Article

Ichthyofaunal diversity and conservation status in rivers of Khyber Pakhtunkhwa, Pakistan

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Abstract

Ichthyofaunal composition is the most important and essential biotic component of an aquatic ecosystem. There is worldwide distribution of fresh water fishes. Pakistan is blessed with a diversity of fishes owing to streams, rivers, dams and ocean. In freshwater bodies of the country about 193 fish species were recorded. There are about 30 species of fish which are commercially exploited for good source of proteins and vitamins. The fish marketing has great socio economic value in the country. Unfortunately, fish fauna is declining at alarming rate due to water pollution, over fishing, pesticide use and other anthropogenic activities. Therefore, about 20 percent of fish population is threatened as endangered or extinct. All Mashers are 'endangered', notably *Tor putitora*, which is also included in the Red List Category of International Union for Conservation of Nature (IUCN) as Endangered. Mashers (Tor species) are distributed in Southeast Asian and Himalayan regions including trans-Himalayan countries like Pakistan and India. The heavy flood of July, 2010 resulted in the minimizing of *Tor putitora* species Khyber Pakhtunkhwa and the fish is now found extinct from river Swat. The purpose of this review study is to explore the fish diversity and its conservation status in rivers of Khyber Pakhtunkhawa and protect the endangered species of fishes like *Tor putitora* from extinction. There are fourteen major rivers flowing in the province Khyber Pakhtunkhwa which are river Siren, river Kunhar, river Indus, river Harrow, river Dour, river Kabul, river Swat, river Panjkora, river Arunai, river Darmai, river Etai, river Chamla, river Barandu and river Bahawal Garh. A total of Sixty eight species of fresh water fishes were recorded from 14 rivers of the province. The family cyprinidae is the dominant family of Khyber Pakhtunkhwa which contains 34 species. The current review study will help the ichthyologists and conservationists in future for detailed investigations and conservation strategies for fish fauna of the region.

Keywords ichthyodiversity; anthropogenic activities; *Tor putitora*; Cyprinidae; conservation; Khyber Pakhtunkhwa.

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1 Introduction

The purpose of this review study is to explore the ichthyo faunal diversity of Khyber Pakhtunkhwa, its conservation status and protective measures to conserve fish species of the region especially those fishes which are only present in the region and also those species which are globally endangered and becoming extinct. Ichthyodiversity is a scientific term which is used for fish diversity or referred to the variety of fish species (Burton et al., 1992). Fishes are the most important, diverse and essential biotic component of an ecosystem and provide directly or indirectly services to human welfare. Fishes are considered as important because they are rich source of proteins, vitamins and minerals for human diet (Usman et al., 2017a). Fishes are also vital for providing income and employment to millions of people across the world (Usman et al., 2017a). Globally there have been reported 8,411 fresh water fish species. Out of which 930 fish species were recorded from Indian fresh water bodies (Shinde et al., 2009). Freshwater fishes live in these water bodies cover 41% of fishes and 20% of vertebrates (Helfman et al., 2009). Pakistan harbors a diversity of fishes due to streams, rivers, dams and ocean. About 179 fresh water fish species have been noted from Pakistan, which belong to 5 super orders, 10 orders, 26 families, and 82 genera (Mirza and Bhatti, 1999). According to Rafique and Khan (2012), there are 193 freshwater fish species in Pakistan. Butt (1986) reported 94 species of fishes from the whole province of Khyber Pakhtunkhwa. There are 28 fish species listed as inhabiting cold waters of Pakistan, Most of the snow trout are restricted to the Trans-Himalayan region of the Indus system (Saeed et al., 2013). There are about 30 fish species which are commercially exploited such as *Tor macrolepi*s, *Cirrhinus mrigal*a, *Cirrhinus reba*, *Labeo rohita*, *Gibelion catla*, *Clupisomanaziri*, *Channastraita*, *Channa marulius*, *Speratasarwari*, *Rita rita*, *Bagarius bagarius*, *Notopterus notopterus*, *Nemacheilus* spp., *Tenualosa ilisha*, *Schizothorax* spp., and *Wallago attu* (Usman et al., 2018a).

Ichthyodiversity is adversely affected by various factors like water pollution, over hunting, diversion of rivers and construction of dams which create hurdles in the migration of fishes from nestling zone to feeding zone. As regards the conservation status of the global freshwater fishes is concerned it has been assessed that 20% of freshwater fish species are mentioned either endangered or became extinct (Postle, 2002).

All Mahseers are unfortunately 'endangered', notably *Tor putitora*, which is now included in the Red List Category as Endangered by International Union for Conservation of nature (IUCN) (Khan and Sihna, 2000). Ecologically, Mahseers (Tor species) are distributed in Southeast Asian countries like Thailand, Malaysia, Vietnam, Cambodia, and Himalayan regions including trans-Himalayan countries like Pakistan, India, Myanmar and Nepal (Akhter et al., 2016). Habitat destruction and alteration remain main causes of freshwater fish diversity loss. Diverse factors like constantly increasing temperatures, lower precipitation and greater water loss from the water bodies for agriculture and other human uses may be the cause of the decline in freshwater fish diversity (Alcamo et al., 2003). In Pakistan great disturbance in fish habitat occurred by heavy flood in July 2010 which resulted in the lessening of fish fauna especially *Tor putitora* fish. It has been observed that after this havoc the numbers of this species gradually diminishing in the rivers of Swat (Akhter et al., 2016). *Tor putitora* was declared extinct locally in the river of Swat by the study of Akhter et al. (2016). A limited number of reviews have been done in Pakistan such as Bibi et al. (2018) recorded 82 freshwater fish species in nature reserves of Southern Punjab, Pakistan.

