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Floral and Faunal Diversity in Alaknanda River

Mana to Devprayag

GRBMP : Ganga River Basin Management Plan

by

Indian Institutes of Technology

IIT Bombay | IIT Delhi | IIT Guwahati | IIT Kanpur | IIT Kharagpur | IIT Madras | IIT Roorkee

Preface

In exercise of the powers conferred by sub-sections (1) and (3) of Section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government has constituted National Ganga River Basin Authority (NGRBA) as a planning, financing, monitoring and coordinating authority for strengthening the collective efforts of the Central and State Government for effective abatement of pollution and conservation of the river Ganga. One of the important functions of the NGRBA is to prepare and implement a Ganga River Basin Management Plan (GRBMP).

A Consortium of 7 Indian Institute of Technology (IIT) has been given the responsibility of preparing Ganga River Basin Management Plan (GRBMP) by the Ministry of Environment and Forests (MoEF), GOI, New Delhi. Memorandum of Agreement (MoA) has been signed between 7 IITs (Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and MoEF for this purpose on July 6, 2010.

This report is one of the many reports prepared by IITs to describe the strategy, information, methodology, analysis and suggestions and recommendations in developing Ganga River Basin Management Plan (GRBMP). The overall Frame Work for documentation of GRBMP and Indexing of Reports is presented on the inside cover page.

There are two aspects to the development of GRBMP. Dedicated people spent hours discussing concerns, issues and potential solutions to problems. This dedication leads to the preparation of reports that hope to articulate the outcome of the dialog in a way that is useful. Many people contributed to the preparation of this report directly or indirectly. This report is therefore truly a collective effort that reflects the cooperation of many, particularly those who are members of the IIT Team. Lists of persons who have contributed directly and those who have taken lead in preparing this report is given on the reverse side.

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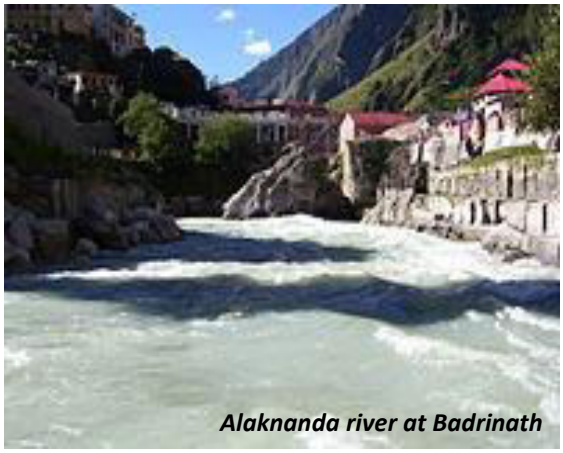
1. Introduction


Alaknanda river at Badrinath

The Alaknanda basin is characterized by hilly terrain, deep gorges, and river valleys. The region is broadly divided into four major divisions (i) The Great Himalayan ranges (snow covered regions), (ii) Alpine and pasture land (covered by snow during the four months of winter season) (iii) Middle Himalaya (characterized by high concentration of population) and (iv) River valleys. Among the major rivers of India, the Alaknanda river and its tributaries (Dhauliganga, Vishnuganga, Nandakini, Pindar, Mandakini, and other numerous perennial streams) originate and flow here (Sati, 2010).

Alaknanda river originates at the water divide between Satopanth and Bhagirathi glaciers (near Vashundhara falls), flows eastward and joins Saraswati river at Mana and then flows in a Southeast direction up to Joshimath where it meets Dhauliganga. After this confluence, it takes a swerve and starts flowing in the Southwest direction to meet Bhagirathi river at Devprayag traversing approximately 179 km (Krishna Murti *et al.* 1991). The Alaknanda contributes significantly a larger portion to the flow of the Ganga than the Bhagirathi. The Hindu pilgrimage centre of Badrinath (one of the four 'Dham') lies along the banks of the Alaknanda river. Several rivers in the Garhwal region merge with the Alaknanda at Panch Prayag or 'holy confluence of rivers' *i.e.* Vishnuprayag (Dhauliganga), Nandaprayag (Nandakini), Karnaprayag (Pindar), Rudraprayag (Mandakini) and Devprayag (Bhagirathi) to become the Ganga river.

