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FRESH WATER FISH SPECIES DIVERSITY AT CHASHMA BARRAGE, PAKISTAN

S. Ashraf[1], M. Altaf[2*], A. M. Khan[3], M. S. Haidar[1], N. Amjad[1], A. Naseem[1] and M. S. Khan[1]

[1]Department of Zoology, University of Lahore, Sargodha campus, Sargodha-Pakistan
[2]Department of Forestry, Range and Wildlife Management, The Islamia University of Bahawalpur-Pakistan
[3]Department of Zoology, University of the Punjab, Lahore-Pakistan
Corresponding author's email: altaf_mughal450@yahoo.com

ABSTRACT

Pakistan managed extensive canal irrigation systems and has 19 Ramsar sites. Almost 27,977 fish species are present globally; there are 786 marine and 171 freshwater fishes in Pakistan. Fish diversity and distribution are closely related to various factors i.e. depth of water, availability of food, topography, breeding sites, and physicochemical features. Therefore, it is necessary to study the diversity of ichthyofauna in various regions and elevations. So, this study was planned to examine the fish diversity of Chashma Barrage to include more data related to fish diversity and distribution. Data were collected both by direct (physical count) and indirect methods (meeting with local people of Chashma Barrage) to find out fish diversity of Chashma Reservoir, Mianwali, from April 2016 to March 2017. In the current study, 1089 fish specimens of 21 species were documented from Chashma Barrage monthly. The Shannon-wiener Index (H') was recorded as 2.17, Simpson Index (S) was 0.16, Richness (R) was 20.67 and Evenness (E) was 0.712. It is concluded that study area has high diversity of fishes. Chashma Barrage is an important wetland for fishes, it should be declared as Ramsar site.

Keywords: Freshwater, diversity, fishes, Barrage, fauna.

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INTRODUCTION

It is observed that the largest canal system is present in Pakistan; and almost 225wetlands, out of total only 19areRamsar sites. Pakistan consists of 9.7% wetland area, out of total nearly 26% consist of coastal and 74% consist of freshwater wetland (Altaf *et al.*, 2014). Indus River is the longest river in Pakistan and consists of one dam i.e. Tarbella (the world's largest rock-filled dam) as well as six barrages i.e. i) Jinnah, ii) Chashma, iii) Taunsa, iv) Guddu, v) Sukkur and vi) Kotri (FAO, 2011). Freshwater is a necessary resource for animals alongwith human activities i.e. domestic needs, agriculture and industry (Bartram and Ballance, 1996) and also has importance for the evolution of fauna and flora (Gleick *et al.*, 2002). Freshwater played critical role in human being societies evolution (Gupta and Gupta, 2006).

A total of 27,977 fish species are present in the world, out of this total, 786 marine fishes (Mirza and Alam, 2000) and 171 freshwater fishes (Mirza, 2004) reported from "Pakistan".Froese and Pauly (2014) documented freshwater ichthyofauna species from selected areas of Asia i.e., 1643 from China, 951 from India, 250 from Bangladesh, 277 from Iran and 128 from Afghanistan.

Although many ichthyologists have documented the fish diversity of river Indus(Mirza and Mirza, 2014; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a) and its tributaries (Khan *et al.*, 2011; Altaf *et al.*, 2015; Hussain *et al.*, 2015) as well as Azad Jammu and Kashmir (Altaf, 2021), but there is need more study about fish diversity and distribution. Furthermore, there are many threats to the ichthyofauna of rivers due to deforestation, illegal hunting and poaching, global warming and pollution (Khan *et al.*, 2008; FAO, 2011).

In the world, marine and freshwater fish diversity and habitat are decreasing due to several factors i.e., habitat loss, agriculture intensification, industrial development, urbanization, overexploitation, change in drainage, and water flow through diversion and damming. Fish diversity and distribution are closely related to various factors i.e. depth of water, availability of food, topography, breeding sites, and water physicochemical features. Therefore, it is necessary to observe the diversity of fish in various ecosystems. This study was planned to examine the fish diversity of Chashma Barrage, Pakistan.