2 Study Area and Methodology

Peer reviewed research papers and project reports published up to 2019 regarding freshwater fish diversity, distribution and conservation status in rivers of KP, Pakistan, were selected. These papers were searched by using the key words like ichthyodiversity, freshwater fishes, distribution and conservation in different electronic databases such as Google Scholar, Science Citation Index, Scopus, Science Direct, Academia,

Elsevier, Springer Link, and Zoological Record. Searched results in which the diversity of freshwater fish in rivers of Khyber Pakhtunkhawa was mentioned were consulted for this review study.

In this review fourteen rivers of KP, Pakistan were focused through literature survey. Total area of the region is 101,741 km^2 and comprises seven divisions: Bannu, Dera Ismail Khan, Hazara Division, Kohat, Mardan, Malakand and Peshawar (Fig. 1).

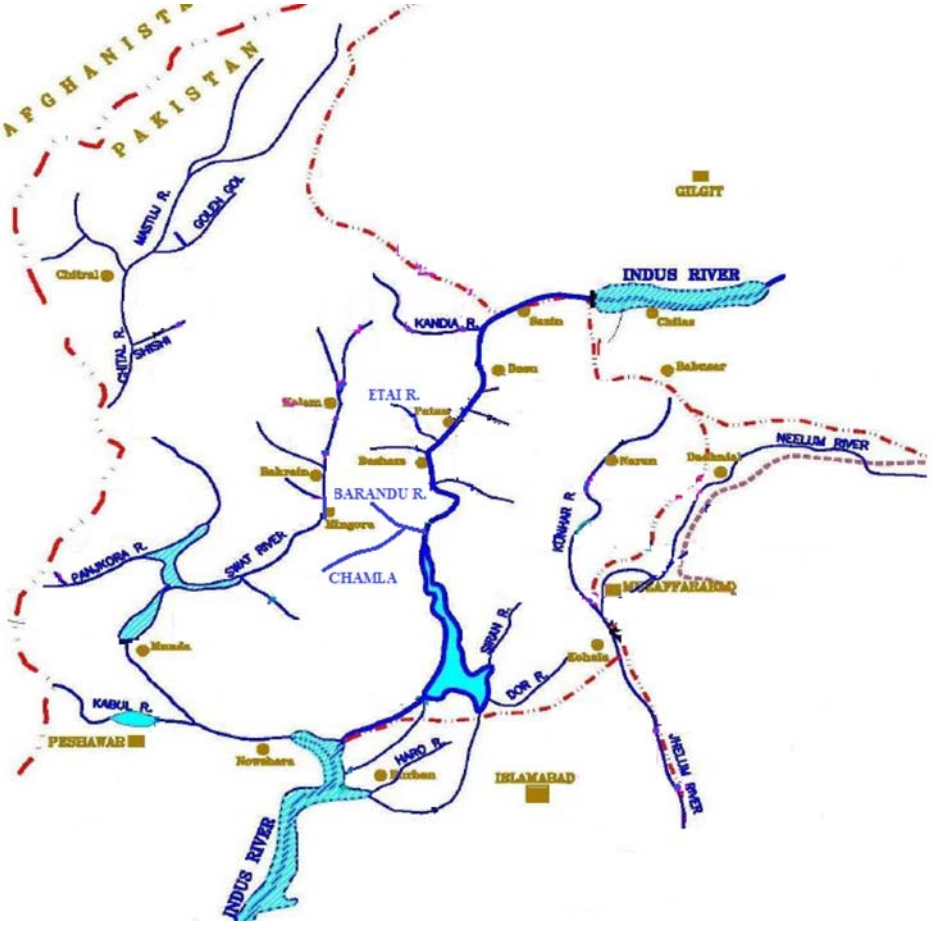

Fig. 1 Map of KP, Pakistan (Source WAPDA).

3 Results

The results for fresh water fish diversity are given in Table 1 and Figs 2 to 4.

Table 1 Taxonomic fresh water diversity in rivers of KP, Pakistan.

S.No	Zoological Name	Common Name	Family	Order	Class
1	*Amblypharyngodon mola*	Mola carplet	Cyprinidae	Cypriniformes	Actinopterygii
2	*Barilius modestus*	Chalwa	Cyprinidae	Cypriniformes	Actinopterygii
3	*Barilius Pakistanicus*	Pakistani Chalwa	Cyprinidae	Cypriniformes	Actinopterygii
4	*Barilius vagra*	Chalwa	Cyprinidae	Cypriniformes	Actinopterygii
5	*Carassius auratus*	Gold fish	Cyprinidae	Cypriniformes	Actinopterygii
6	*Catla catla*	Thaila	Cyprinidae	Cypriniformes	Actinopterygii

