



Longitudinal distribution of the fish fauna in the river Ganga from Gangotri to Kanpur

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Abstract: Fish fauna of the river Ganga from Gangotri to Kanpur consisted of 140 fish species from 9 orders and 25 families; 63 fish species from 6 orders and 12 families in the mountain section (MS), while 122 species from 9 orders and 25 families in the Plains section (PS) of Upper Ganga. Cypriniformes and Cyprinidae were most species rich order and family in both sections. Forty six fish species primarily Cypriniformes and Siluriformes are common to both sections, only 17 in MS and 76 in PS. Orders Tetradontiformes, Osteoglossiformes and Clupeiformes were present in PS only. The taxonomic richness in the MS was low compared to PS. Probably motility and physiological requirements in respect of tolerance for temperature restrict faunal elements.

Keywords: Cyprinidae, Fish distribution, Gangetic plains, Himalaya, River continuum

INTRODUCTION

Distributional patterns of organisms are controlled by dispersal mechanism, historical factors (connecting pathways, dispersal barriers) and tolerance to environmental factors (Carter *et al.*, 1980). According to Gregory *et al.* (1991) streams are intimately related to their drainage basin, their linear form maximizing the interface between terrestrial and aquatic environments. Climate, geological vegetation, land use and topographic conditions in a basin determine the hydrology and chemistry of receiving waters with direct effects on the stream organism (Wiley *et al.*, 1997). The river Ganga is a holy river of India and has been declared as a National River by the Government of India. It originates at Gaumukh (Himalaya) and flows down to Gangasagar (plains) traversing a distance of 2525 km. Various anthropogenic activities viz. urbanisation, hydropower, megadevelopmental projects, agriculture and pollution directly or indirectly change the physical and chemical characteristics of the river along its length. Thus the characteristics that govern the distributional patterns of the aquatic fauna (Allan, 1995) are altered. Thus an effort was made to determine the distributional patterns of the fish fauna in the mountain and plain sections (Upper Ganga) of the Ganga river, as it would help to know the impact of anthropogenic activities on fish communities. Fragmented information is available on the distributional patterns of the fish fauna in the Ganga river (Singh *et al.*, 1987; Rao, 2001; O'Keeffe *et al.*, 2012). No information is

available on the longitudinal distribution of fish fauna in the Ganga river especially from mountain (Gangotri to Haridwar) to upper plain section (Haridwar to Kanpur). In view of the paucity of such information, a study was made to investigate the longitudinal distribution of fish fauna in the Ganga river from Gangotri to Kanpur.

MATERIALS AND METHODS

Study area: Mountain section (MS) *i.e.* from Gangotri to Haridwar and plains section-Upper Ganga (PS-UG) from Haridwar to Kanpur. The primary and secondary data were used for preparing a list of fish species in the MS and PS. Primary data were collected with the help of local fishermen by using cast nets and other indigenous traps during 2010-2011 from the river Bhagirathi (at Dharasu and Chham) and Alakananda (at Karanprayag, Rudrapryag and Srinagar) during pre and post monsoon season. The samples could not be collected in the monsoon season as high flows prevent the use of cast nets. The collected samples were preserved in 10% formalin and brought to the laboratory for further analysis. The fish fauna was identified using Day (1958), Talwar and Jhingran (1991), Jayaram (2002). The secondary sources are Singh *et al.* (1987); Nautiyal *et al.* (2007); Nautiyal *et al.* (2010); www.thdc.gov.in/writereaddata/english/pdf.

RESULTS AND DISCUSSION

Fish fauna of the river Ganga from Gangotri to Kanpur consisted of 140 fish species from 9 orders and 25

Table 1. Distribution of fish fauna in the mountain and upper plain of the Ganga river from Gangotri to Kanpur. Acronyms: MS- Mountain Section, PS- Plain Section. Fish nomenclature is based on Jayaram (2000) and Mahanta *et al.* (2001).

