



Present status of Ichthyofaunal diversity of Garhwal Himalayan river Bhilangna and its tributaries with reference to changing environment

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Abstract

Fish as a group, from biodiversity view point has the highest species diversity among all vertebrate taxa. Present communication deals with the reassessment of ichthyofaunal diversity of the river Bhilangna and its two sub tributaries, the Balganga and the Nailchami of Bhagirathi river system in Garhwal Himalaya. The observation made during study showed the occurrence of 22 fish species belonging to 2 orders, 3 families and 9 genera from varying habitat of falls, cascades, rapids, riffles and pools in various sections of river Bhilangna and its tributaries. *Schizothorax richardsonii*, *S. plagiostomus* are dominate species in the riverine segment of river Bhilangna while *Cyprinus carpio* (common carp) is the dominate species in impoundment segment of river Bhilangana (reservoir area). The comparison of results of present study with earlier reports revealed that fish fauna has decreased with passage of time in the Bhilangana river system which may be due to degradation and fragmentation of riverine habitat caused by various developmental activities, changes in the natural flow pattern of river, indiscriminate fishing by the use of destructive and unscientific fishing methods, and other natural calamities.

Keywords: Fish diversity, Bhilangana river, habitat degradation, River fragmentation

Introduction

Biodiversity is essential for stabilization of ecosystem, protection of overall environment quality and for understanding the intrinsic worth of all species on the earth (Gadgill and Kar, 2000). The fish faunal diversity has its own importance like other aquatic and terrestrial animals. Fishes occupy all the possible habitat of aquatic ecosystem. Some of them are commercially important species with good economic value as food while other small sized species has own ecological importance being of important tropic link in water bodies. India has very rich fish diversity of approximately 2500 fish species, of which 930 are fresh water inhabitants (Jayaram, 1999, 2010). Several attempts have been carried out to document the fish diversity of different parts of India. Ponniah and Gopalakrishnan (2000) have

documented the fish diversity of Western Ghats in form of a compendium entitled 'Endemic Fish Diversity of Western Ghats'. Lakra and Sarkar (2007) have edited a book entitled 'Fresh water fish diversity of Central India' based on the papers presented in a national workshop on 'Conservation Assessment of Fresh water Fish Diversity for central India' organized by NBFGR at Bhopal. Fish Biodiversity of North east India has also been reported in the proceeding of the workshop on 'North East Fish Germplasm Inventory and Conservation' edited by Ponniah and Sarkar (2000). Coldwater of Indian uplands also have rich diversified fish fauna. A total of 258 fish species, both indigenous and exotic ones, has been reported from Indian upland by Sunder *et al.* (1999). While Garhwal Himalayan water bodies encountered 64 species (Singh *et al.* 1987). Pristine water resources with tremendous range of thermal regime support this diversity. Although several studies have been carried out on Ichthyo-faunal diversity of Garhwal Himalayan rivers and streams in past (Badola and Singh, 1980; Bahuguna and Singh, 1981; Singh and

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Bahuguna, 1983; Lakra *et al* 1987; Tilak and Baloni, 1983; Khanna and Badola 1991; Nautiyal and Lal, 1994; Agarwal *et al.*, 2005; Uniyal and Kumar 2006; Bisht *et al.*, 2009) but there is a need to revalidate the diversity and distribution of fish species over time and space as since past 3-4 decades the rich cold water fish biodiversity of Garhwal Himalayan water bodies is under intense pressure from a wide range of anthropogenic disturbances (Agarwal and Singh, 2009). Important among them are –altered land and water use, changes in river flow and habitat, over exploitation of natural stocks, and invasion of exotic species. Considering this fact, present study is made to re-evaluate the status of fish diversity of Bhilangana river –a major tributary of river Bhagirathi of Garhwal Himalaya from viewpoint of degradation and fragmentation of river habitat due to dam construction and various other developmental activities carried out in recent past. The tributaries of river Bhilangana –the Balganga and the Nailchami streams are also explored for stream habitat and Ichthyofaunal diversity in the present study.