One hydroelectric project (at Vishnuprayag) is under operation and 36 others are proposed or under constructions on the river Alakananda and Mandakini. These projects are run-of-the river projects (ROR) and when completed will influence the free flow of the river by storing water in big reservoirs or channeled through tunnels.

Rapids are major habitat type in the stretch followed by riffles and pools. Mature cobbles, pebbles and boulders constitute the major substrate type. However, at Devprayag rock is dominant substratum. Water is clear with transparency of 0.3 m to 2.0 m depth. It is a cold water river (temperature 8°C - 21.5°C) with high velocities (0.6 - 4.2 ms^{-1})(Nautiyal 1985; Kishor 1998; Nautiyal *et al*., 2004). The river Alaknanda can be differentiated in to two stretches:


Pool habitat with Stony Substratum

A) Mana to Vishnuprayag- low temperature, high velocity stretch

B) Vishnuprayag to Devprayag- medium temperature, moderate velocity stretch

The stretch (A) is characterized by the absence of fish, while stretch (B) has Trout as the dominant fish.

2. Locations and meeting points of various tributaries in river Alaknanda

The geographical location of various stations and meeting points of tributaries are represented in Plate 1.

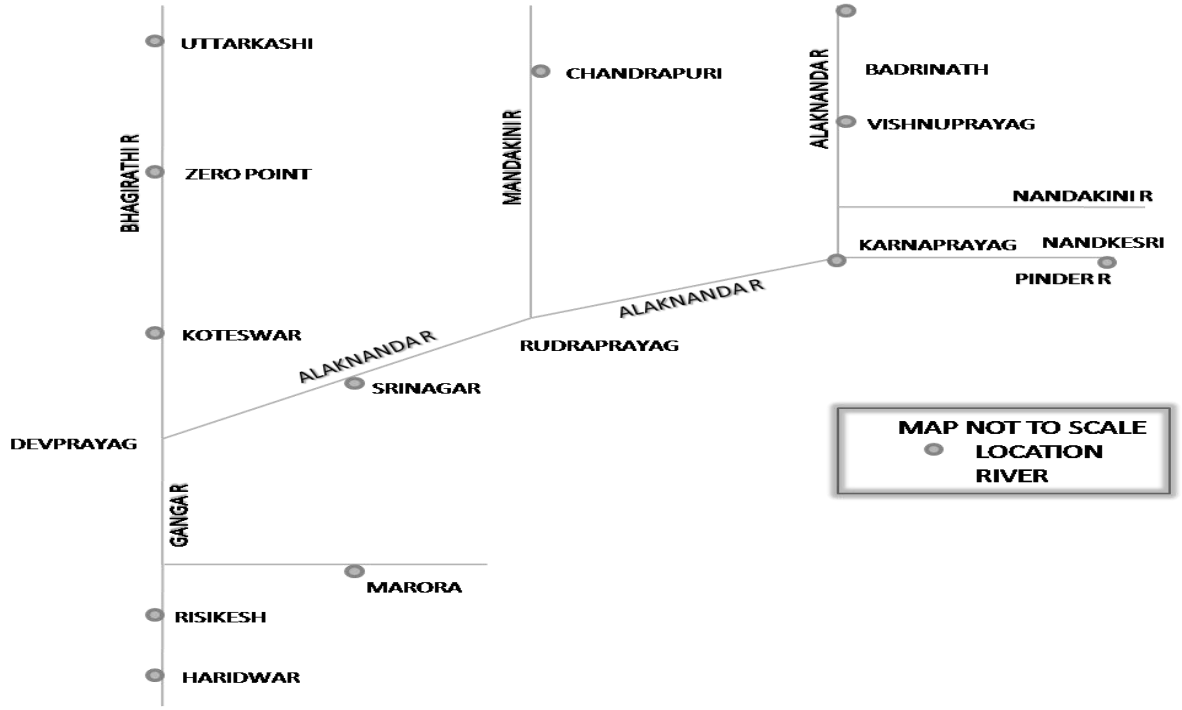
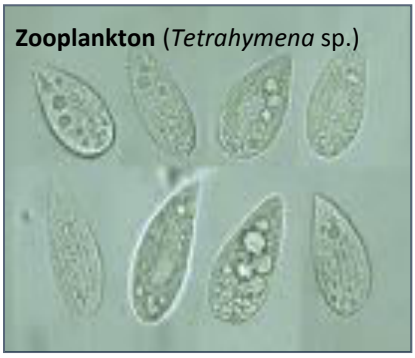


Plate 1: Line digram of Alaknanda river

3. Biodiversity of Alaknanda river


Zooplankton (*Tetrahymena* sp.)

