



## AMPHIBIAN AND ICHTHYOFAUNAL DIVERSITY OF 12 TORRENTIAL STREAMS OF WOKHA DISTRICT, NAGALAND

L. NzanoHumtsoe&SabitryBordoloi

Resource Management and Environment section, Life Sciences Division, Institute of Advanced Study in Science and Technology, PaschimBoragaon, Guwahati -781035, Assam, India.

### ABSTRACT

A survey of fish and amphibian fauna was conducted in 12 (twelve) torrential hill streams of Wokha district, Nagaland for 2 years (2005-2007). The study was planned to give an overview of fish and amphibian diversity and physico-chemical analysis of stream water. Sampling was done during pre-monsoon, monsoon and post monsoon periods. A total of 27 fish species belonging to 3 orders, 9 families and 16 genera and 21 species of Anuran amphibia belonging to four (4) families and twelve (12) genera were recorded from the streams.

**KEYWORDS:**Wokha district, Nagaland, Hill streams, Fish and amphibian fauna.

### INTRODUCTION

The state of Nagaland in North East India is endowed with numerous hill streams that harbour rare and unique fauna. Most of the hill streams in Nagaland remain to be assessed for their amphibian and ichthyofaunal diversity due to remoteness and inaccessibility. A number of workers contributed to fish and amphibian diversity of Nagaland. Kiyasetuo and Khare (1986) reported a new genus of frog, *Ranakhare*; Chanda (1994) reported 10 (ten) species of amphibians from Nagaland; Aoet al. (2003) recorded 32 species of amphibians that included 19 new records for the state and 5 new records for India; Matthew and Sen (2007) reported a new species of frog, *Xenophryszunhebotensis*; Humtsoet al. (2008) reported a new genus of frog for India *Leptolalaxlateralis*; Das and Karmakar (2006) published a list of 108 fish species consisting of their own collection (81 species) from different water bodies of Nagaland as well as from earlier ZSI records (27 species) and Aoet al. (2008) recorded 149 fish species from different water bodies of Nagaland.

The present work is an attempt to record fish and amphibian fauna in 12 (twelve) torrential streams of Wokha district, Nagaland along with recording of habitat data and certain water quality parameters. Ao and Bordoloi (2003) studied Amphibian distribution with respect to water chemistry in the wetlands of Kohima district, Nagaland. Survey has been conducted for the first time in these hill streams of Wokha district, Nagaland. Recording of a viable population of the fish *Amblycepsapangi* and new record of a number of frog species were the important findings in this investigation.

### Description of study area

Wokha district of Nagaland (25°55'-26°35' N Latitude and 94°10'-94°25' E longitude) is a part of the Brahmaputra basin. The altitude of the district ranges from 160m MSL to 1970m MSL and experiences sub-tropical to sub-temperate climate. The Wokha district is bordered by Mokokchung on the North, Kohima on the South, Zunheboto on the East and Assam on the West (Figure 1).

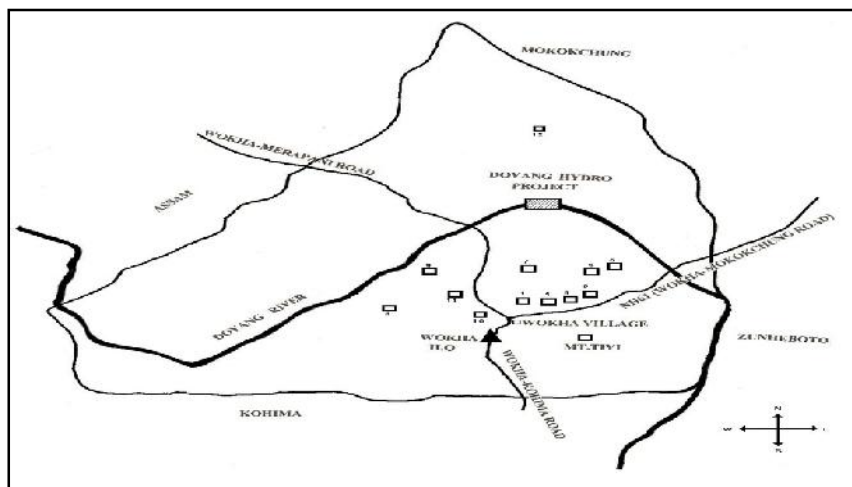
The district is divided into two regions, demarcated by the Doyang River. Northern area is called Lio and Southern hilly area is called Nrung. Topographically, the district is divided into three ranges viz. the upper range, located in Nrung, the middle and lower ranges, both located in the Lio area. The Upper range has high mountains and steep slopes. The highest altitude of Wokha district, Mt. Tiyi (1969m MSL) falls within this range. Vegetation is tropical semi-evergreen type. The average temperature (6°C to 35°C) and rainfall (175-250 mm) are governed by the westerly monsoons. Highest rainfall is governed during June-August. Relative humidity ranges from 85% to 95% during rainy season.

