

Fish diversity of River Bhagirathi Upstream to Tehri Dam Reservoir, Uttarakhand (India)

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ABSTRACT

The fish fauna of river Bhagirathi upstream to the Tehri Dam Reservoir (TDR) consisted of 20 species belonging to 10 genera of 4 families and to orders of 1 class. Indigenous fish species *Schizothorax richardsonii* was reported upto Bhatwari (1638m asl) while the exotic fish brown trout (*Salmo trutta fario* L.) was recorded upto Dharali (2685m asl). Common carp (*Cyprinus carpio* var. *communis*) contributed 38.31%, and *Tor tor* 37.92% in the Chiniyalisaur zone whereas *Schizothorax richardsonii* was dominant fish species at Dharasu and Uttarkashi region constituting 49.31% and 77.02% respectively.

Key words: River Bhagirathi, Fish fauna, Altitudinal distribution, Catch composition.

Introduction

Rivers, considered to be the life line of any region, are valuable natural resources providing ecological and economically services to the mankind ever since the beginning of the civilization. Dams change the natural flow regime of river systems and disrupt the necessary redistribution of resources (Poff *et al.*, 1997; Tockner *et al.*, 2000). Further, the degree of impact on aquatic communities depends on the type and function of the dam as well as the specific characteristics of the affected watershed (Hart *et al.*, 2002). Fish species diversity is correlated with habitat complexity (Gorman and Karr, 1978; Schlosser, 1982), depth flow and substrate types. The influence of these habitat attributes on the structure and function of fish assemblage in the streams has been studied in detailed at different latitudes (Mathew and

Hill, 1980; Leveque, 1997).

River Bhagirathi originates from Gaumukh glacier (4255 m asl) in the state of Uttarakhand. Three dams namely Maneri Dam, Joshiyara Dam and Tehri Dam are already constructed on the river, in addition, eight power projects are proposed or under construction upstream to Tehri Dam (Fig. 1). Maneri Dam and Joshiyara Dam are constructed for hydropower generation while Tehri Dam, Asia's biggest dam is multipurpose. Development of hydropower project has major cascading impact on aquatic biodiversity of the river. The most evident is the adverse impact on the fish resource. Earlier, fish fauna of Garhwal Himalaya have been recorded by Badola and Pant (1973), Badola (1975), Badola and Singh (1977a & b), Nautiyal (1986) and Singh *et al.*, (1987), Sharma (1988), Khanna *et al.*, (1998) and Rawat (2002). Yet, the literature on fish fauna of

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river Bhagirathi is scanty and impact of dams on fish diversity is lesser studied so far. Therefore, the present study was undertaken to ascertain the fisheries of River Bhagirathi upstream to Tehri Dam Reservoir (TDR).

