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Research Paper

Biodiversity, Richness and Evenness of freshwater fish species at Chashma barrage Mianwali, Punjab, Pakistan

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Abstract:

Fish represent an astonishing symphony of evolutionary adaptation. As the most diverse group of vertebrates on Earth, they inhabit a breathtaking range of aquatic realms, from sun-drenched coral reefs to the lightless abyssal plains. Biological diversity is defined by variations in physiology, morphology, and habitat among organisms. Diversity of fish varies according to the various sites at Chashma barrage. A variation occurs in species of the different sites. The weekly survey basis data was conducted from the Chashma barrage site and Kundian site by the physical method using caste and drag nets. Data was also collected by local fisher man by indirect method to identify fish species. A total five-month data collected from Auguest to December 2022. Total of 758 fish specimens were collected from two different sites for the comparative analysis of species. The Shannon-Weiner index of all months was (H') 3.12Species Richness (R) was 30 and Evenness (H/S) was 0.91 while in the site 2 Kundian was 754 specimems. Shannon diversity was (3.15) species Richness was (30) and Evenness (0.92). It was concluded that main Chashma barrage was highly rich in species and diversity among this area is also high.

Keywords: Biodiversity, barrage, fishes, morphology, aquatic realms, vertebrates

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Introduction:

Fish is considered as one of the major sources of protein and is nutritionally rich diet. It is the most diverse and important fundamentals that are playing an important role in the wealth of several counties (Khan et al., 2020). In Pakistan there is both fresh and marine water resources which is enough for high seafood production and can rise the economy of country. There are about 193 freshwater fish species in Pakistan, many of them are economically and commercially important species. On the basis of morphology fish is one of the diverse groups which can inhabit several habitats (Laghari, 2018).

It is important to study the diversity and distribution of fishes, because it gives us knowledge about the biodiversity of an area. Many different fish species inhabit different water habitat on the planet earth (Mamilov et al., 2021).

The relative abundance and composition of fish species may vary due to environmental fluctuation and seasonal variation. Several aquatic ecosystems have been altered completely due to construction of dams on river water which consequently influence the migration of some fish species (Zhou et al., 2019).

It is important to emphasize that freshwater fish have a primary role to play in addressing 'hidden hunger'. Fish in freshwater provide several important benefits to humans, including pest control, biomedical research, and a sense of connection to nature. As a food source, wild and farmed fish are the most commonly used. As a nutritional source, it provides protein, calcium, omega-3 fatty acids, vitamin A, vitamin D, vitamins B, lysine, iron and zinc when other nutritional sources are unobtainable or extremely costly (Radinger et al., 2019).

The actual failure in the diversity and distribution of various freshwater fishes is due to several factors such as loss of habitat, pollution, industrial wastes, saltation, diseases, illegal hunting, water abstraction, exotic species introduction and exploitation etc. (Lamothe et al., 2018).

Chashma barrage is located on Indus river (largest river) in district Mianwali, Punjab Pakistan. It is important due to its unique beauty, it is considering the home of fish and bird's fauna. It is important wetland due to its important characteristics and territory of many migratory birds. Very limited studies on ichthyfauna are conducted in Chashma barrage and some sites are not yet explored. So, the current study is important to explore many hidden fish diversity and distribution of Chashma barrage Current study aimed to explore the diversity and distribution of ichthyo-fauna of Chashma barrage

Material and Methods

Study Area and Data Collection

A weekly fish survey was conducted at the Chashma Barrage from August to December 2022. Local fishermen assisted in the study by identifying optimal sampling areas within the barrage. Over this five-month period, a total of 758 fish specimens were collected.

Sampling Technique

Sampling was carried out between 8:30 AM and 1:30 PM using various nets. A cast net (throw net) was employed to capture fish species, while a drag net was deployed along the riverbed to collect smaller specimens. All collected samples were preserved in the Department of Zoology, Minhaj University, Lahore, for further analysis.