### MATERIALS & METHODS

Of the twelve streams surveyed, seven are along the National Highway 61 (Wokha-Mokokchung road) namely Engorotchu, Kyotchu, Lungkitchu, Nhyatsutchu, Nitsutchu, Tchulumo and Tchupvu, and 4 along Wokha-Merapani road namely HumtsoTsupvu, Sosirotschu, Vekhurotschu and YikhumSanga, and one stream namely Tsurang from LioWokha were selected for monitoring physico chemical characteristics of stream water. Sampling was done during pre-monsoon, monsoon and post-monsoon seasons. The areas surveyed include the localities in and around the streams. Certain physico-chemical parameters such as temperature (air and water), hydrogen-ion-concentration (pH), dissolved oxygen (DO), free CO<sub>2</sub>, total alkalinity, total hardness and trace elements were analysed. Trace elements such as Cu, Cd, Fe, Mn, Pb, Se, Zn, etc were analyzed with Atomic Absorption Spectrometer (Perkin-Elmer-2380 Model 3110). For the physico-chemical parameters standard procedures (APHA, 2000) were followed. Fishes and amphibians were identified in the field and recorded. Only a few difficult ones were carried to the laboratory after narcotization and fixation in 8% formaldehyde solution. The collected fish specimens were identified with the help of existing literatures and keys proposed by various authors (Talwar&Jhingran, 1991; Jayaram, 1999; Vishwanath,

2002; www.fishbase.org ,www.aquabase.org). IUCN status of fish is recorded as per CAMP Report, 1998; NBFGR 2010, IUCN 2013. Identification of amphibian specimens was done with the help of existing literatures and publications such as Boulenger, 1890 & 1920; Dutta

(1997), Ao and Bordoloi 2003; Chanda, 1994 & 2002; Dubois and Ohler (2000), IUCN status (www.iucnredlist.org 2013) of the amphibians has been included.



**FIGURE 1:**Map of Wokha district

(1. Engorotchu 2. Kyotchu 3. Lungkitchu 4. Nhyatsutchu 5. Nitsutchu 6. Tchulumo 7. Tsupvu 10. HumtsoTsupvu  
9. Sosurotchu 10. Vekhvurotchu 11. YikhumSanga 12. Tsurang)

## RESULT

### General habitat ecology of the streams

All these streams flow into the Doyang River. Some flow directly while other smaller streams join other tributaries and flow into the Doyang River. The Doyang River joins the Dhansiri River and finally flow into the Brahmaputra River. All the streams surveyed were highly torrential. Torrential streams harbour scarce fauna which exhibit adaptive modifications suitable for torrential habitat. The data related to Physico-chemical parameters were recorded over a period of two years (2005-2007). Nine streams were found to be highly torrential with rocky bottom and clear water. Two streams (10, and 12) were found to be having sandy and muddy bottom that makes the water

slightly turbid. Monsoon data showed little variation in the streams as they receive surface runoff. Air temperature (13.2-32<sup>0</sup>C) was slightly more than the water temperature (7.2-28<sup>0</sup>C). All the values showed fluctuation in different seasons viz. Dissolved oxygen (7.2-15.2 mg/l), free CO<sub>2</sub> (4-8 mg/l), pH (6.5-8.5), total alkalinity (38-70 mg/l) and total hardness (48-120 mg/l). Trace elements such as Cu (BDL (below detectable limit) -0.04ppm), Cd (BDL - 0.03ppm), Mn (BDL-0.07ppm), Fe (0.10- 0.70 ppm), Pb (BDL - 0.06 ppm), and Zn (0.02 -0.25 ppm) present in the water was recorded monthly (TABLE-1). They are within the MPL (maximum permissible limit) specified by WHO (2004 and 2006).