Taxa	MS	PS	Taxa	MS	PS
Order- Cypriniformes					
Family- Cyprinidae					
1. <i>Salmostoma bacaila</i> (Hamilton)	+	+	49. <i>Garra prashadi</i> (Hora)	+	+
2. <i>Schizothoracichthys progastus</i> (McClelland)	+	+	50. <i>Amblypharyngodon melettina</i> (Valenciennes)	-	+
3. <i>Schizothorax plagiostomus</i> (Heckel)	+	+	51. <i>Amblypharyngodon microlepis</i> (Bleeker)	-	+
4. <i>Schizothorax richardsonii</i> (Gray)	+	+	52. <i>Amblypharyngodon mola</i> (Hamilton)		+
5. <i>Schizothorax sinuatus</i> (Heckel)	+	+	53. <i>Esomus danricus</i> (Hamilton)	+	+
6. <i>Schizothorax esocinus</i> (Heckel)	+		54. <i>Osteobrama cotio</i> (Hamilton)		+
7. <i>Schizothorax curviformis</i> (Heckel)	+		55. <i>Catla catla</i> (Hamilton)		+
8. <i>Schizothorax niger</i> (Heckel)	+		56. <i>Chagunius chagunio</i> (Hamilton)		+
9. <i>Schizothorax intermedius</i> (McClelland)	+		57. <i>Chela laubuca</i> (Hamilton)		+
10. <i>Schizothorax micropogon</i> (Heckel)	+		58. <i>Rasbora daniconius</i> (Hamilton)	+	+
11. <i>Barilius barila</i> (Hamilton)	+	+	59. <i>Rasbora elanga</i> (Hamilton)		+
12. <i>Barilius bendelisis</i> (Hamilton)	+	+	60. <i>Raiamas bola</i> (Hamilton)	+	+
13. <i>Barilius bola</i> (Hamilton)	+	+	61. <i>Hypothalmichthys molitrix</i> (Valenciennes)	+	
14. <i>Barilius dimorphicus</i> (Tilak & Husain)		+	Family- Balitoridae		
15. <i>Barilius barna</i> (Hamilton)	+		62. <i>Nemacheilus botia</i> (Hamilton)	+	+
16. <i>Barilius vagra</i> (Hamilton)	+	+	63. <i>Nemacheilus corica</i> (Hamilton)		+
17. <i>Barilius modestus</i> (Day)		+	64. <i>Nemacheilus montanus</i> (McClelland)	+	+
18. <i>Barilius shacra</i> (Hamilton)	+		65. <i>Nemacheilus rupecola</i> (McClelland)	+	+
19. <i>Labeo bata</i> (Hamilton)		+	66. <i>Nemochilus beavani</i> (Gunther)	+	+
20. <i>Labeo boga</i> (Bloch)		+	67. <i>Nemochilus multifasciatus</i> (Day)	+	+
21. <i>Labeo calbasu</i> (Hamilton)	+	+	68. <i>Nemochilus Savona</i> (Hamilton)	+	+
22. <i>Labeo dero</i> (Hamilton)	+	+	69. <i>Nemochilus scaturigina</i> (McClelland)		+
23. <i>Labeo dyocheilus</i> (Day)	+	+	70. <i>Nemochilus zonatus</i> (McClelland)	+	+
24. <i>Labeo angra</i> (Hamilton)	+		Family-Cobitidae		
25. <i>Labeo gonius</i> (Hamilton)	+	+	71. <i>Botia almorhae</i> (Gray)		+
26. <i>Labeo pangusia</i> (Hamilton)		+	72. <i>Botia dario</i> (Hamilton)	+	+
27. <i>Labeo rohita</i> (Hamilton)		+	73. <i>Botia lohachata</i> (Chaudhari)		+
28. <i>Laubuca atper</i> (Hamilton)		+	74. <i>Lepidocephalus guntea</i> (Hamilton)		+
29. <i>Puntius chagunio</i> (Hamilton)		+	Order- Siluriformes		
30. <i>Puntius chola</i> (Hamilton)		+	Family- Bagridae		
31. <i>Puntius conchonius</i> (Hamilton)		+	75. <i>Mystus aor</i> (Hamilton)		+
32. <i>Puntius sarana</i> (Hamilton)	+	+	76. <i>Mystus bleekeri</i> (Day)		+
33. <i>Puntius sophore</i> (Hamilton)	+	+	77. <i>Mystus cavasius</i> (Hamilton)		+
34. <i>Puntius spp.</i> (Hamilton)		+	78. <i>Mystus menoda</i> (Hamilton)		+
35. <i>Puntius ticto</i> (Hamilton)	+	+	79. <i>Mystus seenghala</i> (Sykes)		+
36. <i>Tor putitora</i> (Hamilton)	+	+	80. <i>Mystus tengara</i> (Hamilton)	+	+
37. <i>Tor tor</i> (Hamilton)	+	+	81. <i>Mystus vittatus</i> (Bloch)		+
38. <i>Tor chilinoides</i> (McClelland)	+		82. <i>Rita rita</i> (Hamilton)	+	+
39. <i>Aspidoparia jaya</i> (Hamilton)		+	Family-Amblycipitidae		
40. <i>Aspidoparia morar</i> (Hamilton)		+	83. <i>Amblyiceps mangois</i> (Hamilton)		+
41. <i>Crossocheilus latius</i> (Hamilton)	+	+	Family-Chacidae		
42. <i>Cyprinus carpio</i> (Linnaeus)	+		84. <i>Chaca chaca</i> (Hamilton)		+
43. <i>Danio devario</i> (Hamilton)	+	+	Family-Siluridae		
44. <i>Danio rerio</i> (Hamilton)	+	+	85. <i>Ompok bimaculatus</i> (Bloch)		+
45. <i>Cirrhinus mrigala</i> (Hamilton)	-	+	86. <i>Ompok boopis</i> (Hamilton)		+
46. <i>Cirrhinus reba</i> (Hamilton)		+	87. <i>Ompok pabda</i> (Hamilton)		+
47. <i>Garra gotyla gotyla</i> (Gray)	+	+	88. <i>Ompok pavole</i> (Hamilton)		+
48. <i>Garra lamta</i> (Hamilton)	+		89. <i>Wallago attu</i> (Bloch)		+