Stretch A: Mana to Vishnuprayag

This stretch lies between latitude (^{o}N) 30°46’21.39" to 30°33’45.15", longitude (^{o}E) 79°29'43.22" to 79°34'32.59" and altitude from 3208 to 1443 m (a msl). This stretch is characterized by the phytoplankton belonging to Bacillariophyceae, Chlorophyceae and Myxophyceae and zooplankton represented by protozoans (Cilliates). The distribution of phytoplankton along Mana to Vishnuprayag is given in Table 1. In each stretch (Mana to Vishnuprayag and Vishnuprayag to Devprayag) the members of Bacillariophyceae were dominant, followed by members of Chlorophyceae and Myxophyceae (Figure 1).

Table 1: Distribution of Phytoplankton in the Alaknanda river from Mana to Vishnuprayag (Joshi *et al.*, 1995)

Family/ Genus	Joshi *et al.*, 1995
Bacillariophyceae	
Achnanthes sp.	+
Cocconies sp.	+
Cymbella sp.	+
Diatoma sp.	+
Stauroneis sp.	+
Stephanodiscus sp.	+
Chlorophyceae	
Spirogyra sp.	+
Myxophyceae	
Phormidium sp.	+
Total	**8**

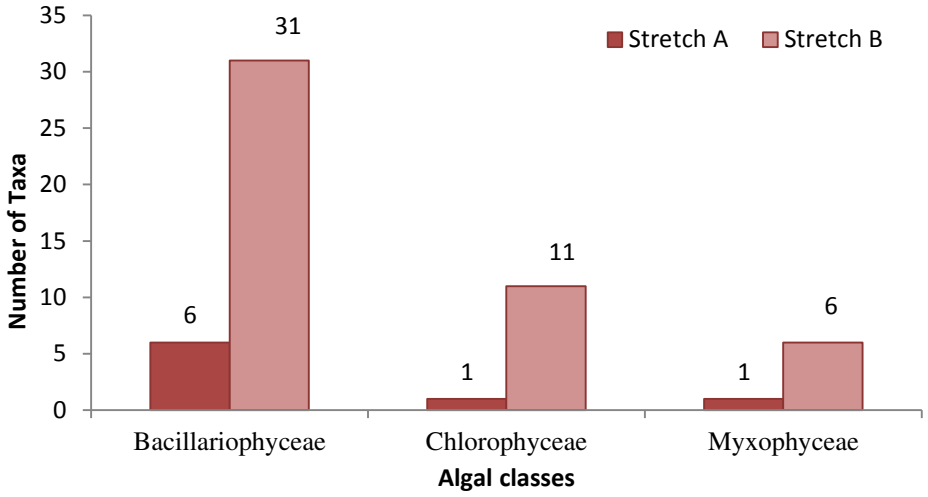


Figure 1: Distribution of phytoplankton in river Alaknanda

Stretch B: Vishnuprayag to Devprayag

Geographically this stretch lies between latitude (^{o}N) 30°33’45.15" to 30°8’40.56", longitude (^{o}E) 79°34'32.59" to 78°36'3.71” and altitude 1443 to 476 m (a msl). This stretch is represented by Diatoms in both phytoplankton and periphyton (Appendix I and II). In phytoplankton, total number of class and taxa are 3 and 48, respectively. However, Nautiyal (1985) has reported 12 taxa in the river Alaknanda (Appendix I). In the periphyton community, the total number of class and taxa are 4 and 157, respectively (Appendix II and Figure 2). In case of periphyton the members of Bacillariophyceae were also dominant in stretch B followed by Chlorophyceae, Myxophyceae and Desmidiaceae. Most common genera were *Achnanthes, Cymbella, Fragilaria, Gomphonema* and *Navicula*.