**TABLE 1:**Monthly variation of trace elements in water measured in ppm (August 2005-July 2007)(Maximum permissible limit in ppm as per WHO)

Months	Cu(ppm)	Pb (ppm)	Mn (ppm)	Cd (ppm)	Zn (ppm)	Fe (ppm)	Se(ppm)
August	BDL	0.04	0.065	BDL	0.25	0.33	1.86
September	0.02	0.02	0.025	0.01	0.2	0.7	1.01
October	0.025	0.04	0.03	0.015	0.19	0.39	2.14
November	0.03	BDL	0.03	0.03	0.03	0.41	0.025
December	0.05	0.01	0.01	0.02	0.02	0.26	0.023
January	0.03	0.05	0.02	0.03	0.07	0.19	0.016
February	0.04	0.06	BDL	0.03	0.08	0.25	0.023
March	0.03	0.03	BDL	0.02	0.04	0.18	0.018
April	0.02	0.01	0.02	0.03	0.04	0.10	0.017
May	0.04	0.01	0.02	BDL	0.16	0.16	0.018
June	BDL	BDL	0.07	BDL	0.05	0.31	0.93
July	0.01	0.01	0.04	0.01	0.15	0.35	1.09
Mean ± SE	0.029 ±0.008	0.028 ±0.008	0.03 3±0.009	0.021 ±0.006	0.10 6±0.030	0.30 2±0.087	0.597 ±0.172
MPL (WHO)	0.05	0.07	0.5	0.05	0.5	3	0.05

(Abbreviations: BDL- Below detectable level; ppm- parts per million; SE-Standard Error of mean; MPL-Maximum permissible limit; WHO- World Health Organization)

**Ichthyofauna**

27 fish species belonging to 3 orders, 9 families and 16 genera were recorded from the hill streams, of which 9 species are true hill stream forms, 3 are semi-torrential forms, 7 species are intermediate/migratory forms and 9 species are riverine forms. The fishes have been

categorized according to their habitats as suggested by Nath (1987) and Ao et al (2008). The following lists mention the fishes collected from the streams (Table-2). Valid names are given according to [www.fishbase.org](http://www.fishbase.org) and [www.aquabase.org](http://www.aquabase.org) ).

