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Longitudinal Patterns of Population Structure for Fishes Inhabiting River Tawi in Jammu region (J&K)

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The present study, was carried out to investigate the diversity and assemblage structure of ichthyofauna of both upstream and downstream section of river Tawi from four different sections i.e. Station I (Chenani), Station II (Jhajjar kotli), Station III (Nagrota), and Station IV (Gujjar Nagar). The sampling was done from January 2016 to December 2016. The results of present investigation revealed the occurrence of twenty one fish species in all the study stations belonging to five orders viz. Cypriniformes, Mastacembeliformes, Synbranchiformes, Perciformes & Siluriformes and 6 families i.e. Cyprinidae, Nemachilidae, Mastacembelidae, Chinnidae, Sisuridae and Bagaridae. In all the study stations Cyprinidae was found to be dominant (62%) **followed by family Nemacheilidae,** (9%) **Mastacembelidae, (**9%**) Channidae,** (10%) **Sisuridae and Bagaridae showed least contribution of** 5% **each. The fish diversity indices i.e. Shannon weiner (H) and Evenness (e) at all the stations were 1.286 & 0.7234, 1.662 & 0.753, 1.959 & 0.5454 and 1.978 & 0.4252 at station I, II, III and IV respectively.**

Keywords: Ichthyofauna, Fish diversity, assemblage structure, Tawi river.

Fishes are the major component of an aquatic ecosystem, as they provide the nutritious and delicious food for mankind. They are indicator of aquatic health, and also play significant role in ecosystem preservation. They play major role in enhancing the economy of nation. India is one of the mega bio-diversity countries in the world, and occupies 9th position in term of fresh water diversity. In India there are 2,500 species of fishes of which 930 live in fresh water and 1,570 are marine (Kar *et al,* 2003).

The share of riverine fisheries in total inland fish production may not be significant, but being the prime source of original fish germplasm, their role becomes crucial for conservation of fish diversity. Moreover, millions of fisherman and their families depend on rivers for their livelihood. Rivers, the life line of our country are a vast repository of unmatched biological wealth. With catchment areas of 3.12 million sq.kms, 14 large (covering 18.3% of drainage area) and 44 medium and minor river system are characterized by highly diverse aquatic communities.

Biological communities reflect the pattern of habitats. In smaller headwater areas and small specialized habitat features, the variety of species may be small. As the size and complexity of habitats incease so too the potential size and variability of fish community. Within the river system, the number and types of species will fluctuate with the variability of habitats. Modification of river system can have serious implications for the sustainability of communities. Dams, water withdrawal, canalization, pollution, modifications of erosion and deposition patterns,

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and other features contribute to an alteration in the pattern and quality of habitat.

J&K region is endowed with potentially rich and varied aquatic resources amendable for fisheries. Most of the area encompasses hill regions from where the rivers, streams and its tributaries meandered in plains and valleys. Moreover, these hill streams are in more precarious conditions as regard to their ecological status because of their metastable eco-geography.

Since most of lotic water bodies in upper reaches of Jammu region have not thoroughly being explored, with hardly any information regarding the fish composition, distribution and population dynamics, primarily on account of inaccessibility to these regions due to presence of deep gorges, narrow valleys and due to meager transport facilities.

Thus, regular documentation and management of fresh water fishery of these sensitive lotic water bodies requires immediate attention to access the ecosystem health, fish community structure, and distribution patterns and to develop management and conservation strategies. Therefore, the present research work has been designed to raise first-hand information on various aspects of population structure in the various sections of river Tawi.

MATERIALS AND METHODS

Site selection

To study the ichthyofaunal diversity of the river Tawi fish samples were collected from four different habitat variables in the various sections of river Tawi. viz., station I (Chenani), situated at 32°57 – 20.45 N latitude and 75°9 59.38 E longitude, station II (Jhajjar kotli), 32°53 48.30 N latitude and 74°57 37.90 E longitude, station III (Nagrota), 32°47 2.92 N latitude and 74°55 – 39.48 E longitude, station IV (Gujjar Nagar), 32°43 – 31.45 N latitude and 74°52 19.72 E longitude.

