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Fish diversity of the Kokcha River in Badakhshan Province, Afghanistan

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Abstract. The reported survey was conducted in the Kokcha River of Badakhshan Province, northeastern Afghanistan. The survey was carried out once in each season of 2021 by using a variety of fishing tackle, e.g., hooks and gill nets. During the research, a total of 311 fish specimens were collected from the four sampling sites. Sabzi Bahar was one of the sites that had the maximum number of fish — 30.69% followed by Baharak, 27.33%, and Pol-e-Bigam 22.50% and the minimum number of fish 19.29% were collected from the Shahr-e Naw site. We found that *Schizothorax curvifrons* is the most abundant species at 38.90%, followed by *Glyptothorax cavia* at 28.29%, *Paracobitis longicauda* at 20.90%, and *Salmo trutta* were the fewer abundance species at 11.89% in the study area.

Keywords: Badakhshan, Kokcha River, fish diversity and abundance

Разнообразие рыб реки Кокча в провинции Бадахшан, Афганистан

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Аннотация. В статье описаны результаты исследования разнообразия и численности видов рыб на реке Кокча в провинции Бадахшан, расположенной на северо-востоке Афганистана. Образцы собирались один раз в каждый из сезонов 2021 года с использованием различных рыболовных снастей: крючки, жаберные сети и т.п. Всего за время исследования с четырех точек отбора было собрано 311 экземпляров рыб. Максимальное количество было собрано на участке Сабзи Бахар (30,69%), за ним следовали Бахарак (27,33%) и Пул Бигам (22,50%). Минимальное количество (19,29%) было собрано на участке Шари Нао. Было обнаружено, что *Schizothorax curvifrons* является наиболее многочисленным видом (38,90%), за ним следует *Glyptothorax cavia* (28,29%) и *Paracobitis longicauda* (20,90%). Наименее многочисленным видом в районе исследования оказался *Salmo Trutta* (11,89%).

Ключевые слова: Бадахшан, Река Кокча, разнообразие и численность видов рыб

Introduction

Biological diversity (biodiversity) is the variety of living things regarded at three levels: genetic diversity, species diversity, and ecosystem diversity (Madhusmita 2012). Fish is an important part of biodiversity and the greatest bioindicator of the ecosystem (Mankodi, 2014). Biodiversity is not the same as the number of diverse species in a territory. Biodiversity is more complex than species richness, while species richness is surely one of the components of biodiversity (Sala et al. 2012). These aquatic organisms are one of the major groups of vertebrates that have had a substantive influence on human civilization from ancient times to date. Fish diversity is more apparent is it is manifest in fish morphology. Fish vary in size from small to very big. E.g., adult gobies are about 8 mm long, while the whale shark, genus Rhincodon, can reach 12 m. Some species lack scales, eyes or fins but others are heavily armored or have adaptations for producing sound, venom, and light (Aurangabad 2009). Fish make half of the total number of vertebrates in the globe. Fish live in all imaginable aquatic environments with hundreds of them documented worldwide (Akhtar et al. 2015). Numerous aquatic animals are often referred to as fish, however, not all of them are fish, e.g., shellfish, jellyfish, starfish, crayfish, or cuttlefish. In aqu-aculture, mainly, the fish *per se* are named 'finfish' to separate them from other animals. An ectothermic fish has a streamlined body for fast swimming that extracts oxygen from water by using gills or that uses an additional breathing organ to breathe in oxygen. This fish has two sets of paired fins, usually one or two dorsal fins, an anal fin, and a tail fin. It also has jaws and skin (usually covered with scales) and lays eggs (Govind 2014). Some groups of fish take oxygen from water and air with the help of other structures. The lungfish have paired lungs. Gouramis and tetrapods have 'labyrinth organs' that do similar functions; though, many catfish (e.g., Corydoras) take oxygen through the stomach or intestine (Akhtar et al. 2015). Fish is an important group of vertebrates, considerably affecting human life by providing high-quality protein and vitamins. These aquatic species are also utilized to procure by-products such as fish meal, fish oil, and fish glue (Ullah et al. 2018).