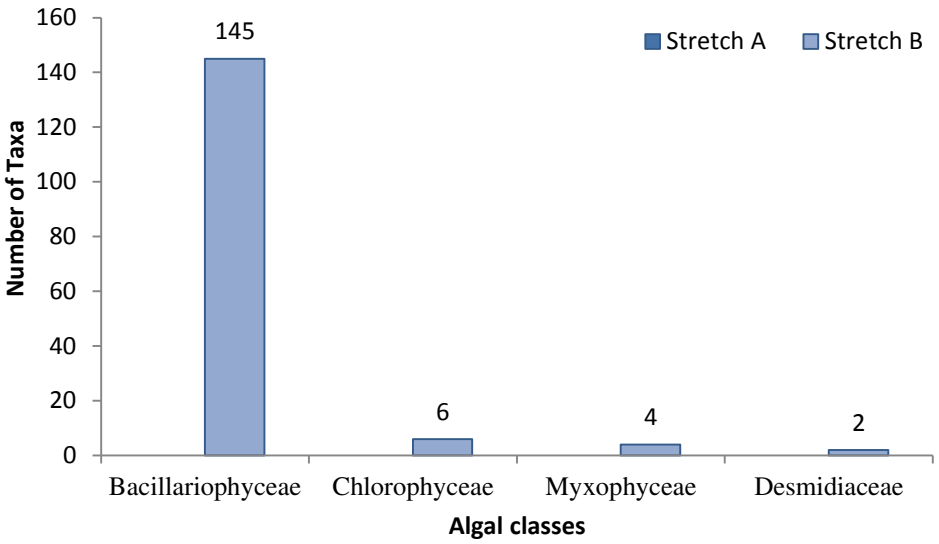


Figure 2: Distribution of periphyton in river Alaknanda

Zooplankton is mainly represented by Protozoans (8) followed by Crustaceans (3) and Rotifers (2) (Appendix III and Figure 3). Cladocera was represented by two species; however the Copepoda was represented by only one species. Rotifera was represented by two species (*Asplanchna* sp. and *Keratella* sp.). Zooplankton genera showing abundance are *Cyclops* and *Keratella*. The **Zoobenthos** is represented mostly by Arthropoda (Figure 4); caddis fly (Trichoptera), may fly (Ephemroptera) and wing fly (Diptera) with occasional presence of Annelida (worms) and molluscs (Appendix IV). Bottom dwelling aquatic macro zoobenthos were represented by 16 taxa from 6 orders (EIA, 2009).

