. Location of Manawar Tawi, River Chenab.


Fig. 1e. Location of Bajwat area, River Chenab.

Table 1. Status of Fish fauna at Head Marala, River Chenab, Punjab, Pakistan.

| S. No. | Family | Scientific Name | Common Name | R.A | $P_I InP_I$ |
|---|---|---|---|---|---|
| I- 1. | Cyprinidae | *Labeo rohita* | Rohu | 0.0381 | -0.1244 |
| 2 | | *Cirrhinus mrigala* | Mori | 0.0690 | -0.1884 |
| 3 | | *Cirrhinus reba* | Reba Machali | 0.0237 | -0.0886 |
| 4 | | *Gibelion catla* | Thaila | 0.0186 | -0.0741 |
| 5 | | *Puntius sophore* | Sophore Popra | 0.1603 | -0.2934 |
| 6 | | *Puntius chola* | Chola popra | 0.0625 | -0.1732 |
| 7 | | *Tor putitora* | Masheer | 0.0050 | -0.0264 |
| 8 | | *Salmophasia punjabensis* | Punjabi Chal | 0.0496 | -0.1489 |
| 9 | | *Securicula gora* | Bari Chal | 0.0416 | -0.1322 |
| 10 | | *Esomus danricus* | Somara Machali | 0.0150 | -0.0629 |
| 11 | | *Osteobrama cotio* | Pali-ro Machali | 0.0136 | -0.0584 |
| 12 | | *Cyprinus carpio* | Gulfam | 0.0265 | -0.0962 |
| 13 | | *Ctenopharyngodon idella* | Grass Carp | 0.0136 | -0.0584 |
| 14 | | *Hypophthalmicthyus molitrix* | Silver Carp | 0.0115 | -0.0513 |
| II-15 | Bagridae | *Sperata sarwari* | Singhari | 0.0194 | -0.0764 |
| 16 | | *Mystus cavasius* | Kanghar | 0.0438 | -0.1370 |
| 17 | | *Mystus bleekeri* | Kanghar | 0.0158 | -0.0655 |
| III-18 | Sisoridae | *Bagarius bagarius* | Fauji Khaga | 0.0079 | -0.0382 |
| 19 | | *Gagata cenia* | Gagata cenia | 0.0064 | -0.0323 |
| IV-20 | Heteropneustidae | *Heteropneustes fossilis* | Sanghi Machali | 0.0115 | -0.0513 |
| V-21 | Siluridae | *Wallago attu* | Malli | 0.0093 | -0.0435 |
| VI-22 | Channidae | *Channa marulius* | Saul | 0.0136 | -0.0584 |
| 23 | | *Channa striata* | Sauli | 0.0036 | -0.0197 |
| 24 | | *Channa punctate* | Daula | 0.0244 | -0.0906 |
| 25 | | *Channa gachua* | Dauli | 0.0050 | -0.0264 |
| VII-26 | Chandidae | *Chanda nama* | Sheesha Machali | 0.0740 | -0.1926 |
| 27 | | *Parambassis ranga* | Ranga Sheesha | 0.0258 | -0.0943 |
| VIII-28 | Nandidae | *Nandus nandus* | Patta Machali | 0.0014 | -0.0091 |
| IX-29 | Gobiidae | *Glossogobius giuris* | Golu Machali | 0.0079 | -0.0382 |
| X-30 | Belontidae | *Colisa fasciata* | Bari Kanghi | 0.0033 | -0.0188 |
| 31 | | *Colisa laila* | Choti Kanghi | 0.0208 | -0.0805 |
| XI-32 | Cichlidae | *Oreochromis niloticus* | Chirra Machali | 0.0474 | -0.1445 |
| 33 | | *Oreochromis mossambicus* | Chirra Machali | 0.0244 | -0.0906 |
| XII-34 | Mastacembelidae | *Mastacembelus armatus* | Baam | 0.0093 | -0.0435 |
| 35 | | *Macrognathus pancalus* | Garoj | 0.0050 | -0.0264 |
| XIII-36 | Schilbeidae | *Eutropiichtys vacha* | Jhalli Machali | 0.0222 | -0.0845 |
| 37 | | *Clupiosoma garua* | Bachwa | 0.0079 | -0.0382 |
| XIV-38 | Notopteridae | *Notopterus notopterus* | But Pari | 0.0093 | -0.0435 |

Table 2. Morphometric measurements (cm) of the recorded fish species from Marala Headwork.