Species Identification and Diversity Analysis

Fish species were identified using standard dichotomous keys. To quantify biodiversity, three key indices were calculated:

Shannon-Wiener Index (H'): This measures species diversity, incorporating both richness and evenness. It was calculated using the formula: $H' = -\sum(pi * \ln(pi))$, where pi is the proportion of individuals belonging to species *i* (Shannon and Wiener, 1963).

Species Richness (SR): This represents the total number of species present in a sample, calculated using Margalef's index: $SR = (S - 1) / \ln(N)$

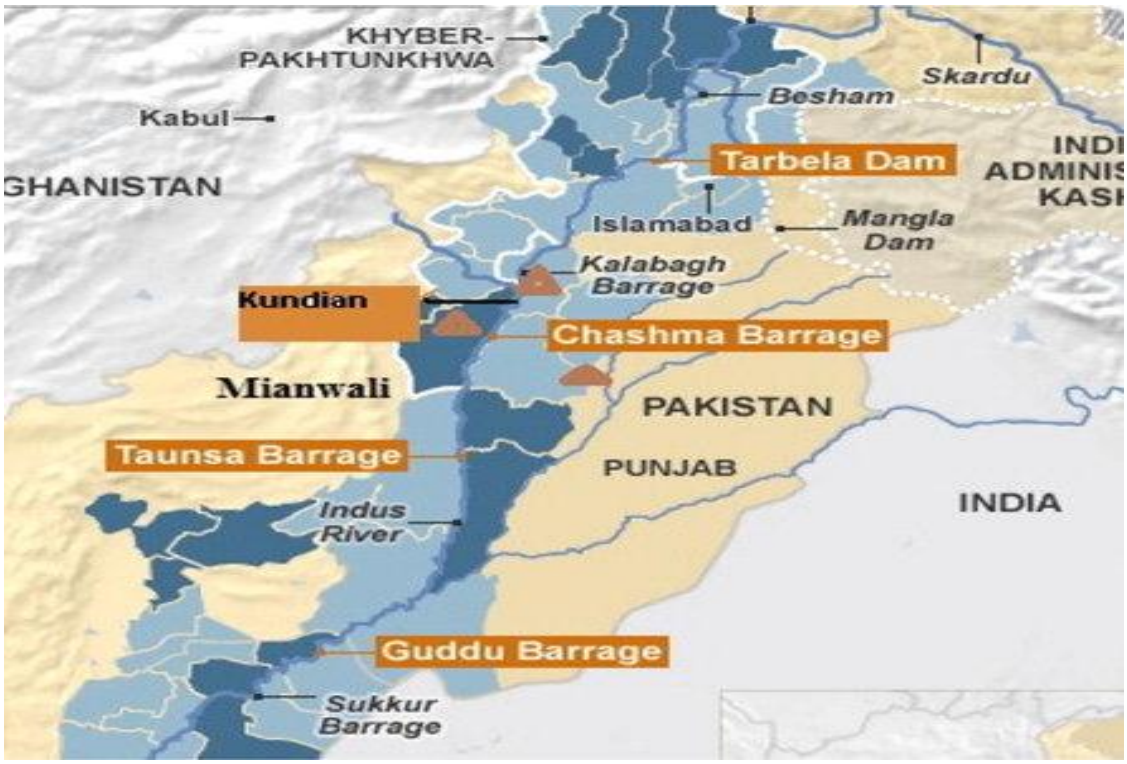

Fig.1. Map of Chashma Barrage

Results and Discussion

In the current study total of 758 specimens were collected total of fish species were 30 and total five months data was collected which showed that in October month higher number of specimens (175) was recorded and in month of November maximum diversity of fish specimens was (170). In the months of August and September the diversity of fishes was low which was (123).

Further, findings revealed that in site 1 the large number of fish species of about 27 in each was found during three months including August, November and December. However, in other two

months such as September and October a total number of fish species were 25 in each. The trend of number of species in each month was August, November and December > September and October.