Table 1. *Contd.*

Taxa	MS	PS
Family-Heteropneustidae		
90. <i>Heteropneustes fossilis</i> (Hamilton)		+
Family-Pangasiidae		
91. <i>Pangasius pangasius</i> (Hamilton)		+
Family-Schilbeidae		
92. <i>Ailia coila</i> (Hamilton)		+
93. <i>Clupisoma garua</i> (Hamilton)	+	+
94. <i>Clupisoma montana</i> (Hora)		+
95. <i>Pseudotropius atherinoides</i> (Bloch)		+
96. <i>Eutropiichthys murius</i> (Hamilton)		+
97. <i>Eutropiichthys vacha</i> (Hamilton)		+
98. <i>Silonia silondia</i> (Hamilton)		+
Family-Sisoridae		
99. <i>Sisor rabdophorus</i> (Hamilton)		+
100. <i>Bagarius bagarius</i> (Hamilton)	+	+
101. <i>Gagata cenia</i> (Hamilton)		+
102. <i>Nangra nangra</i> (Hamilton)		+
103. <i>Glyptothorax dakpathari</i> (Tilak & Husain)		+
104. <i>Glyptothorax indicus</i> (Talwar)		+
105. <i>Glyptothorax pectinopterus</i> (McClelland)	+	+
106. <i>Glyptothorax madraspatanum</i> (Hamilton)		+
107. <i>Glyptothorax cavia</i> (Hamilton)		+
108. <i>Glyptothorax trilineatus</i> (Blyth)		+
109. <i>Glyptothorax lineatum</i> (Hamilton)		+
110. <i>Glyptothorax conirostris</i> (Steindachner)		+
111. <i>Pseudecheneis sulcatus</i> (McClelland)		+
Family-Clariidae		
112. <i>Clarias batrachus</i> (Linnaeus)	+	+
Order-Mugiliformes		
Family-Mugilidae		
113. <i>Rhinomugil corsula</i> (Hamilton)	+	+
114. <i>Mugil corsula</i> (Hamilton)		+
Order-Beloniformes		
Family-Belonidae		
115. <i>Xenentodon cancila</i> (Hamilton)	+	+
Order-Cyprinodontiformes		
Family-Mastacembelidae		