Afghanistan is a landlocked and mountainous country. The average elevation is 1300 m. The climate varies sharply between highlands and lowlands. The Afghan ichthyofauna has not been well studied. The country has 85 documented native species of fish (Coad 2015). The Kokcha River (KR) is located in Badakhshan Province of Afghanistan. A tributary of Amu-Darya (Amu River), the KR flows through Badakhshan Province with the city Fayzabad located along its banks. The KR has its maximum water flow in spring and summer and minimum flow in autumn and winter. The KR is one of the important perennial rivers of Afghanistan. It supports many aquatic living organisms. Fish are one of the important components of its aquatic ecosystem. According to the local office of the National Environmental Protection Agency (NEPA), excessive and improper fishing practices have endangered many fish species of the KR. Based on NEPA's information, so far there have been no prosecution over the crime of fish hunting. This has further encouraged poaching. The main threats to fish diversity in the KR are pollution, hunting, and floods (www.afghanistantimes.af). The reported study aimed to identify and document fish diversity of the Kokcha River in Badakhshan Province of Afghanistan.

Material and methods

Study area

The reported study was conducted in the Kokcha River (KR), located in Badakhshan Province of Afghanistan. It lies between the latitudes of 36°11'30"–37°13'58"N and longitudes of 69°20'4"–71°20'23"E (Fig. 1). Kokcha originates from the high Hindu Kush Mountains of the Kuran wa Munjan District of Badakhshan Province, and flows north passing through Yamgan and Jurm Districts; in

