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Key to Identify the First Recorded Species of Fish from Panjkora River, Shaheed Benazir Bhutto University, Sheringal, Khyber Pakhtunkhwa, Pakistan

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Abstract: A fish is any member of a paraphyletic group of organisms that consists of all gill bearing aquatic craniates that lack limbs with digits. This was the 1st study, to prepare a key to identify the 1st recorded species of fish from Panjkora River, near Shaheed Benazir Bhutto University (SBBU), Main Campus, Sheringal, Dir Upper (DU), Khyber Pakhtunkhwa (KP), Pakistan during June 2013-July 2014. Three species belong to 2 families and 2 genera (n_t=102: total; n_i=61: identified; n_u=41: unidentified) were recorded. In which, the Nangra, *Nangra robusta* Mirza and Awan, 1973 (n=5) collected from middle of the river, having nasal barbles are shorter than head, branched rays are 7 in numbers on dorsal side. The chirruh snow trout, *Shizothorax esocinus* Heckle, 1838 (n=43) is collected from deep in rivers and lakes, having lower lip is not modified into a complete labial fold, silvery with black spots on dorsal and lateral sides. The Khont, *Shizothorax plagiostomus* Heckle, 1838 (n=13) is collected from bank of rivers. It is silvery with grayish back, fins pinkish, young fish with black spots on dorsal and lateral sides. A dichotomous key has been developed for identification of fish fauna of Panjkora River at Sheringal. A detail study is required for further exploration of fish fauna of Panjkora River, Sheringal.

Key words: Dichotomous key · *Nangra robusta* · River Panjkora · Shaheed Benazir Bhutto University · *Shizothorax esocinus* · *Shizothorax plagiostomus*

INTRODUCTION

Fishes are the most diverse group of vertebrates and have occupied almost every niche of hydrosphere. They are the most ancient and abundant vertebrate [1]. They exhibit a great diversity in shape, size and colour according to their habitat. Biodiversity is the variety of species in the ecosystem, or variety of life on earth [2]. The most distinguished rivers in Pakistan are Jhelum up to Head Mangla, river Indus upstream from Kalabagh up to Besham including Tarbela Dam, river Kabul up to Batgram near Charikar in Afghanistan, River Swat up to Bagh Dheri [3]. They are generally identified on the basis of morphometric measurements. Different morphometric measurements show different pattern of relationship among each other at different stages of life. The constant ratio is helpful in identification. Those ratios which change regularly or irregularly are not useful in identifying the species. Furthermore, environmental conditions in different regions also bring some changes in different parts of the body like number of scales and vertebrae etc [4]. The normal growth of fish is affected by parasites that live on their body if they are highly infested. The ectoparasites not only harm the fish directly but also render the fish for grown, reduce host population and induce mortalities [5].

Fish species identification is traditionally based on external morphological features, including body shape, pattern of colors, scale size and count, number and relative position of fins, number and type of fin rays or various relative measurements of body parts [6]. In many cases, their diverse developmental stages are difficult to identify by morphological characters [7]. Food production (FP) is an essential process for energy transformation. Accordingly, the aquaculture is one of the important methods for food production. Due to increase in human

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Fig. 1: The dichotomous key have been prepared to identify the 1st recorded species of fish from Panjkora River, near Shaheed Benazir Bhutto University (SBBU), Main Campus, Sheringal, Dir Upper (DU), Khyber Pakhtunkhwa (KP), Pakistan during June 2013-July 2014: arrows show map of the study area: a) river Panjkora; b) SBBU, Main Campus; c) Sheringal, where the present research was conducted; d) map of Khyber Pakhtunkhwa, which is one of the provinces of Pakistan and; e) map of Pakistan [17]

population, there is an increase in global interest for development of aquaculture towards larger economic benefits [8]. On account of importance in every sphere of life, fisheries or aquaculture is one of the most debatable issues. Fish studies are as clear as bright day light on the horizon of animal research. Fish is having significance in a number of ways. It is a manageable sector, boosting the economy of many countries [9]. It is also a stapled food item on account of its nutritional and medicinal values [10]. Fisheries sector is also providing employment to millions of people throughout the world [11]. They also play a crucial role in the second tropic level of the aquatic ecosystem [12].