Study area and physiography of the river Bhilangana and its tributaries

The Garhwal Himalaya situated between the latitude $29^{\circ} 26'$ to $31^{\circ} 28'N$ and longitudes $77^{\circ} 49'$ to $86^{\circ} 06'E$ is blessed with large number of river system. The river Bhilangana is a major tributary of river Ganga in Garhwal Himalaya. It originates from the Khatling glacier approximately 50 km south of the ice cave at Gaumukh at an elevation of 3717 masl. Earlier, the river Bhilangana flowed to a length of 95 Km from its origin to join river Bhagirathi at old Tehri. But after its impoundment for the Tehri dam reservoir, 25 km river length has inundated to lacustrine habitat thus shrinking riverine habitat to 70 Km length. Further, 45 km from the origin of the river Bhilangana, a small Bhilangana hydropower project of 22.5 MW has been constructed at Ghuttu village obstructing the natural flow of river while two small hydro power projects on this river are under planning stage (Fig 1).

The River Bhilangana has its own two sub-tributaries, namely the Balganga- right bank tributary and the Nailchami - left bank tributary (Fig 1). The Balganga is also facing the

fragmentation of riverine habitat due to the construction of a small hydro-power project at 25 km upstream to Ghansali near Budakedar. The stream Nailchami- left bank tributary of river Bhilangana is a life line for people settled in the small hamlets along its banks. Water from the streams is abstracted for irrigation and drinking. The villagers do fishing in the stream for their own consumption and recreation. In summer and winter, river has very less water discharge due to abstraction of water to irrigate agricultural fields.

The change in river habitat, flow pattern and land and water uses have affected the density and diversity of fish fauna in the river Bhilangana and its tributaries. Considering this aspect, the river Bhilangana and its tributaries- the Balganga and Nailchami were thoroughly surveyed for the occurrence of fish fauna. Four sampling sites viz. S1, S2, S3, S4 were selected for the study. Sampling site S1 is located at Ghansali in lotic water and S2 at Pilkhi in lentic habitat of river Bhilangana. S3 site is located in Balganga stream at Chamiyala and S4 is located on river Nailchami, 5 km upstream to Ghansali (Fig. 1).



Fig. 1: Physiographic map of river Bhilangana and its tributaries.

Material and Methods

Regular sampling was conducted for collection of fishes from the river Bhilangana, the Balganga and the Nailchami during the year 2009-2011. Besides personal fish collection, fishes were also procured from local fishermen fishing at different sites using indigenous fishing methods. The common fishing methods namely -Gill net, Cast net, Hook and lines, Baur (Phans), Goda were used for fish collection. Colored images of fresh collected specimen were taken prior to their preservation. Fish specimens were preserved in 10% formaldehyde solution at the sampling sites. Large sized specimens were also injected with formalin for their better preservation. Extensive care was paid for proper maintaining of specimen during their transport from sampling sites to laboratory. The identification of fishes was done on the basis of various morphometric and meristic characters. Standard keys, literature and work of Day (1878), Srivastava (1968, 1980), Menon (1974), Tilak, (1987) Talwar and Jhingran (1991) Jayaram (1999), Badola (2009) was consulted for identification.

Results and Discussion

In our present study, 22 fish species belonging to 2 orders, 3 families and 9 genera have been encountered from varying habitat of falls, cascades, rapids, riffles and pools in various sections of river Bhilangna and its tributaries (Table 1). *Cyprinus carpio* (Common carp) is the new record of fish species reported from the lentic habitat of this river. Studies revealed that there is heterogeneity in habitat and ecological characteristics of both the river Bhilangna and its tributaries. In the upper reaches from its origin to Ghansali, river Bhilangana (S1) flows torrentially due to high gradient. River has rocky substratum with big and small sized boulders in this section. The torrentially flowing river has become almost stand still, downstream to Pilkhi as it is impounded for Tehri dam reservoir. River has deep water and sandy substratum for 25 km stretch of impounded area (S2). The pattern of species distribution and abundance highly varied in these two different habitat (lotic and lentic).