7	*Cirrhinus marigala*	Mori	Cyprinidae	Cypriniformes	Actinopterygii
8	*Crossocheilus diplocheilus*	Dogra machli	Cyprinidae	Cypriniformes	Actinopterygii
9	*Crossocheilus latius*	Minor carp	Cyprinidae	Cypriniformes	Actinopterygii
10	*Ctenopharyngodon idella*	Grass carp	Cyprinidae	Cypriniformes	Actinopterygii
11	*Cyprinion watsoni*	Sabzak	Cyprinidae	Cypriniformes	Actinopterygii
12	*Cyprinus carpio*	Common carp	Cyprinidae	Cypriniformes	Actinopterygii
13	*Garra gotyla*	Pathar Chat	Cyprinidae	Cypriniformes	Actinopterygii
14	*Hypophthalmichthys moltrix*	Silver carp	Cyprinidae	Cypriniformes	Actinopterygii
15	*Hypophthalmichthys nobilis*	Big Head carp	Cyprinidae	Cypriniformes	Actinopterygii
16	*Labeo caeruleus*	Sind labeo	Cyprinidae	Cypriniformes	Actinopterygii
17	*Labeo diplostomus*	Pahari Raho	Cyprinidae	Cypriniformes	Actinopterygii
18	*Labeo rohita*	Raho	Cyprinidae	Cypriniformes	Actinopterygii
19	*Labeo dyocheilus*	Boalla	Cyprinidae	Cypriniformes	Actinopterygii
20	*Orienus plagiostomus*	Aselghay	Cyprinidae	Cypriniformes	Actinopterygii
21	*Puntius chola*	Chola barb	Cyprinidae	Cypriniformes	Actinopterygii
22	*Puntius conchonius*	Rosy barb	Cyprinidae	Cypriniformes	Actinopterygii
23	*Puntius sarana*	Olive barb	Cyprinidae	Cypriniformes	Actinopterygii
24	*Puntius sophore*	Pool barb	Cyprinidae	Cypriniformes	Actinopterygii
25	*Puntius ticto*	Ticto barb	Cyprinidae	Cypriniformes	Actinopterygii
26	*Rasbora daniconius*	Slender rasbora	Cyprinidae	Cypriniformes	Actinopterygii
27	*Salmophasia bacaila*	ND	Cyprinidae	Cypriniformes	Actinopterygii
28	*Salmophasia punjabensis*	Punjabi Chal	Cyprinidae	Cypriniformes	Actinopterygii
29	*Schizothorax esocinus*	Chirruh snowtrout	Cyprinidae	Cypriniformes	Actinopterygii
30	*Schizothorax labiatus*	Kunar snowtrout	Cyprinidae	Cypriniformes	Actinopterygii
31	*Schizothorax plagiostomus*	Hill trout	Cyprinidae	Cypriniformes	Actinopterygii
32	*Schizothorax progastus*	Dinnawah snow trout	Cyprinidae	Cypriniformes	Actinopterygii
33	*Tor macrolepis*	Indus golden mahseer	Cyprinidae	Cypriniformes	Actinopterygii
34	*Tor putitora*	Mahseer	Cyprinidae	Cypriniformes	Actinopterygii
35	*Acanthocobitis botia*	Mottled loach	Nemachilidae	Cypriniformes	Actinopterygii
36	*Paraschistura sargadensis*	Kessler's loach	Nemachilidae	Cypriniformes	Actinopterygii
37	*Schistura alepidota*	ND	Nemachilidae	Cypriniformes	Actinopterygii
38	*Schistura macrolepis*	ND	Nemachilidae	Cypriniformes	Actinopterygii
39	*Schistura nalbanti*	Rawlakot loach	Nemachilidae	Cypriniformes	Actinopterygii
40	*Schistura prashari*	ND	Nemachilidae	Cypriniformes	Actinopterygii
41	*Schistura punjabiansis*	Punjab loach	Nemachilidae	Cypriniformes	Actinopterygii
42	*Triplophysa kashmirensis*	Triplophysa loach	Nemachilidae	Cypriniformes	Actinopterygii
43	*Triplophysa microps*	Leh Triplophysa loach	Nemachilidae	Cypriniformes	Actinopterygii
44	*Triplophysa naziri*	ND	Nemachilidae	Cypriniformes	Actinopterygii
45	*Triplophysa choprai*	ND	Balitoridae	Cypriniformes	Actinopterygii
46	*Gagata cenia*	Indian gagata	Sisoridae	Siluriformes	Actinopterygii
47	*Gagata pakistanica*	Sanglai	Sisoridae	Siluriformes	Actinopterygii
48	*Glyptothorax armeniacus*	Armenian mountain catfish	Sisoridae	Siluriformes	Actinopterygii

49	*Glyptothorax cavia*	Cat fish	Sisoridae	Siluriformes	Actinopterygii
50	*Glyptothorax naziri*	Naziri catfish	Sisoridae	Siluriformes	Actinopterygii
51	*Glyptothorax punjabensis*	Paharhi khaga	Sisoridae	Siluriformes	Actinopterygii
52	*Glyptothorax stocki*	ND	Sisoridae	Siluriformes	Actinopterygii
53	*Glyptothorax sufii*	Sulemani khagga	Sisoridae	Siluriformes	Actinopterygii
54	*Mystus bleekeri*	Bleekeri tingara	Bagridae	Siluriformes	Actinopterygii
55	*Rita rita*	Khaga	Bagridae	Siluriformes	Actinopterygii
56	*Sperata sarwari*	Sanghari	Bagridae	Siluriformes	Actinopterygii
57	*Clupisoma garua*	Garua bachwa	Schilbeidae	Siluriformes	Actinopterygii
58	*Clupisoma naziri*	Naziri bachwa	Schilbeidae	Siluriformes	Actinopterygii
59	*Ompok pabda*	Mountain pafta	Siluridae	Siluriformes	Actinopterygii
60	*Wallago attu*	Malee	Siluridae	Siluriformes	Actinopterygii
61	*Channa gachua*	Dauli	Channidae	Chaniformes	Actinopterygii
62	*Channa punctate*	Daula	Channidae	Chaniformes	Actinopterygii
63	*Oncorhynchus mykiss*	Rainbow trout	Salmonidae	Salmoniformes	Actinopterygii
64	*Salmo trutta*	Brown trout	Salmonidae	Salmoniformes	Actinopterygii
65	*Xenentodon cancila*	Needle fish	Belonidae	Beloniformes	Actinopterygii
66	*Chanda nama*	Elongate glass-perchlet	Ambassidae	Perciformes	Actinopterygii
67	*Oreochromis mossambicus*	Tilapia	Chichlidae	Perciformes	Actinopterygii
68	*Mastacembelus armatus*	Spiny eel	Mastacembelidae	Mastacembeliformes	Actinopterygii
Total	*68*		13	7	1

