



# Aquatic Biodiversity in Upland Streams of Kameng Drainage in Arunachal Pradesh

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## ABSTRACT

The study was conducted to analyze the physicochemical parameters, nutrient variables, plankton and fish diversity in three snow-fed tributaries rivers viz., Dirang chu, Sangti and Tenga of Kameng drainage in West Kameng district of Arunachal Pradesh in the Eastern Himalayas during 2016-17. The key physicochemical parameters in the three rivers viz., temperature, pH, dissolved oxygen were found in the range of 11.42±0.04 to 14.25±0.06°C; 7.32±0.02 to 7.9±0.03; 8.06±0.05 to 8.31±0.05 ppm, respectively. Nutrient variables i.e., ammonium, nitrite, phosphate, alkalinity, hardness were observed in the range of □0.01 mg/l; 8.33±0.58 to 11.0±1.0 µg/l; 0.11±0.005 to 0.38±0.03 mg/l; 25.33±2.31 to 17.33±2.31 mg/l; 26.66±1.15 to 15.33±1.15 mg/l, respectively. The rivers being snow fed remained clear and transparent (0.39±0.02 NTU) during the study period. The abundance of plankton species was comprised of Stigeoclonium (50%), Pinnularia (20%), Navicula (15%) at river Dirang chu, whereas Stigeoclonium (30%), Fragilaria (30%) and Lyngbya (10%) dominated at river Sangti, followed by Pinnularia (40%), Acanthidium (20%) and Synedra (10%) at river Tenga. Three species of snow trout (Schizothoracids) remained abundant and formed the major catch with an average length of 24.16 ± 6.17 cm and average weight of 161.2 ± 102.22 g in cast nets and noose and line method. The abundance of diverse plankton groups along with a favorable range of most of the essential hydrological characteristics indicated a good health of the water body and an environment conducive for thriving of snow trout and endowing nutritional security in turn for the mountain dwellers in a remote and fragile Himalayan region of India.

**Key Words:** Upland, Drainage, Hydrological, Plankton, Snow Trout, Diversity and Dirang.

## INTRODUCTION

The West Kameng district is located in the western part of Arunachal Pradesh covering an area of 8.86 percent of the total area of the state and is situated between 91°40' and 92°40' East Longitude and 26°54' and 28°01' North Latitude. The district encompass international boundary with high peaks of the Himalayas demarcating India and China (Tibet) in the north and Bhutan from India in the west. The name of the district is derived from river Kameng, a major tributary of river Brahmaputra. The district with an altitude range from 100m to 4,500m (msl) plays a dominant role in the aquatic biodiversity, hydrological characteristics and distribution of fish species. Therefore, this study was conducted with the objectives of to know the

aquatic biodiversity in upland streams of kameng drainage in Arunachal Pradesh.

## MATERIALS AND METHODS

The field studies were conducted during 2016-17 (Fig. 1-3) at each sampling site to collect fish samples for biological studies, catch composition, the gear specifications, plankton diversity and physicochemical parameters of water. Thirty numbers of fish samples were collected from each site caught in the gears during daytime (06:00-11:00 hr) and mid night (20:00-24:00 hr). Small fish specimen (<150 mm in length) were preserved directly in 10 percent formaldehyde while the larger specimen (>150 mm in length) were preserved by slitting the abdomen. Fish identification was performed at laboratory on

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the basis of morphometric and meristic character (Talwar and Jhingran, 1991; Jayaram, 1999). As a part of aquatic ecology, plankton diversity was monitored (Armantrout, 1999). The physico-chemical variables of water each sampling site were analyzed using electronic digital multiprobe (Hanna model HI 9828) and nutrient variables were analyzed by standard methods outlined by Merck Spectroquant Multy (SN 072414) kits. Turbidity of water was analyzed by Turbidity meter (HACH-2100Q). Fishermen, local residents and Fishery Officers were interacted to collect information on the fishing devices, method of operation and their catch details (Miyamoto, 1962; Sreekrishna and Shenoy, 2001).

### Study area

The study was conducted in three major snow-fed tributaries *viz.*, river Dirang chu, river Sangti and river Tenga of Kameng drainage in West Kameng district of Arunachal Pradesh in the Eastern Himalayas during 2016-17. The topography of the basins is hilly with steep slopes, situated at an altitude ranging between 1411 to 1512 m. All these rivers in their total route confluences with many major and minor tributaries and carries all of the discharge to Kameng river system, a right bank tributary of river Brahmaputra. Three sampling sites on river Dirang chu (27.3537N, 92.2506E), river Sangti (27.3517N, 92.2681E) and Tenga (27.2186N, 92.43E) were selected (Table 1).