| S. No. | T.L | S.L | F.L | B.W | B.H | Pr.L | Ps.L | H.L | L.C.P |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.3 | 20.2 | 22.1 | 7.1 | 7.4 | 9.8 | 7.2 | 5.3 | 3.9 |
| 2 | 15.3 | 12.4 | 13.4 | 3.5 | 3.8 | 6.1 | 4.7 | 2.9 | 2.2 |
| 3 | 14.5 | 12.1 | 12.9 | 3.4 | 3.9 | 5.6 | 5.1 | 2.8 | 2.1 |
| 4 | 42.1 | 35.4 | 38.2 | 11.2 | 12.3 | 18.2 | 11.9 | 9.6 | 3.8 |
| 5 | 8.7 | 7.1 | 7.9 | 3.1 | 3.2 | 3.7 | 2.5 | 2.1 | 1 |
| 6 | 7.1 | 6.1 | 6.4 | 2.2 | 2.4 | 3.1 | 2.1 | 1.6 | 0.8 |
| 7 | 16.2 | 14.8 | 15.9 | 4.3 | 4.6 | 7.3 | 8.1 | 3.9 | 2.6 |
| 8 | 7.2 | 5.3 | 5.7 | 1.5 | 1.7 | 3.3 | 2.3 | 1.6 | 0.8 |
| 9 | 15.3 | 13.4 | 14.3 | 2.8 | 3.2 | 8.9 | 3.9 | 2.9 | 2.4 |
| 10 | 5.4 | 4.9 | 5.1 | 1.1 | 1.3 | 2.9 | 1 | 1.1 | 0.6 |
| 11 | 9.5 | 7.5 | 7.7 | 3.5 | 3.8 | 4 | 3.7 | 1.7 | 0.9 |
| 12 | 18.7 | 15.1 | 15.9 | 5.9 | 6.3 | 7.2 | 2.5 | 4.5 | 2.9 |
| 13 | 31.3 | 26.3 | 27.9 | 6.2 | 6.5 | 13.9 | 11.5 | 6.2 | 3.7 |
| 14 | 36.5 | 30.2 | 32.2 | 9.3 | 10.4 | 16.8 | 11.7 | 8.7 | 5.5 |
| 15 | 32.1 | 25.2 | 25.6 | 4.4 | 4.6 | 11 | 11.3 | 6.4 | 4.2 |
| 16 | 13.3 | 10.4 | 10.9 | 2.5 | 3.1 | 4.2 | 5.7 | 2.2 | 2.5 |
| 17 | 5.2 | 4.1 | 4.4 | 1.2 | 1.4 | 1.9 | 0.8 | 1.4 | 0.5 |
| 18 | 39.3 | 35.1 | 37.2 | 7.3 | 7.6 | 21.4 | 14.1 | 6.3 | 4.2 |
| 19 | 4.9 | 3.9 | 4.5 | 2.1 | 2.3 | 2.1 | 3.2 | 1.9 | 1.3 |
| 20 | 10.9 | 9.9 | - | 2.1 | 2.3 | 3.9 | 6.7 | 1.6 | - |
| 21 | 47.5 | 43.5 | 44.3 | 9.5 | 9.9 | 12.6 | 30.1 | 9.7 | 1.1 |
| 22 | 48 | 41 | - | 9.5 | 10.7 | 11.9 | 1.5 | 11.8 | 2.5 |
| 23 | 47 | 37 | - | 7.1 | 7.5 | 11.3 | 2.5 | 10.3 | 2.9 |
| 24 | 16.3 | 13.7 | - | 4.1 | 4.4 | 6.9 | 1.1 | 5.3 | 0.9 |
| 25 | 8.2 | 6.9 | - | 2.1 | 2.2 | 2.6 | 0.6 | 2.9 | 0.4 |
| 26 | 4.2 | 3.2 | 3.7 | 1.3 | 1.4 | 1.5 | 0.3 | 1.2 | 0.2 |
| 27 | 8.3 | 6.2 | 7.9 | 3.2 | 3.3 | 3.2 | 1.1 | 2.2 | 0.9 |
| 28 | 15.5 | 13 | - | 5.5 | 5.8 | 6.1 | 1.7 | 5.3 | 1.6 |
| 29 | 4.9 | 3.7 | - | 1.2 | 1.4 | 2.1 | 0.9 | 1.4 | 1.1 |
| 30 | 8.1 | 6.6 | - | 3.1 | 3.3 | 2.4 | 0.6 | 1.9 | 0.2 |
| 31 | 5.3 | 4.8 | - | 2.6 | 2.9 | 1.8 | 0.3 | 1.2 | 0.1 |
| 32 | 19.5 | 16.3 | - | 7.3 | 7.5 | 6.3 | 2.9 | 4.5 | 2.3 |
| 33 | 9.5 | 7.6 | - | 3.5 | 3.8 | 3.3 | 1.1 | 2.1 | 1 |
| 34 | 36.2 | 34 | - | 3.6 | 3.7 | 23.2 | - | 5.4 | - |
| 35 | 29.3 | 28.2 | - | 3.1 | 3.3 | 18.3 | - | 4.3 | - |
| 36 | 13.6 | 11.7 | 13.2 | 2.7 | 3.6 | 8.2 | 3.7 | 2.9 | 1.4 |
| 37 | 35.3 | 30.2 | 31.3 | 6.8 | 7.9 | 8.9 | 19.1 | 6.2 | 6.5 |
| 38 | 16.8 | 16.1 | - | 3.8 | 4.9 | 8.5 | 7.6 | 3.5 | - |