**TABLE 2:** List of fishes recorded

Classification	Distribution in the 12 streams	Status (as per iucnredlist.org 2012)
Order: Cypriniformes		
Family: Cyprinidae		
Sub-Family: Cyprininae		
1. <i>Puntiussophore</i> (Hamilton, 1822)	7, 8, 12	LC
2. <i>Puntiusticto</i> (Hamilton, 1822)	7, 8, 12	LC
3. <i>Tor putitora</i> (Hamilton, 1822)	7, 12	EN
	7, 12	EN
Sub- Family: Danioninae		
4. <i>Bariliusbarila</i> (Hamilton, 1822)	7, 8, 12	LC
5. <i>Bariliusbarna</i> (Hamilton, 1822)	7, 8, 12	LC
Sub-Family: Danioninae		
6. <i>Danioreio</i> (Hamilton, 1822)	7, 8, 12	LC
7. <i>Daniodangila</i> (Hamilton, 1822)	7, 8, 12	NT
8. <i>Devarioaequipinnatus</i> (McClelland, 1839)	7, 8, 9, 10, 12	LC
Sub-Family: Garrinae		
9. <i>Garrakempi</i> (Hora, 1921)	1, 4, 5, 6	LC
10. <i>Garralissorhynchus</i> (McClelland, 1842)	7, 8, 10, 11, 12	LC
Family: Psilorynchidae		
11. <i>Psilorhynchusbalitora</i> (Hamilton, 1822)	8, 12	LC
12. <i>Psilorhynchushomalopectera</i> (Hora and Mukerji, 1935)	7, 8	LC
13. <i>Psilorhynchussucatio</i> (Hamilton, 1822)	7, 8, 12	LC
Family: Balitoridae		
Sub-family: Nemacheilinae		
14. <i>Schisturamanipurensis</i> (Choudhuri, 1921)	1, 2, 3, 4, 5, 6, 11	NT
15. <i>Schisturavinceguerrae</i> (Hora, 1935)	7, 8, 9, 10, 11, 12	LC
Family; Cobitidae		
Sub-family: Cobitinae		
16. <i>Lepidocephalichthysberdmorei</i> (Blyth, 1860)	7, 8, 12	LC
17. <i>Lepidocephalichthysguntea</i> (Hamilton, 1822)	7, 8, 12	LC
18. <i>Canthophrysgongota</i> (Hamilton, 1822)	8, 12	LC
Order: Siluriformes		
Family: Amblycipitidae		
19. <i>Amblycepsapangi</i> Nath&Dey, 1989	2, 4, 5, 8, 9, 10, 11	NT
20. <i>Amblycepsarunachalensis</i> Nath&Dey, 1989	12	EN
Family: Sisoridae		
21. <i>Exostomalabiatum</i> (McClelland, 1842)	4, 6	LC
22. <i>Glyptothoraxtrilineatus</i> (Blyth, 1860)	7, 8, 12	LC
Family: Olyridae		
23. <i>Olyralongicaudata</i> (McClelland, 1842)	8, 12	NT
Order: Perciformes		
Family: Nandidae		
Sub-family: Badinae		
24. <i>Badisbadis</i> (Hamilton, 1822)	7, 8, 9, 10, 11, 12	LC
Sub-Order: Chanoidei		
Family: Channidae		
25. <i>Channagachua</i> (Hamilton, 1822)	7, 8, 9, 10, 12	LC
26. <i>Channapunctatus</i> (Bloch, 1793)	7, 8, 9, 10, 12	NE
27. <i>Channastewartii</i> (Playfair, 1867)	7, 8, 11, 12	LC

(Abbreviations: EN – endangered; LC – least concern; NT - Near threatened; NE-Not evaluated,(1. Engorotchu 2. Kyotchu 3.Lungkitchu 4.Nhyatsutchu 5.Nitsutchu 6.Tchulumo 7.Tsupvu8.HumtsoTsupvu 9. Sosurotchu 10. Vekhvurotchu 11.YikhumSanga 12. Tsurang)

**Amphibian fauna**

21 species of anurans belonging to four (4) families and twelve (12) genera were recorded. The (Table-3) lists the frogs collected during survey. Of the species recorded,

three (3) are new records from the state. For each species the valid names with its authority is given. The species are presented in order of families, genera and species group names.