Some of their classifications are very complex and divide fishes into more than 100 orders and suborders. In the most generally used system, the subphylum Vertebrata is divided into 2 super classes: Agnatha, which includes the lamprey, *Petromyzon marinus*

(Linnaeus, 1758) and other fishes without jaws and Gnathostomata, which includes fishes with hinged jaws. The latter are further divided into the class Chondrichthyes, the cartilaginous fishes such as the sharks, rays and chimaeras, however, the class Osteichthyes, the bony fishes. The bony fishes are made up of the subclass Sarcopterygii, lobe-finned fishes and the subclass Actinopterygii, ray-finned (spiny-finned) fishes. The recent ray fins consist of 2 groups, the Chrondrostei and Neopterygii, which includes the division Teleostei or modern bony fishes [13]. According to the information about 179 species were found in Pakistan. They belong to 82 genera, 26 families, 10 orders, 5 super classes and 3 cohorts [14].

Sheringal valley is located between the latitude 35°-90° to 35°-47° north longitudes 71°-52° to 72°-22° east in Pakistan. Altitude is approximately 2000 m above the sea level. This is a small valley situated northern site of district Dir Upper (DU), KP, Pakistan. Bajauar Agency and Jandool is located toward the west, while it is surrounded by district Swat and Malakand Agency from the East and South, respectively. Total area covered by this hilly valley is 7992.7 hec. The northern part is generally covered with forests. The climate is extremely cold in winter and warm in summer. The minimum and maximum temperature in January has been recorded as -2.3 and 11.22 °C, respectively (Figure 1) [15]. Panjkora flows, meanderingly, through this lush green valley. The average depth is about 6 feet, while width is 15-25 feet. It is northern in KP and north-western in Pakistan. It rises high in the Hindu Kush and flows south through DU and DL districts and joins the river Swat near Chakdara, Malakand, KP, Pakistan. The name Panjkora is because of the main 5 tributaries that fall in the river at 4 different places, viz., Gwaldi stream at Patrak, Barawal at Chukiatan, Dobando at Akhagram and Usherai Dara and Nurhund at Darora [16]. The objective of the present research is to make the dichotomous key to identify fish fauna in Panjkora River, Sheringal, KP, Pakistan (Table 1).

MATERIALS AND METHODS

The people of Sheringal, Dir Upper (DU), Khyber Pakhtunkhwa (KP), Pakistan usually concern with agriculture. Total area covered by this hilly valley is 7992.7 acres. The population is about 20, 000 and literacy rate is 51%. Panjkora River flows meanderingly through this lush green valley. Its average depth is about 3 feet, while width is 15-25 feet. It is northern in KP and north-western in Pakistan. It rises high in the Hindu Kush and flows south through DU and Dir Lower (DL) districts and joins the Swat River near Chakdara, Malakand, KP. The present research was conducted during June 2013-August 2014 in study area, Panjkora River near Shaheed Benazir Bhutto University (SBBU) located in Sheringal, DU, KP, Pakistan (Figure 1) [15].

Fishes samples were collected from both sides (East and South) of Panjkora River near SBBU at Sheringal. The collection (total number of specimen collected: n_t=102; number of specimen identified: n_i=61; number of specimen unidentified: n_u=41) was made for 3 months on daily basis during October-December 2013. During collection, different types of instruments, e.g., hand net, cast net, hooks and other locally adopted methods were used. The collected fish were brought into the laboratory, Department of Zoology (DOZ), SBBU, Sheringal, DU, KP, Pakistan, faint by mortin® (CIC Enterpriser, Lahore, Pakistan) in a bottle. Collected fish were identified with the help of keys [1, 18], literature available, experts, pictures, already identified specimens and internet. The dichotomous key to identify fish fauna in Panjkora River, Sheringal (Table 1) was prepared. These specimens (n=61) were preserved in 10% formalin solution. The specimens were deposited in Laboratory cum Museum, DOZ, SBBU, Sheringal.

RESULTS

During the present research, the dichotomous key was prepared to identify fish fauna in Panjkora River. The collected specimens (n_t=102) were belonging to chirruh snow trout, *Shizothorax esocinus* Heckle, 1838 (n=43); Khont, *Shizothorax plagiostomus* Heckle, 1838 (n=13) and Chukaysary, *Nangra robusta* Mirza and Awan, 1973 (n=5). However, due to unavoidable circumstances 41 specimens has been unidentified (n_u=41). Moreover, identified specimens (n_i=61) were belonging to 2 families, further, the most dominant family was Cyprinidae ($n_{Cyprinidae}$ =56), furthermore, the less number of species were recorded from family Sisoridae ($n_{Sisoridae}$=5). The 91.8% of collected fishes were belonging to Cyprinidae while 8.2% belonging to Sissoridae.