Legend: T.L= Total length, S.L= Standard length, F.L= Forked length, B.W= Body width, B.H= Body height, Pr.L= Pre-dorsal length, Ps.L= Post-dorsal length, H.L= Head length, L.C.P= Length of caudal peduncle.

Table 3. Number and percentage composition of families, genera and species of fishes under various orders.

| S. No. | Orders | Families | Genus | Species | % of families in an order | % of genera in an order | % of species in an order |
|---|---|---|---|---|---|---|---|
| 1 | Cypriniformes | 01 | 12 | 14 | 7.14 | 40 | 37 |
| 2 | Siluriformes | 05 | 08 | 09 | 35.7 | 27 | 24 |
| 3 | Channiformes | 01 | 01 | 04 | 7.14 | 3.3 | 10 |
| 4 | Perciformes | 05 | 06 | 08 | 35.7 | 20 | 21 |
| 5 | Synbranchioformes | 01 | 02 | 02 | 7.14 | 6.6 | 5.3 |
| 6 | Osteoglossiformes | 01 | 01 | 01 | 7.14 | 3.3 | 2.6 |
| Total | | 14 | 30 | 38 | | | |

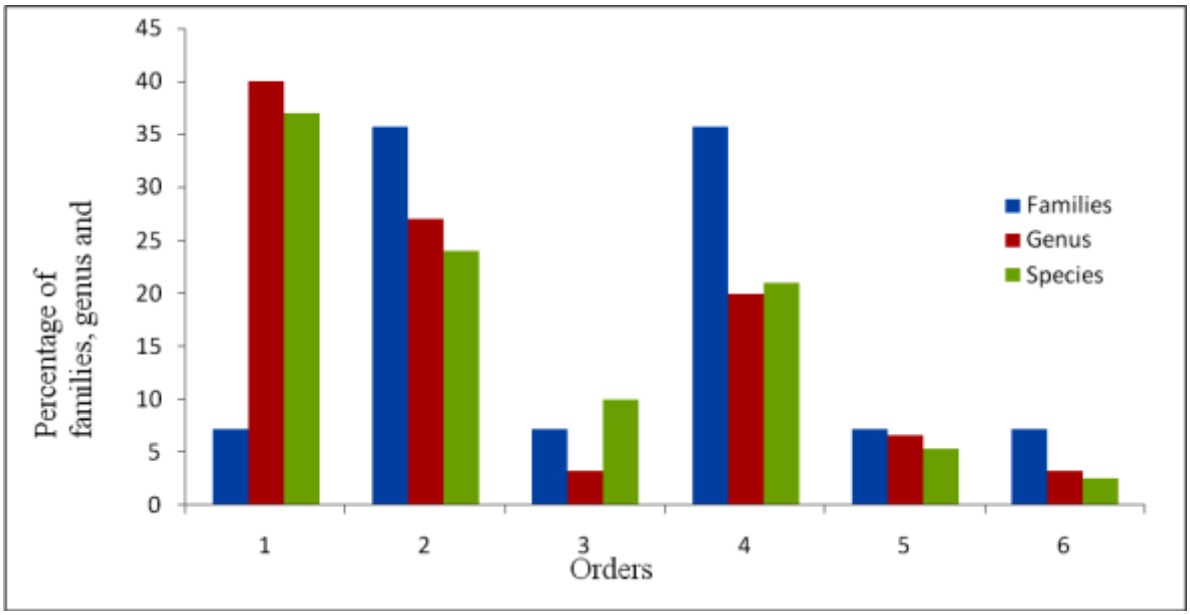


Fig. 2. Number and percentage contribution of families, genera and species.

