



Diversity of freshwater fishes of the Kherem river, a tributary of Noa-Dihing river of Brahmaputra Basin in the Changlang district of Arunachal Pradesh, India

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Abstract

The present study was carried out on 17th of October 2022, in one section of the Kherem river in Changlang district of Arunachal Pradesh in an attempt to document the fish faunal diversity in this section of the river. The river forms an important tributary of Noa-Dihing which debouches into the Brahmaputra. The fish sampling was done from one site (27°32'35.89"N and 95°56'22.12"E) occurring at an elevation of 153m. The study documented the occurrence of 21 species belonging to 5 orders, 13 families and 15 genera. Order Cypriniformes and Anabantiformes were the most diverse followed by Siluriformes and least were order Sybranchiformes and Gobiiformes. Further species wise, family Cyprinidae and Badidae emerged as the most dominant with 3 species each (15%). Succeeded by 2 species each (10%) in the family of Cobitidae, Bagridae, Channidae and Osphronemidae. Others like Danionidae, Xenocyprididae, Clariidae, Heteropneustidae, Synbranchidae, Gobiidae and Anabantidae were among the least diverse family with 1 species each (5%). The study also recorded the presence of an exotic carp species *Ctenopharyngodon idella* from Kherem river which might have swum its way from the fishery ponds nearby. According to IUCN red list as many as 19 Out of 21 species reported were under least concerned (90%) category and 2 under Not evaluated (10%) category (Table-1). The Simpson index and Shannon index incorporated to quantify the fish diversity were recorded to be 0.9404 and 2.943 respectively. The evenness index added upto a near perfect score of 0.9037 indicating an even distribution of species at the study site.

Keywords: Fish, diversity, Kherem river, Brahmaputra, Arunachal Pradesh.

Introduction

Freshwater biodiversity encompassing a major group of habitats in form of rivers, lakes, ponds, wetlands etc around the world is home to a remarkably large proportion of aquatic life. Fish as a group inhabits almost all conceivable aquatic habitats and represents highest species diversity accounting for 10% of all known species, and one-third of all vertebrates¹. It occupies a significant trophic level at near the top of the food chain, along with serving as an excellent ecological indicators of aquatic water bodies. Furthermore, has recreational and aesthetic values and importantly contributes as a primary source of protein for nearly one billion people worldwide especially in developing countries like India.

India has rich freshwater fish resources attributing to its four biodiversity hotspots viz., the Himalaya, the Western Ghats, the North-east and the Nicobar Islands, which harbours 3,022 fish species (both freshwater and marine) constituting to about 9.41% of the known fish species of the world. Arunachal Pradesh endowing rich diversity and endemism is the part of Himalayan biodiversity hotspot, adding up to 60.93% of the Eastern Himalayan region².

It is the largest state in NER of India, situated between 26.28° N and 29.30° N latitude and 91.20° E and 97.30° E longitude and covers a total area of 83,743 square km. It's mountains, hills and the undulating valleys gives rise to numerous rivers, streams and rivulets harbouring diverse species of flora and fauna with significant number of endemic species.

Early ichthyological documentation of the state dates back to 1839 by McClelland³ and Chaudhuri (1911-1912)⁴. By and by significant contribution includes work of prominent researchers like Hora^{5,6}, Jayaram and Mazumdar⁶, Choudhury and Sen⁷, Barman⁸, Nath and Dey⁹, Sen¹⁰, Tamang¹¹, Nebeshwar¹², Ng and Tamang¹³, Lokeshwar and Vishwanath¹⁴, Kosygin¹⁵, Tesia and Bordoloi¹⁶, Tamang and Sinha¹⁷, Loyi¹⁸, Darshan¹⁹, Nanda²⁰, Das²¹, Gurumayum²², and Satpathy²³. In due course others like Bagra²⁴, Sen and Khynrian²⁵ and more recently Gurumayum²⁶, has compiled and reported the availability of 259 species throughout the state. Nanda²⁷ reported 45 species from river Pachin belonging to 14 family. Later 2000 onwards, explosion of literature on taxonomic research of new fish species discovered has been witnessed from the state²⁶. Gurumayum et al, augmenting the state list illustrating potentially huge unexplored diversity of this region.

For instance some recent species discoveries include *Amblyceps motumensis*²⁸, *Aborichthys palinensis*²⁹, *Aborichthys uniobarensis*³⁰, *Mustura subhashi*³¹, *Pterocryptis barakensis*³², *Psilorhynchus kamengensis*³³, *Aborichthys iphipaniensis*³⁴, *Pethia arunachalensis*³⁵, *Creteuchiloglanis tawangensis*³⁶, *Olyra parviocula*³⁷, *Amblyceps waikhomi*³⁸ among many others. On the contrary, massive research gap exist in terms of incomplete or fragmentary fish faunal documentation of the various drainage systems of the state and mostly confined to the description of new species. Kherem river, a tributary of Noa dihing river in Changlang district, Arunachal Pradesh makes to the list with no prior documentation. Therefore, this study was formulated with an objective to explore the fish faunal count of this river.

