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Current Status of Ichthyo-Faunal Diversity of Glacier Fed Stream Balkhila from Garhwal Himalaya

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Abstract: The present paper deals with the study of ichthyo-faunal diversity of glacier fed stream Balkhila. The stream Balkhila is an important tributary of Alaknanda River of Garhwal Himalaya. After its origin from the Lal Mati glacier, it drains through the famous Mandal valley of Garhwal region. The stream was represented by 10 fish species belonging to 3 families namely Cyprinidae (*Schizothorax richardsonii, Schizothorax plagiostomus, Schizothoraichthys niger* and *Tor chelynoides*), Cobitidae (*Noemacheilus rupicola, N. montanus, N. denisonii* and *N. multifasciatus*) and Sisoiridae (*Pseudecheneis sulcatus* and *Glyptothorax pectinopterus*). Among all these fishes *Schizothorax richardsonii* was abundant in the stream. The *Schizothorax plagiostomus* was common fish of the stream, whereas, rest all other fishes of the stream were found in less number. The relative abundance was calculated to show the abundance of different fish species of the stream. The various habitat preferences of different fish species were also studied. The diversity indices such as Shannon-Wiener diversity index, Simpson index, Margalef index and Sorensen's similarity index was also calculated.

Key Words: Diversity, Ichthyo-fauna, Balkhila Stream, Himalaya

Introduction

Fish is an important vertebrate group present in an aquatic ecosystem, which plays a very important role in country's economy. Fish diversity of the river represents the variety of fish fauna and their abundance. There are several anthropogenic activities namely industrialization, urbanization and agricultural practices, etc. which are responsible for destroying the ecological setup and due to which many species have become endangered. There are several factors which are responsible for threatening fish diversity. Introduction of exotic species is one of the factors (Copp *et. al.,* 2005). Heavy metals are responsible for polluting the environment and effect the ecosystem ecology and productivity in an irreversible manner (Majagi, *et. al.,* 2008). The common consequence of damming are loss of habitat heterogeneity and a reduction in the structural features diversity, as these structural features are preferred by fishes and other organisms in an aquatic ecosystem (Poff *et. al.,* 2007).

The physico-chemistry of water is crucial for all the living organisms including fishes and any abrupt change in it influence the aquatic life greatly. According to Singh et. al. (2007) the various anthropogenic activities deteriorate the water quality and this deterioration is increasing day by day. Lakra, *et. al.,* (2010) suggested that less biological communities are supported by altered habitat whereas, less perturbed habitat represents diverse fish fauna. They also suggested that open river, shallow water and deep pools are the primary habitats which contributes to diversity maximally, therefore, for the conservation and management of fish

diversity they recommend the protection of these habitats. Khan and Ali (2013) studied the ichthyo-fauna of the river Jhelum and found that fish diversity and fish catch have apparently reduced due to some stress and abnormal external influences.

According to Kar (2003) there are about 2500 fish species in India (930 are freshwater fishes and 1570 are marine) whereas, there are 27,977 fish species found across the globe (Nelson, 2006; Helfman *et. al.*, 2009).

In Uttarakhand, extensive work on fish diversity has been conducted by several researchers. The geographical distribution of ichthyo-fauna of the Garhwal Himalaya was extensively studied by Singh *et. al.*, (1987). Dobriyal and Kumar (1988) studied the fish and fisheries of river Mandakini. The ichthyo-faunal variations in two hillstreams of Garhwal Himalaya was carried out by Dobriyal and Singh (1988). The ecological studies on the biodiversity of Khoh river was conducted by Kumar *et. al.*, (2006). The Ganga River system is represented by a total 53 fish species as reported by Khanna *et. al.*, (2013). Fifteen fish species have been reported by Singh and Agarwal (2014) in the glacier fed stream Assiganga. Agarwal *et. al.*, **(2019)** studied the ichthyo-fauna of Pinder River and reported a total 27 fish species. Rana, *et. al.* (2017) has reported 56 fish species in Doon valley. Studies on hill streams fishes are of great significance and have great commercial value because these are an important source of food for the local people of the region. Furthermore, studies on their conservation and management is very crucial to maintain the biological diversity. In our present work an attempt has been made to study the ichthyo-fauna of glacier fed stream Balkhila from Garhwal Himalaya.

Materials and methods

Study area: The stream Balkhila is glacier fed and originates from the Lal Mati glacier and important tributary of Alaknanda River.The 1st site is Siron and is situated in 30° 24′ 22″ N and 79° 18′ 26″ E in an altitude of about 1061 masl. This spot is covered by thick and dense forests. The second spot is Tilfara and it is situated in 30^0 23′ 17″ N and 79^0 19′ 15″ E in an altitude 932 masl (Fig. 1).