The present dichotomous key is a nontraditional key designed as a tool that helps to the user to identify a few of the fishes that may find in the aquatic habitats of SBBU, Sheringal (Table 1). It provides a systematic

Table 1: The dichotomous key for the Phylum, Sub-phylum, Class, Sub-class and Super-order, Order, Family, Sub-family and Genus of species of fishes of Panjkora River near SBBU at Sheringal, Khyber Pakhtunkhwa, Pakistan during June 2013-July 2014

SNr	Characteristics
1a:	Notochord, hollow nerve cord that lies dorsal to the notochord and pharyngeal pouches ……Phylum: Chordata
1a(i):	Having living endoskeleton, advanced nervous system, presence of the spinal cords and vertebrae…….....……....Sub-phylum: Vertebrata
1a(ii):	Generally having flexible leptoid scales, the branchiostegal rays evolved from the bones at the base of the branchial cavity and branchiostegal rays..Class: Actinopterygii
1a(I):	Very successful group of fishes, they lost the sense, even if it has later been re-evolved within Gymnotiformes and their scales and skeletons began to lighten during their evolution……..……..Sub-class: Neopterygii
1a(II):	The swim bladder is divided into two chamber, minute, unicellular, horny projections known as unculi are commonly present and an alarm substance that is part of a fright reaction……Super-order: Ostariophysi
Key to the Order of fish fauna of River Panjkora, Sheringal	
1a(i):	Scales mostly present teeth on the jaws always absent, no dorsal adipose fins, pectoral fin without a spine……Order: Cyprinformes
1b (ii):	Scales are always absent, teeth on the jaws usually present, dorsal adipose fin present or absent, pectoral fin always with a spine…….……....Order: Siluriformes
Key to the Family of fish fauna of River Panjkora, Sheringal	
1a:	Abdomen or part of abdomen with sharp edged……..……..2
1b:	Abdomen without sharp edged……..……3
3a(1b):	Barbless 2, 4 or non, scales mostly prominent……..…Family: Cyprinidae
3b(1b):	Maxillary barbless extend beyond the base of pectoral fin……Family: Sissoradae
Key to the Subfamily of fish fauna of River Panjkora, Sheringal	
1a:	Abdomen rounded or flat not compressed……...……..2
1b:	Abdomen dorso-ventrally compressed……..……3
2(1a):	Scales small, more than 90, vent and base of anal fin enclosed by tile like rows of scales……..…Sub-family: Shizothoracinae
3(1b):	Very long nasal barbels, length is much greater than the eye diameter and often as long as the head……Sub-family: Sisorinae
Key for Genus	
1a:	Lower lip modified in to a well-developed papillated plate……...……2
1b:	Lower lip not modified in to a well-developed papillated plate.……3
3a(1b):	Lower lip modified in to a complete labial fold ……4
3b(1b):	Lower lip not modified in to a complete labial fold...*Geus Shizothorax* Heckel, 1839
4a [3a(1b)]:	Nasal barbles longer than head, branched rays of dorsal 9-10….....5
4b [3a(1b)]:	Nasal barbles shorter than head, branched rays of dorsal 7…*Geus Nangra* Day, 1877
Key for Species	
1a:	Silvery with black spots on the dorsal and lateral sides …….....2
1b:	Dorsally dark brown, ventrally light yellow and fins yellowish…….....3
2a(1a):	Silvery with grayish back, fins pinkish, found in mountain streams and river…… ……..….*S. plagiostomus*
2b(1a):	It is found in mountains streams, rivers and lakes……..…*S. esocinus*
3a(1b):	Muddy with three indistinct vertical greenish half bands…….……4
3b(1b):	Found in middle of rivers, total length is about 12 cm ……..*N. robusta*

(step-by-step) way to classify fishes in the same area. A series of choices were made based on the fishes' characteristics to discover its distinctiveness. This fish key is based on body shape and physical features. It is prepared for the Phylum, Sub-phylum, Class, Sub-class and Super-order, Order, Family, Sub-family and Genus of species of fishes of Panjkora River near SBBU at Sheringal, KP, Pakistan during June 2013-July 2014.