Materials and Methods

Study area: Changlang is one of the 25 district of Arunachal Pradesh located in the eastern zone between 27°45'27.5904"N and 96°37'25.4352"E. The Kherem river flows through Bordumsa of Changlang district, forming a notable tributary of Noa-Dihing river finally debouching into the mighty Brahmaputra.

Methods: The present study of fish diversity was carried out on 17th of October 2022. Fish sampling was carried out from a single site (27°32'35.89" N and 95°56'22.12" E) at elevation of 153 m. As per the requirement of the habitats, sampling was carried out using gill nets of varying mesh size and cast nets.

The sampled fish were then preserved in 10% formaldehyde solution following Jayaram³⁹. Taxonomic identification of the collected fish samples was carried out based on standard taxonomic literatures³⁹⁻⁴¹. Nomenclature names were validated as per Catalog of Fishes of the California Academy of Sciences⁴² and Fish Base⁴³. Subsequently the assessment of the conservation status of sampled fish species were also undertaken (IUCN)⁴⁴.

All the sampled fish species are deposited in Dera Natung Government College, Museum of Fishes (DNGC/MF), Itanagar, Arunachal Pradesh. Diversity indices were established through past software wherein Simpson index, Shannon index⁴⁵ as well as evenness index were adopted to throw light on the Ichthyofaunal diversity and their quantification of Kherem river.

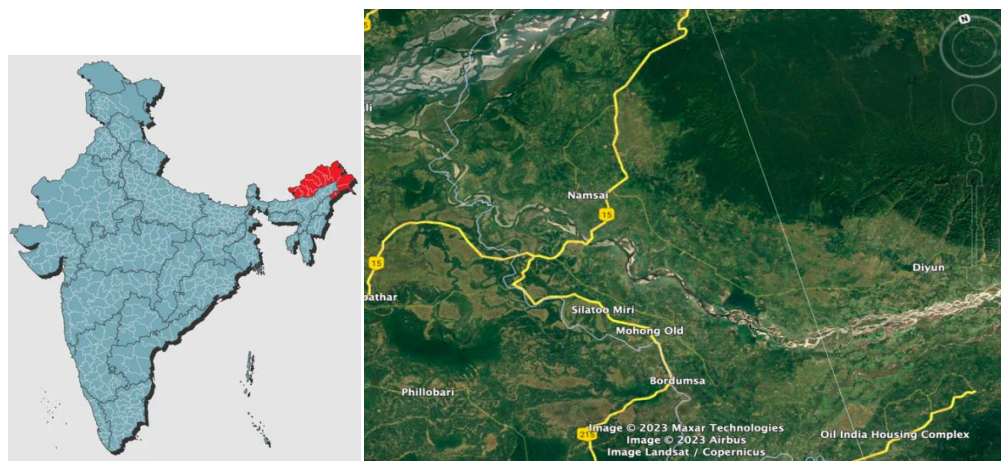


Figure-1: Map showing Kherem river basin in Changlang district.



Figure-2: Kherem river, a tributary of Noa dihing river in Changlang district, Arunachal Pradesh.

Results and Discussion

A total of 61 fish individuals were collected comprising of 21 species across 5 orders, 13 families and 15 genera from river Kherem of Changlang district (Table-1). Among orders Cypriniformes and Anabantiformes accounted for the highest diversity each including 4 families followed by Siluriformes including 3 families and finally Sybranchiformes and Gobiiformes with one family each (Table-1). Further species wise, family Cyprinidae and Badidae were revealed to be most dominant with 3 species each (15%). Followed by 2 species each (10%) in the family of Cobitidae, Bagridae, Channidae and Osphronemidae.

Others like Danionidae, Xenocypridae, Clariidae, Heteropneustidae, Synbranchidae, Gobiidae and Anabantidae were among the least diverse family with 1 species each (5%) (Figure-3). According to IUCN 2019 as many as 19 out of 21 species reported were under least concerned (90%) and 2 under not evaluated (10%) category (Figure-4). The Simpson index and Shannon index incorporated to quantify the fish diversity were recorded to be 0.9404 and 2.943 respectively. The evenness index added upto a near perfect 0.9037 score indicating the even distribution of species at the study site (Table-2). The physico-chemical parameters of water sample were recorded from kherem river as shown in Table-3.

Table-1: Details of taxonomic classification of fish species of river Kherem.