MATERIALS AND METHODS

During study data were noted both by direct (i.e., total count) and Indirect (i.e., meetings with local people of study area) methods to find out fish diversity of Chashma Barrage, Mianwali, from April, 2016 to March, 2017.

Fish specimens were collected from the upper and lower side of Chashma Barrage, Mianwali (Figure 1);

using different types of fishnets i.e. hooks, drag nets, cast nets, gill nets and hand nets each month whole year. All fish specimens were preserved in the research laboratory of "Department of Zoology, University of the Lahore, Sargodha campus". All specimen were tagged and identified with the help of standard keys (Mirza, 2004).

Shannon-Weiner Diversity (H'): "Shannon-Weiner Diversity index" was analyzed as (Shannon and Weaver, 1949);

$$"H' = - [\sum P_1 Ln P_1]"$$

Where

H': "Shannon-Weiner Index"

P_i: "Proportion of species / Total no. of species".

Ln P_i: "Natural Logarithm of P_i".

Relative Abundance: We used the following formula to calculate the relative abundance of fish species,

$$R.A\ (\%) = "ni / N"$$

Where 'ni' represents the number of individuals of one species and 'N' represented the total number of individuals of all fish species.

Evenness Index (E): "Evenness Index" was derived by the following formula (Pielou, 1966);

$$Evenness\ Index = "H' / Logn\ (S)"$$

H' is "Shannon-Weiner Index", Logn represents the natural logarithm and S represents the total no of species.

Richness Index (R): "Richness Index" of Chashma reservoir was calculated as(Margalef, 1958);

$$Richness\ Index = "S- 1 / Logn\ (N)"$$

Where 'S' represent the total no. of species, while 'N' represent the total number of individual of all species.

Figure 1. Map of Chashma Barrage.

RESULTS AND DISCUSSION

In the current study, a total of 1089 fish specimens of 21 species were collected from Chashma Lake on a monthly basis (Table 1). During study noted that the highest specimens reported in February (n=158), the highest diversity was noted in December as H'=0.28592 (Table 2). Diversity indices showed that the study area has high diversity (Shannon-Weiner index=2.17) and richness (20.67) (Table 3). Fishing was prohibited in June, July and August according to the Punjab fisheries department rules. The numbers of fish catches were increased from October, November up to January. The maximum catches were observed in December 165, January 153 and February 158 (Table 1).Altaf *et al.* (2015) recorded 34 species and 1766 ichthyofauna specimens from the river Chenab and also reported Shannon diversity indices were 2.83, 2.5 and 2.62 and richness indices were 5.14, 5.02 and 4.77 from head Qadirabad, Khanki and Marala respectively. Hussain *et al.* (2015) recorded the 22 ichthyofauna specimens species and 976 individuals from river Ravi and also documented Shannon diversity indices as 2.749,

2.706 and 2.654, while richness indices as 3.515, 3.421 and 3.27 in 2011, 2012 and 2013 from river Ravi. Khan *et al.* (2008) recorded the twenty ichthyofauna species from the Chashma barrage and also 22 ichthyofauna species noted from the Taunsa barrage. Altaf *et al.* (2011b) documented the 33 ichthyofauna species from the head Qadirabad. While, Khan *et al.* (2011) recorded the 50 ichthyofauna species from the Ravi while 30 ichthyofauna species documented from the river Jhelum.

Table 1: Fish diversity recorded during study period of 2016-2017 from Chashma Reservoir.