Collection and identification

During present study fishes were monthly captured from January to December 2016 by using different types of nets i.e. cast net, drag net, hand/ dip net. Collected fish samples were preserved in 10 % formalin for detailed examination.

Table 1. Showing fish abundance and percentage at station I (Chenani). For the year January to December 2016. (Upstream)

S. No	Fish species	Family	Total Abundance	%
1	*Garra gotyla* (Gray)	Cyprinidae	55	51.88
2	*Schizothorax richardsonii* (Gray)	Cyprinidae	19	17.92
3	*Labeo boga* (Ham Buch)	Cyprinidae	18	16.98
4	*Tor putitora* (Ham Buch)	Cyprinidae	11	10.37
5	*Schistura montanus* (Clelland)	Nemacheilidae	3	2.83
Total			106	

Table 2. Showing fish abundance and percentage at station II (Jhajjar kotali). For the year January to December 2016

S. No	Species	Family	Total Abundance	%
1	*Labeo boga* (Ham Buch)	Cyprinidae	168	23.56
2	*Tor putitora* (Ham Buch)	Cyprinidae	161	22.58
3	*Barilius vagra* (Ham Buch)	Cyprinidae	145	20.33
4	*Garra gotyla* (Gray)	Cyprinidae	142	19.91
5	*Puntius ticto* (Ham Buch)	Cyprinidae	83	11.64
6	*Bagarius yarrellii* (Ham Buch)	Sisoridae	9	1.26
7	*Mastacembelus pancalus*(Ham Buch)	Mastacembelidae	5	0.7
Total			713	

The collected specimens were sorted at species level and all the species obtained were counted. Species identification and confirmation were carried out using available literature (Day, 1958; Talwar and Jhingran, 1991; Jayaram 1999).

Population studies

Information on structure of fish assemblage was extracted by using different univariate indices, namely Shannon diversity index, Simpson index, Margalef Index and Evenness Index.

Shannon's Diversity index (H)

H=-Σpi In pi

Pi=ni/N

Ni=Number of individuals of each species in the Sample.

N=Total number of individuals of all species in the sample

ii. Simpson's index (D)

D=Σ (n-1)/N (N-1)

n=the total number of organisms of a particular

Table 3. Showing Fish abundance and percentage at station III (Nagrota).for the year January 2016-December 2016

S.No	Fish species	Family	Total Abundance	%
1	*Barilius vagra* (Ham Buh)	Cyprinidae	260	31.9
2	*Puntius conchonius* (Ham Buch)	Cyprinidae	149	18.28
3	*Aspidoparia morar* (Ham Buch)	Cyprinidae	118	14.47
4	*Tor putitora* (Ham Buch)	Cyprinidae	99	12.14
5	*Crossocheilus latius* (Ham Buch)	Cyprinidae	15	1.84
6	*Garra gotyla* (Gray)	Cyprinidae	52	6.38
7	*Barilius bendelisis* (Ham Buch)	Cyprinidae	44	5.398
8	*Labeo boga* (Ham Buch)	Cyprinidae	16	1.963
9	*Puntius ticto* (Ham Buch)	Cyprinidae	13	1.595
10	*Schizothorax richardsonii* (Gray)	Cyprinidae	1	0.122
11	*Labeo bata* (Ham Buch)		1	0.122
12	*Puntius sophore* (Ham Buch	Cyprinidae	4	0.49
13	*Nemacheilus botia* (Ham Buch)	Nemacheilidae	43	5.276
Total			815	

Table 4. Showing Fish abundance and percentage at station IV (Gujjar Nagar).for the year January 2016-December 2016 (Downstream)