Sampling of Fishes: Fish samples were collected from local fish market or fisherman round the year. The collected fishes were preserved in 5% formalin. Before preservation a small cut was given at abdominal region and formalin injection was also given for proper preservation of fishes.

For the identification of fish species various morphometric and meristic characters were taken into consideration. The identification of different fishes was made with the help of Day (1878), Srivastava (1968), Badola (1979), Datta Munshi and Srivastava (1988) and Talwar and Jhingran (1991).

Use of biostatistical tools: The various diversity indices were calculated to study the diversity of stream during both the study years. The Shannon-Wiener index, Simpson index and Margalef index were calculated by using PAST 3.0 software. The Sorenson similarity index was also calculated to show the similarity between the study years. Relative abundance of fishes was calculated by the following formula:

$$\text{R.A.} = \frac{\text{Number of samples of particular fish species}}{\textbf{Total} \text{ number of fish samples}} \text{x } 100$$

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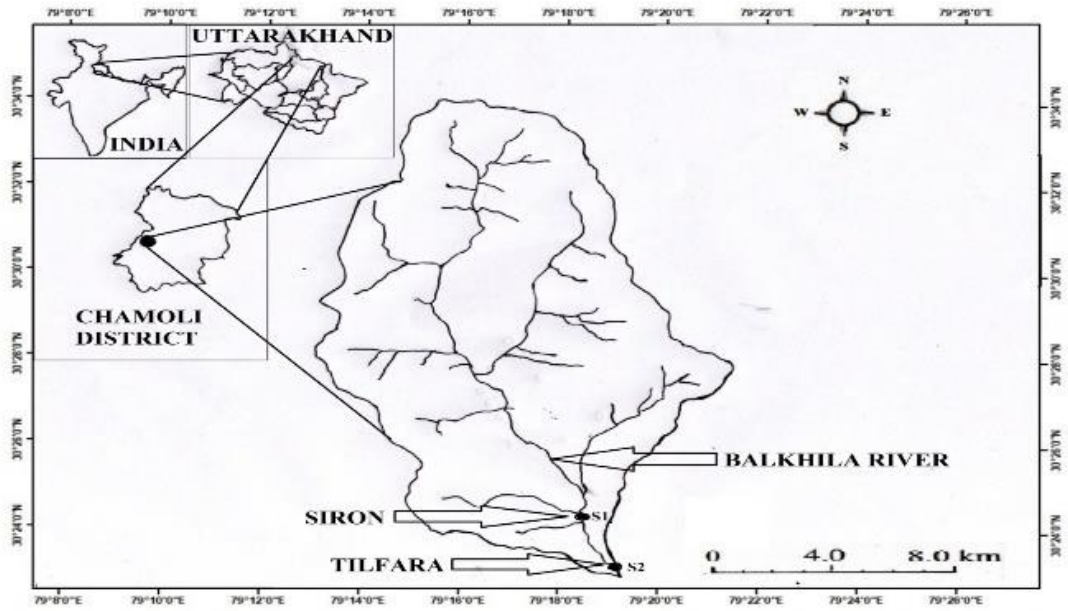

Fig. 1: Location of sampling sites of the stream Balkhila.

Result and discussion

Fishes were brought from the local fisherman of the region and the most common fish gear used by them was cast net. More than 200 fish specimen were collected during the two year of study 2018-20 and most of the fishing was done in lower stretch of the stream Balkhila. The ichthyo-faunal status of the stream is presented in the Table 1. The stream was represented qualitatively by 10 fish species belonging to 3 families namely Cyprinidae,Cobitidae and Sisoiridae. The Family cyprinidae was represented by 4 fish species namely *Schizothorax richardsonii, Schizothorax plagiostomus, Schizothoraichthys niger* and *Tor chelynoides.* The family cobitidae was represented by 4 fish species viz. *Noemacheilus rupicola, N. montanus , N. denisonii* and *N. multifasciatus* whereas, the Family Sisoiridae was represented by 2 species i.e. *Pseudecheneis sulcatus* and *Glyptothorax pectinopterus.* The species *Schizothorax richardsonii* was found to be abundant in the stream. The *Schizothorax plagiostomus* was also common fish found in the stream, whereas, all other fish species of the stream were rare. Riverine ecosystems are very important for the human population as these acts as source of food, water for irrigation and many other recreational activities. There are many abiotic factors (temperature, hydrology and geomorphology) which affect the distribution of species. Among all these, thermal regime have strong affect on species diversity of the region. There are only few species which can tolerate the low temperature extreme coupled with wide range of annual temperature resulting in inverse relationship between diversity and latitude (Winemiller, 1991; Oswood *et al.,* 1995). Relative abundance of different fish species of the stream Balkhila is presented in the Table 2. The relative abundance (%) of various fish species of the stream was *Schizothorax richardsonii* (47.034), *Schizothorax plagiostomus* (36.441), *Schizothoraichthys niger* (1.695) *Tor chelynoides* (4.661), *Noemacheilus rupicola* (2.966), *N. montanus* (2.119) N. *denisonii* (1.271) *N. multifasciatus* (0.847),