families; 63 fish species from 6 orders and 12 families in the mountain section, while 122 species from 9 orders and 25 families in the Plains of Upper Ganga (Table 1). Cypriniformes and Cyprinidae were the most species rich order and family in both MS and PS (Figs.1 and 2). Forty six fish species primarily Cypriniformes and Siluriformes were common to both sections. However, 17 species were present in MS and 76 in PS. Most of the fish species common to MS and PS belonged to order Cypriniformes and Siluriformes (Table 1). Orders Tetradontiformes, Osteoglossiformes and Clupeiformes were present only in PS.

In the upper mountain section *i.e.* up to Devprayag, 39

Table 1. *Contd.*

Taxa	MS	PS
116. <i>Macrogathus pancalus</i> (Hamilton)		+
117. <i>Mastacembelus armatus</i> (Lacepede)	+	+
Order-Perciformes		
Family-Channidae		
118. <i>Channa gachua</i> (Hamilton)	+	+
119. <i>Channa marulius</i> (Hamilton)		+
120. <i>Channa punctatus</i> (Bloch)		+
121. <i>Channa stewartii</i> (Playfair)		+
122. <i>Channa striata</i> (Bloch)		+
123. <i>Chanda nama</i> (Hamilton)		+
124. <i>Chanda ranga</i> (Hamilton)		+
125. <i>Ophiocephalus punctatus</i> (Bloch)		+
Family-Nandidae		
126. <i>Nandus nandus</i> (Hamilton)		+
127. <i>Badis badis</i> (Hamilton)		+
Family-Belontiidae		
128. <i>Colisa fasciatus</i> (Schneider)	+	+
129. <i>Colisa lalia</i> (Hamilton)		+
Family-Sciaenidae		
130. <i>Sciaena coitor</i> (Hamilton) now valid as <i>Johnius coitor</i> (Hamilton)		+
Family-Gobiidae		
131. <i>Glossogobius giuris</i> (Hamilton)		+
Family-Anabaniitidae		
132. <i>Anabas testudineus</i> (Bloch)		+
Order-Tetraodontiformes		
Family-Tetraodontidae		
133. <i>Tetraodon cutcutia</i> (Hamilton)		+
Order-Osteoglossiformes		
Family-Notopteridae		
134. <i>Notopterus notopterus</i> (Pallas)		+
135. <i>Chitala chitala</i> (Hamilton)		+
Order-Clupeiformes		
Family-Clupeidae		
136. <i>Gudusia chapra</i> (Hamilton)		+
137. <i>Hilsa ilisha</i> (Hamilton)		+
Family-Engraulidae		
138. <i>Setipinna phasa</i> (Hamilton)		+
139. <i>Leiocassis rama</i> (Hamilton)		+
Total	63	122

fish species were reported in the Bhagirathi from Gangotri to Devprayag and 42 species in the Alaknanda from Mana to Devprayag (Singh *et al.*, 1987). Recently, Nautiyal *et al.*, (2007) reported brown trout (*Salmo trutta* morph *fario* Linnaeus, 1758) in a left side tributary (Kherag Gad) of the Bhagirathi river downstream of Bhaironghati. Twenty species were reported in the Alaknanda river and its tributaries near up and down stream of the proposed barrage and power house sites for Vishnugad Pipalkoti Hydro-Electric Project (www.thdc.gov.in/writereaddata/english/pdf). However, Khanna and Badola (1994) recorded 30 fish species around Rishikesh-Hardwar section in the foothill section of mountain zone. In the