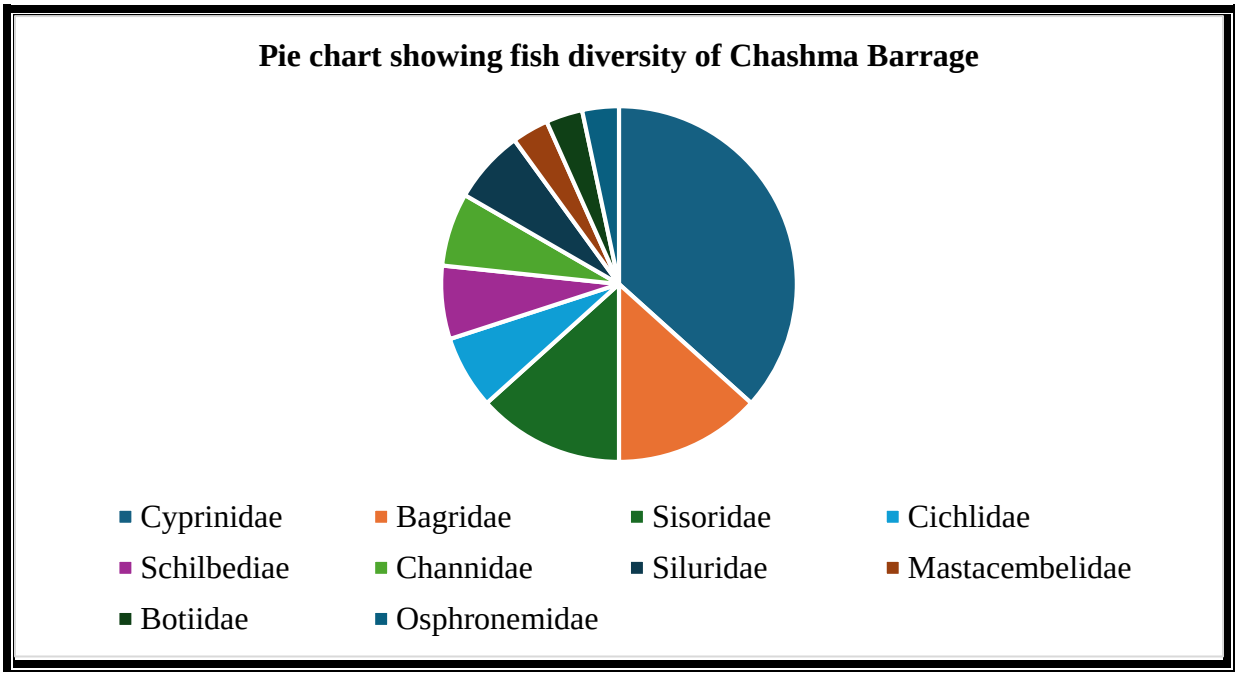

Fig. 2: Diversity of fish families of Chashma Barrage

Table 1. Diversity of fishes in Chashma barrage site and Kundian site of barrage

Family	Species	Site 1	Site 2
Cyprinidae	*Cyprinus carpio*	64	66
	Cirrhinus mrigala	60	55
	Catla catla	72	65
	Labeo rohita	64	62
	Cirrhinus reba	25	24
	Hypophthalmichthys molitrix	37	32
	Labeo calbasu	13	14
	Ctenopharyngodon idella	24	24
	Puntius chola	13	15
	Labeo gonius	10	9
	Barbodes sarana	7	15
Bagridae	*Rita rita*	29	19
	Mystus bleekeri	11	10
	Mystus vittatus	13	12
	Sperata seenghala	15	14
Sisoridae	*Glyptothorax punjabensis*	22	26
	Bagarius bagarius	14	24

	Sisor rabdophorus	11	7
	Glyptothorax cavia	6	3
Cichlidae	*Oreochromis aureus*	31	22
	Oreochromis niloticus	65	77
Schilbediae	*Clupisoma garua*	4	25
	Eutropiicthys vacha	3	12
	Channa marulius	11	9
Channidae	*Channa punctuata*	17	18
Siluridae	*Ompok bimaculatus*	17	14
	Wallago attu	39	31
Mastacembelidae	*Mastacembelus armatus*	16	17
Botiidae	*Botia birdi*	26	17
Osphronemidae	*Colisa lalia*	19	16
Total		758	754
Total species			

