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COMPARATIVE ANALYSIS OF FISH DIVERSITY OF UTTARAKHAND (GANGANANI TO HARIDWAR)

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ABSTRACT

Present investigation was carried out during December 2012 to April 2013, to assess the comparative analysis of diversity and composition of freshwater fishes in Uttarakhand. Uttarakhand is a beautiful hilly part of India, enriched with various aquatic ecosystem like rivers, streams, lakes and reservoirs. They all contain a very rich and colourful fish fauna. In the present study, we analyze fish diversity of river Ganga at two different locations i.e. UG-1(Ganganani to Devprayag) and UG-2(Devprayag to Haridwar). The paper examines the effect of human interference and pollution over fish diversity. The study is focussed on a total of 21 fish species belonging to 12 families reported in both the region. The paper also deliberates over some endangered and rare fish fauna.

Keywords: Endangered, Fish diversity, Human interference, Pollution.

INTRODUCTION

Uttarakhand came into existence as the 27th state of India on November 9, 2000. It is located between latitude 28°40' – 31° 29' N and longitude 77° 35' – 81° 5' E. It covers about 53,483 Km² area and is inhabited by 10.1 million people (2011 Census). It encompasses thirteen districts i.e. Uttarkashi, Chamoli, Rudraprayag, Tehri Garhwal, Dehradun, Pauri Garhwal, Pithoragarh, Champawat, Almora, Bageshwar, Nainital,Udham Singh Nagar and Haridwar. Uttarakhand is enriched with aquatic ecosystem of various disciplines like rivers, streams, lakes and reservoirs. Some of the important rivers are Alaknanda, Bhagirathi, Bhilangana, Mandakini, Koshi and Ganga. There are several spring- fed and snow-fed rivers such as Henwal, Hemganga, Song, Suswa and hundreds of rivulets which have very rich flora and fauna. The climate of the region is mainly tropical with a well defined rainy season between June and October, a very mild winter between December and February and a relatively dry pre-monsoon summer between March and May.

In the present paper, we study fish diversity of fresh water fishes of the river Ganga at two different locations. Some earlier work on fresh water fishes are as follows:

Out of the 2,500 species of freshwater fishes that have been recognised in the Indian subcontinent, 930 are categorized as freshwater species (Jayaram 1999). Much of the early study on the freshwater systems of the Indian subcontinent can be traced back to the works of British officers working for the East India Company, who took great interest in the natural history of the region. Some early assistance were those of Hamilton-Buchanan in '*The Fishes of the Ganges'*(1822) and by others like McClelland (1839), Sykes (1839) and Jerdon (1849). Subsequently, studies were made by Francis Day in his *Fishes of India* (1875–1878). Substantial literature is now available on the identification and systematic of freshwater fishes of India, starting with Hora's assistance between 1920–1950s. Hora in the 1930s to 1950s addressed the difficulty of the anomalous division of hill stream fishes in peninsular India. Many species belonging to the peninsular part of India were found to be the same to

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the species found in the North East of India. Most recent texts by Talwar & Jhingran (1991), and Jayaram (1999) discuss this similarilty in fish diversity.Though most of these contributions have been taxonomic in nature, there exist some works on the bio- geographic distributions of fishes in the region as well (Jayaram 1974).

A sequence of papers published by *Introduction Studies of Freshwater Fishes in the Indian Subcontinent* have been limited to scattered works on commercial fisheries and even these have been largely restricted to some of the major river systems like the Ganges and the Yamuna.

Taxonomic collections apart, not much work has been done on the study of freshwater fishes in the Northern India mainly in the Upper Ganga Region. Given the high levels of faunal diversity observed so far, there is an urgent need to understand the fish diversity and distribution of this region. The need is, in fact, made all the more urgent by the recent spurt of human actions in this region in exploiting its water resources for hydroelectric purposes. Not only are the rivers directly affected by the developmental activities, but they are also affected by other threats like introduction of exotic species, overfishing and the disposal of industrial and domestic wastes from new industries and settlements. Before the rich species diversity of this region of the subcontinent is lost forever, the records of the species found here as well as their distribution is essential; this together with the identification of the threats will help in formulating the needed conservation measures. As an initial step in this direction, the main objective of this study was to collect data on species richness and distributions that could serve as baseline information to monitor the potential Upper Ganga Region and show that this region is very high in diversity. One would expect similar trends during the study in different region since human impact over aquatic ecosystem is similar all across the country. Secondly, with the help of this study on fish diversity in the Northern India, we try to answer following questions: What is the level of diversity of freshwater fishes in this region and how does it compare to rivers of similar dimensions in other parts of the subcontinent? How does this diversity vary at differing spatial scales like entire river systems, or the upper and lower reaches in a river?