From river Bhilangna upstream to Ghansali (S1), 21 species belonging to 2 order, 3 families and 9 genera have been observed during study period (Table 1). Family Cyprinidae (representing 13

species) was found dominated over Cobitidae family (representing 6 species) and Sisoridae family (representing 2 species). The *Schizothorax richardsonii* was recorded most abundant fish species throughout all seasons. Species of genus *Tor* and *Pseudochenus* were also reported along with other *Schizothorax* species but in limited number. Further *Noemacheilus* and *Barilius* spp. were also reported in some catches during study period but species of genus *Garra*, *Botia* and *Glyptothorax* were found rarely only in few catches. However, earlier reports of Badola (1979) showed the occurrence of 43 species and Singh *et al.* (1983) reported 37 species from same river Bhilangna (Table 2). The observation of present study when compared with the work on fish faunal diversity reported during 1980's, it appears that there is continuous decrease in fish fauna with passage of time. The factors responsible for this decline are the unscientific and unsustainable fishing methods (Dynamiting Poisoning, Electrocuting, and Channel diversion), various developmental activities such as Dam, and road construction, and other natural calamities like adverse weather conditions especially flood in monsoon season which flows away all the eggs and small fishes. *Schizothorax richardsonii*, *S. plagiostomus* were dominant species in past and these are still dominant at present but the total fish catch has drastically decreased with the passage of time.

The fish catch of impounded area of river Bhilangna (S2) (lentic habitat) is found dominated by *Cyprinus carpio* followed by *Tor putitora* with occasional occurrence of *Tor tor* and Snow trout *Schizothorachthys progastus*. No other species was observed from this stretch. *Tor putitora*, *Tor tor* and *Schizothorachthys progastus* are column feeder native fish species. These were also present in the Bhilangana river before the reservoir came into existence. These can very well withstand in the impounded water/lentic habitat due to column feeding habit. But introduction of exotic carp *Cyprinus carpio* has proved detrimental to these native fish species.

From the Balganga stream (S3), 20 species belonging to 2 orders, 3 families and 7 genera have been reported. Species of genus *Schizothorax* were observed abundantly. *Tor* and *Pseudecheneis* spp. were procured in limited number.



Table1. Status of Ichthyofaunal diversity of river Bhilangana and its tributaries.

Name of species	Local name	Sampling sites			
		Balganga	Nailchami	Bhilangana	Bhilangana river impoundment
Order Cypriniformes					
1. Family Cyprinidae					
<i>Tor putitora</i>	Khasra	c	c	c	c
<i>Tor tor</i>	Khasra	r	n	r	r
<i>T. chilinoides</i>	Mahaser	c	r	a	n
<i>Schizothorax richardsonii</i>	Maseen	a	c	a	n
<i>S. plagiostomus</i>	Asela	c	c	a	n
<i>S. sinuatus</i>	Maseen	r	r	r	n
<i>Schizothorachthys progastus</i>	Chongu	r	n	r	r
<i>S. curvifrons</i>	Chongu	r	n	c	n
<i>Barilius bendelisis</i>	Fulra	c	c	c	n
<i>B.barna</i>	Fulra	r	c	c	n
<i>B.bola</i>	Dhaur	r	r	n	n
<i>B.vagra</i>	Fulra	c	c	r	n
<i>Garra gotyla gotyla</i>	Gunthala	r	n	r	n
<i>Cyprinus carpio</i>	Carp	n	n	r	a
2. Family Cobitidae					
<i>Noemacheilus rupicola</i>	Gadiyal	c	c	c	n
<i>N. montanus</i>	Gadiyal	c	c	c	n
<i>N. bevani</i>	Gadiyal	c	c	c	n
<i>N. savona</i>	Gadiyal	r	r	r	n
<i>N. multifasciatus</i>	Gadiyal	c	c	c	n
<i>Botia Dario</i>	Gadiyal	n	n	r	n
Order Siluriformes					
1. Family Sisoridae					
<i>Glyptothorax pectinopterus</i>	Kathrua	c	r	c	n
<i>Pseudecheineis sulcatus</i>	Kathrua	c	r	c	n
Total number of taxa reported = 22		20	16	21	4