Pseudecheneis sulcatus (2.542) and *Glyptothorax pectinopterus* (0.424). The similar high relative abundance of *Schizothorax richardsonii* and *Schizothorax plagiostomus* in the Garhwal Himalayan rivers was also found by Singh and Agarwal (2014) in the stream Asiganaga, Agarwal *et al*. (2019) in the river Pinder. The Schizothorax *richardsonii* was the dominant fish of the stream. Dominancy of this species was also reported by Rawat *et. al.*, (2020) at Dharasu and Uttarkashi region of the river Bhagirathi. Habitat of different fish species of the stream Balkhila is presented in the Table 3. The different fishes showed different types of habitat preferences in the stream viz. deep pools, shallow pools, runs, riffles, rapids and cascades. The fish species *Schizothorax richardsonii* and *Schizothorax plagiostomus* were found in all types of habitats in the stream. The *Schizothoraichthys niger* was found in deep pools, riffles and runs. The *Tor chelynoides* was found in deep pools and runs. The Noemacheilus *rupicola* was found in deep pools , shallow pools and riffles. The *N. montanus* was found in deep pools, shallow pools, riffles and runs and absent in other types of habitats. The *N.denisonii* was found in deep pools, shallow pools and riffles and absent in other habitats. The *N. multifasciatus* was found in deep pools as well shallow pools. The fish species *Pseudecheneis sulcatus* was found in riffles, rapids and cascades type of habitats whereas, *Glyptothorax pectinopterus* was found in deep pools

Table 1: Ichthyofaunal status of the stream Balkhila

S.NO.	FISH SPECIES	LOCAL NAME	PRESENT STATUS
	Family Cyprinidae		
1	*Schizothorax richardsonii* (Gray)	Maseen	Abundant
2	*S. plagiostomus* (Heckel)	Asela	Common
3	*Schizothoraichthys niger* (Heckel)	Chongu	Rare
4	*Tor chelynoides* (McClelland)	Mahseer	Rare
	Family Cobitidae		
5	*Noemacheilus rupicola* (McClelland)	Gadiyal	Rare
6	*N. montanus* (McClelland)	Gadiyal	Rare
7	*N. denisonii* (Jordan)	Gadiyal	Rare
8	*N. multifasciatus* (Day)	Gadiyal	Rare
	Family Sisoiridae		
9	*Pseudecheneis sulcatus* (McClelland)	Kathrua	Rare
10	*Glyptothorax pectinopterus* (McClelland)	Kathrua	Rare

Table 2: Relative abundance of different fish species of the stream Balkhila.

S.NO.	FISH SPECIES	Relative Abundance (%)
	Family Cyprinidae	
1	*Schizothorax richardsonii* (Gray)	47.034
2	*S. plagiostomus* (Heckel)	36.441
3	*Schizothoraichthys niger* (Heckel)	1.695
4	*Tor chelynoides* (McClelland)	4.661
	Family Cobitidae	
5	*Noemacheilus rupicola* (McClelland)	2.966
6	*N. montanus* (McClelland)	2.119
7	*N. denisonii* (Jordan)	1.271
8	*N. multifasciatus* (Day)	0.847
	Family Sisoiridae	
9	*Pseudecheneis sulcatus* (McClelland)	2.542
10	*Glyptothorax pectinopterus* (McClelland)	0.424

Table 3: Habitat of different fish species of the stream Balkhila.