MATERIAL AND METHODS

STUDY AREA

The study was conducted in two region of Uttarakhand UG-1 (Ganganani to Devprayag) and UG-2 (Devprayag to Haridwar).

UG-1 (Ganganani to Devprayag): The stretch between Ganganani (Latitude: 30°55'.15.4" N; Longitude: 78°40'43.2" E ; Elevation: 1945 m above mean sea level) to Devprayag (Latitude: 30°08'49.5"N; Longitude: 78°35'51.9"E; Elevation: 474 m above mean sea level) was undertaken for study since there is considerable lack of variety of river system and connectivity has been ruined by the building of barrages and dams (Maneri Bhali I and II Projects, Tehri and Koteshwar dams). Water temperature ranges between 4.3-16.3°C (Nautiyal, 2010). Water temperatures (in the range 8.5-17.2°C) have also been recorded by Agarwal *et al*. (2003) and Sharma *et al*. (2008) at Tehri.

*UG-2(*Devprayag to Haridwar): The stretch between Devprayag (Latitude: 30°08'49.4"N; Longitude: 78°35'51.9"E; Elevation: 474 m above mean sea level) to Haridwar (Latitude: 29o57'20.1"N; Longitude: 78°10'56.3"E; Elevation: 290 m above mean sea level) is the convergence point of the rivers Bhagirathi and Alaknanda, and the river Ganga descends downstream at Rishikesh before traversing upto Haridwar in plains. Before reaching Rishikesh, it is connected by another tributary Nayar, which is a recognized breeding ground for the most important game fish of Ganga, referred as Mahseer (*Tor* sp.). The river stretch consists of rapids, riffles and pools. The substrate consists of mature boulders, cobbles and pebbles. Sand is also present at few places in this zone. The river water in this stretch appears clean and clear, and has high transparency with moderate depth. The current velocity ranges between 0.1-3.0 m/s (Kishor, 1998). The water temperature is also moderate and varies between 15-23°C. The flows are significantly fluctuating and the river meanders into few channels at Haridwar downside of Rishikesh.

SAMPLING

Fishes were collected from two sampling sites identified as UG1 (Gangnani to Devprayag) & UG2 (Devprayag to Haridwar). Details of the length, catchment areas and elevation for each river are summarized in Table 1. Fishes on these rivers were sampled regularly over a period from Dec. 2012–Apr. 2013 (see Table 2 for dates of samplings) on two sampling sites. The sites were chosen such that one was on the higher elevation zone and another at the lower elevation zone. Thus, regional comparisons along a river were made across the upstream and downstream sites. Sampling was done from a boat along the shoreline during period of comparable discharge and focused on the near shore zone where most fishes are found and where our sampling method was most efficient. A selection of about 150 to 200 m was sampled upstream at every river kilometer marker within the study stretch. Two selected sites were sampled in the Upper Ganga region. Captured fishes were stored in a big container in the boat. As sampling was done at each stretch, all fishes were identified, measured (SL) and dropped back to water. The relative density (catch per unit efforts) was explained as the number of individual per 100 meter of sampled shoreline, with a standard width 3.0 m of the sample area. The fishes were identified and some representative specimens were collected and preserved in (4% formaldehyde solution) in plastic bottles. Identifications done were based on keys for fishes of the Indian subcontinent (Jayaram 1999, Talwar & Jhingran 1991) and also with the help of taxonomic expertise from the Regional Station of the Zoological Survey of India at Chennai.

We collated data on fishes of the Himalayan Rivers from published sources, documents, checklists and augmented this with primary data from our regular field surveys undertaken during the last six to eight years (see *Appendix* S1). We also used online sources (**www.fishbase.org**) for supplementing data on diversity and distributions of the Himalayan fishes.

Table 1: Details of the length, catchment areas and elevation

		Latitude	Longitude	Total area	Elevation	Source of pollution
UG1						
Gangnani to Devprayag	Gangnani	30°55' 15.4" N	78°40'43.2"E	239 km²	1945 m	minimal
	Devprayag	30°08'49.5"N	78°35'51.9"E		474 m	minimal
UG2						
Devprayag to Haridwar	Devprayag	30°08'49.5"N	78°35'51.9"E	93.4 km²	474 m	minimal
	Haridwar	29°57'20.1"N	78°10'56.3"E		290 m	Sewage, pesticides

