Icthyodiversity and Species Richness of Chadwal Stream, Kathua District (Jammu & Kashmir)

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ABSTRACT   *The present study encompasses Chadwal stream, diversity rich stream that falls in Chadwal area of Kathua district covering entire stretch in the plains. During the present study, a total of 19 species belonging to 4 families and 12 genera were recorded. Among the stations, family Cyprinidae formed the largest dominant family contributing 16 species (91%), followed by Nemachelidae (4%); Belonidae (3%) and Channidae (2%) each contributing one species each. The Dominance index (D) estimated ranges 0.09 to 0.16 whereas the value of Simpson diversity index (I-D) ranged from 0.84-0.91. The values of Shannon-Weiner diversity ranged between 2.08-2.57. Also the physico-chemical parameters for water body were analyzed monthly and the values of all the parameters were found to be in permissible limits which support the growth and survival of fish.*

1. INTRODUCTION

Icthyodiversity refers to variety of fish species, depending on context and scale; it could refer to alleles or genotypes within piscian population, to species of life forms within a fish community, and to species or life forms across aqua regime (Burton *et al.*, 1922). Fishes are the important elements in the economy of many nations as they are stable item of diet and are good indicator of the ecological integrity and functioning of riverine system as the fishes have ability to occupy multiple trophic levels (Schlosser, 1985 and Copp *et al.*, 1991). Fresh water fish diversity represents the most diverse group of Indian vertebrates with a minimum of 600 species (Talwar and Jhingran, 1991). Fishes are one of the threatened taxonomic groups because of their high sensitivity to quantitative and qualitative alteration of aquatic habits (Sarkar *et al.*, 2008 and Kang *et al.*, 2009).

In Jammu region, particularly in district Kathua, the tributaries of river Ravi support the fish biodiversity and offers better livelihood but has been less studied with regard to fish community and their diversity. Studies are on record but with limited access and that too pertaining to commercial fishing only i.e. Ranjit Sagar dam, other streams however, have remained unexplored particularly with fisheries view point. Though enormous work for overall Kathua district fish fauna has been done by Nath, 1969; Das and Nath, 1971; Dutta and Malhotra, 1984; and Jyoti and Gupta, 1978. In past and since last few decades no detailed study on accessing the status of fish community in this particular area has been undertaken. Thus in order to update the records and fill up the gaps, the present study encompasses the parameters like present status of fish community structure, abundance, diversity, distribution and richness of the stream.

2. MATERIAL AND METHODS
2.1. Site description:
Chadwal stream, diversity rich stream that falls in Chadwal area of Kathua district covering entire stretch in the plains. The stream area falls along the road side to agricultural site to downstream up to the pure agricultural belt with less disturbance and better vegetation cover. Two study sites were selected along the entire stretch. Sites were selected on the basis of distance, distribution and undisturbed area.

Site I road side (disturbed and polluted area)

Site II Agricultural side (undisturbed and unpolluted area)

2.2. Collection and identification:
Fish sampling and analysis of physico chemical parameters of study stations was done in mid of each month throughout the study year at a fixed time. Water temperature was measured using mercury thermometer; pH was measured by Hanna's thermometer while other parameters viz. Speed, DO, Free Carbon dioxide, carbonates, bicarbonates, chloride, calcium and magnesium were also analysed in the field by APHA (1998).

The collection of fishes was made with gill net and cast net. Representative specimens of all the fish species were fixed in 10% formaldehyde solution. The fishes collected were labelled and transferred to the laboratory for further study. The fishes were subsequently identified by following standard literature by Dutta and Malhotra, 1984; Talwar and Jhingran, 1991; Day, 1994 and Jayaram, 1999.

2.3. Analysis of data:
The diversity of fishes was analysed using different indices: Simpson Index (Simpson, 1949) and Shannon-Weiner index (Shannon and Weiner, 1949). Species richness was calculated in terms of Marglef´s index and Menhinicks's index (Marglef, 1958) and evenness by Pielou's index (Pielou, 1975) by PAST software (diversity calculator) version 2.17c.

Also the pattern of similarities in fish composition between two study stations was calculated using Sorenson's similarity index (Sorenson, 1948) to know the uniqueness of the study stations. Sorenson's coefficient index calculated in between two habitats A and B as:

$$SC = \frac{2a}{2a + b + c}$$

a = number of species common for two habitats

b = number of species present in habitat B but absent in habitat A

c = number of species present in habitat A but absent in habitat B

The index varies between 0 and 1, where 0 indicates no similarity and 1 indicates maximum similarity.