a=Abundant; c=Common; r=Rare; n=Nil

From the stream Nailchami (S4), 16 species belonging to 2 orders, 3 families and 6 genera were recorded. Species of genus *Schizothorax* were also found dominated over other species in this stream but average size of them are less in comparison to the fishes procured from the rivers Bhilangana and Balganga. Both the tributaries of river Bhilangana

– the Balganga and the Nailchami were unexplored from the view point of their fish diversity. The

result of present study has filled this lacuna and is an attempt to develop base line data of ichthyofaunal diversity of these streams. In River Balganga and Nailchami, maximum fish diversity was observed during monsoon and summer months in contrast to winter months. This may be related with the



migratory behavior of some fishes which migrate upstream when river is flooded. Substratum of river largely influences distribution of fish fauna. The substratum of Bhilangna River in the lentic habitat

(S2) is sandy while upstream to Pilkhi in the lotic habitat of river, the substratum is stony. Due to such type of sandy substratum, only four species of column feeding habit has been recorded from S2.

Table 2. Fish fauna of river Bhilangana in relation to previous reports

Name of species	Badola (1979)	Singh <i>et al.</i> (1983)	Present study
<i>Schizothorax richardsonii</i>	P	c	a
<i>S. plagiostomus</i>	p	c	a
<i>S. sinuatus</i>	p	c	r
<i>Schizothoraichthys progastus</i>	p	r	r
<i>S. esocinus</i>	p	r	n
<i>S. micropogon</i>	p	c	n
<i>S. longipinnis</i>	p	n	n
<i>S. curvifrons</i>	p	c	c
<i>S. niger</i>	p	c	n
<i>S. planifrons</i>	p	n	n
<i>S. intermedius</i>	ab	c	n
<i>Barilius bendelisis</i>	p	c	c
<i>B. shacra</i>	p	n	n
<i>B. barna</i>	p	c	c
<i>B. barila</i>	p	c	n
<i>B. vagra</i>	p	c	r
<i>B. bola</i>	ab	r	r
<i>Labeo dyocheilus</i>	p	c	n
<i>L. dero</i>	p	c	n
<i>Tor tor</i>	p	r	r
<i>T. putitora</i>	p	r	c
<i>T. chilinoides</i>	p	c	a
<i>T. hexastichus</i>	p	n	n
<i>Noemacheilus rupicola</i>	p	a	c
<i>N. montanus</i>	p	a	c
<i>N. bevani</i>	p	a	c
<i>N. savona</i>	p	a	r
<i>N. denisonii</i>	p	n	n
<i>N. zonatus</i>	p	n	n
<i>N. multifasciatus</i>	p	c	c
<i>Garra gotyla gotyla</i>	p	c	r
<i>G. lamta</i>	p	r	n
<i>Garra prashadi</i>	ab	c	n
<i>Glyptothorax madraspatanum</i>	p	n	n
<i>G. pectinopterus</i>	p	c	c
<i>G. telchitta</i>	p	n	n
<i>G. conirostris</i>	p	c	n
<i>G. cavia</i>	p	c	n
<i>G. trilineatus</i>	p	n	n
<i>G. kashmirensis</i>	p	n	n
<i>G. brevipinnis</i>	p	c	n
<i>Pseudecheneis sulcatus</i>	p	c	c
<i>Crossocheilus latius latius</i>	p	c	n
<i>Clupisoma garua</i>	p	r	n
<i>Euchiloganis hodgarti</i>	p	n	n
<i>Chagunius chagunio</i>	p	n	n
<i>Botia dario</i>	ab	r	r
<i>Balitora brucei</i>	ab	r	n
<i>Mastacembelus armatus</i>	ab	c	n
<i>Cyprinus carpio</i>	ab	n	r*
Total number of taxa reported	43	37	22