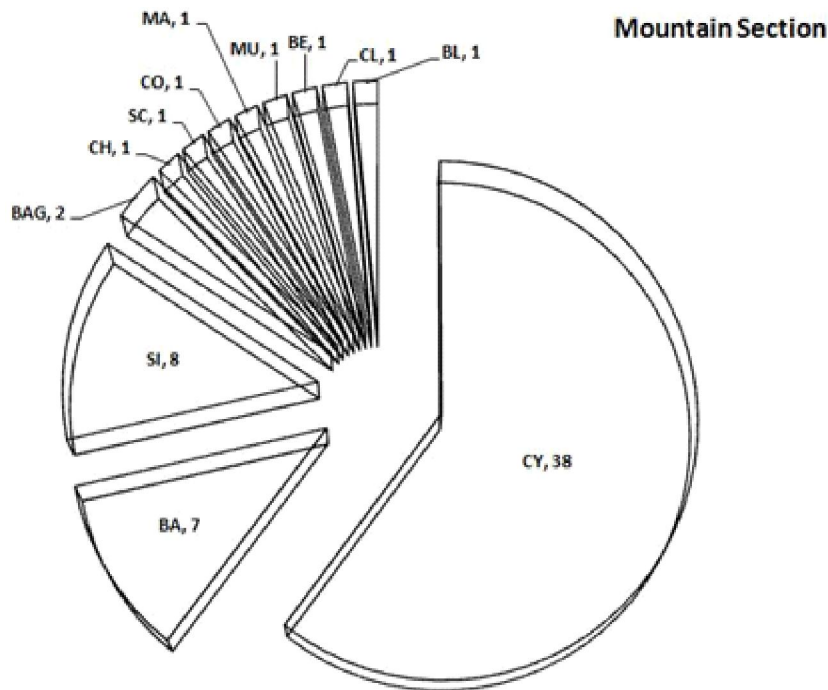


Fig. 1 . Pie chart indicating the number of species in each family in the mountain section. Acronyms: CY-Cyprinidae; BA-Balitoridae; SI- Sisoridae; BAG- Bagaridae; CH-Channidae; SC - Schilbeidae; CO- Cobitidae; MA- Mastacembelidae; MU-Mugilidae; BE- Belontiidae; CL - Clariidae; BL- Belonidae.

foothill section, Negi and Malik (2005) recorded 35 species at Rishikesh and Nautiyal *et al.* (2010) recorded 20 species between Kaudiyala and Rishikesh.

However, in the PS, there is a transition zone from Hardwar to Bijnor (77 km. apart). This zone is the junction of two biogeographic regions, the west Himalaya and the Upper Gangetic Plains. This zone has a larger share of mountain element. It was notable that some essentially coldwater species i.e. snow trout, *Garra* and *Glyptothorax* extend their range but few were in the junction zone. The coldwater character of these species was also obvious because they were not present after this junction zone, while the cool-water elements continue to be found in PS. The other elements included migratory fish *Tor* and *Labeo* and a mixture of loaches and barils that can be called as cool water forms. The most typical fish in MS were Cyprinidae; snow trouts (*Schizothorax* sp, *Schizothoraichthys* sp. *Tor chelynoides*,) Balitoridae (*Schistura* sp.) and Sisoridae (*Pseudecheneis* sp., *Glyptothorax* sp.). In PS besides *Schistura* and *Glyptothorax* sp., a wide variety of other genera of these families were exclusive. Presence of diverse silurid families (Order Siluriformes) was the unique feature of this section. Thus, a general increase in fish richness was evident from MS to PS. Sharma and Rajput (1986) recorded 26 fish species around the Bijnor District. Rao (2001) reported 82 fish species between Brijghat to Narora (RIS, 2004). Shukla and Vandana (1995) recorded 25 fish species around Kanpur.