Plate 2: Some nektonic species reported in river Alaknanda

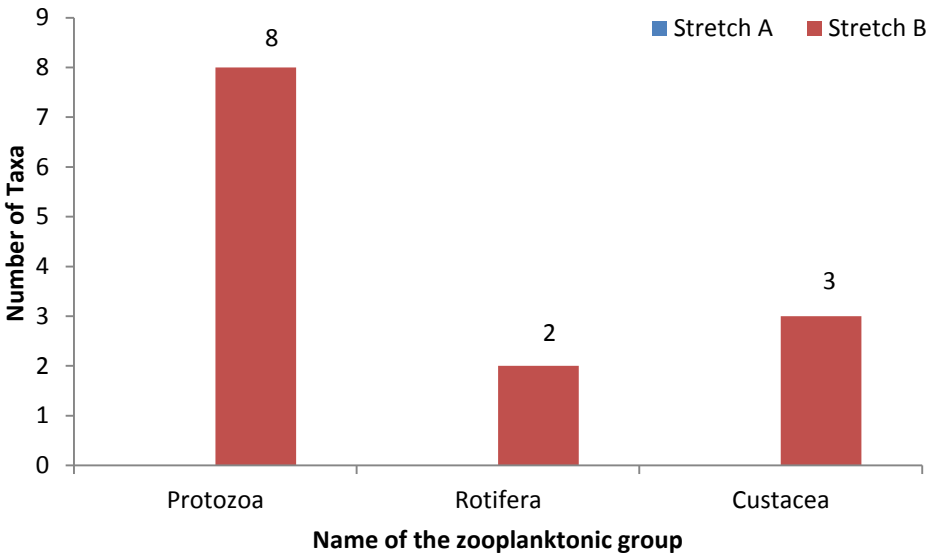


Figure 3: Distribution of zooplankton in river Alaknanda

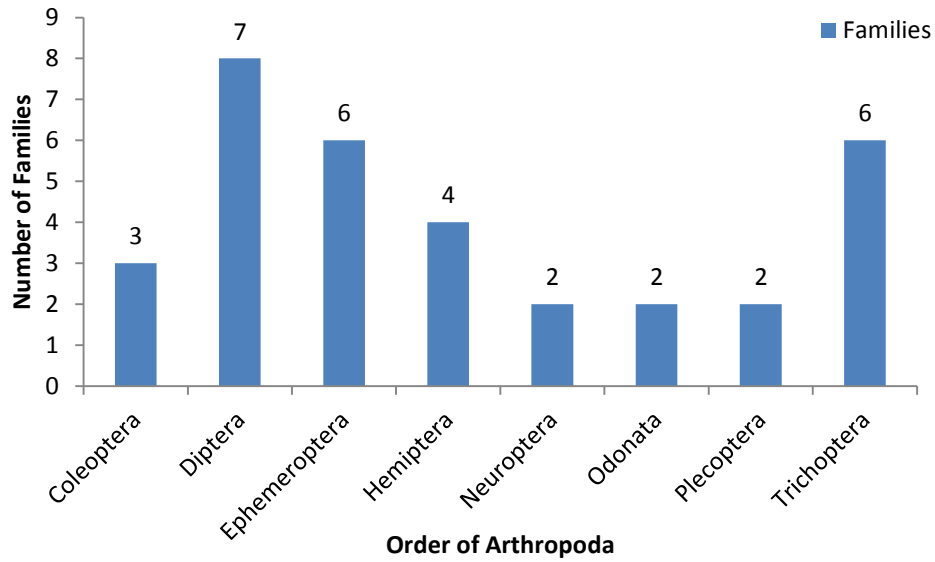


Figure 4: Distribution of Arthropoda in river Alaknanda (Stretch B)

In **nektonic** communities; snow trout (*Schizothorax* sp.) is most abundant fish followed by *Glyptothorax* sp. and *Nemacheilus* sp. (Appendix V). Total 43 fish species are recorded. Cyprinidae (26 species) is most abundant family followed by Sisoridae (7) and Balitoridae (6) (Figure 5). The abundance of producers (phytoplankton and periphyton) and consumers (zooplankton and zoobenthos) govern the population of fish community. The trouts breed at stony substrate of 1-3 m depth during August to October and migrate towards upper reaches in search of suitable environment for breeding.