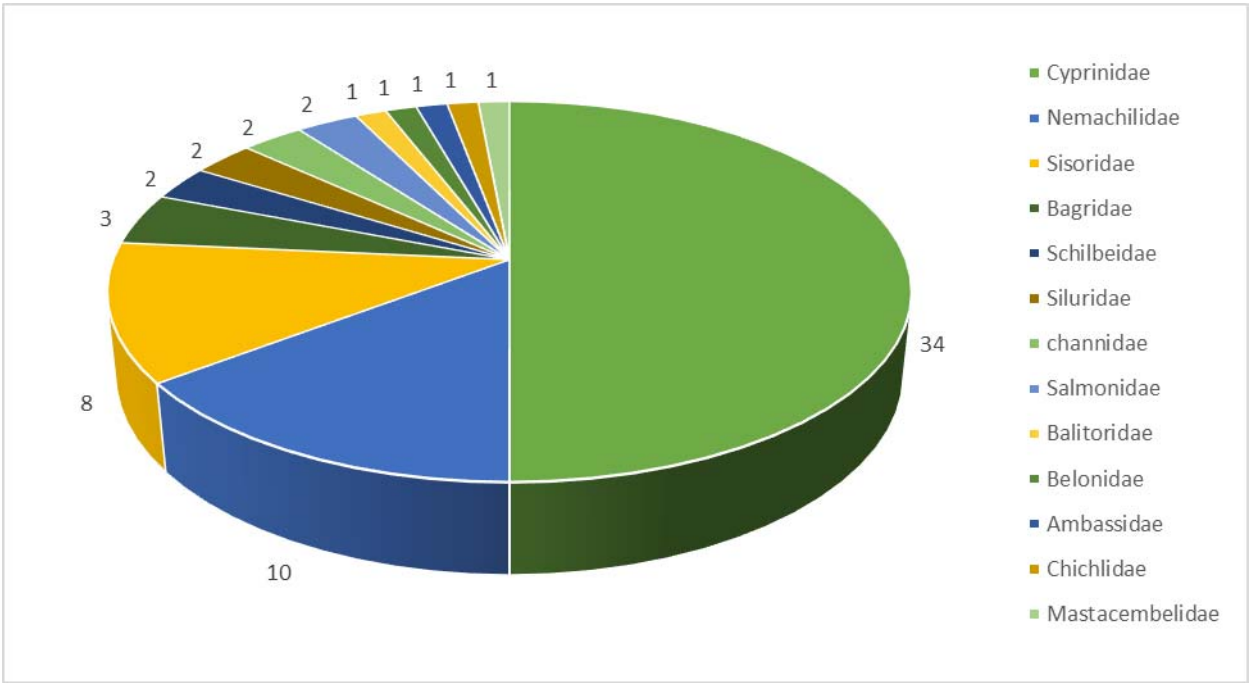

Fig. 2 Comparison of species number among different fish families found in Khyber Pakhtunkhwa, Pakistan.

Distribution of fresh water fishes in fourteen different rivers of Khyber Pakhtunkhawa, and their conservation status is given in Table 2 and Fig. 3-4.

Table 2 Distribution and conservation status of fishes in the rivers of KP, Pakistan (+ =Reported, - =Not Reported, DD=Data deficient, NE=Not evaluated, VU=Vulnerable, EN=Endangered, NT=Near threatened, LC=Least concern).