The taxonomic richness in the mountain was low

compared to plain section attributed probably to motility. The physiological requirements in respect of tolerance for temperature restrict the faunal elements in a different fashion from other biotic components. The river is extensively regulated in the MS compared to PS till Kanpur. This has modified the continuum of the Ganga in the examined stretch. The continuum of the fauna depends on their dispersal ability so essential for population dynamics, and since aquatic organisms can disperse only if there are no barriers, their dispersal was hindered, inhibited and impaired. This may have lead to decline in the similarity in the UGP, where no major river from different biogeographic zone is joining the Ganga. There is a serious lacuna about the natural range of each species (however small in size), as there have been no dedicated research programs for the Ganga with economic implications for the country, especially irrigation and the variety of livelihood it provides to poverty ridden areas of north India. For instance it is well known that the snow trouts *S. richardsonii* and *S. plagiostomus* reside from little below Badrinath to Hardwar and *Tor putitora* reside in the foothills (even Bijnor) but migrate even beyond Srinagar (Alaknanda) and Tehri (not now because of Tehri Dam). If these species are not found in impounded areas then it is obvious that the continuum does not exist, but then the fish needs the food web and each component has an ecological function in the ecosystem. Hence there is emphasis on the knowledge of various components of biodiversity and their distribution to know the health

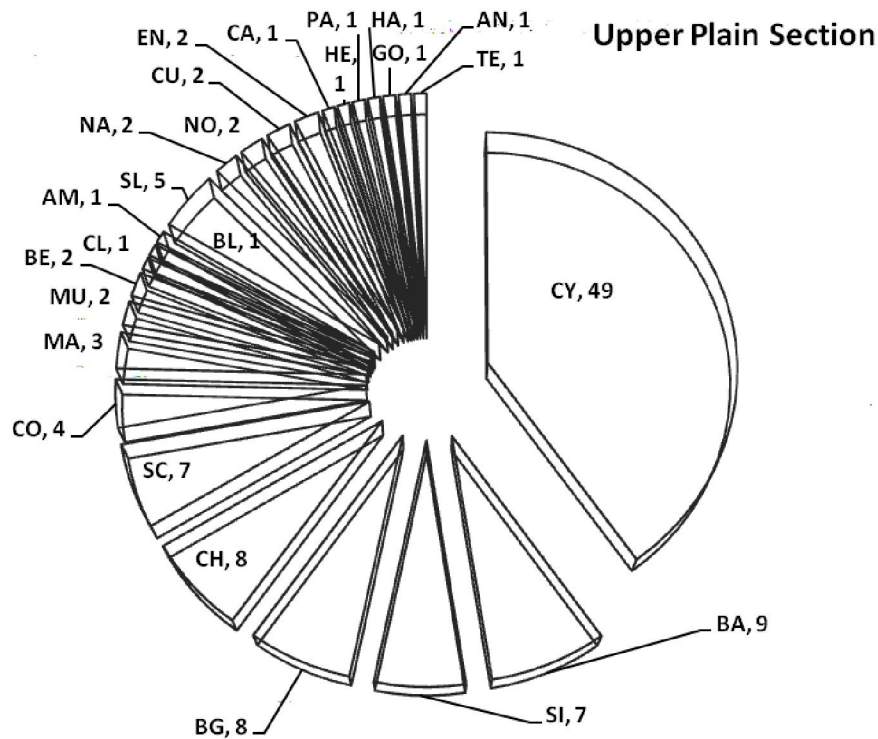


Fig.2. Pie chart indicating the number of species in each family in the upper plain section. Acronyms: AM-Amblyciptidae; SL-Siluridae; NA-Nandidae; NO-Notopteridae; CU-Clupeidae; EN-Engraulidae; CA-Chacidae; HE-Heteropneustidae; PA-Pangasiidae; HA-Haemulidae; GO-Gobidae; AN-Anabaniidae; TE-Tetraodontidae. For other acronyms see Legends for Fig. 1

of the ecosystem. Changes in distribution indicate the perturbances in the continuum.