## RESULTS AND DISCUSSION

### Fish catch

Snow trouts (Fig. 4-6) belonging to *Schizothoracids* accounts the major and important part of the capture fishery in the sampling sites of the river systems. These fishes are locally known

as Nga in local dialect of Monpa community. The dominant species of snow trout identified by morphometric characters and meristic counts are recorded as *Schizothorax richardsonii*, *Schizothorax plagiostomus* and *Schizothorax progastus*. The average length of snow trouts was recorded as  $24.16 \pm 6.17$  cm with an average catch size in weight of  $161.2 \pm 102.22$  g during the investigation (Table 1). The highest recorded catch of snow trout weighed 1.2 kg with a length of 52 cm (Fig. 7).

### Qualitative analysis of planktons

Analysis of plankton communities in the rivers of West Kameng are shown in Fig. 8. Altogether, 28 species of planktons were identified belonging to 23 families, 18 orders and 6 classes from the upland rivers of Kameng drainage. The most dominant planktons in river Dirang chu was comprised of *Stigeoclonium* (50%), *Pinnularia* (20%), *Navicula* (15%) followed by *Nitzschia* (10%) and *Meridion* (10%). Planktons in river Sangti was comprised of *Gonyostomum* (40%), *Nitzschia* (20%), *Cymbella*, *Synedra* whereas plankton diversity in river Tenga was comprised of *Gomphonema* (40%), *Nitzschia* (20%), *Fragilaria*, *Eunotia*.

### Water sampling

The physicochemical and nutrient variables of water (Table 3) analyzed in each sampling sites has direct and indirect effects on nearly all aspects of stream ecology. The temperature in the snow-fed rivers remains within 20° C and falls below 0°C in winter. As cold water can hold more oxygen than warm water, certain species of aquatic invertebrates and fish with high oxygen demands (snow trout) are found only in these waters. Temperature also influences the rate of photosynthesis by algae and aquatic plants. As water temperature rises, the rate of photosynthesis increases provided there are

**Table 1. Snow trout catch details at sampling sites of snow-fed rivers of Kameng drainage.**

Location	Dirang	Sangti	Tenga
Average length (cm)	$22.10 \pm 4.74$	$19.29 \pm 5.33$	$31.10 \pm 3.57$
Average weight (g)	$117.62 \pm 86.75$	$88.00 \pm 63.52$	$278.00 \pm 109.68$

## Aquatic Biodiversity

**Table 2. Physico-chemical parameters of water in rivers of West Kameng, district of Arunachal Pradesh**

Parameter	Dirang	Sangti river	Tenga river
Dissolved oxygen (PPM)	8.13 ± 0.02	8.06 ± 0.05	8.31 ± 0.05
pH	7.32 ± 0.02	7.90 ± 0.03	7.33 ± 0.02
Temperature (°C)	14.0 ± 0.08	11.46 ± 0.04	13.20 ± 0.06
Resistivity (MΩ.cm)	0.06 ± 0.00	0.02 ± 0.00	0.06 ± 0.00
Conductivity (µS/cm)	16.00 ± 2.00	50.0 ± 5.00	124.0 ± 11.00
TDS (ppm)	8.00 ± 1.00	25.00 ± 4.00	62.00 ± 6.00
Salinity (ppt)	0.01 ± 0.00	0.02 ± 0.00	0.01 ± 0.00
ORP	-42.20 ± 0.00	-62.47 ± 0.21	-41.63 ± 0.12

adequate amounts of nutrients. Dissolved oxygen concentration was also found above the optimum requirement of the fishes as the river water flow through riffles amid boulders and stones. The low TDS values indicate the concentration of cations and anions are well within the permissible limit (Table 2). The low calcium and magnesium levels are responsible for soft nature of water in river Dirang chu whereas the values are little higher in river Sangti and Tenga which may be attributed due to human habitation. The concentration of various heavy metals was below the permissible limit specified for domestic, agriculture and fisheries use

(Table 3).

All the river sites being snow fed remained clear and transparent in the study period. Most of the essential water quality parameters were within the optimum level concluding a good health of the water body and conducive for the abundance of the snow trout. On this basis of alkalinity studied the rivers comes under the category of moderately rich nutrient (Spence, 1964) and the measure of hardness (Moyle, 1946) revealed that water of the river sites were soft except in river Tenga which may be attributed due to higher inhabitants around the sampling site.

**Table 3. Nutrient variables in rivers of West Kameng, district of Arunachal Pradesh**

Parameter	Dirang	Sangti	Tenga
Ammonium (mg/L)	<0.01	<0.01	<0.01
Phosphate (mg/L)	0.14 ± 0.01	0.36 ± 0.13	0.90 ± 0.15
Iron (mg/L)	<0.01	0.12 ± 0.02	0.01 ± 0.00
Sulphate (mg/L)	<0.02	0.26 ± 0.12	0.55 ± 0.23
Chloride (mg/L)	<2.5	<2.5	<2.5
Nitrate (mg/L)	4.00 ± 0.42	4.80 ± 0.31	5.80 ± 0.23
Magnesium (mg/L)	<5.0	76.0 ± 2.32	<5.0
Nitrite (µg/L)	10.0 ± 1.02	8.0 ± 0.45	16.0 ± 2.00
Calcium (µg/L)	17.0 ± 1.04	42.0 ± 2.10	70.0 ± 3.05
Cadmium (µg/L)	<5.0	<5.0	<5.0
Zinc (µg/L)	<0.20	<0.20	<0.20
Copper (µg/L)	<0.05	<0.05	<0.05
Turbidity (NTU)	0.48 ± 0.11	0.31 ± 0.01	0.37 ± 0.02
Alkalinity (mg/L)	16.0 ± 0.01	28.0 ± 0.02	52.0 ± 2.00
Hardness (mg/L)	14.00 ± 1.15	26.00 ± 2.00	64.00 ± 4.30