Fish specie	Common name	April	May	September	October	November	December	January	February	March	Total	Relative abundance (%)
Cyprinus carpio	Common Carp	14	11	19	18	30	41	29	34	17	**213**	19.5
Labeo rohita	Rohu	8	5	7	11	12	17	14	15	15	**104**	9.55
Cirrhinus mrigala	Mori	0	0	0	2	1	2	2	3	1	**11**	1.01
Cirrhinus reba	Reba Machhali	1	1	1	1	3	4	3	4	3	**21**	1.92
Ctenopharyngodon idella	Grass Carp	2	1	1	1	2	3	3	2	1	**16**	1.46
Labeo gonius	Sareha	27	23	21	23	36	41	39	43	41	**294**	26.99
Labeo calbasu	Kalbans	3	1	0	2	2	4	3	4	1	**20**	1.83
Hypopthalmichthys molitrix	Silver carp	0	0	1	2	3	3	1	2	1	**13**	1.19
Catla catla	Thaila	0	0	0	0	1	1	1		1	**4**	0.36
Carassius auratus	Goldfish	0	0	0	0	1	0	1	0	0	**2**	0.18
Oreochromis aureus	Tilapia	0	0	0	0	0	0	1	1	0	**2**	0.18
Oreochromis mossambicus	Mozambique Machhali	3	2	1	1	4	3	3	4	1	**22**	2.02
Channa punctata	Dola	1	1	2	1	3	6	4	2	4	**24**	2.20
Channa marulius	Soul	2	1	1	2	4	8	5	4	5	**32**	2.93
Sperata sarwari	Sanghari	3	1	3	5	7	11	9	7	6	**52**	4.77
Rita rita	Khagga	0	0	0	1	0	2	1	0	1	**5**	0.45
Eutropiichthys vacha	Jhalli	0	0	0	0	0	0	1	1	0	**2**	0.18
Clupisoma garua	Bachhwa	0	0	0	0	0	0	1	1	0	**2**	0.18
Wallago attu	Malli	26	27	25	20	16	15	25	27	28	**209**	19.19
Mastacembelus armatus	Baam Machhali	4	3	2	4	3	3	5	3	6	**33**	3.03
Notopterus notopterus	But Pari	0	1	0	0	1	1	2	1	2	**8**	0.73
Total		**94**	**78**	**84**	**94**	**129**	**165**	**153**	**158**	**134**	**1089**	**H'=2.17**

Twenty-one species were belonged to 5 orders, belonged to8 families and belonged to14 genera during one year study as shown in (Table1). The overall dominance of fish species by family showed that the Cyprinidae 48% was the most dominating family having ten genera while the family Schilbeidae 10%, Cichlidae 9%, Channidae 9% and Bagridae 9% have two genera with a frequency of 9% in Chashma reservoir. The other three families Siluridae, Mastacembelidae and Notopteridae have a frequency 5% with one genus for each (Figure 2). During the study noted that dominated species of fishes were as; *Labeo gonius, Cyprinus carpio, Wallago attu*, *Labeo rohita*, *Sperata sarwari, Channa marulius, Oreochromis mossambicus*, *Channa punctata, Cirrhinus reba*, *Labeo gonius,* and *Hypopthalmichthys molitrix,* respectively (Table 1). The Shannon-wiener Index of fish fauna at Chashma reservoir was calculated as H'=2.17, while Simpson (S), Richness (R) and Evenness (E) were calculated as 0.16, 0.712767 and 20.67, respectively (Table 2). Altaf *et al.* (2011b) documented the 33 fish species from head Qadirabad. Similarly, Khan *et al.* (2011)reported50 fish species from the Ravi while 30 fish species were listed from river Jhelum. Altaf *et al.* (2015) recorded the total number of species individual which were following Thaila 107, Dola 129, Chirra 89, Keengar 70, Mali 68, Khaga 28, Battu 49, Shinghara 9, Kaan 1, Doli 14, Soli 48, Sol 6, Kalbaso 37, Grass carp 43, Gulfam 53, Mori 22, Rohu 110, Silver 53, Garoj 7, Pari 15, Foji khaga 2 and Singhi 16.Altaf *et al.* (2015) and Altaf *et al.* (2011b) reported the Shannon index as; 1.33 and 3.11 from river Chenab and head Qadirabad, respectively.