TABLE 3: List of collected amphibian specimens

Classification	Distribution in the 12 streams	Status
Order: Anura		
Family: Bufonidae		
1. <i>Bufo (Duttaphrynus) melanostictus</i> Schneider, 1799	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	LC
Family: Megophryidae		
2. <i>Leptolalax lateralis</i> (Anderson, 1871)	2, 4	NA
3. <i>Xenophrys major</i> (Boulenger, 1908)	1, 2, 3, 4, 5, 6	LC
4. <i>Xenophrys wuliangshanensis</i> (Ye and Fei, 1995)	4, 5	DD
Family: Ranidae		
5. <i>Euphlyctiscyanophlyctis</i> (Schneider, 1799)	1, 2, 3, 4, 5, 6, 8, 9, 10, 11	LC
6. <i>Fejervaryanepalensis</i> (Dubois, 1975)	2, 8	LC
7. <i>Fejervaryateraiensis</i> (Dubois, 1984)	1, 2, 4, 5, 6, 8, 11	LC
8. <i>Hoplobatrachustigerinus</i> (Daudin, 1802)	7, 8, 9, 10, 12	LC
	7, 8, 9, 10, 12	LC
	7, 8, 9, 10, 12	LC
	7, 8, 9, 10, 12	LC
9. <i>Amolops formosus</i> (Gunther, 1875)	12	LC
10. <i>Amolops gerbillus</i> (Annandale, 1912)	12	LC
11. <i>Amolops marmoratus</i> (Blyth, 1855)	8	Vu
12. <i>Hylaranahumeralis</i> (Boulenger, 1887)	4, 5	DD
13. <i>Hylaranaleptoglossa</i> (Cope, 1868)		
14. <i>Ranakhare</i> (Kiyasetuo and Khare, 1986)		
15. <i>Odoranalivida</i> (Blyth, 1855)		
Family: Rhacophoridae		
16. <i>Polypedates megacephalus</i> (Hallowell, 1861)	1, 2, 3, 4, 5, 6, 7	LC
17. <i>Polypedates teraiensis</i> (Dubois, 1987)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	LC
18. <i>Rhacophorus bipunctatus</i> Ahl, 1927	1, 2, 3, 4, 5, 6	LC
19. <i>Rhacophorus maximus</i> Gunther, 1858	1, 2, 3, 4, 5, 6, 8, 10	LC
20. <i>Rhacophorus rhodopus</i> Liu and Hu, 1960	3	LC
21. <i>Rhacophorus suffry</i> Bordoloi, Bortamuli and Ohler, 2007	3	LC

(Abbreviations: DD - data deficient; LC - least concern; NA - not assessed; vu-vulnerable

(1. Engorotchu 2. Kyotchu 3. Lungkitchu 4. Nhyatsutchu 5. Nitsutchu 6. Tchulumo 7. Tsupvu 10. Humtso Tsupvu 9. Sosurotchu 10. Vekhvurotchu 11. Yikhum Sanga 12. Tsurang)

## DISCUSSION

The present investigation is the first report on ichthyofaunal and amphibian diversity of hill streams of Wokha district, Nagaland. Study was conducted from August 2005-July 2007. The areas surveyed include the localities in and around the 12 hill streams. Wokha district of Nagaland has numerous hill streams all of which flow into the Doyang river, a tributary of the river Brahmaputra of Assam. These hill streams are characterized by shallow, narrow channels with rocky stream beds and swift turbulent water flow and they harbour unique fauna. The rocky stream beds form a useful hiding and anchoring substratum for aquatic biota including algal mats, periphytons, fishes and amphibians. The analysis of water quality of the 12 streams of Wokha district has revealed that the water quality remained within the productive range throughout different seasons. Elemental analysis of stream water also showed seasonal variation (Table-I). A number of torrential fauna could be recorded from these streams. The high concentration of dissolved oxygen (7.2-15.2 mg/l) is a characteristic feature of torrential streams and well saturated water body. It also implies that there is less amount of organic matter (Nikolskii, 1963). Ao and Bordoloi (2003) also obtained similar result in their studies on lotic systems in Nagaland.

The survey of fish and amphibian fauna has revealed that the ecological conditions of the hill streams is conducive for harbouring a good number of hill stream fishes and amphibian species. Of the 28 fish species including two new records for Nagaland (*Amblyceps apangi* and