P=present,ab=absent,a=Abundant;c=Common;r=Rare;n=Nil,r*= rare in river and abundant in impoundment



However, twenty one species are found in the upstream as fast flowing meandering river having rocky bed with stones and pebbles supports the survival of various life stages of fish. A striking observation during the collection of fish fauna is the high dominance of *Cyprinus carpio* (introduced exotic carp) in the fish catch from impounded water of river Bhilangana. The change in river habitat (from riverine to lacustrine) has led to the drastic changes in fish species composition and distribution. Prior to impoundment, fishes of snowtrout group namely *Schizothorax richardsonii*, *S. plagiostomus*, *S. curvifrons*, and *Schizothorachthys progastus* were dominated in fish catch. *Tor putitora*, *S. sinuatus*, *Pseudecheneis sulcatus*. *Glyptothorax pectinopterus* were also found regularly in the fish catch. The *Schizothorax richardsonii*, *S. plagiostomus*, *S. curvifrons*, *Garra gotyla gotyla* are bottom feeder, herbivorous fish species highly adapted for scraping periphyton (algae, diatoms) from submerged stones and boulders in the river (Fig. 2). The *Pseudecheneis* and *Glyptothorax* spp. are also bottom feeder, feeds on stony substratum and highly adapted to withstand in fast water current of torrential hill streams. Thus, these species were surviving very well in fast flowing environment of river Bhilangana due to presence of good feeding and breeding ground on its shallow banks with stony and bouldary substratum. As the river has been impounded, this peculiar hill stream river habitat is now replaced with the stagnant/slow moving deep water, steep banks and sandy substratum. The peculiar feeding and breeding ground characteristics of fish have disappeared. This has forced the bottom feeder hill stream fish species to migrate upstream in fast flowing shallow areas having stony substratum. Thus, the impounded area of Bhilangana river (25 km stretch) is now totally devoid of above bottom feeder resident species, restricting these species to riverine reaches only. The native fish species -*Tor putitora*, *Tor tor* (Mahseer) and *Schizothorachthys progastus* are of column feeder habit thrive in deep water, hence have remained in impounded segment of river. These are now struggling for their existence in changed habitat with the introduced exotic carp *Cyprinus carpio*- giving tough competition due to its fast growth and prolific breeding habit. Thus, fragmentation of river habitat and change in river

flow has affected species distribution. At present, impounded section of river has only four species in comparison of 21 species (unpublished observation) observed earlier, before the reservoir came into existence.



Fig.2: Feeding marks of bottom feeder snowtrout species on a boulder. Fish scrapes algae and periphyton from stones and boulders by hard cartilaginous lower labial fold on ventrally situated mouth.

Total water discharge of river is directly proportional to distribution of fish fauna. High discharge of water will have large size fishes. The Nailchami stream having less water discharge has small sized fishes as compare to river Bhilangana and Balganga stream. The water of Nailchami stream is abstracted for agricultural fields located on both sides along its length thus, further reducing the water discharge in summer and winter months restricting the occurrence of small size fishes with low faunal diversity. Stream also has high gradient with cascade type habitat providing frequent falls and shallow pools among big boulders in upper reaches. Though, in lower reaches, stream has shallow runs with stony, pebbly substratum- ideal for small sized *Barilius* sp. and loaches. Stream is highly disturbed due to anthropogenic activities. Use of bleaching powder, ichthyotoxic plants, and

channel diversion for fishing has drastically affected the fish population in the stream.

Gradient is inversely proportional to distribution of fish fauna. River Bhilangna and its tributaries-Balganga and Nailchami have high gradient towards their sources, thus density and diversity of fish is low in the upper stretches of these streams.

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