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REFERENCES

- Allan, J.D. (1995). Stream Ecology. Structure and Function of Running Waters. Chapman and Hall, New York.
- Carter, J.C.H., Dadswell, M.J., Roff, J.C. and Sprules, W.G. (1980). Distribution of zoogeography of planktonic crustaceans and dipterans in glaciated eastern North America. *Canadian Journal of Zoology*, 58:1355-1387.
- Day, F. (1958). The fishes of India: being a natural history of the fishes known to inhabit the seas and freshwater of India, Burma and Ceylon. William Dawson, London.
- Gregory, S.V., Swanson, F.J., Mckee, W.A. and Cummins, K.W. (1991). An ecosystem perspective of riparian zones. *Bioscience*, 41: 540-551.
- RIS (2004). Information Sheet on Ramsar Wetlands. World Wide Fund (WWF), India, pp. 1-14.
- Jayaram, K.C. (2002). The freshwater fishes of the Indian region. Narendra Publishing House, Delhi.
- Khanna, D.R. and Badola S.P. (1994). Habitat and breeding grounds. In: P. Nautiyal (Ed.) Mahseer: The Game fish Jagdamba Prakashnan, Dehradun.
- Nautiyal P., Shivam, A., Verma J. and Semwal, V.P. (2007). Bhagirathi river- An endangered ecosystem. In: B. Venkatramani, V.D. Puranik, S.K. Apte, H.N. Gour, S.K. Sharma, L.L. Sharma, Y.S. Durve, H.C.L. Gupta, P.C. Verma, B.K. Sharma, (Eds.), *Proceedings of DAE-BRNS National Symposium on Limnology*, Paliwal Printers, Udaipur, India. pp 164-166
- Nautiyal, P., Shivam, A., Verma, J. and Dwivedi, R.K. (2010). Quarterly progress report (September 09) for the Living Ganga Programme with respect to environmental flow submitted to WWF, New Delhi, India.
- Negi, K.S. and Malik, D.S. (2005). Fish fauna of Ganga river at Rishikesh. *Himalayan Journal of Environmental Zoology*, 19(2): 145-148.
- O'Keeffe, J., Kaushal, N., Bharti, L. and Smathkin, V. (2012). Assessment of Environmental Flows for the Upper Ganga Basin. WWF – India.
- Rao, R.J. (2001). Studies on biological restoration of Ganga river in Uttar Pradesh: an indicator species approach. *Hydrobiologia*, 458: 159–168.
- Sharma, M.K. and Rajput, D.B. (1986). Ichthyofauna of Bijnor District (Uttar Pradesh). *Journal Bombay Natural History Society*, 83 (3):562-569.
- Shukla, A.C. And Vandana, A. (1995). Ganga: A water marvel. Ashish Publishing House, New Delhi.
- Singh, H.R., Badola, S.P. and Dobriyal, A.K. (1987). Geographical distributional list of ichthyofauna of the Garhwal Himalaya with some new records. *Journal of Bombay Natural History Society*, 84: 126-132.
- Talwar, P.K. and Jhingran, A.G. (1991). Inland Fishes of India

and Adjacent Countries. Oxford & IBH Publishing Co Pvt Ltd., New Delhi Volumes I-II.

Wiley, M.J., Kohler, S.L. and Seelbach, P.W. (1997). Reconciling landscape and local views of aquatic communities: lessons

from Michigan trout streams. *Freshwater Biology*, 37: 133-148.

<http://thdc.gov.in/writereaddata/english/pdf/VOL4.pdf>, accessed on 15.09.2011