S. No	Zoological Name	Siren	Kunhar	Indus	Harrow	Dour	Kabul	Swat	Panjkora	Arunai	Darmai	Etai	Chamla	Barandu	Bahawalgarh	Conservation Status
1	*A. mola*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	**LC**
2	*B. modestus*	-	-	-	-	-	+	+	-	+	-	-	-	-	-	**NE**
3	*B. pakistanicus*	+	-	+	-	-	+	+	+	+	+	+	+	+	-	**NE**
4	*B. vagra*	+	-	+	-	-	+	+	+	-	-	-	-	-	-	**LC**
5	*C. auratus*	-	-	-	-	-	+	+	+	-	-	-	-	-	-	**LC**
6	*C. catla*	+	-	+	+	+	-	-	-	-	-	-	-	-	-	**LC**
7	*C. marigala*	+	-	+	+	+	+	+	-	+	-	-	-	-	-	**LC**
8	*C. diplocheilus*	+	-	-	-	-	+	+	+	+	-	-	-	+	-	**NE**
9	*C. latius*	-	-	-	-	-	-	-	-	+	-	-	-	+	-	**LC**
10	*C. idella*	-	-	-	-	-	-	-	+	-	-	-	-	-	+	**NE**
11	*C. watsoni*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	**LC**
12	*C. carpio*	+	-	+	+	+	+	+	+	+	-	-	-	-	-	**VU**
13	*G. gotyla*	+	+	+	+	-	+	+	+	+	-	+	+	+	-	**LC**
14	*H. moltrix*	+	-	+	+	+	+	-	-	-	-	-	-	-	-	**NT**
15	*H. nobilis*	+	-	+	-	-	-	-	-	-	-	-	-	-	-	**DD**
16	*L. caeruleus*	+	-	+	+	+	-	-	-	-	-	-	-	-	-	**NE**
17	*L. diplostomus*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	**LC**
18	*L. rohita*	+	-	+	+	+	+	+	-	+	-	-	-	-	-	**LC**
19	*L. dyocheilus*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	**LC**
20	*O. plagiostomus*	-	-	-	-	-	+	-	+	-	+	-	-	-	-	**NE**
21	*P. chola*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	**LC**
22	*P. conchonius*	-	-	-	-	-	-	+	-	-	-	-	-	-	+	**LC**
23	*P. sarana*	-	-	-	-	-	-	-	-	+	-	-	-	-	-	**LC**
24	*P. sophore*	+	-	+	+	-	+	+	-	+	-	-	+	+	-	**LC**
25	*P. ticto*	+	-	+	+	-	+	+	-	-	-	-	-	+	-	**LC**
26	*R. daniconius*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	**LC**
27	*S. bacaila*	-	-	-	-	-	-	+	-	+	-	-	-	-	-	**LC**
28	*S. punjabensis*	-	-	-	-	-	-	+	-	+	-	-	-	+	-	**NE**
29	*S. esocinus*	+	+	+	-	-	-	-	+	-	+	-	-	-	-	**NE**
30	*S. labiatus*	+	+	+	-	-	-	+	+	-	-	-	-	-	-	**NE**
31	*S. plagiostomus*	+	+	+	+	+	-	+	+	+	+	+	-	+	-	**NE**
32	*S. progastus*	-	-	-	-	-	-	-	-	+	-	-	-	-	-	**LC**
33	*T. macrolepis*	-	-	-	-	-	+	+	+	-	-	-	-	+	-	**NE**
34	*T. putitora*	+	-	+	-	-	-	-	+	-	-	+	+	+	-	**EN**
35	*A. botia*	-	-	-	-	-	+	+	-	-	-	-	-	-	-	**LC**
36	*P. sargadensis*	-	-	-	-	-	-	-	-	+	-	-	-	-	-	**NE**
37	*S. alepidota*	-	-	-	-	-	-	+	+	-	+	-	-	-	-	**NE**
38	*S. macrolepis*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	**NE**
39	*S. nalbanti*	+	-	+	-	-	-	-	-	-	-	-	-	-	-	**NE**
40	*S. prashari*	-	-	-	-	-	-	+	+	-	-	-	-	-	-	**NE**
41	*S. punjabiansis*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	**NE**
42	*T. kahsmirensis*	+	+	-	-	-	-	-	-	-	-	-	-	-	-	**NE**
43	*T. microps*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	**LC**
44	*T. naziri*	-	-	-	-	-	-	+	+	-	-	-	-	+	-	**NE**
45	*T. choprai*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	**NE**
46	*G. cenia*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	**LC**
47	*G. pakistanica*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	**NE**
48	*G. armeniacus*	-	-	-	-	-	-	-	-	+	-	-	-	-	-	**NE**
49	*G. cavia*	-	-	-	-	-	-	+	-	+	-	-	-	-	+	**LC**
50	*G. naziri*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	**NE**
51	*G. punjabensis*	+	+	+	+	-	+	+	+	+	+	-	-	+	-	**NE**
52	*G. stocki*	-	-	-	-	-	-	+	+	-	+	+	-	-	-	**LC**

53	*G. sufii*	-	-	-	-	-	-	+	+	+	-	-	-	-	-	**NE**
54	*M. bleekeri*	-	-	+	-	-	+	+	-	-	-	-	-	-	-	**LC**
55	*R. rita*	+	-	+	+	+	-	-	-	-	-	-	-	-	-	**LC**
56	*S. sarwari*	-	-	+	-	-	+	-	-	-	-	-	-	-	-	**LC**
57	*C. garua*	+	-	+	-	-	-	+	-	-	-	-	-	-	-	**LC**
58	*C. naziri*	+	-	+	+	-	+	+	-	-	-	-	-	-	-	**NE**
59	*O. pabda*	-	-	-	-	-	+	+	-	-	-	-	-	-	-	**NT**
60	*W. attu*	+	-	+	+	+	+	-	-	-	-	-	-	-	-	**NT**
61	*C. gachua*	+	-	+	-	-	+	+	+	-	-	-	+	+	-	**LC**
62	*C. punctate*	-	-	-	-	-	+	+	+	-	-	-	-	-	-	**LC**
63	*O. mykiss*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	**LC**
64	*S. trutta*	-	+	-	-	-	-	-	+	-	-	-	-	-	-	**LC**
65	*X. cancila*	-	-	-	-	-	-	+	-	-	-	-	-	-	+	**LC**
66	*C. nama*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	**LC**
67	*O. mossambicus*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	**NT**
68	*M. armatus*	+	-	+	+	+	+	+	+	+	-	+	+	+	+	**LC**
	Total	**27**	**8**	**27**	**15**	**10**	**24**	**40**	**27**	**20**	**7**	**6**	**7**	**14**	**6**	