DISCUSSION

In the present research, a dichotomous key to identify fish fauna in Panjkora River near SBBU at Sheringal, DU, KP, Pakistan was prepared during June 2013-August 2014. For this task fishes samples (n_t=102) were collected from both side (East and South) of river. However, 3 species under 2 genera, 2 families and 2 orders were recorded.

Ishaq *et al*. [19] worked on fish biodiversity of river Swat from Madyan to Chakdara. A total number of 18 species were collected belonging to 5 orders and 6 families. These species were *Barilius pakistanicus* Mirza and Sadiqi, 1978; goldfish*, Carassius auratus* Linnaeus, 1758; dwarf snakehead, *Channa gachua* Hamilton, 1822; spotted snakehead, *Channa punctata* Bloch, 1793; Kashmir latia, *Crossocheilus diplocheilus* Heckel, 1838; white carp, *Cirrhinus mrigala* Hamilton, 1822; *Garra gotyla* Gray, 1830; *Glyptothorax punjabensis* Blyth, 1860; rainbow trout, *Oncorhynchus mykiss* Walbium, 1792; *S. plagiostomus*; pool barb, *Puntius sophore* Hamilton, 1822; Kunar snowtrout, *Shizothorax labiatus* McClelland, 1842; cat fish, *Clupisoma nazirri* Mirza and Awan, 1973; Indus Mahseer, *Tor macrolepis* Heckel, 1838; *S. alepidota* and *S. esocinus.* The richest family was family Cyprinidae represented by 10 species. In the present Ichthyofauna study, the species collected belong to family Cyprinidae, i.e., *S. plagiostomus*, *S. esocinus* and *Nangra robusta.* The family Cyprinidae was the most dominant represented by 2 species, which shows somewhat similarity in both of the results. Similarity in the results may be either due to same method of collection and the same habitat, i.e., fresh water.

Mirza and Sandhu [18] developed a simple key for identifying fishes of the genera of Shizothorax and *Nangra*. In this key, they described the characteristics of *S. plagiostomus*; *S. esocinus* and *N. robusta* respectively. They stated that *S. plagiostomus* colour is silvery with grayish spots on back side, young fishes having black spots on dorsal sides, its maximum length reach up to 60 cm. They also stated that *S. esocinus* colour is yellowish ventrally, grayish, brown dorsally, fins pinkish other than dorsal and caudal its maximum length reach up to 60 cm. Furthermore, they stated that *N. robusta* colour is dark brown dorsally; light yellow ventrally, fins yellowish and mostly found in rivers. In the present Ichthyofauna study, the observed species *S. plagiostomus* has silver colour with grayish on back side, fins pinkish, found in mountain streams and rivers, however, *S. esocinus* has gray-brown colour, while yellowish ventrally, found in mountain streams and rivers, moreover, *Nangra robusta* is dark brown back, fins yellowish, about 12 cm. All the described fishes are found in mountain streams and rivers, which shows similarity in both results. Similarity, in the results may be either due to same habitat, i.e., fresh water, same resources of food and same environmental condition.

Bhat *et al*. [13] carried a study on the biology of fishes of river Lidder (Jammu and Kashmir) during 2003-2005. About 7 species of fishes were collected from the river, out of which, 3 was commercially important species, i.e., *S. plagiostomus* (n=133), *S. esocinus* (n=70) and *S. labiatus* (n=40). In the present Ichthyofauna study, collected commercially important species belong to family Cyprinidae, i.e., *S. plagiostomus* (n=13) and *S. esocinus* (n=43), which shows similarity in both of the results. Similarity in the results may be either due to same habitat, which is fresh water.

Muhammad *et al*. [16] reported a total of 11 fish species belonging to 4 orders and 4 families were recorded from River Panjkora at DU. The richest family represented by 7 species were Cyprinidae (trout, *Barilius pakistanicus* Mirza and Sadiq, 1978; ray-finned fish, *Carassius auratus* Temminck and Schlegel, 1846; ray-finned fish, *Crossocheilus diplocheilus* (Heckel, 1838); sucker head, *Gara gotyla*, (Gray, 1830); kunar snowtrout, *Racoma labieta* McClelland and Griffith, 1842; *S. esocinus* and ray-finned fish, *S. plagiostomus* Heckel., 1838) followed by Sisoridae [*Gagata cenia* (Hamilto, 1822) and *G. punjabensis*). The family Channidae and Salmonidae were comprised of one species each, spotted snakehead, *Channa punctata* Bloch, 1793; and rainbow trout, *Oncorhynchus mykiss* Walbium, 1792, respectively. In the present Ichthyofauna study, the richest family was Cyprinidae represented with 2 species (*S. esocinus* and *S. plagiostomus*) followed by family Sisoridae was represented by only 1 species *N. robusta* It was the new species reported form river Panjkora first time near SBBU at Sheringal, DU, KP, Pakistan. There was no data observed about *N. robusta* fish by Muhammad *et al.* [16] results, as well as it was not collected before the present report throughout the River Panjkora. However, during the present research, it was first time collected, it was may be migrated from other rivers; however, its abundance is still critical because only 5 specimens were collected at the present.