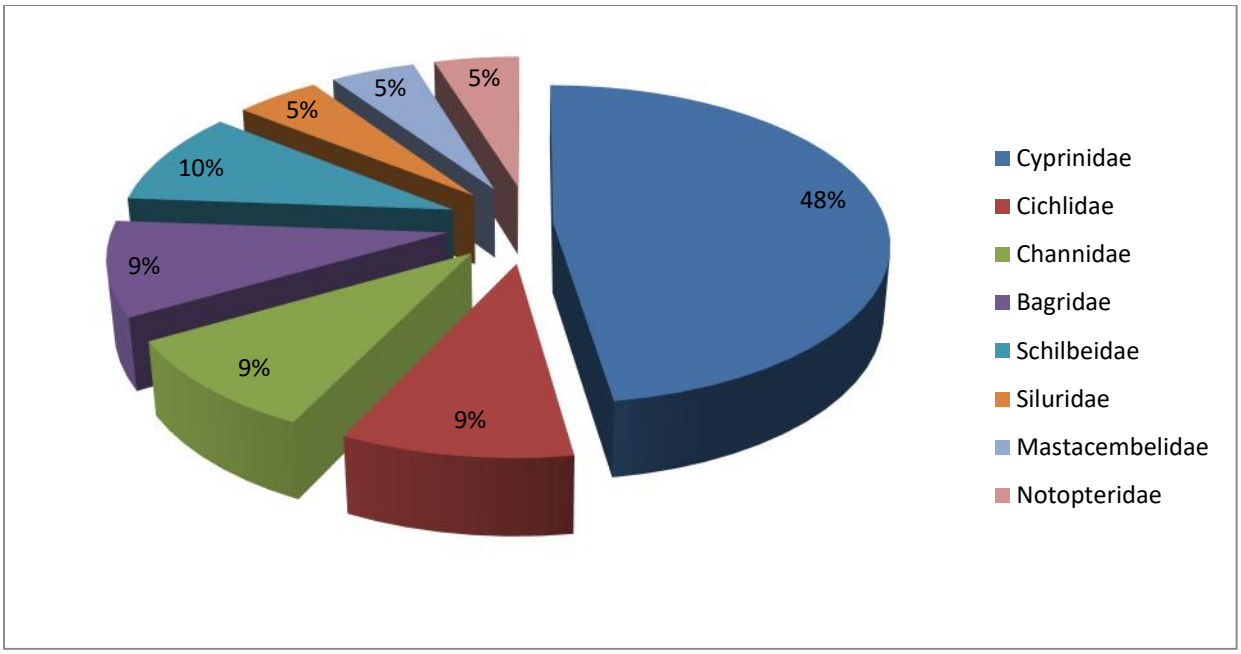

Figure 2: Family wise specie composition of Chashma Reservoir

Common carp *Cyprinus carpio* (n=213) was abundant in the study area (Table 1) and also reported from river Chenab (Altaf *et al.*, 2011a; Altaf *et al.*, 2011b; Altaf *et al.*, 2015; Latif *et al.*, 2016; Muhammad *et al.*, 2017c; Muhammad *et al.*, 2018), Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a), Jhelum (Khan *et al.*, 2008; Mirza *et al.*, 2011), Sutlej (Iqbal *et al.*, 2017), and Ravi (Hussain *et al.*, 2015).

Table 2:Month-wise diversity at fish fauna of Chashma Lake.

Months	N	R	RA	H'	E
April	94	11.7799	8.631772	0.211454	0.017621
May	78	12.77047	7.162534	0.188826	0.014525
September	84	11.77431	7.713499	0.197635	0.01647
October	94	14.7799	8.631772	0.211454	0.014097
November	129	16.79423	11.84573	0.252693	0.014864
December	165	16.80415	15.15152	0.28592	0.016819
January	153	20.80121	14.04959	0.275734	0.01313
February	158	18.80247	14.50872	0.280079	0.014741
March	134	16.79583	12.30487	0.257809	0.015165

Note: N (number of individuals); R (Richness Index); RA (relative abundance); H' (Shannon Index) and E (Evenness Index).