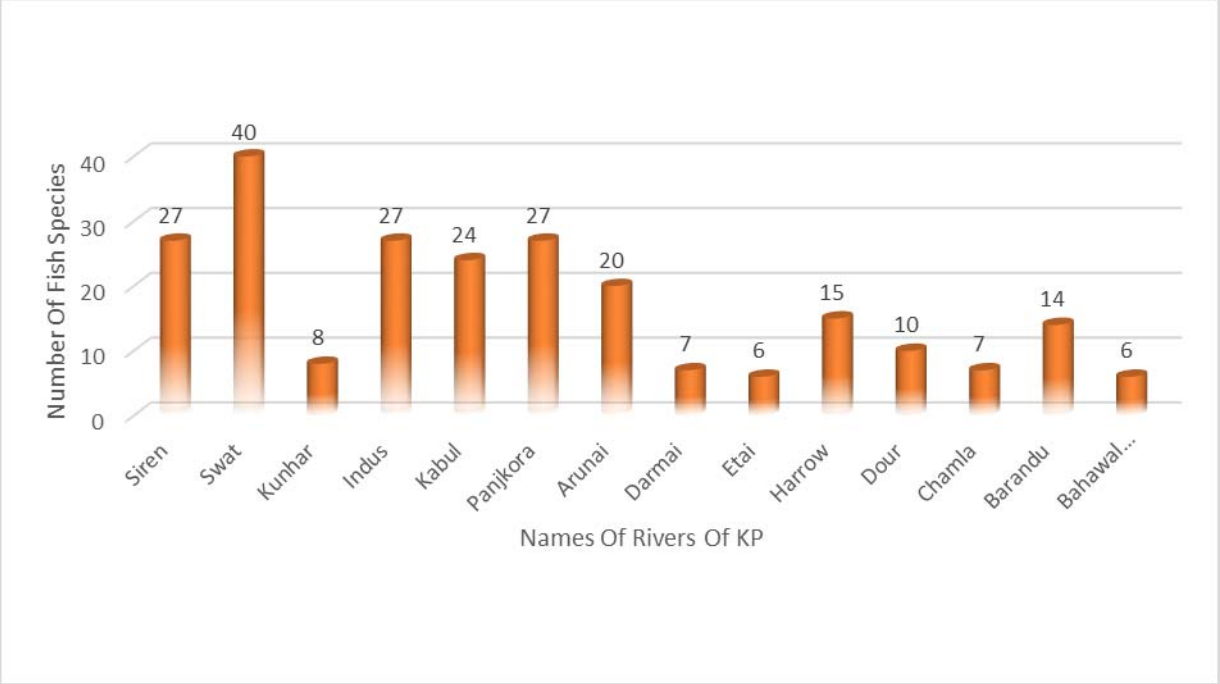

Fig. 3 Comparison of recorded ichthyodiversity in rivers of KP, Pakistan.

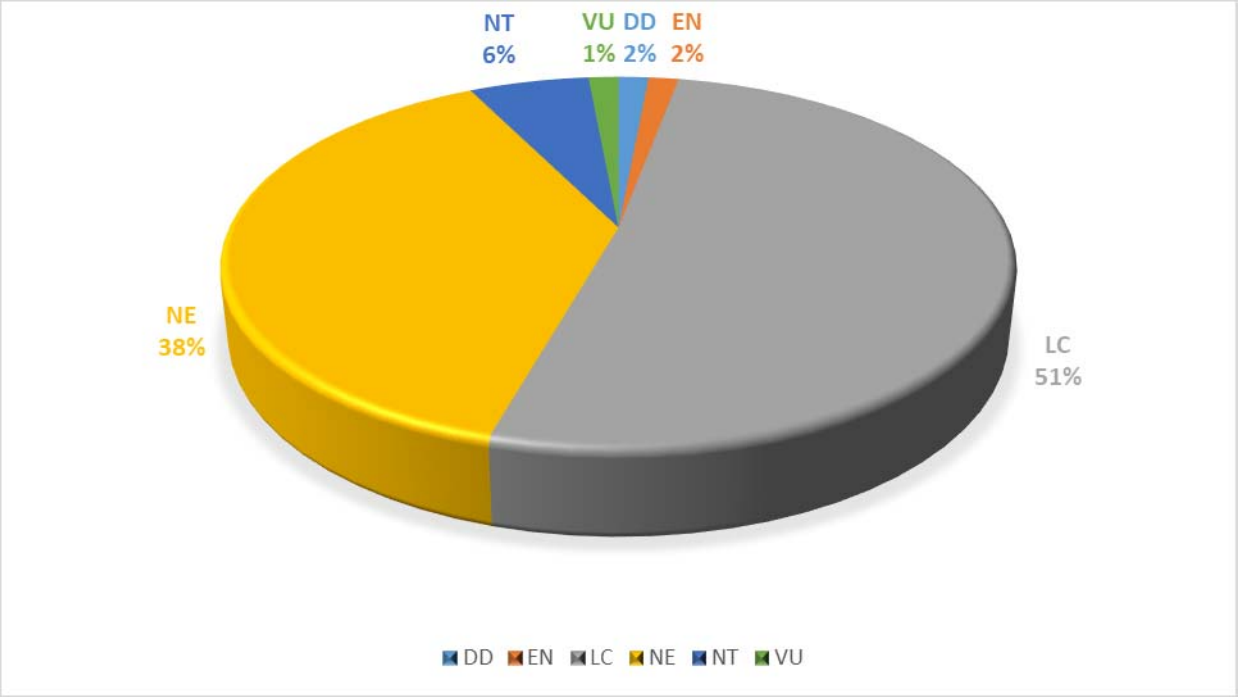

Fig. 4 Conservation status of fish species collected from rivers of Hazara division, KP, Pakistan

The river Siren is 130 km long and originates from the hills of Musa ka Musalla glaciers and enters into Tarbela Dam of district Haripur (Usman et al., 2018b). During the period of four years, a total of 25 fish species were recorded from all the selected sampling sites, which belong to 4 orders, 9 families and 18 genera respectively (Usman et al., 2018b). The family cypirnidae was the dominant family having16 species (Usman et al., 2018b). *Tor putitora* which is an endangered species is recorded from two sites of river siren that are khaki and Beer sites (Usman et al., 2018b). Another study was conducted by Ali et al. (2019) and reported 4 species from river Siren, 3 of them belong to family cyprinidae while 1 species belongs to family balitoridae. Two new fish species *Crossocheilus diplocheilus* and *Triplophysa choprai* were also recorded.

The River Swat is one of the main rivers flowing in Khyber Pakhtunkhwa that is 240 km long. The first contribution to explore the fish fauna of river swat was done by Ahmad and Mirza (1963) who recorded 8 species of fishes from Swat. A study was also conducted by Yousafzai et al. (2013) on river Swat at Charsadda which determined the diversity of fish fauna after the heavy flood of July, 2010 in the province of Khyber Pakhtunkhwa. For fish distribution a 35 km belt of the river was explored. During this survey, thirty eight fish species belonging to 6 orders 9 families and 24 genera were recorded. In a survey study conducted on the fish biodiversity of River Swat from Madyan to Chakdara in which 18 species were collected belonging to 5 orders and 6 families (Ishaq et al., 2014).