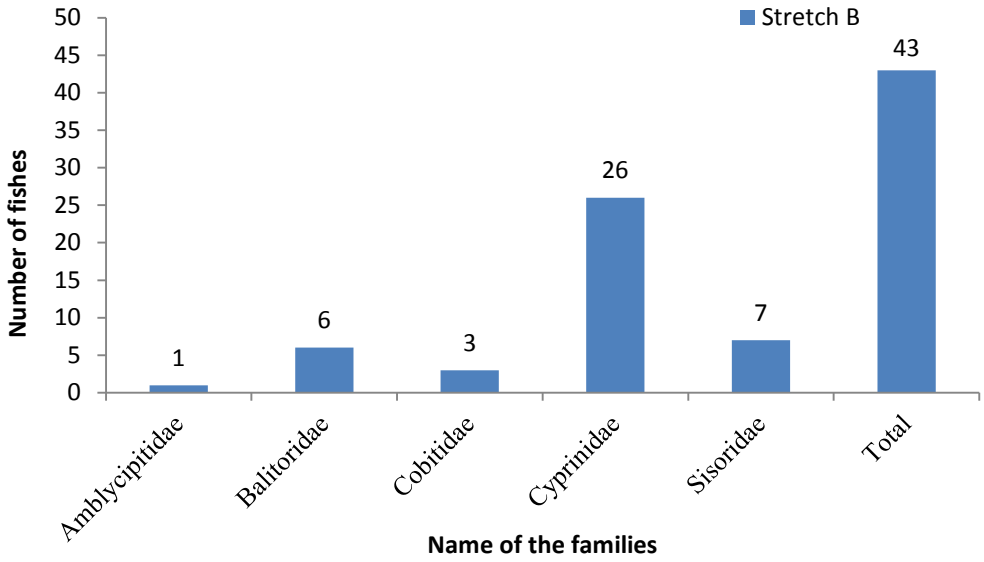


Figure 5: Distribution of fishes in river Alaknanda

4. Conclusions

- ✓ In stretch A (from Mana to Vishnupryag), the biotic community is unexplored, attributed to low temperature and very high water current. However, Joshi *et al.,* (1995) recorded only phytoplankton as dominant community. This stretch is not reported as habited by any fish species.
- ✓ The stretch B has diatoms (Bacillariophyceae) as dominant group in the phytoplankton and periphyton communities. Green algae (Chlorophyceae) and blue green algae (Myxophyceae) contribute one third share in the total planktonic community. Protozoans contribute highest share in the zooplankton community. Wing fly (Diptera) is dominant taxa followed by cadis fly (Trichoptera) and may fly (Ephemeroptera). The dominance of the indicated flies indicated the presence of both type of food particles i.e. coarse particulate organic matter (CPOM) and fine particulate organic matter (FPOM). According to 'River Continuum concept' (Vannote *et al*., 1980), the community composition changes from headwater to downstream of the river due to change in physical and chemical characteristic of the river. Snow trout is characteristic fish in this stretch because of moderate water temperature, current velocity and preferred physical habitat (rocks and boulders).

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Appendix I

Distribution of Phytoplankton in the Alaknanda river from Vishnuprayag to Devprayag

Taxa	Joshi *et al.*, 1995	Kishor, 1998	EIA, 2009	Nautiyal, 1985
Bacillariophyceae				
Achnanthes sp.				+
A. fragilariodes		+		
A. minutissima		+		
Asterionella sp.	+			
Caloneis sp.	+			
Cocconies placentula		+		
Cyclotella sp.	+			
Cymatopleura sp.	+			
Cymbella sp.				+
C. affinis		+		
C. cistula			+	
C. laevis		+		
Diatoma elongate			+	
Diatomella sp.	+			
Diploneis sp.	+			
Fragillaria sp.				+
F. inflata			+	
Frustulia sp.	+			
Gomphonema sp.				+
G. sphaerophorum		+		
Gyrosigma sp.	+			+
Hantzschia sp.	+			
Meridion sp.	+			
Navicula sp.				+
N. radiosa		+		
Nitzschia sp.	+		+	+
Pinnularia sp.	+			
Stauroneis sp.	+			
Stephanodiscus sp.	+			
Synedra sp.	+			+
Tabellaria fenestris			+	
Chlorophyceae				
Chaetophora sp.	+			
Cladophora sp.	+			+
Closteriopsis sp.	+			
Eudorina sp.	+			
Hydrodictyon sp.	+			
Scenedesmus sp.	+			+

Selenastrum sp.	+			
Spirogyra sp.	+		+	+
Ulothrix sp.				+
U. zonata			+	
Zygnema sp.	+			
Myxophyceae				
Anabaena sp.	+		+	
Lyngbya sp.	+			
Merismopoedia sp.	+			
Oscillatoria tenuis			+	
Phormidium sp.	+			
Spirulina sp.	+			
Total	**29**	**7**	**9**	**12**