Table 3: Fish diversity of Chashma Reservoir.

Serial Number	Results
No of species (S)	21
Total no of individuals (N)	1089
Shannon-Weiner index (H')	2.17
Simpson Index (S)	0.16
Richness (R)	20.67
Evenness (E)	0.712
Average population size	51.86

Rohu *Labeo rohita*(n=104) was common in study area (Table 1) and also reported from river Chenab (Khan *et al.*, 2008; Mirza *et al.*, 2011; Altaf *et al.*, 2015; Latif *et al.*, 2016; Muhammad *et al.*, 2017c), Indus (Khan *et al.*, 2008; Mirza and Mirza, 2014; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a; Sheikh *et al.*, 2017), Jhelum (Mirza *et al.*, 2011; Mirza and Mirza, 2014), Sutlej (Iqbal *et al.*, 2017) and Ravi (Hussain *et al.*, 2015; Hussain *et al.*, 2017).

Mori *Cirrhinus mrigala* (n=11) was captured from the study area (Table 1) and also reported from river Chenab (Altaf *et al.*, 2011a; Altaf *et al.*, 2011b; Altaf *et al.*, 2015; Muhammad *et al.*, 2017c), Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016), Jhelum, Sutlej (Iqbal *et al.*, 2017) and Ravi (Hussain *et al.*, 2015; Hussain *et al.*, 2017).

Reba Machhali *Cirrhinus reba* (n=21) was observed from the study area (Table 1) and also reported from river Chenab (Altaf *et al.*, 2011b), Indus (Hussain *et al.*, 2016), Jhelum (Mirza *et al.*, 2011; Sheikh *et al.*, 2017), Sutlej (Iqbal *et al.*, 2017) and Ravi (Hussain *et al.*, 2015).Grass Carp *Ctenopharyngodon idella*(n=16)was documented from the study area (Table 1) and also reported from river Chenab (Altaf *et al.*, 2011a; Altaf *et al.*, 2011b; Altaf *et al.*, 2015; Muhammad *et al.*, 2017c), Indus (Khan *et al.*, 2008), Jhelum (Khan *et al.*, 2008) and Ravi (Hussain *et al.*, 2015).

Sareha *Labeo gonius* (2n=94) was abundant in study and also reported from area river Indus (Khan *et al.*, 2008; Hussain *et al.*, 2017; Muhammad *et al.*, 2017a). Kalbans *Labeo calbasu* (n=20)was observed from the study area (Table 1) and also documented from the study area river Chenab (Altaf *et al.*, 2011b), Indus (Khan *et al.*, 2008; Muhammad *et al.*, 2017c), Jhelum (Khan *et al.*, 2008; Mirza *et al.*, 2011), Sutlej (Iqbal *et al.*, 2017) and Ravi (Hussain *et al.*, 2015).

Very few specimens of thaila *Catla catla* (n=4) was captured from the study area (Table 1) and also reported from river Chenab (Altaf *et al.*, 2011a; Altaf *et al.*, 2011b; Altaf *et al.*, 2015; Muhammad *et al.*, 2017c), Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a; Sheikh *et al.*, 2017), Jhelum (Khan *et al.*, 2008; Muhammad *et al.*, 2017c), Sutlej (Iqbal *et al.*, 2017; Muhammad *et al.*, 2017c) and Ravi (Hussain *et al.*, 2015; Hussain *et al.*, 2017; Muhammad *et al.*, 2017c).