Similarly in a research project carried out by Akhter et al. (2014) 18 fish species were recorded from river Sawat at Manglawar valley belonging to 3 order and 3 families. The family cyprinidae was dominant including 14 species. From the different sites of river Swat in Charsadda, 13 fish species belonging to 4 orders and 7 families were documented by Rehman et al. (2018). *Tor putitora* was also recorded by Akhter et al. (2014) but another study conducted two years later by Akhter et al. (2016) in which *Tor putitora* was not found from river Swat and declared as extinct from river Swat.

River Panjkora is about 220 km long. A survey was conducted by Ahmad et al (2014) on river Panjkora upper Dir during November, 2012 to May, 2013 in which the samples were gathered from 9 different sampling

sites from Dir upper to Khagram. During this survey 11 fish species were reported which belong to 5 orders and 5 species. Whereas in the study of Hasan et al. (2015) river Panjkora was surveyed from April to September, 2012 in which 3 sampling sites were selected. There are 25 fish species which belong to 4 orders 5 families. The family cyprinidae was the dominant family of river Panjkora. This river is also facing anthropogenic problems like over hunting and use of blasting materials to catch the fishes due to which fish diversity is reduced at alarming rate (Ahmad et al., 2014).

River Arunai Matta Swat is a famous river of Khyber Pakhtunkhwa. The first study on the river was conducted by Akhter et al. (2014) during the period of January to December 2013. There were 20 fish species found in river Arunai Matta Swat, and these species belong to 3 orders and 4 families. Family cyprinidae was also found dominant family of the river in which 14 species were recorded. The available threats to fish fauna of the valley is pollution due to domestic sewage (Akhter et al., 2014).

River Darmai is flowing through Darmai valley of upper Swat. A survey was conducted during the period of September to December 2014 in order to explore the fish fauna of the river and 114 specimens belonging to 2 orders, 3 families, 5 genera and 7 species were recorded from the river Darmai. The large fish collected was Schizothorax esocinus and the small fish collected was *Barilius pakistanicus*. No anthropogenic activities were found in the study period in river Darmai, therefore, the fish fauna of the river Darmai was rich in diversity and water seems suitable for the survival of fish (Akhter et al., 2016).

River Etai is found in district Shangla Khyber Pakhtunkwa that terminates into the river Indus. Hameed et al. (2017) investigated fish diversity of the river and is divided into 6 sampling stations from which the fishes were collected during the period of June 2015 to June 2016. A total of 80 specimens were collected which were taxonomically classified in to 7 species, 7 genera, 4 orders and 4 families. Most dominant family was recorded as cyprinidae.

River Chamla flows in the Chamla valley of the district Buner. First time the river was explored by Din et al. (2016). The study was carried out from April 2015 to July 2015. There are 8 different sampling sites from which 92 specimens of fish were collected which are classified into 7 species, 7 genus and 4 families (Din et al., 2016).

The River Kunhar is 166 Km long and joins the river Jhelum at Rara. There are 7 fish species which were collected from Rara site where the river Kunhar discharge into river Jhelum (Usman et al., 2017d). About 9 fish species were recorded from 5 sampling stations that belong to 3 orders, 4 families and 7 genera and the Cyprinidae was the richest family which was represented by 4 Species that are *Schizothorax plagiostomus, S. esocinus, S. labiatus* and *Gara gotyla* and trout fish is also reported from this river while *Tor putitora* is not recorded from river Kunhar (Usman et al., 2017b).

The river Barandu is important river of district Bunir. Saeed et al. (2013) explored this river by dividing the river into eight collection sites from which 11 fish species were collected by the permission of fishery department. Collected fish fauna was categorized in to 3 orders and 4 families. Another study was conducted by Akhter et al. (2014) that recorded 10 fish species from river Barandu. These fishes belong to 3 orders and 4 families. A more detailed study was conducted by Hasan et al. (2014) on same river from November 2012 to November 2013. During this survey 851 specimens were collected which were taxonomically fallen into 4 orders, 5 families and 13 species. Family cyprinidae was the dominant family of this river while most abundant fish is Schizothorax plagiostomus.

River Kabul is 435 km long and originates from the base of the Unai Pass in the Paghman mountain of Afghanistan and enters in to Pakistan and end at Warsak dam. Khattak et al. (2015) investigated the fish fauna of river Kabul at Nowshera from August 2011 to November, 2011. During this study the collection sites were selected from Pabbi to Nowshera Cantt. There were 24 fish species reported belonging to 4 orders and 8

families and family cyprinidae was also recorded as the dominant family which was represented by 14 species. Most abundant and dominant genus of fish in this area of the river is Puntius.

The river Bahawal Garh flows near Dhoda Sharif, district Kohat. There are 6 fish species which belong to 6 genera, 5 orders and 5 families while the most dominant family in this river was also reported family cyprinidae (Azeem et al., 2019).

River Indus originates from Mansorawar Lake in Tibet and ends with discharging into Arabian Sea. Fish specimens were collected from the selected sampling stations during 2013 to 2017. Fishes were properly identified by using keys of fish's identification given by Jayaram (1999), Mirza and Sadhu (2007), and Mirza (1990). There are about 26 species of fishes were recorded from all the 5 sampling sites. The recorded species belong to 4 orders, 8 families and 19 genera respectively (Usman et al., 2017a). The family Cyprinidae was found the dominant family of river Indus which was represented by16 Species (Usman et al., 2017c). The endangered species of fish that is *Tor putitora* was also recorded from the river.