### Fishing gears

The major gears employed for catching the snow trouts were the cast nets (Fig. 9) and noose and line method (Fig. 10). The average catch per unit effort (CPUE) of noose and line fishing gear was recorded as 1.8-2.2 kg/hr/gear. CPUE of the cast nets is 2.0-5.5 kg/hr/day. The noose and line mostly operated during day time and cast nets are operated during

mid night. The noose and line method of fishing is very selective for catching the snow trout and is designed with the concept of a modern day fishing rod and line operated by anglers for sport fishing. Locally available bamboos (Baruah, 2014) mostly used to construct traditional fishing gears (Baruah *et al.*, 2013) in most part of north-eastern region of India.



Fig. 1: Water sampling site at river Dirang chu



Fig. 2: Fish sampling site at river Sangti



Fig. 3: Sampling site at river Tenga

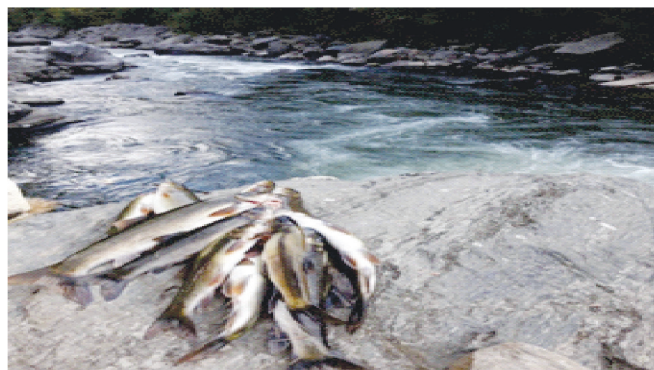


Fig. 4: Snow trout catch at river Dirang chu



Fig. 5: Snow trout catch at river Sangti



Fig. 6: Snow trout catch at river Tenga

## Aquatic Biodiversity



Fig. 7: A large size catch of snow trout in Kameng drainage

### CONCLUSION

The upland and snow-fed rivers of Kameng drainage resembles typical V-shaped valley of Himalayan terrain surrounded by denudation hills and cultivated terraces. These river valleys are low in fertility due to rock out-crops, boulders and gravels. There are no major sources of organic pollution as indicated by the ammonium and nitrate and nitrite levels. The study shows that long term monitoring

of the aquatic environment will be required to understand the habitat ecology of the snow trouts for their successful propagation and to maintain river richness in terms of fish diversity and their food materials in the form of planktons. However, major degradation due to human intervention through farming, unauthorized usage of pesticides chemicals and industrial discharges etc was not observed. The inhabitants of the valley comprising mainly of Monpa tribes and Buddhists by religion also promotes conservation of indigenous fish species by prohibiting fishing in many areas of Dirang area.

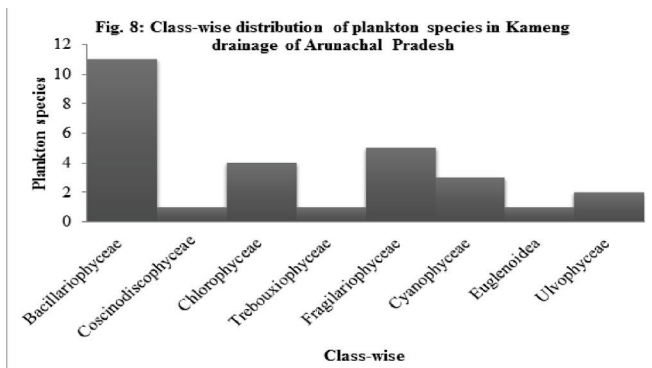


Fig. 8: Class-wise distribution of plankton species in Kameng drainage of Arunachal Pradesh

### ACKNOWLEDGEMENT

The authors are highly grateful to the Director, ICAR-DCFR, Bimital for rendering all his support and help in carrying out the programme successfully. The support received from the Nodal Officers, concerned scientists of ICAR-DCFR, staffs of KVK West Kameng and Officers of Department of



Fig. 9: Fishing snow trouts by noose and line method at river Dirang chu



Fig. 10: Fishing of snow trouts by cast nets at river Sangti

Fisheries, Govt. of Arunachal Pradesh thanked and more importantly the fishermen and local community for sharing their information on this subject.

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Received on 2/10/2017

Accepted on 10/6/2018