Appendix II

Distribution of Periphyton in the Alaknanda river from Vishnuprayag to Devprayag

Taxa	Negi (1993)	Nautiyal *et al.*, 1996	Kishor (1998)	Nautiyal *et al.*, 2004	Nautiyal (2005)	EIA (2009)
Bacillariophyceae						
Achnanthes affinis			+		+	
A. biasolettiana					+	
A. clevei					+	
A. exigua					+	
A. exilis					+	
A. fragilarioides					+	
A. grimmei					+	
A. hauckiana					+	
A. kryophila					+	
A. lemmermannii					+	
A. laterostrata				+	+	
A. lanceolata					+	
A. lanceolata					+	
A. minutissima			+		+	
A. nodosa					+	
A. orientalis				+	+	
A. plonensis					+	
A. saxonica					+	
A. suchlandti					+	
A. trigibba			+		+	
Amphora ovalis		+			+	
A. veneta		+				
Caloneis bacillum		+			+	
C. boccariana		+				
C. obtusa				+	+	
C. silicula		+				
Cocconeis diminuta				+	+	
C. disculus				+	+	
C. placentula			+		+	
C. pediculus					+	
Ceratoneis sp.	+					
Cymbella affinis		+	+		+	
C. amphicephala					+	
C. angustata				+	+	
C. austriaca				+	+	
C. biporlita				+	+	

C. cistula					+	+
C. cymbiformis		+			+	
C. gonzalvesii		+			+	
C. gracilis		+			+	
C. helvetica		+			+	
C. hustedtii		+			+	
C. kappii				+	+	
C. lacurstris		+				
C. laevis		+			+	
C. nagpurensis		+			+	
C. naviculiformis				+	+	
C. parva		+			+	
C. perpusilla		+				
C. pusilla		+			+	
C. reinhardtii				+	+	
C. tumida		+			+	
C. tumidula		+			+	
C. turgidula		+			+	
C. turgida		+			+	
C. ventricosa		+	+			
Denticula sp.						+
Diploneis ovalis		+			+	
D. puella				+	+	
Diatoma anceps					+	
D. hymale					+	
D. subovalis		+				
D. tenue					+	
D. vulgaris					+	+
Encyonema brehmii					+	
E. gracile					+	
E. lacustre					+	
E. minutum				+	+	
E. silesiacum				+	+	
Epithemia hebridicum					+	
E. sorax					+	
Eunotia tenella					+	
Fragilaria bidens					+	
F. capucina				+	+	
F. inflate						+
F. intermedia				+	+	
F. vaucheriae					+	
F. virescens					+	

Gomphonema acuminatum		+			+	
G. angustatum		+			+	
G. augur				+	+	
G. bohemicum		+				
G. constrictum		+			+	
G. gracile		+				
G. intricatum		+			+	
G. lanceolatum		+			+	
G. nagpurense		+				
G. olivaceum		+		+	+	
G. parvulum		+			+	
G. pseudoaugur				+	+	
G. sphaerophorum		+			+	
G. subtile		+				
G. tergestinum		+				
G. ventricosum				+	+	
Gyrosigma scalproides		+				
G. spencerii		+				
Hannaea arcus					+	
Hantzschia sp.	+					
Meridion circulare						+
Navicula bacillum		+				
N. bryophila				+	+	
N. cari		+				
N. cincta		+	+			
N. cryptocephala		+		+	+	
N. grimii		+			+	
N. halophila		+		+		
N. intergracilis				+	+	
N. minima		+				
N. pupula		+				
N. radiosa		+			+	+
N. rostellata					+	
N. rhynchocephala		+	+		+	
N. viridula		+			+	
Nitzschia amphibia			+		+	
N. dentucula					+	
N. capitellata					+	
N. dissipata					+	
N. filiformis					+	
N. frustulum			+		+	
N. hybrida					+	

N. linaris					+	
N. microcephala					+	
N. paleacea					+	
N. sinuata					+	
N. sublinaris					+	
Neidium sp.	+					
Pinnularia appendiculata				+	+	
P. borealis		+			+	
P. braunii		+				
P. microstauron				+	+	
Reimeria sinuta					+	
Rhoicosphenia abbreviata					+	
R. vanheurkii					+	
Sellaphora pupula					+	
S. leptostauron					+	
S. pupula					+	
Stauroneis sp.	+					
Staurosira construens					+	
S. pinnata					+	
Surirella angusta					+	
Synedra amphicephala				+	+	
S. rumpens					+	
S. ulna			+	+	+	+
Tabellaria sp.	+					
T. fenestris						+
Chlorophyceae						
Cladophora sp.						+
Closterium leibleinii	+					+
Spirogyra sp.	+					+
Stigeoclonium sp.	+					
Ulothrix zonata						+
Zygnema sp.						+
Myxophyceae						
Anabaena sp.						+
Nostoc sp.	+					
Oscillatoria tenuis						+
Phormidium sp.						+
Desmidiaceae						
Desmidium sp.	+					
Gonatozygon sp.	+					
Total	**11**	**52**	**11**	**28**	**115**	**16**