River Harrow originates from the hills of Mushkpuri. The total length of this river is 54 km. A study was conducted by Usman et al. (2017c) from March, 2013 to February, 2017. A total of 15 species were recorded from 5 sampling sites of this river which belong to 3 orders, 6 families and 13 genera, family Cyprinidae was the richest family of this river which was represented by 10 Species. *Tor putitora* was not recorded from river Harrow (Usman et al., 2018c).

River Dour is about 50 km long and started from northern end of Nathiagali range and ends by falling into river Siren at Haripur. A study was conducted by Usman et al. (2018d) on this river by which fish specimens were collected. All the collected fish specimens belong to 3 orders, 4 families, 9 genera and 9 species, while the family Cyprinidae was the dominant family which comprises 6 species (Usman et al., 2018d). *Tor putitora* was not recorded from this river.

It has been estimated that 155 specimens of *Tor putitora* were collected from rivers of Hazara division during March 2013 to February 2017 (Usman et al., 2016). The population of *Tor putitora* is gradually decreased and now become extinct in river Swat and various other rivers of Pakistan as well (Akhter et al., 2016).

4 Discussion

Fresh water fishes are main source of nutrition and livelihood of millions of people across the world. Pakistan is gifted with numerous fresh water bodies and having a diversity of fishes. The present review revealed that rivers of Khyber Pakhtunkhawa containing plenty of fresh water fish fauna. There are 68 fish species were recorded from all rivers of KP. Forty species from river Swat, 27 from Indus and Panjkora and river Siren, 24 from river Kabul, 20 from river Arunai,15 from river Harrow,14 from Barandu, 10 from Dour, 8 from Kunar, 7 from Darmai and Chamla rivers and 6 each from Bahawalgarah and Etai rivers. Among 14 rivers, maximum fish diversity was found in river Swat that is 40 species followed by river Indus with 27 species. River Indus is the greatest reservoir of fish diversity. There are almost 193 freshwater fish species found in Pakistan (Rafique and Khan, 2012). But more than 180 fish species are reported from Indus River in Pakistan (Mirza and Mirza, 2014). The portion of river Indus in KP has not been explored extensively like Punjab and Sindh, therefore, shows lesser diversity. *M. armatus* fish was found in all 13 rivers of KP thus indicating its secure position in the region but not evaluated (NE) globally by IUCN. When the recorded fishes of 14 rivers of KP were matched with red list of IUCN It was revealed that 50% of fishes were found least concerned (LC), 40 % were not evaluated (NE), one species is vulnerable (VU), one was regarded as data deficient (DD), 4 species are near threatened (NT), while one species declared as endangered (EN). Overall 50 % fish fauna is secure, 40% falls in not evaluated category and rest may be under various degrees of threatening that is vulnerable, near

threatened and endangered. However, national fish of Pakistan *Tor putitora* which is globally endangered and is also endangered and extinct in many rivers of Pakistan but still found in rivers of KP. Due to anthropogenic activities, diversion of rivers, overexploitation, use of pesticides and fertilizers in Siren valley, throwing of garbage by tourists, sanitation in rivers and over fishing negatively affects the population of *Tor putitora* and other fishes of the region (Akhter et al., 2016). Similarly famous, delicious and high commercial valued fish *Oncorhynchus mykiss* and *Salmo trutta* fario were also recorded from river Kunhar and missing in other 13 rivers of KP. The *Tor putitora* which is the national fish of Pakistan and unfortunately endangered fish species is found in river Indus, river Siren, river Panjkora, river Etai, river Chamla and river Barandu whereas it is found endangered in river swat. It is worth mentioning that 94% of freshwater fish are found in developing countries that provide food and a livelihood. It also contributes to the general economic wellbeing because of export product trade, tourism and refreshment (Worldfish Center, 2002). Freshwater fishes comprise above 6% of the world's animal protein for humans annually (Ricciardi and Rasmussen, 1999). The global values of freshwater ecosystem including fish as food, freshwater to drink, formation of climate and rain via hydrological cycle, ecosystem sustenance, and recreation that yield a value estimated in trillions of dollars (Reid et al., 2013).

5 Conclusions

The ichthyodiversity in rivers of Khyber Pakhtunkhwa comprises 7 Orders, 13 families, 37 genera and 68 species. The family cyprinidae is the dominant family of Khyber Pakhtunkhwa which comprises 34 species. The second largest family in this area is family Nemachilidae which comprises 10 species. The family Sisoridae is the third largest family which comprises 8 species. Family Bagridae contain 3 species, Schilbeidae, Siluridae, Channidae and Salmonidae comprises 2 fish species respectively, while Balitoridae, belonidae, Ambassidae, Cichlidae and Mastacembelidae contain only 1 species respectively. Most expensive fish that is trout (*Oncorhynchus mykiss*) is also present in river Kunhar. The literature survey revealed that 33 species are least concerned, 1 species is data deficient, 27 fall in not evaluated category, 1 species is endangered, 4 species are near threatened and 1 species is vulnerable. The major causes were recorded heavy flood of 2010 and anthropogenic disturbances.

6 Recommendations

(1) Fishery department must implement some strict rules and regulations against over fishing, diversion of rivers, uses of chemicals for fishing to overcome the loss of fish diversity.

(2) The agencies must contribute to the protection and artificial breeding of *Tor putitora* and other fishes that are endangered, and create awareness among the local fishermen about the rules and techniques of legal hunting.

(3) The concerned departments should facilitate more research activities in these rivers in order to get detailed information regarding fish diversity and its conservation status.

(4) There should be periodic reviews on fish diversity of the region.

(5) There is still need of more researches in the area to conserve and restore the freshwater fish biodiversity.

(6) Increased simulated releasing and restoration of habitat should be considered instant steps in order to preserve the diversity of fresh water fish in the region.

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