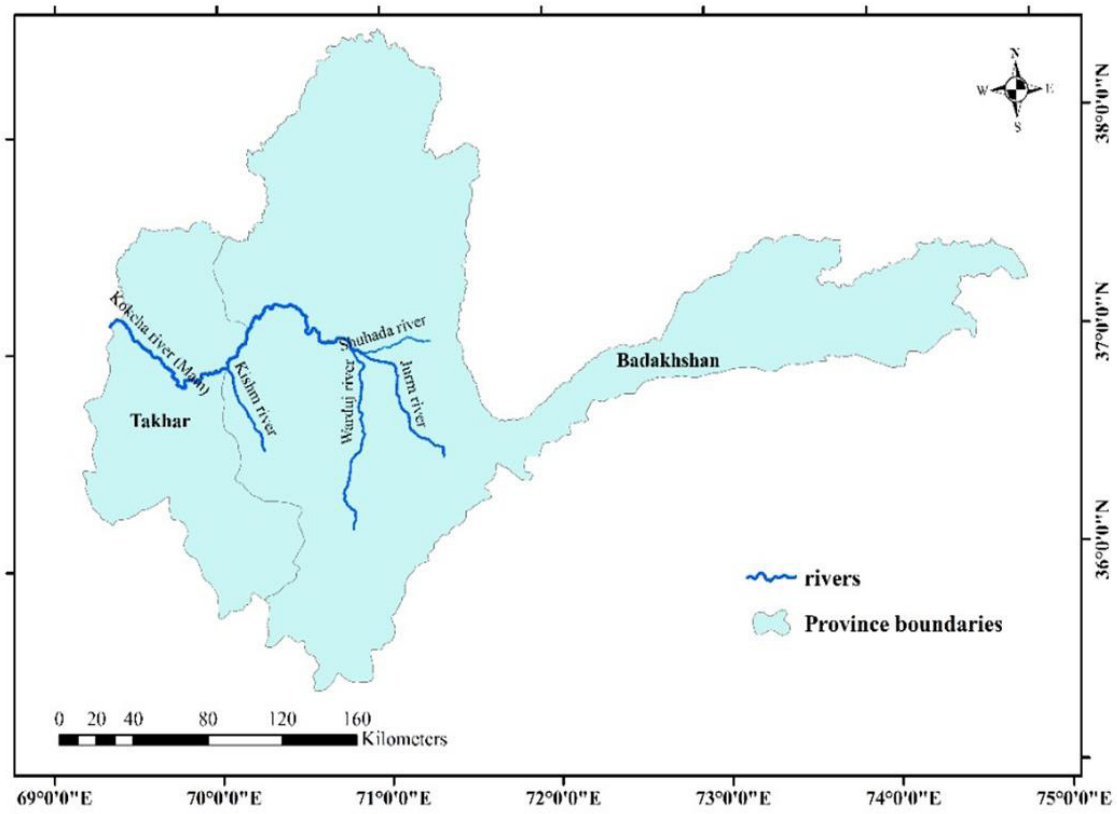

Fig. 1. Location of the Kokcha River, Badakhshan Province, northeast of Afghanistan
Рис. 1. Расположение реки Кокча, провинция Бадахшан, северо-восток Афганистана

the Baharak District, the Warduj and Shuhada rivers meet the KR. The river then flows east, going around the northern border of Argo District and passing the city Fayzabad. Near Pool Bigam, the Kishim River joins the KR. Finally, Kokcha enters Takhar Province, flows around the southern border of Rustaq District, and ends at the Amu River by Ai-Khanoum. We selected four sites for assisting fish diversity in the Kokcha River: 1) Pol-e-Bigam at the latitude 36°57'31.31"N and longitude 70°2'52.44"E; 2) Sabze Bahar at the latitude 37°10'11.31"N and longitude 70°13'56.00"E; 3) Shahr-e Naw at the latitude 37°6'15.86"N and longitude 70°33'30.06"E; 4) Baharak at the latitude 36°59'45.09"N and longitude 70°53'41.69"E. The KR is 400 km long and from 1 to 4 meters deep. Its temperature is from about 10 to 20°C. The KR has a variety of fish. Its fish has short migration routes. During the cold seasons of autumn and winter, they migrate down the river. In spring and summer, they go to upstream sites with colder water. Fish hunting, water pollution, and flooding are the main deleterious forces causing the loss of fish diversity in the study area. The activities of fisheries in the KR are unlimited. Thus, during the survey we saw tens of young people hunting in the river. Aquatic diversity of the Kokcha River is also threatened by floods. The checklist contains 101 species of known Afghan fish species, with another 38 species suspected to occur in the country (Biodiversity profile of Afghanistan 2008).

Methods

Fish diversity of the Kokcha River was analyzed from each of the sampling sites during the year 2021. The survey was conducted once in each season of the year using a range of fishing tackle, e.g., dragnets, hooks, and gill nets (Mirza et al. 2011) with the same length (5 m) and height (2 m) with meshes varying from 3 to 3 cm, knot to knot. Four samples were taken from each site (Khan et al. 2011). The specimens were preserved in 10% formalin for further study in the laboratory of the Education Faculty in the Department of Bi-

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Table 1

Fish diversity in the Kokcha River, Badakhshan Province, Afghanistan

Таблица 1

Разнообразие рыб в реке Кокча, провинция Бадахшан, Афганистан

No	Order	Family	Genus and Species	Local name
1	Cypriniformes	Cyprinidae	*Schizothorax curvifrons*	Shir-mahi
2	Salmoniformes	Salmonidae	*Salmo trutta*	Khal-mahi
3	Siluriformes	Sisoridae	*Glyptothorax cavia*	Sag-mahi
4	Cypriniformes	Nemacheilidae	*Paracobitis longicauda*	Mor-mahi

ology, Badakhshan University (Shinde et al. 2009). Collected specimens were identified to order, family, genus, and species level using taxonomic keys (Maitland, Herdson 2006; Coad 2015; Fish Base 2021). The computation of data for the Simpson (S), Shannon diversity (H), Dominance (D) Evenness (E), and Margalef (R) of fish was done with a computer-based program PAST 4.03 (Altaf et al. 2015).