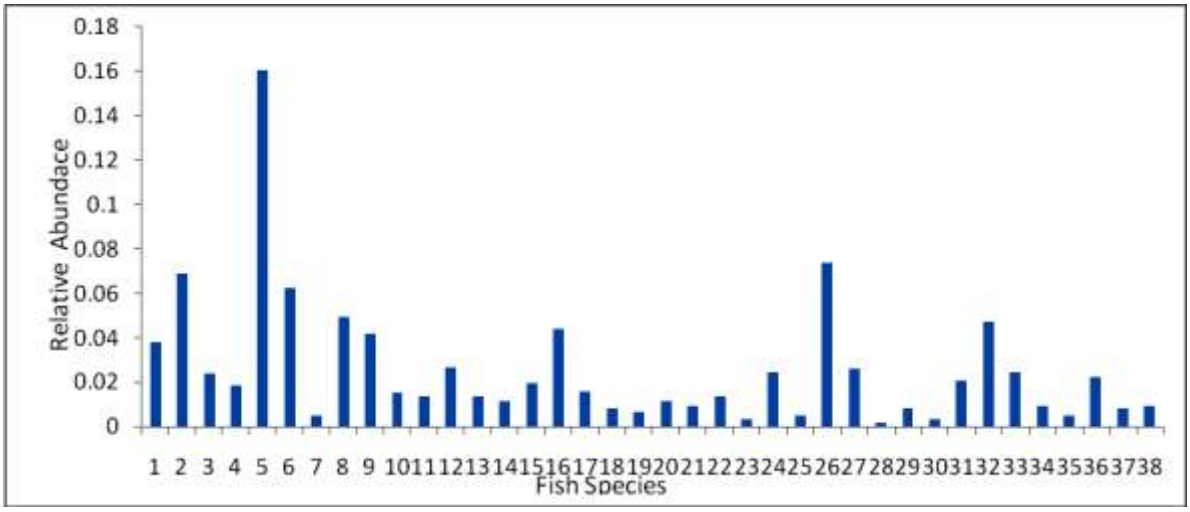


Fig. 3. Fish species diversity and their relative abundance from Head Marala, Chenab.

## RESULTS AND DISCUSSION

A total of 1391 fish specimens were collected from all the sampling sites at Head Marala. These fishes belong to 6 orders, 14 families, 30 genera and 38 species. The list of recorded fish species is given in Table 1. Morphometric measurements of the largest specimen of all recorded fish species are given in Table 2. Order Cypriniformes was found dominant represented with 14 species included in a single family Cyprinidae. Order Siluriformes was represented with 9 species included into five families namely Bagridae, Sisoridae, Hetropneustidae, Siluridae and Schilbeidae. *Sperata sarwari*, *Mystus cavasius* and *Mystus bleekri* were represented under a single family Bagridae. Both Sisoridae and Schilbeidae families were represented with two species each. Hetropneustidae and Siluridae each represented with single species. Order Channiformes was represented with a single family Channidae having four species. Order Perciformes included 5 families, Chandidae, Cichlidae, Belontidae, Nandidae and Gobiidae. Families Chandidae, Belontidae and Cichlidae included two species each. Nandidae and Gobiidae were each represented with a single species. Order Synbranchioformes was represented with single family Mastacembelidae and two species. Order Osteoglossiformes was represented with single species under family Notopteridae. The number and percentage composition of these families, genera and species of fishes under various orders is given in Table 3 and Figure 2.

The highest value for the relative abundance was calculated for *Puntius sophore* (0.1603) followed by *Chanda nama* (0.0740) and *Puntius chola* (0.0625). *Nandus nandus* and *Tor putitora* showed lowest values for their relative abundance. The species diversity and their relative abundance showed in Figure 3. The diversity index was 2.95 for the study area. The value for the richness of the study area was 11.7. The value for the species evenness from all the sampling sites was found low (0.81). The statistical analysis of different diversity indices has been shown in Table 4.