S.No	Fish species	Family	TotalAbundance.	%
1	*Puntius conchonius* (Ham Buch)	Cyprinidae	325	33.78
2	*Barilius vagra*(Ham Buch)	Cyprinidae	25	2.59
3	*Puntius ticto*(Ham Buch)	Cyprinidae	223	23.18
4	*Aspidoparia morar*(Ham Buch)		122	12.68
5	*Barilius bendelisis*(Ham Buch)	Cyprinidae	97	10.08
6	*Puntius sophore*(Ham Buch)	Cyprinidae	50	5.19
7	*Labeo boga*(Ham Buch)	Cyprinidae	31	3.22
8	*Crossocheilus latius*(Ham Buch)	Cyprinidae	20	2.07
9	*Labeo dero*(Ham Buch)	Cyprinidae	6	0.62
10	*Garra gotyla* (Gray)	Cyprinidae	4	0.41
11	*Tor putitora*(Ham Buch)	Cyprinidae	13	1.35
12	*Nemachilus botia*(Ham Buch)	*Nemacheilidae*	8	0.83
13	*Mystus seenghala*(Skyes)	Bagridae	7	0.72
14	*Mastacembelus puncalus* (Hamilton)	Mastacembelidae	7	0.72
15	*Mastacembelus armatus* (Lacepede)	Mastacembelidae	3	0.31
16	*Channa punctatus*(Bloch)	Channidae	14	1.45
17	*Channa striatus* (Bloch)	Channidae	7	0.72
Total	962			

species.
N=the total number of organisms of all species.
iii. Margalef's Index Margalef's index was used as a simple measure of species richness (Margalef, 1958).
Margalef's index = (S – 1)
S = total number of species
N = total number of individuals in the sample
In = natural logarithm
iv Pielou's Eveness For calculating the evenness of species, the Pielou's
Evenness Index (e) was used (Pielou, 1966).
e = H / In S
H = Shannon – Weaver diversity index
S = total number of species in the sample.

RESULTS AND DISCUSSION

During the present investigation, for a period of one year (January 2016 to December 2016) a total of 21 fish species belonging to five orders viz.Cypriniformes, Mastacembeliformes, Synbranchiformes, Perciformes and Siluriformes and 6 families i.e. Cyprinidae, Nemachilidae, Mastacembelidae, Chinnidae, Sisuridae and Bagaridae including variety of fishes were present i.e. Cold water, warm water, food fishes and ornamental fishes etc. In all the study stations Cyprinidae was found to be dominant (62%) followed by family Nemacheilidae, (9%) Mastacembelidae, (9%) Channidae, (10%)