S.NO.	FISH SPECIES	Deep pools	Shallow pools	Riffles	Runs	Rapids	Cascades
	Family Cyprinidae						
1	*Schizothorax richardsonii* (Gray)	+	+	+	+	+	+
2	*S. plagiostomus* (Heckel)	+	+	+	+	+	+
3	*Schizothoraichthys niger* (Heckel)	+	-	+	+	-	-
4	*Tor chelynoides* (McClelland)	+	-	-	+	-	-
	Family Cobitidae						
5	*Noemacheilus rupicola* (McClelland)	+	+	+	-	-	-
6	*N. montanus* (McClelland)	+	+	+	+	-	-
7	*N. denisonii* (Jordan)	+	+	+	-	-	-
8	*N. multifasciatus* (Day)	+	+	-	-	-	-
	Family Sisoiridae						
9	*Pseudecheneis sulcatus* (McClelland)	-	-	+	-	+	+
10	*Glyptothorax pectinopterus* (McClelland)	+	-	-	-	-	-

The distribution and abundance of fish species in the rivers exhibit the longitudinal zonation (Habit *et. al.*, 2006). The various factors (hydrology, temperature, geomorphology and the associated riparian vegetation) in combination makes habitat template which

controls the species diversity at local and regional scale (Poff and Ward, 1990). The stream Balkhila provides good catch of *Schizothorax sps.* because of their abundance and acts as food source to the local population of the region. All other fish species (*Schizothoraichthys niger, Tor chelynoides, Noemacheilus rupicola, N. montanus, N. denisonii, N. multifasciatus, Pseudecheneis sulcatus* and *Glyptothorax pectinopterus*) were rare. Bhutyal and Langer (2015) have also found that *Schizothorax sps* was abundant in the river Chenab and acts as food fish to the local population. The abundance of *Schizothorax sps* was also reported by Hamid and Singh (2019) in the left tributary of river Jhelum in Jammu and Kashmir. Studies on the other aspects of hillstreams fishes such as their spawning and fecundity patterns was carried out by Singh *et. al.*, (1985) and Dobriyal and Singh (1989).

The values of various diversity indices is presented in the Fig. 2 to 4. The Shannon-Wiener diversity index values was found to be 1.388 in the first year whereas, the index values was 1.208 during the second year of study. The Simpson index value was 0.657 during first year of study and 0.599 during second year of study, whereas, the Margalef index value was 1.808 and 1.552 during the first and second year of study. The Sorenson similarity index value between two years of study was 0.88.

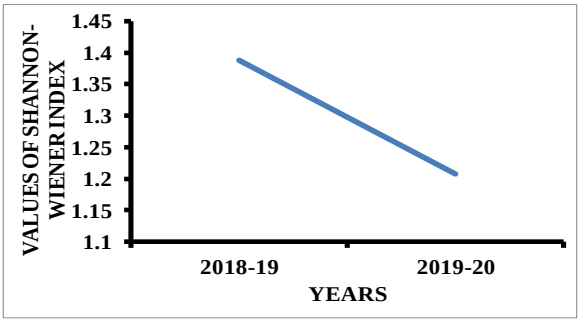

Figure 2: Shannon-Wiener diversity index values during two years of study 2018-19 and 2019-20.

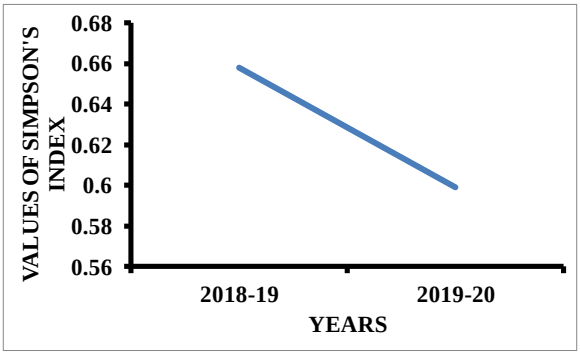

Figure 3: Simpson's index values during two years of study 2018-19 and 2019-20.

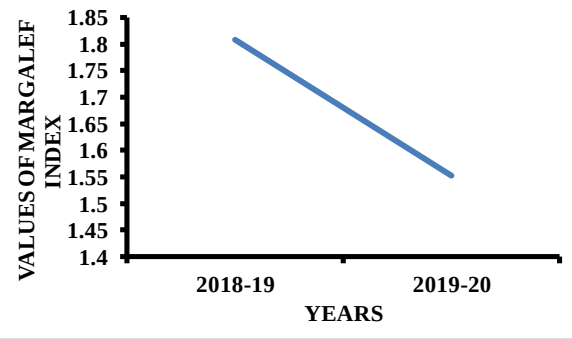

Figure 4: Margalef index values during two years of study 2018-19 and 2019-20.

With increasing human population there is more pressure on the protein rich diet in most of the developing countries. Many developing countries of the world have suffered from lack of dietary protein, so it is very important to develop the conservation strategies for riverine fishery and there is urgent need to aware the local population of the region to avoid all the illegal methods of fish catching because illegal method of fishing not only kills the entire fish population but also destroy all the aquatic communities.

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