Table 2 : Details of seasons, date and time of sampling

Sampling season	Sampling date	Time of Sampling	Duration (Hrs.)
Winter	Dec, 2012-Jan,2013	Day	6:00-10:00
Summer	Mar, 2013	Night	17:00-24:00
Pre-monsoon	April,2013	Day	8:00-10:00, 16:00-18:00

RESULTS AND DISCUSSION

During the present study, 21 species of fishes belonging to 12 families (as shown in Table 3)were reported. Out of these *Tor tor, Tor putitora, Raimas bola* were found as endangered fishes while *Barilius vagra* and *Garra gotyla gotyla* were found as vulnerable fish species, while *Garra lamta, Labeo boga, Labeo dero, Labeo dyocheilus, Puntius chola, Puntius sarana, Puntius sophore, Puntius phutunio, Rasbora daniconius, Esomus danricus, Crossocheilus latius latius, Leploephalus guntea, Noemacheilus botia, Noemacheilus savona, Noemacheilus bevani, Mystus vittatus, Xenentodon cancila, Mastacembelus armatus, Channa gachua,Glyptothorax pectinopterus* were found at low risk.

Table 3: Comparative analysis of fish species of Gangnani to Devprayag and Devprayag to Haridwar

TAXA	Gangnani to Devprayag	Devprayag to Haridwar
Cyprinidae		
Barilius barna	P	A
B. barila	P	P
B. bendelisis	A	P
B. bola	A	P
B. vagra	P	A
Crossocheilus latius latius	P	P
Garra gotyla gotyla	P	P
G. lamta	P	A
G. prashadi	A	A
Labeo angara	A	P
L. calbasu	A	P
Labeo dero	P	P
L. dyocheilus	A	P
L. gonius	A	A
Puntius sarana sarana	A	A
P. sophore	A	A
P. ticto	A	P
Raiamas bola	A	A
Rasbora daniconius	A	A
Salmostoma bacaila	A	P
Schizothoraichthys esocinus	A	A
S. progastus	P	P
Schizothorax curviforns	A	A
S. intermedius	A	A
S. micropogan	A	A
S. niger	A	A
S. plagiostomus	P	P
S. richardsonii	P	A
S. sinuatus	P	P
Tor chilinoides	A	A

T. putitora	P	P
Tor tor	P	P
Balitoridae		
N. multifasciatus		
N. montanus	A	A
N. rupicola	P	A
N. Savona	A	A
N. zonatus	P	A
Sisoridae		
Bagarius bagarius	P	A
Glyptothorax cavia	A	A
G. conirostris	A	A
Glyptothorax lineatus	A	P
G. madraspatanum	P	A
G. pectinopterus	A	A
G. trilineatus	A	A
Pseudecheneis sulcatus	P	A
Schilbeidae		
Clupisoma garua	P	A
Osphronemidae		
Colisa fasciatus	A	A
Cobitidae		
Botio Dario	A	A
Belonidae		
Xenantodon cancila	A	A
Channidae		
Channa gauchua	A	A
Mastacembelidae		
Mastacembelus armatus	A	A
Bagridae		
Mystus tengara	A	A
Rita rita	A	A
Clariidae		
Clarias batrachus	A	A
Mugilidae		
Rhinomugil corsula	A	P
Total	21	19

(Note: A *stands for Absent*, **P** *stands for Present*)

An overall fish survey in the area has revealed a rapid decline in fish diversity. As compared to previous data of fish diversity of river Ganga in UG1(Gangnani to Devprayag), there were total of 36 fish species which has now dwindled to 21 species with a loss of nearly 15 species. This is a worrying sign for the aqua system in this region. In fact, fecal coliform levels are increasing very fast in this stretch of river , suggesting that there is inadequate flow for dilution even in these highly oxygenated stretches .In UG2(Devprayag to Haridwar), there was a total of 35 species which has now declined to the figure of 19 with a loss of nearly 16 species. According to the CPCB's monitoring data, biological oxygen demand (BOD) levels are high downstream of Haridwar. The main reason for decline of fishes is due to overfishing by various destructive fishing methods especially during breeding season. The pollution of the river by flash flood, landslides and soil erosion etc. are also responsible for the depletion of fish fauna.