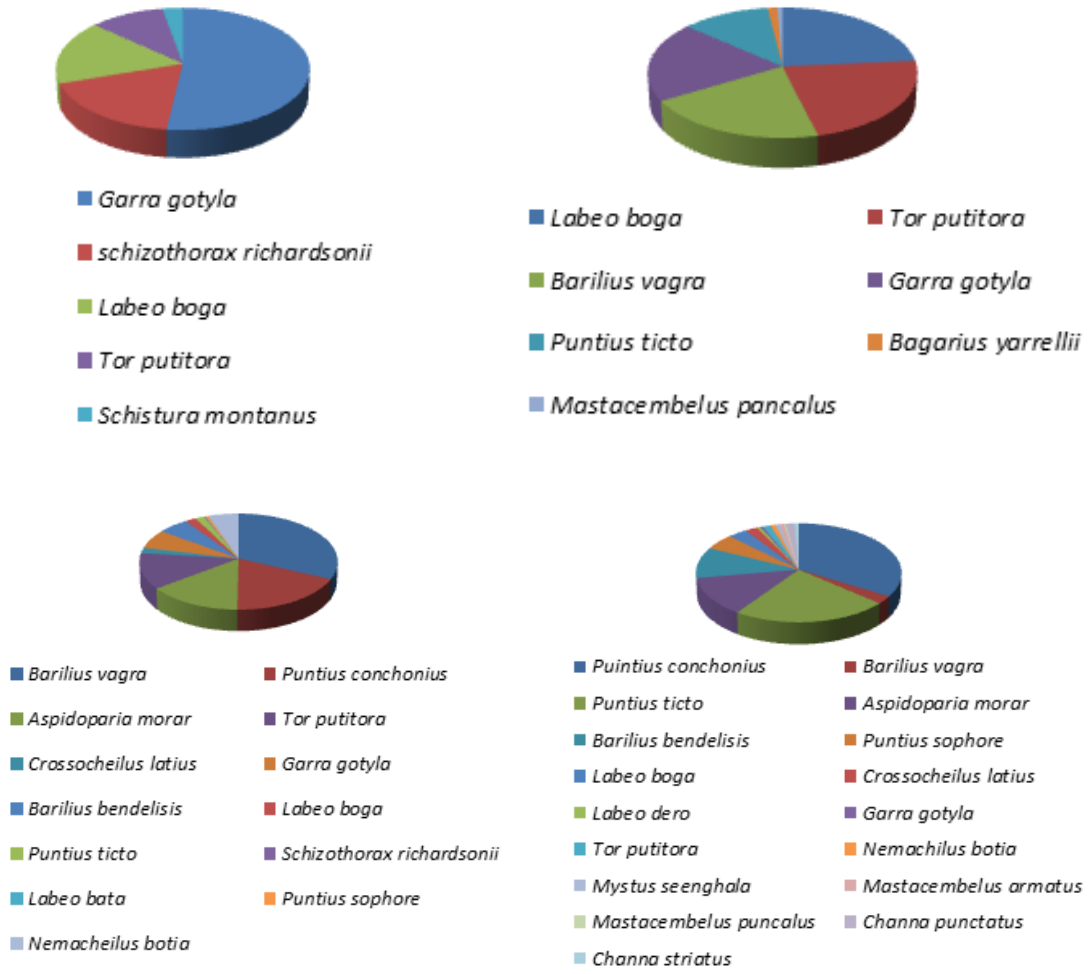

Fig. 1-4. Showing contribution of fish species at all the study stations i.e. I, II, III, & IV

Sisuridae and Bagaridae showed least contribution of 5% each representing single species. Dominance of Cyprinids in the assemblage structure, as seen during the present study, was due to their high adaptive variability to occupy all possible habitats and presence of appropriate environment, river bottom, depth, water current and food abundance etc for cyprinids which is in accordance with the observations of Dass and Nath (1966), Dutta and Malhotra, (1984), Dutta *et al*. (2002), Kaur (2006), Mishra *et al*, (2013), Andotra (2014), Gandotra and Poonam (2015),Vivek (2016) and Abdul razak *et al*. (2017). (Table1-4 & fig 1-4).

Station wise data of fish abundance revealed that at Station I (Chenani) 5 fish species were collected (H=1.286) i.e. *Garra gotyla, Schizothorax richardsonii, Labeo boga, Tor putitora, Schistura montanus.* At Station II (Jhajjar kotli) 7 species were recorded (H=1.662) i.e. *Labeo boga, Tor putitora, Barilius vagra, Garra gotyla, Puntius ticto, Bagarius yarrellii and Mastacembelus pancalus.*13 fish species were identified (H=1.959) at station III (Nagrota) which includes *Barilius vagra, Puntius conchonius, Aspidoparia morar, Tor putitora, Crossocheilus latius, Garra gotyla, Barilius bendelisis, Labeo boga, Puntius ticto, Schizothorax richardsonii, Labeo bata, Puntius sophore and Nemacheilus botia*. Whereas, station IV (Gujjar Nagar) was representated by 17 fish species (H=1.978) which includes *Barilius vagra, Puntius conchonius, Puntius ticto, Aspidoparia morar, Barilius bendelisis, Puntius sophore, Labeo boga, Crossocheilus latius, Labeo dero, Garra gotyla, Tor putitora, Nemacheilus botia, Mystus seenghala, Mastacembelus puncalus, Mastacembelus armatus, Channa punctatus and Channa striatus.*

Moreover, a comparative study of various stations revealed that there was more abundance of cold water fishes in upstream sections (Station 1)

Table 5. Showing Fish species Richness, Abundance and diversity indices of four longitudinal sections of river Tawi