Table 4. Statistical analysis of the fish diversity of Marala Headwork, Chenab.

| | |
|---|---|
| Number of Species | 38 |
| Shannon diversity (H') | 2.95 |
| Evenness (E) | 0.81 |
| Margalef's (R) | 11.7 |

In the present study, 38 fish species belonging to six genera (Cypriniformes, Osteoglossiformes, Perciformes, Siluriformes, Channiformes and Synbranchiformes) were recorded. Among these *Labeo rohita*, *Cirrhinus mrigala*, *Gibelion catla*, *Tor putitora*, *Sperata sarwari*, *Bagarius bagarius*, *Wallago attu*, *Channa marulius*, *Channa punctate*, *Mastacembelus armatus*, and *Eutropiicthyus vacha* were commercially and economically important fishes in Pakistan. Five commercially important exotic fish species *Cyprinus carpio*, *Ctenopharyngodon idella*, *Hypophthalmicthyus molitrix. Oreochromis mossambicus* and *Oreochromis niloticus* were also found in the present collection.

Among the collected fish specimens *Puntius sophore* and *Chanda nama* were abundantly found. This was may be due to their wide distribution in the river and also their smaller size rendering them inedible to the humans. *Tor putitora* and *Nandus nandus* were found from the upstream of head Marala. These species have shown lower relative abundance in the present collection. Their population has seemed to decline in the river due to the various anthropogenic stresses such as overfishing, pollution, Damming, and introduction of alien fish species.

Qazi *et al*. (2000) studied the fish fauna of Bajwat area, District Sialkot during the period 1998-99. They reported this area as an important wetland representing 37 species of fishes belonging to 13 families and 28 genera. Their collection included some remarkable cold water fish species (*Schizothorax plagiostomus*, *Racoma labiate*, *Lepidocephalus gentea* and *Glyptothorax cavia*) which were not found in present collection. Altaf *et al*. (2008) reported various threats to Indian and Chinese carps of river Chenab. Their results supports our findings as commercially important fishes were being highly exploited showed low relative abundance in the Chenab river.

Another study, Altaf *et al*. (2011a) reported 33 fish species from Head Qadirabad, Chenab. Their study found that *Oreochromis niloticus*, an exotic fish species in the river showed highest relative abundance. This species was also found with high (0.0474) relative abundance in the present collection. Various threats to ecology and fish diversity were also indicated in their report. Qadir *et al*. (2009) conducted a survey on the two tributaries of River Chenab in Pakistan namely Nullah Aik and Nullah Palkhu to assess the distribution of freshwater fish fauna. They collected 1506 fish specimens belonging to 24 species and 12 families. They reported that fish assemblage was relatively stable throughout the year at upstream of Nullah's; however, downstream are severely affected due to various anthropogenic activities. In a recent study on fish diversity of river Chenab conducted by Altaf *et al*. (2015) at the three heads of river and reported 34 species. The highest diversity index was found at Head Qadirabad followed by Khanki and Marala headworks. Their findings did not include these fish species *Nandus nandus*, *Channa striata*, *Channa gachua* and *Colisa laila* from Head Marala which were found in the present collection. Our findings showed that the relative abundance of these fish species is very low in the river.

Fresh water icthyo-diversity has been studied by different researchers in the country. Khan *et al*. (2008) conducted a survey at Chashma (Jhelum) and Taunsa (Indus) to analyze the freshwater fish status. Twenty fish species from Chashma Reservoir and twenty two species from Taunsa Reservoir were collected. Their collection was dominated with native fish species however; exotic fish species such as *Carassius auratus, Ctenopharyngodon idella, Hypopthalmichthys molitrix, Hypopthalmichthys nobilis and Cyprinus carpio* were also reported from these two important freshwater reservoirs. Another study, Mirza *et al*. (2011) reported 51 freshwater fish species from River Jhelum.

Their results showed that the population of a commercially important fish species, *Tor macrolepis* has diminished, while *Oreochromis aureus* an exotic fish has become established. Khan *et al*. (2011) studied the impact of exotic fish species on the native fish fauna of the rivers in Punjab and reported that these alien species has become invasive and are competing with economically important native fish species. Earlier, Iqbal *et al*. (2013) studied population dynamics of *Tor macrolepis* and other commercially high valued species in Attock region. They reported that population of commercial fishes is declining due to various anthropogenic activities. Their finding has supported our results.

## CONCLUSION

River Chenab is an important water body in Pakistan supporting diverse fish fauna and other aquatic biodiversity. Various anthropogenic activities such as pollution, habitat destruction, overfishing, damming and introduction of alien fish species into the river are responsible for declining the population of commercially and economically important fish species in the river. Authorities should take necessary steps to conserve fish fauna by minimizing adverse human activities.

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