Results

One of the tributaries of the Amu River, the Kokcha River is the second largest wetland in the north of Afghanistan. Kishm, Warduj, Shuhada, and Jurm Rivers are tributaries of the KR (Fig. 1). The KR has a varied diversity of fauna and flora. During the research, four fish species belonging to four orders and four families were recorded. These species include *Schizothorax curvifrons*, *Salmo trutta*, *Glyptothorax cavia*, and *Paracobitis longicauda* (Table 1 and Figs. 2: *1-4*) (Tamboli, Jha 2012, UNEP, 2088).

In the reported study, a total of 311 fish specimens were collected from all the four sampling sites. The list of documented fish species is given in Table 2. Of the sampling sites, Sabzi Bahar had the maximum number of collected fish (30.69%) followed by Baharak (27.33%) and Pol-e-Bigam (22.50%). The minimum number of fish (19.29%) was collected from the Shahr-e-Naw site (Mirza et al. 2011).

We found that *Schizothorax curvifrons* is the most abundant species with 38.90% (n = 121), followed by *Glyptothorax cavia,* 28.29% (n = 88), *Paracobitis longicauda,* 20.90% (n = 65), and *Salmo trutta* as the least abundant species with 11.89% (n = 37) in the study area (Fig. 3) (Singh et al. 2015).

According to Altaf et al. (2015), the fish diversity indices (Table 3) of the studied zones showed the dominance of fish at Pol-e-Bigam with 0.33, followed by Sabze Bahar, 0.30, Shahr-e Naw, 0.30, and Baharak, 0.27. The Simpson index at Pol-e-Bigam was 0.66, at Sabze Bahar 0.69, at Shahr-e-Naw 0.69 and at Baharak 0.72. The Shannon index at Pol-e- Bigam was 1.14, at Sabze Bahar 1.26, at Shahr-e Naw 1.26 and at Baharak 1.33. Evenness at Pol-e-Bigam was 0.78, at Sabze Bahar 0.88, at Shahr-e Naw 0.88 and at Baharak 0.94. The Brillouin index at Pol-e-Bigam was

Table 2

Fish diversity recorded in four sites of the Kokcha River

Таблица 2

Разнообразие рыб, зарегистрированных на четырех участках реки Кокча

Fish name	Pol-e- Bigam	Sabzi Bahar	Shahr-e Naw	Baharak	Total collected fish
Schizothrorax curvifrons	27	38	24	32	121
Salmo trutta	1	8	5	23	37
Glyptothorax cavia	24	29	19	14	88
Paracobitis longicauda	18	21	12	14	65
Total No. of fish observed	**70**	**96**	**60**	**85**	**311**

Fig. 2. Fish species documented in the Kokcha River, Badakhshan Province: *1* — *Schizothorax curvifrons* (Order Cypriniformes, Family Cyprinidae); *2* — *Salmo trutta* (Order Salmoniformes, Family Salmonidae); *3* — *Glyptothorax cavia* (Order Siluriformes, Family Sisoridae); 4 — *Paracobitis longicauda* (Order Cypriniformes, Family Nemacheilidae)

Рис. 2. Виды рыб, отмеченные в реке Кокча, провинция Бадахшан: *1* — *Schizothorax curvifrons* (Order Cypriniformes, Family Cyprinidae); *2* — *Salmo trutta* (Order Salmoniformes, Family Salmonidae); *3* — *Glyptothorax cavia* (Order Siluriformes, Family Sisoridae); *4* — *Paracobitis longicauda* (Order Cypriniformes, Family Nemacheilidae)

1.06, at Sabze Bahar 1.2, at Shahr-e-Naw 1.16, and at Baharak 1.25. The Menhinick index at Pol-e-Bigam was 0.47, at Sabze Bahar 0.40, at Shahr-e-Naw 0.51, and at Baharak 0.43. The Margalef index at Pol-e-Bigam was 0.70, at Sabze Bahar 0.65, at Shahr-e-Naw 0.73 and at Baharak 0.65. Statistically computed results and biodiversity indices indicate that the Sabzi Bahar area is marked by high fish biodiversity. A possible reason is that during flood, fish, fingerlings, and eggs transfer from the upper to the lower zone of the river.