Materials and Methods

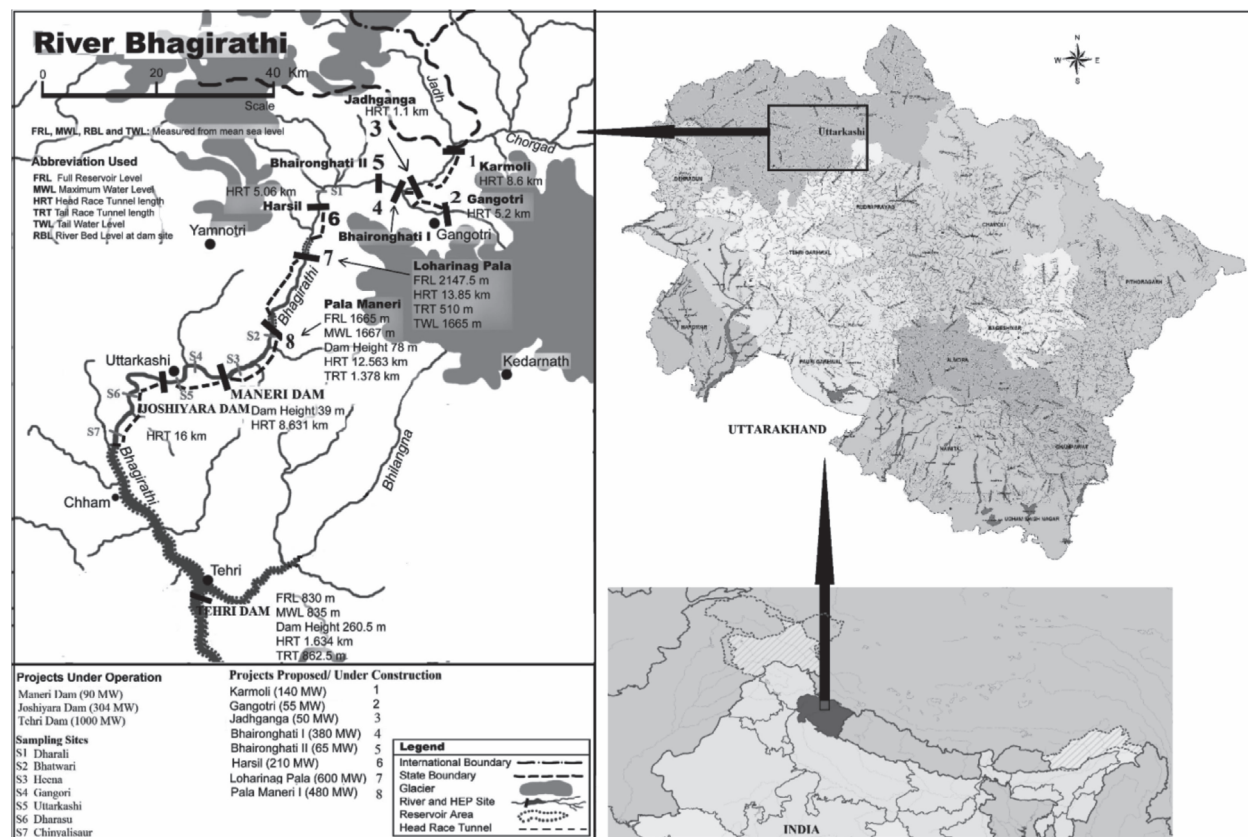
The present study was carried out upstream to TDR in River Bhagirathi at a stretch of about 95km between Chinyalisaur (755m asl) and Dharali (2685m asl) during May 2009 to April 2014. To study the fish and fisheries samples were collected from seven sampling locations at different altitudes *viz.*, Dharali (2685m asl), Batwari (1638m asl), Heena (1266m asl), Gangori (1219m asl), Uttarkashi (1158m asl), Dharasu (837m asl) and Chinyalisaur (755m asl). The whole stretch of river was divided into three zones *viz.* upstream to Maneri dam reservoir (>1300 m asl), upstream to Joshiyara dam reservoir (>1158 m asl) and upstream to Tehri dam reservoir (755m asl). Sampling sites Dharali, Batwari and Heena

were upstream to Maneri dam, while Gangori and Uttarkashi lie in between the Maneri dam and Joshiyara dam, whereas Dharasu and Chinyalisaur were downstream of Joshiyara dam and upstream of Tehri dam. At Dharali, sampling was done only during April to September every year due to inaccessibility.

Catch composition of river Bhagirathi was studied at Uttarkashi, Dharasu and Chinyalisaur as these places are important fish catching/landing centre. Fish samples were collected by employing cast net, gill net and local fishing methods with the help of local fishermen, also samples were procured from local landing centres and fish vendors. For identification of fish samples Day (1878), Jhingran and Sehgal (1978) and Badola (2009) were followed.

Results and Discussion

Fishery survey of river Bhagirathi for diversity, altitudinal distribution and catch composition was conducted upstream to TDR. The fish fauna of the



river Bhagirathi consisted of 20 species belonging to 10 genera of 4 families 2 orders of class Teleostomi (Table 1). Earlier, Badola and Pant (1973) reported 18 species of fishes from district Uttarkashi, while Sharma (1988) reported 23 species of fishes during the survey of the Bhagirathi River. Also, Singh *et al.* (1987) have given a comprehensive account of the distributional pattern of 65 species from Garhwal region. Badoni (2003) and Menon (1974) mentioned a number of physical, geographical and biological parameters, which influence the distribution and abundance of fish fauna