Appendix III

Distribution of Zooplankton in the Alaknanda river from Vishnuprayag to Devprayag

Phylum/ Genus	Joshi *et al.,* 1995	EIA, 2009
Protozoa		
Actinophrys sp.	+	
Amoeba sp.	+	
Colpoda sp.	+	
Loxodes sp.	+	
Oxytricha sp.	+	
Paramecium sp.	+	
Tetrahyemna sp.	+	
Vorticella sp.	+	
Rotifera		
Asplanchna sp.		+
Keratella sp.		+
Arthropoda (Custacea)		
Ceriodaphnia sp.		+
Cyclops sp.		+
Daphnia sp.		+
Total	**8**	**5**

Appendix IV

Distribution of Zoobenthos in the Alaknanda river from Vishnuprayag to Devprayag

Taxa	Alaknanda					Mandakini
	Negi & Singh, 1990	Kishor, 1998	Nautiyal *et al.*, 2004	Rawat & Nautiyal, 2005	EIA, 2009	Semwal, 2002
Phylum-Annelida				+		
Phylum-Arthropoda						
Coleoptera						
Dryopidae						+
Elmidae						+
Psephenidae	+	+	+	+	+	+
Diptera						
Athericidae	+				+	
Blepharoceridae	+					+
Chironomidae	+	+	+		+	+
Culicidae	+					
Muscidae	+					
Simulidae	+				+	+
Tabanidae	+					+
Ephemeroptera						
Baetidae	+	+	+	+		+
Caenidae	+			+	+	+
Ephemerillidae	+		+		+	+
Heptageniidae	+	+	+	+	+	+
Leptophlebiidae	+			+	+	+
Siphlonuridae	+				+	
Hemiptera						
Belostomatidae	+					
Corixidae	+					
Naucoridae	+					
Nepidae	+					
Neuroptera						
Corydalidae	+				+	
Sialidae						+
Odonata						
Agrionidae						+
Gomphidae	+			+		+
Plecoptera						
Perlidae	+	+		+	+	+
Perlodidae	+				+	+
Trichoptera						
Brachycentridae	+				+	+
Hydropsychidae	+	+			+	+
Leptoceridae	+	+			+	+
Limnephilidae	+	+			+	+
Glossosomatidae						+
Psychomyiidae		+				+
Phylum-Mollusca				+		
Total	**26**	**9**	**5**	**9**	**16**	**23**

Appendix V

Distribution of fishes in the Alaknanda river from Vishnuprayag to Devprayag

Taxa	Singh *et al.*, 1983	EIA, 2009
Amblycipitidae		
Amblyceps mangois	+	
Balitoridae		
Nemacheilus beavani	+	+
N. montanus	+	+
N. multifasciatus	+	+
N. rupicola	+	
N. savona	+	
N. zonatus	+	+
Cobitidae		
Botia dario	+	
B. geto	+	
Lepidocephalus guntea	+	
Cyprinidae		
Barilius barna		+
B. bendelisis		+
B. bola	+	+
B. vagra		+
Crossocheilus latiuslatius	+	+
Danio devario	+	
Garra gotylagotyla	+	+
G. lamta	+	+
G. prashadi	+	
Labeo dero	+	
L. dyocheilus	+	
Pseudecheneis sulcatus		+
Puntius chilinoides		+
P. sophore		+
Schizothoraichthys progastus	+	+
Schizothorax curvifrons	+	
S. esosinus	+	
S. intermedius	+	
S. micropogan	+	
S. niger	+	
S. plagiostomus	+	
S. richardsonii	+	+
S. sinuatus	+	
Tor chilinoides	+	
T. putitora	+	+
T. tor	+	+
Sisoridae		
Glyptothorax brevipinnis	+	
G. cavia	+	
G. conirostris	+	
G. madraspatnum	+	+
G. pectinopterus	+	+
G. trilineatus	+	
Pseudecheneis sulcatus	+	
Total	**37**	**20**