Table 2: Diversity indices of species collected from site 1

Index	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***	***Total***
No. of specimens	123	123	175	170	167	758
Shannon's diversity (H')	3.06	2.95	2.96	3.00	0.18	3.12
Species Richness (S)	27	25	25	27	27	30
Evenness (H/S)	0.92	0.91	0.92	0.91	0.05	0.91

Table 3: Diversity indices of species collected from site 2

Index	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***	***Total***
No. of specimens	155	164	153	145	137	754
Shannon's diversity (H')	3.00	3.07	2.99	3.06	2.96	3.15
Species Richness (S)	28	28	25	25	27	30
Evenness (H/S)	0.90	0.92	0.93	0.95	0.89	0.92

Table 4: Comparison between ichthyfauna of site 1 and 2

S.NO.	***Parameters***	***Site 1***	***Site 2***
1	No. of specimens	758	754
3	Shannon's diversity (H')	3.12	3.15
4	Species Richness (S)	30	30
5	Evenness (H/S)	0.91	0.92

After comparative analysis of fish fauna explored at site 1 and site 2 of Chashma Barrage, it was found that the total number of specimens collected at site 1 was 758 which is comparatively higher as compared to site 2 of having about 754 specimens recorded during the five month surveys to barrage. In addition, the number of species observed after proper identification by using different morphometric tools and taxonomic keys the findings revealed that in both sites high species diversity of about 30 species was found, so the richness of the species on both sites was 30. Moreover, comparatively, Shannon diversity and Evenness of species of site 2 was higher as compared to site 1.

It was found that the total number of 10 fish families were recorded from both sites of Chashma Barrage which representing the fish fauna diversity. The family Cyprinidae can be clearly viewed of having large number of fish species as compared to all other families. Followed by the other two families such as family Bagridae and Sisoridae It was found that the least number of fish species were recorded of the last three families including (Mastacembelidae, Botiidae and Osphronemidae).

Furthermore, the values Shannon diversity index, Species Richness and Evenness at site 1 of the barrage was 3.12, 30 and 0.91 respectively. While in site it was 3.15, 30 and 0.92 respectively. However, after comparative analysis of both sites the Shannon diversity index of site 1 was lower as compared to site 2. The species richness both sites were same. Moreover, the Evenness of the species in site 1 was also lower than site 2.

The findings of our study revealed that the family Cyprinidae was the dominant family in Chashma Barrgae which is according to the study carried out by Abro et al. (2020), who studied fish fauna of Freshwater diversity in the Sindh province section of the Indus River. Other studies also obey the findings of the current study such as Muhammad, Iqbal and Saleemi (2018). They carried out research on Taunsa Barrage to explore their fish fauna which is located on the Indus River of Pakistan. Their results revealed that the large number of species was observed in the family Cyprinidae followed by Bagridae. Moreover, the findings of Shannon diversity index, species richness and Evenness was also according to the results of this study and the study conducted by Zaidi Zona, Ahmad and Zainab (2022) who evaluated the fish diversity of Upper Indus River basin.

Conclusion

An analysis of the fish fauna of the Chashma Barrage on the Indus River has been undertaken in this study to provide an insight into its biodiversity and distribution pattern. It has been demonstrated that the fish diversity of the Chashma Barrage of Indus River was high at the local level, but it is however poor in comparison to other main rivers of Asia, including the Mekong, Hwang Ho, Ganges, Yangtaz, Brahamputra and Salween. Fish diversity in the Indus appears to be primarily affected by its flow through gorges, high sediments, pollution etc. Indus River fish populations and biodiversity was in decline at Chashma Barrage. Overfishing and illegal fishing place a great deal of stress on commercial species. An alarming threat to the local species population has been posed by the establishment of three exotic species (O. aureus, O. mossambicus and R. rita). The number of specimen's month wise were different, in addition the dominant family recorded in both sites was family Cyprinidae and Bagridae and Sisoridae, while the least number of fish species was found in the families such as Mastacembelidae, Botiidae and Osphronemidae.

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