The fish fauna recorded in river Bhagirathi have great altitudinal distribution difference and are presented in Table 2. Upstream to Maneri dam at Dharali (2685m asl) only one fish species *Salmo trutta fario* L. was recorded in river Bhagirathi and its tributary and two fish species *Salmo trutta fario* L. and *Schizothorax richardsonii* were collected up to Bhatwari (1638m asl) while at Heena five species (*S. richardsonii*, *Noemacheilus bavaeni*, *Tor chilinoides*, *Pseudocenus salcatus*, *Salmo trutta fario* L.) were recorded. The brown trout was introduced in River Asiganga in the year 1910, from where these migrate into River Bhagirathi. Downstream to Maneri dam at Gangori and Uttarkashi eight and thirteen fish species have been recorded respectively. In between Joshiyara dam and Tehri Dam at Dharasu 14

fish species were collected while only five fish species viz. *S. richardsonii*, *Tor tor*, *Tor putitora*, *Cyprinus carpio* var. *communis*, *C. carpio* var. *specularis* were recorded from Chinyalisaur area during the present study. Low fish diversity at Chinyalisaur may be due to transitional location *i.e.* where the river Bhagirathi joins the upper reaches of TDR, and the water level in this area fluctuated seasonally. During monsoon approximately 4 km river is completely submerged and becomes the part of the dam. Thereafter the water level of reservoir decreases and the habitat of fish gets eroded thereby affecting the fish diversity.

Fish assemblages are structured by biotic, abiotic and historical factors. Typically, the distribution and abundance of native fishes, in rivers exhibit longitudinal zonation from upstream to downstream (Hughes and Gammon, 1987; Bhat, 2004; Habit *et al.*, 2006). Species also assort themselves along environmental gradients, with species diversity increasing downstream. Lowe-McConnell (1975) explained this pattern as being a reflection of habitat diversity, which also increases along the upstream to downstream axis. Greater fish species diversity downstream could also be the result of the increased richness of detritus and plankton there. Larinier (2001) concludes that the construction of dams on rivers block or delay upstream migration and thus contrib-

Table 1. Systematic position (Check list) of fish fauna recorded from River Bhagirathi.

Class	Order	Family	Genus	Species
Teleostomi	Cypriniformes	Cyprinidae	<i>Schizothorax</i>	<i>richardsonii</i>
				<i>plagiostomus</i>
				<i>sinatus</i>
			<i>Schizothoraichthys</i>	<i>progastrus</i>
			<i>Garra</i>	<i>lamta</i>
			<i>Tor</i>	<i>tor</i>
				<i>putitora</i>
				<i>chilinoides</i>
				<i>hexastichus</i>
			<i>Puntius</i>	<i>chola</i>
			<i>Cyprinus</i>	<i>carpio</i> var. <i>communis</i>
				<i>carpio</i> var. <i>specularis</i>
		Cobitidae	<i>Noemacheilus</i>	<i>montanus</i>
				<i>multifasciatus</i>
				<i>bavaeni</i>
				<i>zonatus</i>
				<i>rupicola</i>
	Salmoniformes	Sisoridae	<i>Glyptothorax</i>	<i>cavia</i>
			<i>Pseudocenus</i>	<i>sulcatus</i>
			<i>Salmo</i>	<i>trutta fario</i> L.

ute to the decline and even the extinction of species that depend on longitudinal movements along the stream continuum. In contrast, Mathews (1986) suggests that riverine fish assemblages respectively change abruptly or gradually because of abrupt or gradual changes in the physicochemical habitat. In river Bhagirathi fish diversity was increasing gradually upstream to downstream viz. Dharali to Dharasu supporting above statements.

Catch composition was studied at three sites as these are important fish catching centres and having good yield. At Chiniyalisaur Common carp (*Cyprinus carpio var. communis*) contributed 38.31%, followed by *Tor tor* 37.92%, mirror carp (*Cyprinus carpio var. specularis*) 13.14%, *Schizothorax richardsonii* 9.39% and *Tor putitora* constitutes 1.24 % (Fig. 2). At Dharasu region *Schizothorax richardsonii* was dominant fish species constitute about 49.31%, followed by Common carp (*Cyprinus carpio var. communis*) 15.10%, *Tor tor* 13.37%, Mirror carp (*Cyprinus carpio var. specularis*) 7.25%, *Schizothorax plagiostomus* (5.64%), *Tor chilinoide*s (3.17%), and others (6.16%) *Schizothoraichthys progastus* (1.81%), *Garra lamta* (1.71%), *Pseudocenus sulcatus* (0.91%), *Puntius chola* (0.91%) *Tor putitora* (0.60%), *Noemacheilus montanus*