3. RESULTS
3.1. Species assemblage and distribution
During the present study a total of 19 species belonging to 4 families and 12 genera (Table1) were recorded. Among the stations, Cyprinidae formed the largest dominant family contributing 16 species (91%), followed by Nemachelidae (4%); Belonidae (3%) and Channidae (2%) each contributing one species each (Figure 1). A total of 543 individuals of fishes were caught during one year study period. The most abun-

dant family was Cyprinidae having 496 individuals and rest of families contributed less in order of abundance throughout the study period as summarized in Table 1. Out 0f 19 species recorded, maximum of 17 species were recorded in station II and 12 species at station I. Overall, both the stations were dominated by family Cyprinidae. Family Belonidae and Channidae show complete absence from station I. Also among the recorded fish species, *Labeo boga* 117 (21.54%) was the dominant species followed by *Puntius ticto* 53 (9.76%), *Labeo dero* 46 (8.47%), *Danio devario* 39 (7.18) *Crossocheilus latius* 38 (6.99%) and *Puntius sophore* 29 (5.34%) while other fish species viz, *Xenentodon cancila* 20 (3.68%), *Chela bacila* and *Nemacheilus botia* 18 (3.31%), *Barilus bendelesis* 16 (2.94%), *Labeo calbasu* and *Puntius sarana* 14 (2.57%) and *Barilius Vagra* 11(2.02%) are often found in catches while rest of fish species *Channa punctatus* 9 (1.65%), *Labeo rohita* 5 (0.92%), *Garra gotyla gotyla* 5 (0.92%) and *Tor putitora* 3 (0.55%) are found rare in catches and are low among the study stations (Figure 2).

3.2. Statistical estimation of species diversity

The Statistical estimation of species diversity of Chadwal stream is shown in table 2. The Dominance index (D) estimated range between 0.09 to 0.16 where lowest value was found in Station II and highest in station I. The value of Simpson diversity index (I-D) ranged from 0.84-0.91 being highest at station II and lowest at station I. The values of Shannon-Weiner diversity ranged between 2.08-2.57. The evenness index value was high at station II (0.77) and lowest at station I (0.67). Similarly Margalef's index was highest at station II (2.70) and minimum at station I (2.14). Sorenson's similarity index was also used to evaluate the faunal similarities between the study stations and showed to be 0.69 which indicates the maximum similarity among the study stations.

Evaluation of commercial utilization of fishes of Chadwal stream indicated that this stream is rich in supporting many ornamental fishes (63.90%); commercial food fishes (41.07%) and sport fishes (0.55%). Also the physico-chemical parameters for water body were analyzed monthly and the readings are shown in Table 3 and are in permissible limits which support the growth and survival of fish.

4. DISCUSSION

Out of the total 19 species present in the water body, 17 species were recorded from station II and 12 from station I. The high fish diversity at station II is due to diverse network of undercut banks, huge vegetation due to agricultural runoff. Moreover this station also harbours larger and deeper pools which support fishes to accumulate in diverse habitats. However, station II is also a religious place hosting some Asharam on the bank of stream which restricts the fishing activities in that stretch and fishermen do not perform fishing activities very effectively. Also there is very low human distortion which all is in favour of high fish diversity. The overall fish diversity in the stream is dominated by family Cyprinidae (91%) which might be due to presence of an appropriate environment and river bottom that family members prefer (Alam et al, 2013). Similar results were also reported by Sharma *et al* (2012) from Behlol Nullah. Higher diversity and abundance of fish was also reported by Zalewski and Naiman (1985) as a result of heavy rains and submergence of nearby water bodies which probably carried more fishes from surrounding. The factors responsible for comparative low diversity at station I is due to anthropogenic activities in the form of direct discharge of domestic sewage, agricultural waste and other pollution load as this station is situated along road side with high fishing pressure due to direct links to road and water level is also low being low at this station. However, the taxa present at station I is dominated by hardy fishes (*Puntius*

ticto, P. conchonious, P. sophore, Labeo boga, Danio devario) which are capable of tolerating wide vaiations in environmental conditions, whereas sensitive species like *Tor putitora and Garra gotyla gotyla* showed their complete absence. These variations in number of species in two study stations of same water body are definitely a function and a consequence of degree of pollution.

When a comparison is drawn, the species diversity and its abundance reach its peak in monsoon due to favourable conditions such as sufficient water level and ample of food resources and is low in summers and winters due to shrinkage of water level as also highlighted by Murugan and Prabaharan (2012). High value of CPUE was recorded in middle and lower stretch of water body due to presence of deep pools and moderate velocity of water as also reported by Boruah and Biswas, 2002 from river Brahmaputra.