The species belong to family Cyprinidae such as *S. plagiostomus* and *S. esocinus* were reported in Allai Khoar by Mirza [20]; in Shakarparian, Islamabad, Pakistan by Rafique and Khan [21]; in Behrain, Madyan, Fateh Pur, Khwaza Khela, Fizagat, Kanju and Barikot Swat, Khyber Pakhtunkhwa, Pakistan by Ahmad *et al.* [22]. They were also reported in Kashmir Ladakh by Dar *et al.* [23]; in river Jhelum, Kashmir, India by Qureshi *et al.* [24]; in Mizoram, tripura and Barak drainage of Northeastern India by Kar and Sen [25]; in North East India, inclusive of the Himalayan and Indo Burma biodiversity hotspots zones by Goswami *et al*. [26]. In the present Ichthyofauna study, family Cyprinidae species such as *S. plagiostomus* and *S. esocinus* collected from river Panjkora near SBBU, Sheringal, DU, KP, Pakistan, which shows closed

similarity in both of the results. Similarity in the results may be either due to same environmental condition, the same temperature and same water resources.

The limitations encountered during the research were the climatic conditions of the study area, shortage of time period for the collection, unawareness of the people about the importance of fish and initially inexperience of proper catching practices by authors. Additionally, in both side of River Panjkora, fishers and other people who like fishing, often they did fishing by generating strong electric shocks by generators to collect the great number of fishes and they also use dynamites. Therefore, no proper conservation of the Panjkora River, no proper methods of collection and overfishing, on the other hand, people of Sherigal are mostly illiterate; consequently, they poured every type of garbage in the river, which is not only polluted the water of river, as well as harm to fish fauna of river. Furthermore, such unhygienic conditions, i.e., garbage, sewage and waste products etc were thrown into the river, which change the quality of water, may lead to decrease the numbers of such fish species. In 2010, the flood destructed the habitat of the fish species in the River Panjkora, therefore, a lot of fishes were lost or may be migrated. Moreover, which led lesser number of fish species were collected according to the expectation at the present.

CONCLUSION

The dichotomous key has been prepared for identification species of fishes collected from Panjkora River near SBBU at Sheringal, DU, KP, Pakistan for the 1st time. The reported species were *S. plagiostomus*, *S. esocinus* and *N. rhobusta*, which were belonging to family Cyprinidae and family Sisoridae respectively. From the present investigation, it is also concluded that the fish population is declined due to overfishing, pollution of natural water of the river, high levels of anthropogenic activities, i.e., discharge of pollutants, throw of garbage and drain of sewage etc,. There are no effective protection measures for conservation of fish fauna of River Panjkora.

Recommendations: A detail study is required for further exploration of fish fauna of River Panjkora, Sheringal, KP, Pakistan. The people of community of Sheringal should be educated to create awareness about the importance of fishes. In order to protect and restore fish population in river Panjkora, the following specific suggestions for protection at the local level must be taken: 1) The rules regarding fishing in river Panjkora need to be established and oriented more towards protection should be reinforced to the community; 2) Study the factors behind poor reproduction and rates of recruitment in fish populations with an effective reintroduction of fishes; 3) Expand cooperation and collaboration among ichthyologists, conservationists and fishermen working in the breeding range of fish populations; 4) take eco-tourism measures and extend public education programs involving fishermen; 5) River Panjkora should be protected from agro-industrial chemicals, discharge of pollutants, throw of garbage and drain of sewage and house-hold pollutions etc; 6) Rangers or security guards should be appointed and placed at adequate distances throughout the River Panjkora who look after illegal fishing etc; 7) those found to be conducting such activities should be punished.

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