During the reported study, we recorded three main threats to fish diversity in the Kokcha River. They include hunting, water pollution, and floods. According to the local office of the National Environmental Protection Agency (NEPA), excessive and improper fishing practices have endangered many fish species in northeastern Badakhshan Province (Fig. 4).

Discussion

During the reported study four species of fish were documented from the Kokcha River. The study found that *Salmo trutta* is the least abundant species in the study area. Little information is available on the current status of fish stocks and fisheries in Afghanistan. Coad (1981) mentioned that coldwater fish stocks

Table 3

Statistical analysis of the fish diversity in the Kokcha River

Таблица 3

Статистический анализ разнообразия рыб реки Кокча

Indices	Pol-e-Bigam	Sabzi Bahar	Shahr-e-Naw	Baharak
Number of Species	4	4	4	4
Dominance (D)	0.33	0.30	0.30	0.27
Simpson (S)	0.66	0.69	0.69	0.72
Shannon (H')	1.14	1.26	1.26	1.33
Evenness (E)	0.78	0.88	0.88	0.94
Brillouin index (B)	1.06	1.2	1.16	1.25
Menhinick index (M)	0.47	0.40	0.51	0.43
Margalef (R)	0.70	0.65	0.73	0.67

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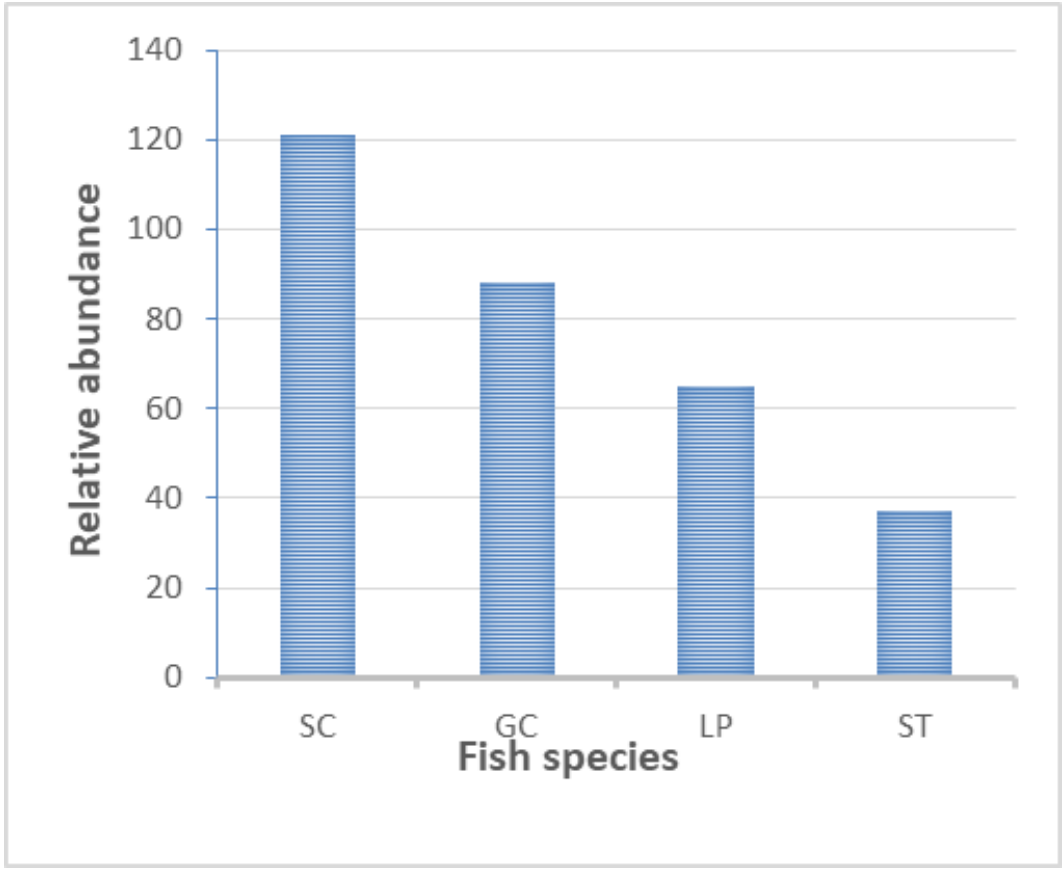