CONCLUSION

India is gifted with affluent water resources with nearly 45000 km long riverine system that criss-crosses the length and breadth of the country. Out of this, Ganga basin is amazingly diverse in altitude, climate, land use and cropping pattern. Ganga has been a cradle of human civilization since time immemorial. It is one of the most holy rivers in the world and deeply regarded by the people of the country. India has 12 river basins, and 14 minor and desert river basins. Out of those, Ganga is the largest river basin which flows through the state of Uttarakhand, Uttar Pradesh, Himachal Pradesh, Bihar, Jharkhand and West Bengal. The quality of Ganga which makes it different from other rivers is its self-cleansing ability, which allows for assimilation and treatment of biological waste. But in the current context, withdrawal from the river is much higher than the discharge of water. Moreover growing discharge of waste and pollutant is devastating the aquatic ecosystem. In the upper reaches of the river, where the oxygenating abilities of the river are the highest, there are growing signs of contamination. This suggests that even here, water withdrawal for hydroelectricity is endangering the health of the Ganga .As the river reaches the plains, the water withdrawal peaks for irrigation and drinking water. In this stretch of the river from Rishikesh to Allahabad, there is almost no water during winter and summer months. In other words, the river stops flowing. But the waste water flow does not ebb. The river then receives only waste and turns into a sewer which results in decreasing fish diversity in the river Ganga and increased number of fish mortality due to choking of gills. Besides these problems, illegal fishing causes decline of fish population in the Ganga river system. Hence there is an urgent need of an Action Plan for conservation of fish habitat, fishery development etc. Moreover, safety measures should be taken to control illegal fishing by directing a total ban on fishing especially during the breeding season.

REFERENCES

1. Agrawal, N. K., Rawat, U. S., Thapliyal, B. L. and Raghuvanshi, S. K. 2003. Seasonal variation in physico-chemical characteristics of the river Bhagirathi and its impact on phytoplankton and benthic entomofauna. In: *Proceeding of XII National Symposium on Environment*, pp.430-437.
2. Arunachalam, M. 2000. Assemblage structure of stream fishes in the Western Ghats (India). *Hydrobiologia,* **430**: 1–31.
3. Ayyoade, A. A., Agrawal, N. K. and Chandola Saklani, A. 2009. Changes in physico-chemical features and plankton of two regulated high altitude rivers Garhwal Himalayas, India. *European Journal of Scientific Research*, **27**, 1: 72-92.
4. Binaxi. 2006. *Assessment of water quality of the river Ganga from Shivpuri to Haridwar segment of the Garhwal Himalaya in relation to algae*. D.Phil. Thesis, HNB Garhwal University, Srinagar, Uttranchal, India.
5. Day, F. 1875–78. *Fishes of India; being a natural history of the fishes known to inhabit the seas and freshwaters of India, Burma, and Ceylon*. Text and atlas in 4 parts. London: xx+778,195 pls.
6. Hamilton-Buchanan, F. 1822. *An account of the fishes of river Ganges and its branches*. Edinburgh and London,vii + 405 pp.

7. Jayaram, K.C. 1974. Ecology and distribution of fresh-water fishes, amphibia and reptiles. pp. 517–584. *In*: M.S. Mani (ed.) *Ecology and Biogeography in India.* The Hague: Dr W. Junk, B.V. Publ.

8. Jayaram, K.C. 1999. The freshwater fishes of the Indian Region. Delhi : Narendra Publishing House, 551 pp.

9. Jerdon, T.C. 1849. On the freshwater fishes of Southern India.Madras. *J. Lit. Sci.* 15: 302–346.

10. Kishor, B.1998. Foraging patterns of *Tor putitora* (Hamilton) with reference to entomofauna and its population dispersal. D.Phil. Thesis, HNB Garhwal University, Srinagar, Uttranchal, India.

11. McClelland, J. 1839. Indian Cyprinidae. 19, *Asiatic Researches.* Calcutta: Bishop College Press ,pp.217–468

12. Nautiyal, P.2010. Food chains of Ganga River ecosystems in the Himalayas. *Aquatic Ecosystem Health & Management*, **13**,4: 362-373.

13. Negi, K. S. and Malik, D. S. 2005. Fish fauna of Ganga river at Rishikesh. *Himalayan Journal of Environmental Zoology*, 19,2: 145-148.

14. Singh, H. R.; Nautiyal, P.; Dobriyal, A. K.; Pokhriyal, R. C.; Negi, M.; Baduni, V.; Nautiyal, R.; Agrawal, N. K.; and Gautam, A. 1994. Water quality of the river Ganga (Garhwal Himalayas). *Acta Hydrobiologica,* 36: 3-15.

15. Sykes, W.H. 1839. An account of the fishes of the Dukhen.In Proceedings of learned societies. Zoological Society. *Ann.Mag. Nat. Hist*., **4**: 54–62.

16. Talwar, P.K., & A. Jhingran. 1991. *Inland fishes of India and adjacent countries*. New Delhi: IBH Publishing Co. Pvt. Ltd, 2 volumes: xix + 1158 pp.