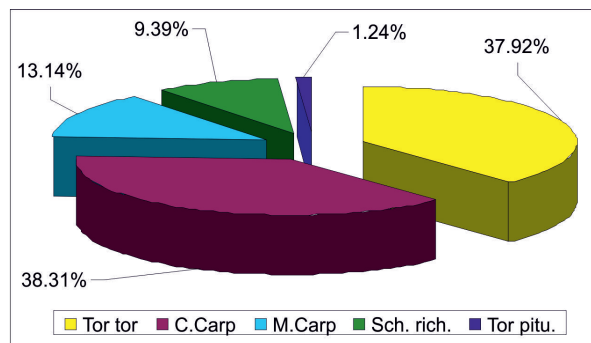


Fig. 2. Percentages catch composition of fishes at Chiniyalisaur

(0.10%), *Glyptothorax cavia* (0.07%) and *Noemacheilus multifasciatus* (0.05%) (Fig.3). However, in Uttarkashi region *Schizothorax richardsonii* was again emerging as most dominant fish species with 77.02%, followed by *Schizothorax plagiostomus* (9.00%), *Salmo trutta fario* L. with 3.02%, then by *Schizothorax sinatus* (2.60%), *Schizothoraichthys progastus* (2.01%), and other (6.35%) (*Puntius chola* (1.21%), *Noemacheilus bavaeni*, (1.02%), *Tor hexastichus* (1.10%), *Tor tor* (0.60%), *Noemacheilus multifasciatus* (0.60%), *Noemacheilus montanus*

Table 2. Altitudinal distribution of fish fauna in River Bhagirathi.

S. No.	Sampling station	Altitude m asl	Sps. No.	Fish Species
1	Dharali	2685	01	<i>Salmo trutta fario</i> L.
2	Bhatwari	1638	02	<i>Schizothorax richardsonii</i> , <i>Salmo trutta fario</i> L.
3	Heena	1266	05	<i>S. richardsonii</i> , <i>Noemacheilus bavaeni</i> , <i>Tor chilinoide</i> s, <i>Pseudocenus salcatus</i> , <i>Salmo trutta fario</i> L.
4	Gangori	1219	08	<i>S. richardsonii</i> , <i>S. plagiostomus</i> , <i>Schizothoraichthys progastus</i> , <i>Salmo trutta fario</i> L., <i>Noemacheilus bavaeni</i> , <i>Tor chilinoide</i> s, <i>Tor tor</i> , <i>Pseudocenus salcatus</i> .
5	Uttarkashi	1158	13	<i>S. richardsonii</i> , <i>S. plagiostomus</i> , <i>S. sinatus</i> , <i>Schizothoraichthys progastus</i> , <i>Salmo trutta fario</i> L., <i>Tor chilinoide</i> s, <i>Tor hexastichus</i> , <i>Noemacheilus bavaeni</i> , <i>N. multifasciatus</i> , <i>N. montanus</i> , <i>N. zonatus</i> , <i>N. rupicola</i> , <i>Puntius chola</i> .
6	Dharasu	837	14	<i>S. richardsonii</i> , <i>S. plagiostomus</i> , <i>Schizothoraichthys progastus</i> , <i>Garra lamta</i> , <i>Pseudocenus salcatus</i> , <i>Glyptothorax cavia</i> , <i>Tor tor</i> , <i>T. chilinoide</i> s, <i>Tor putitora</i> , <i>Cyprinus carpio var. communis</i> , <i>C. carpio var. specularis</i> , <i>N. multifasciatus</i> , <i>N. montanus</i> , <i>Puntius chola</i> .
7	Chinyalisaur	755	4	<i>S. richardsonii</i> , <i>Tor tor</i> , <i>Cyprinus carpio var. communis</i> , <i>C. carpio var. specularis</i> .