S. No	Study Stations	Abundance (N)	Shannon-Weiner Index(H)	Simpsons Index of Dominance(D)	Margalefs Richness Index d=S-1/logN	Evenness Index E=H´/log(S)
1	Chenani	106	1.286	0.3418	0.8577	0.7234
2	Jhajjar Kotli	713	1.662	0.2013	0.9133	0.753
3	Nagrota	815	1.959	0.1817	0.79	0.5454
4	Gujjar Nagar	962	1.978	0.1997	2.329	0.4252

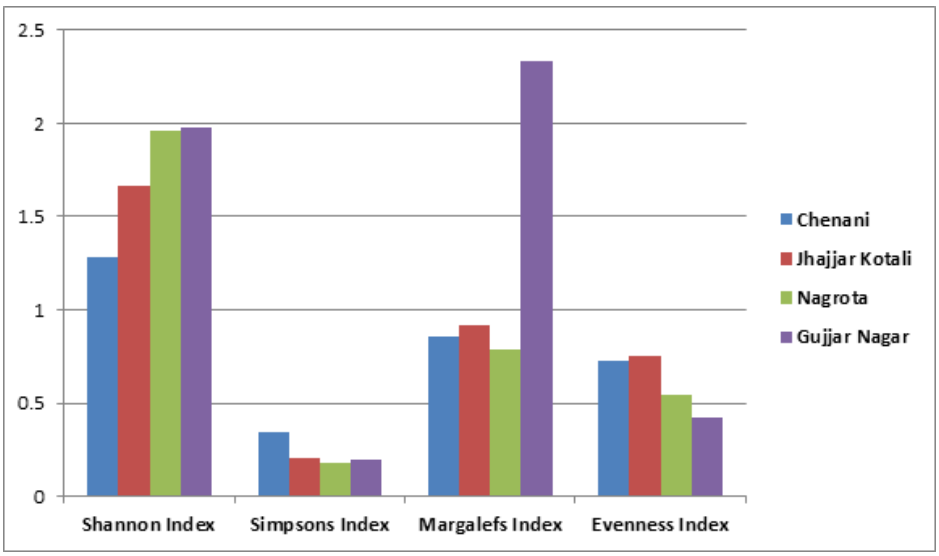

Fig. 5. Graph showing various diversity indices at four different longitudinal sections of river Tawi

whereas downstream section (station IV) showed more abundance of hardy warm water fishes. Similar abundance pattern of both cold and warm water fishes was also advocated by Sharma and Dutta (2010), while studying the ichthyofaunal diversity of river Basantar, an important tributary of river Ravi. Andotra (2014) in river Tawi and Gandotra and Poonam (2015) who also reported that there was more abundance of cold water fishes in upstream sections of Rajouri district whereas downstream sections showed more abundance of warm water and hardy fishes.

Further, during the present study fish diversity indices i.e. Shannon weiner (H) and Evenness (e) revealed that value of H and e was 1.286 & 0.7234, 1.662 & 0.753, 1.959 & 0.5454 and 1.978 & 0.4252 at stations I, II, III and IV respectively (Table 5 & fig, 5). The result thus, clearly shows that maximum number of abundance and species diversity was found at station IV (downstream) and minimum at station I i.e. (upstream).The diversity indices of all the four longitudinal sections of river Tawi during present investigations shows inconsistency at all the study stations these variations may be due to variation in habitat and different conditions of selected sites such as food availability, primary production of plants and alga, bottom type depth, marginal vegetation, water current, substrate and temperature etc. Present findings are in line with other workers who also correlate rich diversity in downstream rivers with better food availability, breeding sites and water depth (Marais, 1988; Welcomme, 1985; Hina, 2010; Khajuria *et al.,* 2013; Andotra, 2014; Samal *et al,.* 2016).

CONCLUSION

The present study on diversity and abundance of Ichthyofauna at four different longitudinal sections of river Tawi, clearly discloses that all the study stations has ample number of fish species and variety which shows that habitat of river Tawi is conducive and can be used for aquaculture. The data also revealed that all the stream sections harbour food fishes and majority of them with some ornamental values. In order to conserve these valuable resources, a holistic approach integrating the concept of sustainable development and conservation measures should be adopted which will not only increase the economy but also provide employment to the rural folk.

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