Various indices of biodiversity have been created in an attempt to capture the diversity of an ecosystem. These indices are used to describe the diversity of an ecosystem as accurately as possible (Vyas *et al*., 2012) and are given in table 2. In the present study, we have applied five diversity indices i.e. Dominance index, Simpson index, Shannon index, Evenness and Margalef's index. According to Wilhm and Dorris (1966), Shannon index value ranged from 1-3, where >3 indicates clean water, <1 indicates polluted water and in between as moderate water. In both the study stations value of shannon index ranged between 2.08-2.57 which indicates moderate water condition. Simpson index is used to measure diversity whose value ranged between 0-1. The low value of index indicates high diversity and high value indicates low diversity. In the study stations the index value ranges between 0.84-0.91 which indicates low diversity at study stations. Margalef value has no limit of value and is used for comparison of sites which indicates station II (2.70) has more species diversity than station I (2.14). Species evenness refers to how close in numbers is each species in an environment. In the present study the evenness value 0.67-0.77 clearly indicates that there is not much even distribution of species in both study stations.

| S No	Family	Genus	Upstream (Station I)					Downstream (Station II)				
			Presence	Abundance	Relative abundance	% Contribution	CPUE	Presence	Abundance	Relative abundance	% Contribution	CPUE
1	Cyprinidae	Barilus bendelesis	+	9	0.052	5.23	1.8	+	7	0.018	1.88	1.4
2		Barilius vagra	+	6	0.034	3.48	1.2	+	5	0.013	1.34	1
3		Chela bacila	-	0	0	0	0	+	18	0.048	4.85	3.6
4		Danio devario	-	0	0	0	0	+	39	0.105	10.51	7.8
5		Tor putitora	+	3	0.017	1.74	0.6	-	0	0	0	0
6		Puntius sarana	-	0	0	0	0	+	14	0.037	3.77	2.8
7		Puntius ticto	+	35	0.203	20.34	7	+	47	0.126	12.66	9.4
8		Puntius conchonius	+	19	0.110	11.04	3.8	+	54	0.091	9.16	6.8
9		Puntius sophore	+	12	0.069	6.97	2.4	+	17	0.045	4.58	3.4
10		Cirrhinus mrigala	=	1	0.005	0.58	0.2	=	5	0.013	1.34	1
11		Labeo calbasu	-	0	0	0	0	+	14	0.037	3.77	2.8
12		Labeo dero	+	15	0.087	8.72	3	+	31	0.083	8.35	6.2
13		Labeo boga	+	50	0.291	29.06	10	+	67	0.180	18.06	13.4
14		Labeo rohita	-	0	0	0	0	+	5	0.013	1.34	1
15		Crossocheilus latius	+	13	0.075	7.55	2.6	+	25	0.067	6.73	5
16		Garra gotyla gotyla	+	5	0.029	29.06	0	-	0	0	0	0
17	Nemacheilidae	Nemacheilus botia	=	4	0.023	2.32	0.8	=	14	0.037	3.77	2.8
18	Belonidae	Xenentodon cancila	-	0	0	0	0	+	20	0.053	5.39	4
19	Channidae	Channa punctatus	-	0	0	0	0	+	9	0.024	2.42	1.8

Table 1: Abundance, relative abundance, percentage contribution and CPUE of study stations of Chadwal stream

Variables	Station I	Station II
Taxa_S	12	17
Individuals	172	371
Dominance_D	0.16	0.09
Simpson_1-D	0.84	0.91
Shannon_H	2.08	2.57
Evenness_e^H/S	0.67	0.77
Margalef	2.14	2.70

Table 2: Ecological indices of fish fauna at study stations

Parameters	Station I (Mean)	Station II (Mean)
Water Temperature (^{0}C)	24	25.2
pH	8.0	7.92
Dissolved Oxygen (mg/l)	5.4	6.0
Free Carbon dioxide (mg/l)	1.16	1.16
Carbonates(mg/l)	40.05	40.5
Bicarbonates (mg/l)	231.8	237.9
Chloride (mg/l)	16.92	19.98
Calcium (mg/l)	28.07	28.07
Magnesium (mg/l)	39.37	40.0

Table 3: Mean of physico chemical parameters at study stations
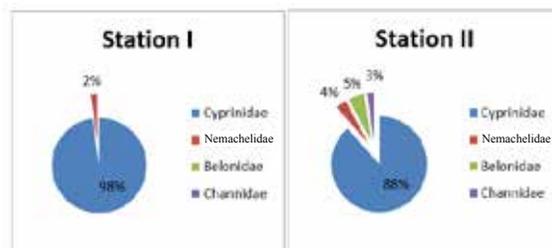
Figure 1: Percentage contribution of different families in two study stations
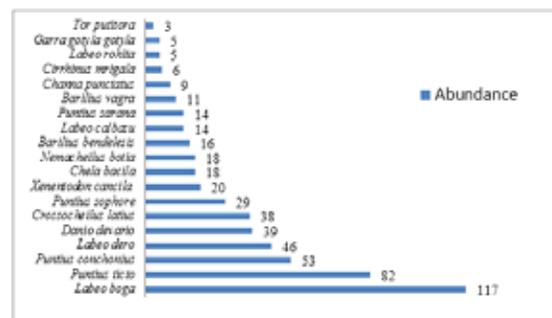
Figure 2: Diagrammatic representation of abundance of Fish species

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