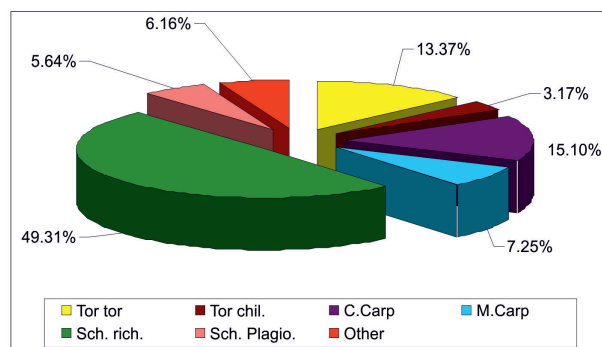


Fig. 3. Percentages catch composition of fishes at Dharsu

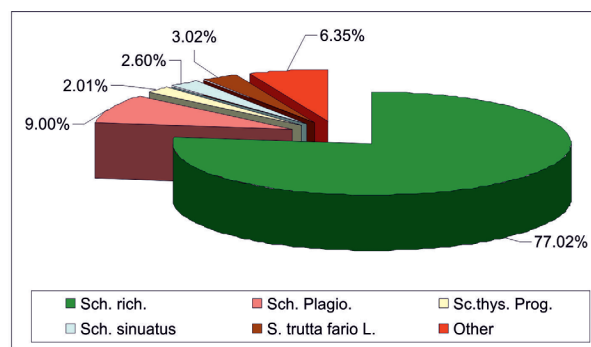


Fig. 4. Percentages catch composition of fishes at Uttarkashi

(0.60%), *Noemacheilus zonatus* (0.40%), *Noemacheilus rupicola* (0.40%) and *Tor chilinoideis* (0.40%) (Fig. 4). In all *Schizothorax richardsonii* was the dominant fish species above Uttarkashi which contributes about 40–80%.

Habitat preferences of fishes were also studied and mentioned in the Table 3. The fish genera like *Garra*, *Glyptothorax* and *Pseudocenus* have suction disc on their ventral side for clinging to stones and rocks and thus are found in fast water current. Small fishes like *Noemacheilus bavaeni*, *N. multifasciatus*, *N. montanus*, *N. zonatus*, *Puntius chola* have restricted food habitat in sandy bottoms hiding under stones found mostly in the tributaries of River Bhagirathi

like Indrawati Gad, Ranuki Gad and Dharasu Gad etc. and also found at confluence site of these gads with the River Bhagirathi. *Schizothorax* species and *Tor* species are present in pool, rapids and riffles. Negi and Negi (2010) reported *Schizothorax* preferred deep, shallow pools with low velocity while *Tor putitora* preferred shallow pools with medium velocity.

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Table 3. The preferential habitat of fish fauna in River Bhagirathi.

Family	Scientific Name	Local name	Preferential fish Habitat
Cyprinidae	<i>Schizothorax richardsonii</i>	Asela, Snow trout	Rapid, riffles, runs, pools
	<i>Schizothorax plagiosomus</i>	Asela, Dhibrua	Rapid, riffles, runs, pools
	<i>Schizothorax sinatus</i>	Asela, Maseen	Rapid, riffles, runs, pools
	<i>Schizothoraxichthys progastrus</i>	Chongu	Rapid, riffles, runs
	<i>Garra lamta</i>	Gondal, Gunthala, Bhagnera	Pools, rapids
	<i>Tor tor</i>	Dansulu, Mahseer	Pools, rapids
	<i>Tor putitora</i>	Dansulu, Mahseer	Pools, rapids
	<i>Tor chilinoideis</i>	Dansula, Karanchula	Pools, rapids, riffles
	<i>Tor hexastichus</i>	Dansula	Pools, rapids, riffles
	<i>Puntius chola</i>	Damra, Sidhari	Pools, runs
	<i>Cyprinus carpio var. communis</i>	Common carp	Pools, reservoir
	<i>Cyprinus carpio var. specularis</i>	Mirror carp	Pools, reservoir
	<i>Noemacheilus montanus</i>	Tiliya Gadiyal	Shallow pools, riffles, gravel beds
	<i>Noemacheilus multifasciatus</i>	Gadiyal, Gadera	Shallow pools, riffles, gravel beds
Cobitidae	<i>Noemacheilus bavaeni</i>	Gadiyal, Gadera	Shallow pools, riffles, gravel beds
	<i>Noemacheilus zonatus</i>	Gadiyal	Shallow pools, riffles, gravel beds
	<i>Noemacheilus rupicola</i>	Gadiyal, Gadera	Shallow pools, riffles, gravel beds
	<i>Glyptothorax cavia</i>	Sipliya	Runs, rapids, gravel beds
	<i>Pseudocenus sulcatus</i>	Mungria, Nowu, Kathrua	Shallow pools, runs, gravel beds
Sisoridae			
Salmonidae	<i>Salmo trutta fario L.</i>	Trout (Brown trout)	Rapids, snow/spring fed highly oxygenated water

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