Fig. 3. Abundance of fish species in the Kokcha River: *Schizothorax curvifrons (SC), Glyptothorax cavia (GC) Paracobitis longicauda (PL),* and *Salmo trutta (ST)*

Рис. 3. Численность видов рыб р. Кокча: *Schizothorax curvifrons* (SC), *Glyptothorax cavia* (GC), *Paracobitis longicauda* (PL), *Salmo trutta* (ST)

in the upper Kabul River basin are dominated by a variety of cyprinid snow trutta (Schizothoracini) and Cobitidae. Afghanistan rivers and streams contain a mix of Oriental and Palaearctic species, northern and southern species, high and low-altitude-adapted species. The fauna is divided between Oriental and Palaearctic species. It is dominated by Cyprinidae (56.9%), Cobitidae (24.5%), and, to a lesser extent, by Siluriformes (11.8%). According to Mirza et al. (2011), biodiversity appears to play a considerable role in ecosystem resilience, while Mankodi (2014) highlights that understanding fish diversity of an ecosystem is a vital requirement for an effective development of fisheries, sustainable use of fishery resources and adoption of suitable conservation measures. Kumar (2014) reported 56 species belonging to 35 genera, 19 families, and 7 orders for the Mahanadi River in India. Another study reported 57 fish species belonging to 36 genera, 19 families, and 7 orders from the seven regions along the stretch of the Mahanadi River in India (Kumar et al. 2020).

The reported survey was the first to record fish diversity in the Kokch River of Badakhshan Province (Biodiversity profile of Afghanistan 2008). Our results correspond with the report on India with a total of 40 species belonging to 18 families, 27 genera and 9 orders identified and recorded (Niraj, 2012). Another study on India reported 56 species belonging to 35 genera, 19 families, and 7 orders in the Stretch of the River Mahanadi in Odisha, India (Kumar 2014). In yet another study, Abro et al. (2020) reported 44 species belonging to 35 genera contained in 18 families of 9 orders in the Indus River, Pakistan. In another research 34 species were reported from the river Chenab, Pakistan (Altaf et al., 2015). The same results were reported by (Jain et al. 2005; Mirza et al. 2011; Madhusmita 2012; Rafique et al. 2012).

Fig. 4. Hunted fish of the Kokcha River in Badakhshan Province
Рис. 4. Промысловая рыба реки Кокча в провинции Бадахшан

Badakshan Province of Afghanistan has plenty of water and a suitable climate for fish farming. Fishing takes place in the Kokcha River all year round, however, fish constitutes a small part of diet in Badakshan Province because fish farmers are unable to produce enough fish to keep up with the customer demand. Using explosives for fishing, called dynamite fishing, is popular in study areas and today it is illegal. The recorded fish species are under a threat due to their delicious meat. There are two fish farms in Badakhshan Province. Currently, there are no previous reports about fish diversity in the Kokcha River. Therefore, these findings are of great importance for future studies on fish diversity in Afghanistan.

Conclusion

The reported study was conducted in the Kokcha River situated in northeastern Afghanistan. The area was surveyed for fish diversity in the year 2020. During the research four fish species belonging to four orders and four families were recorded. Among the recorded species are *Schizothorax curvifrons*, *Salmo trutta*, *Glyptothorax cavia*, and *Paracobitis longicauda*. We found that *Schizothorax curvifrons* is the most abundant species with 38.90% (n = 121), followed by *Glyptothorax cavia,* 28.29% (n = 88), *Paracobitis longicauda,* 20.90% (n = 65) and *Salmo trutta* as the least abundant species in the study area with 11.89% (n = 37). During this study, three main threats to fish diversity in the Kokcha River were recorded: hunting, water pollution, and floods.

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