Gold fish *Carassius auratus* (n=2) was rare in study area (Table 1) and also reported from river Indus (Khan *et al.*, 2008) and Ravi (Hussain *et al.*, 2015). Tilapia *Oreochromis aureus* (n=2) was also rare in study area ea and also reported from river Chenab (Altaf *et al.*, 2015), Indus (Khan *et al.*, 2008; Muhammad *et al.*, 2017a), Jhelum (Khan *et al.*, 2008; Mirza *et al.*, 2011), Sutlej (Iqbal *et al.*, 2017) and Ravi (Hussain *et al.*, 2015). Specimens of Mozambique machhali *Oreochromis mossambicus* (n=22) was captured from the study area (Table 1) and also reported from River Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a) and Sutlej (Iqbal *et al.*, 2017).

Dola *Channa punctata* (n=24) was documented from the study area (Table 1) and also reported from river Chenab (Altaf *et al.*, 2011b; Altaf *et al.*, 2015), Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a), Jhelum (Khan *et al.*, 2008; Mirza *et al.*, 2011), Sutlej (Iqbal *et al.*, 2017) and Ravi (Hussain *et al.*, 2015). Specimens (n=32) of soul *Channa marulius* were captured from the study area (Table 1) and also reported from river Chenab (Altaf *et al.*, 2011b; Altaf *et al.*, 2015; Muhammad *et al.*, 2017b), Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a; Muhammad *et al.*, 2017b), Jhelum (Khan *et al.*, 2008; Mirza *et al.*, 2011; Muhammad *et al.*, 2017b), Sutlej (Iqbal *et al.*, 2017; Muhammad *et al.*, 2017b) and Ravi (Hussain *et al.*, 2015; Muhammad *et al.*, 2017b).

Sangari *Sperata sarwari* (n=52) was seen from the study area and it was also reported from river Chenab (Altaf *et al.*, 2011b; Altaf *et al.*, 2015), Indus (Khan *et al.*, 2008), Jhelum (Mirza *et al.*, 2011), Sutlej (Iqbal *et al.*, 2017) and Ravi (Hussain *et al.*, 2015).

Very few specimens (n=5) of khaga *Rita rita* were recorded from the study area (Table 1) and khaga was also reported from River Chenab (Altaf *et al.*, 2011b; Altaf *et al.*, 2015), Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016), Jhelum (Mirza *et al.*, 2011), Sutlej (Iqbal *et al.*, 2017) and Ravi (Hussain *et al.*, 2015). Only two specimens of Jhali *Eutropiichthys vacha* and Bachhwa *Clupisoma garua* were documented from the study area (Table 1) and both were also reported from river Chenab (Altaf *et al.*, 2011b; Altaf *et al.*, 2015), Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a), Jhelum (Khan *et al.*, 2008; Mirza *et al.*, 2011), Sutlej (Iqbal *et al.*, 2017) and Ravi (Hussain *et al.*, 2015).

Mali *Wallago attu* (2=09) was abundant in study area (Table 1) and mali was also reported from river Chenab (Altaf *et al.*, 2011b; Altaf *et al.*, 2015), Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a), Jhelum (Khan *et al.*, 2008; Mirza *et al.*, 2011), Sutlej (Iqbal *et al.*, 2017) and Ravi (Hussain *et al.*, 2015). Baam Machhali *Mastacembelu sarmatus* (n=33) was documented from the study area (Table 1) and also reported from river Chenab (Altaf *et al.*, 2011b; Altaf *et al.*, 2015), Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a), Jhelum (Khan *et al.*, 2008) and Sutlej (Iqbal *et al.*, 2017).

But Pari *Notopterus Notopterus* (n=8) was noted from the study area (Table 1) and also reported from river Chenab (Altaf *et al.*, 2011b; Altaf *et al.*, 2015), Indus (Khan *et al.*, 2008; Hussain *et al.*, 2016; Muhammad *et al.*, 2017a), Jhelum (Khan *et al.*, 2008), Sutlej (Iqbal *et al.*, 2017) and Sutlej (Iqbal *et al.*, 2017).

It is concluded that study area has high diversity of fishes. Chashma Barrage is an important wetland for many aquatic species especially fishes, it should be declared as Ramsar site.

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