*Amblyceps arunachalensis*) and 21 amphibian species include three new records for the state (*Rhacophorus rhodopus*, *Rhacophorus suffry* and *Hylaranaleptoglossa*). Ao *et al.* (2003) listed 32 species from Nagaland. During the investigation, it has been noted that the ecological condition of the area is deteriorating due to over exploitation, deforestation and habitat degradation. The hill streams are rich in fish diversity as 28 fish species could be recorded. Out of the species reported here, 15 species have distribution in Myanmar. *Schisturamanipurensis* is endemic to Manipur and Nagaland (Vishwanath and Laishram, 2001) and *Schisturavinciguerrae* first reported from Manipur and considered endemic to the state (Vishwanath, 2000; Vishwanath and Laishram, 2001) was reported from Brahmaputra drainage by Das *et al.* (2001), *Amblyceps apangi* and *Amblyceps arunachalensis* first reported from Arunachal Pradesh by Nath and Dey (1989) have been recorded from Nagaland, a new locality record (Vishwanath and Linthoingambi, 2007; Humtsoe and Bordoloi, 2009). As per IUCN Redlist of threatened species (2012), of the 28 fish species recorded, 20 are in least concern (LC) category, 5 are near threatened (NT), 2 are endangered (EN) and 1 not evaluated (NE). It has been observed during the survey of the streams that a number of intermediate zone fishes were recorded. These fishes comprise of the species *Daniorerio*, *Devario aequipinnatus*, *Daniodangila*, *Lepidocephalichthys berdmorei*, *Lepidocephalichthys guntea*, *Somileptes gongota*,

*Channastewartii*, *Tor tor*. They do not possess any structural modifications (Hora, 1922; Ojha, 2002). They are generally met in the pools and at small crevices along the sides of the streams. Members of *Lepidocephalichthys* have spines on the head which enable them to entangle with the fixed vegetation in their habitats and therefore prevent them from being swept away by the current. The free swimming *Danio* and others like *Lepidocephalichthys*, *Tor*, *Channa* etc do not possess frictional and adhesive devices. They escape the fast current by moving to the sides of the streams with comparatively low water current. The fishes of the species *Amblycepsapangi*, *Amblycepsarunachalensis*, *Exostomalabiatum*, *Glyptothoraxtrilineatus*, *Garrakempi*, *Garralissorynchus*, *Psilorynchusbalitora*, *Psilorynchussucatio* and *Psilorynchushomalopectera* are true hill stream forms showing highly specialized structural modification suitable for torrential water while fishes of the species *Olyralongicaudata*, *Schisturamanipurensis* and *Schisturavinciguerrae* are semi-torrential forms showing lesser degree of body modification. Out of the 21 species of frogs recorded, 5 species are ubiquitous and occur throughout India, South Western China and Myanmar, 11 species occur in the foothills of Himalayan range, South Western China and Myanmar and 6 species occur only in South Western China, Myanmar and NE India. Two species (*Ranakhare* and *Rhacophorusuffry*) have been recorded so far only from North-East India. One species (*Leptolalaxlateralis*) has been recorded from Myanmar (Anderson, 1871) and NE India only (Humtsoe et al., 2008). Thus the species recorded are closely related to the fauna of South China and Myanmar. Species such as *Fejarvaryanepalensis*, *Rhacophorusmaximus*, *Rhacophorusrhodopus*, *Xenophrys major*, etc are widely distributed in North East region. Most important finding of amphibian survey is publication of a new genus *Leptolalaxlateralis* (Anderson, 1871) for India (Humtsoe et al., 2008) and record of the 21 amphibian species from these areas as per IUCN status, 1 is vulnerable (Vu), 2 are data deficient (DD) and 17 are in least concern (LC) category. The conservation status of 1 species (*Leptolalaxlateralis*) has not been assessed. Torrential stream frogs (also known as torrent or cascade frogs) are adapted to life in torrents, waterfalls and wet boulders which cascade out of the forests. They are usually found clinging to rocks just above the stream level, however, if disturbed they do not hesitate to leap into the fiercest flowing water, only to emerge moments later, clinging to another rock downstream. Adults of the species of the genus *Amolops* such as *Amolopsformosus*, *Amolopsgerbillus* and *Amolopsmarmoratus*, some species of *Rana* such as *Ranalivida*, and *Ranakhare*, species of the genus *Xenophrys* such as *Xenophrysmajor* and *Xenophryswuliangshanensis* and *Leptolalaxlateralis* were found to inhabit the hill streams. They exhibit various types of hill stream adaptation like dorso-ventrally flattened bodies, long and strong hind limbs, toes fully webbed and tip of finger and toes with adhesive discs. The present study has allowed us to record rare torrential fauna present in these hill streams. The study is important because due to increasing habitat deterioration and

anthropogenic stress, these fauna might lose their habitat and may not be recorded in future.

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