Order	No. of samples	Family	Sl. no.	Scientific name	IUCN Statuds	Regd No.
Cypriniformes	7	Cyprinidae	1	<i>Puntius sophore</i> (Hamilton 1822)	LC	DNGC/MF/055/3
			2	<i>Puntius terio</i> (Hamilton 1822)	LC	DNGC/MF/091/1
			3	<i>Pethia punctata</i> (Day 1865)	LC	DNGC/MF/083/1
		Danionidae	4	<i>Devario devario</i> (Hamilton 1822)	LC	DNGC/MF/014/2
		Cobitidae	5	<i>Lepidocephalichthys annandalei</i> (Chaudhuri 1912)	LC	DNGC/MF/086/1
			6	<i>Lepidocephalichthys guntea</i> (Hamilton 1822)	LC	DNGC/MF/095/1
		Xenocypridae	7	<i>Ctenopharyngodon idella</i> (Valenciennes 1844)	NEv	DNGC/MF/081/1
Siluriformes	4	Bagridae	8	<i>Mystus montanus</i> (Jerdon 1849)	LC	DNGC/MF/099/1
			9	<i>Olyra longicauda</i> (McClelland 1842)	LC	DNGC/MF/062/5
		Clariidae	10	<i>Clarias batrachus</i> (Linnaeus 1758)	LC	DNGC/MF/090/1
		Hetero-pneustidae	11	<i>Heteropneustes fossilis</i> (Bloch 1794)	LC	DNGC/MF/094/1
Sybranchi-formes	1	Synbranchidae	12	<i>Ophichthys cuchia</i> (Hamilton 1822)	LC	DNGC/MF/093/1
Gobiiformes	1	Gobiidae	13	<i>Glossogobius giuris</i> (Hamilton 1822)	LC	DNGC/MF/088/1
Anabantiformes	8	Anabantidae	14	<i>Anabas testudineus</i> (Bloch 1792)	LC	DNGC/MF/092/1
		Badidae	15	<i>Badis badis</i> (Hamilton 1822)	LC	DNGC/MF/085/1
			16	<i>Badis blocheri</i> (Kullander & Britz 2002)	LC	DNGC/MF/089/1
			17	<i>Badis singensis</i> (Geetakumari & Kadu 2011)	NEv	DNGC/MF/082/1
		Channidae	18	<i>Channa gachua</i> (Hamilton 1822)	LC	DNGC/MF/074/2
			19	<i>Channa punctata</i> (Bloch 1793)	LC	DNGC/MF/046/4
		Osphronemidae	20	<i>Trichogaster chuna</i> (Hamilton 1822)	LC	DNGC/MF/087/1
			21	<i>Trichogaster fasciata</i> (Bloch & Schneider 1801)	LC	DNGC/MF/084/1

LC- least concern, NEv- not evaluated.

Table-2: Diversity indices

Taxa_S	21
Individuals	61
Dominance_D	0.05
Simpson_1-D	0.94
Shannon_H	2.94
Evenness_e^H/S	0.9

Table-3: Details of physico-chemical parameters of water sample from kherem river.

Physico-chemical parameters	Value
Temperature	22.23°C
Potential of hydrogen	6.4
Oxidation reduction potential	50mv
Electrical conductivity	183s\m
Total dissolved solids	121ppm
Salinity	92ppm

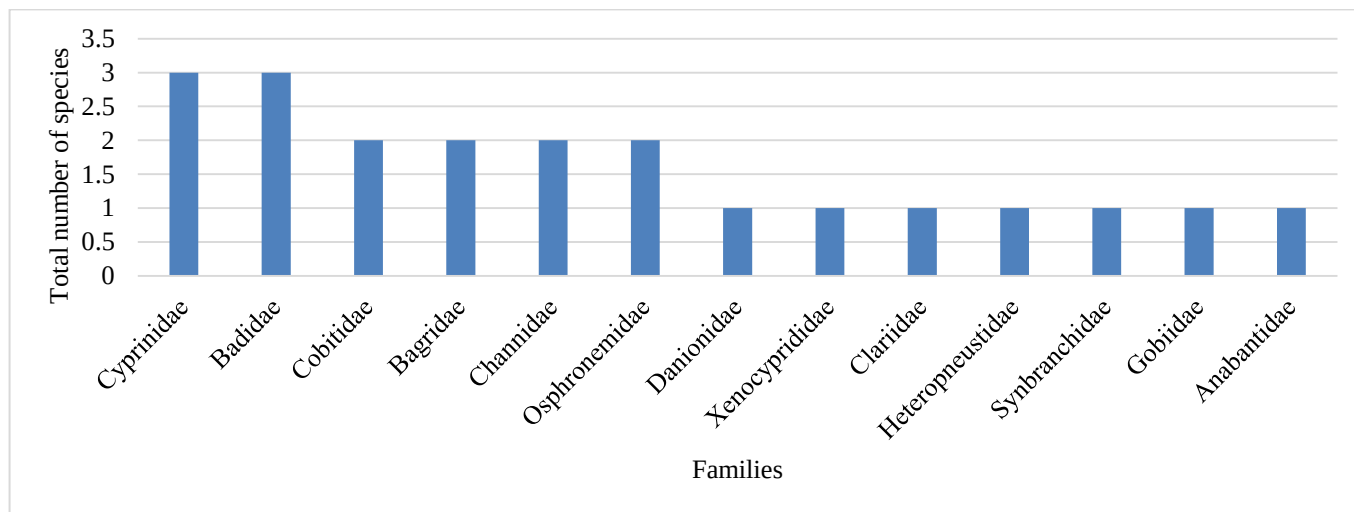


Figure-3: Species distribution of different families.

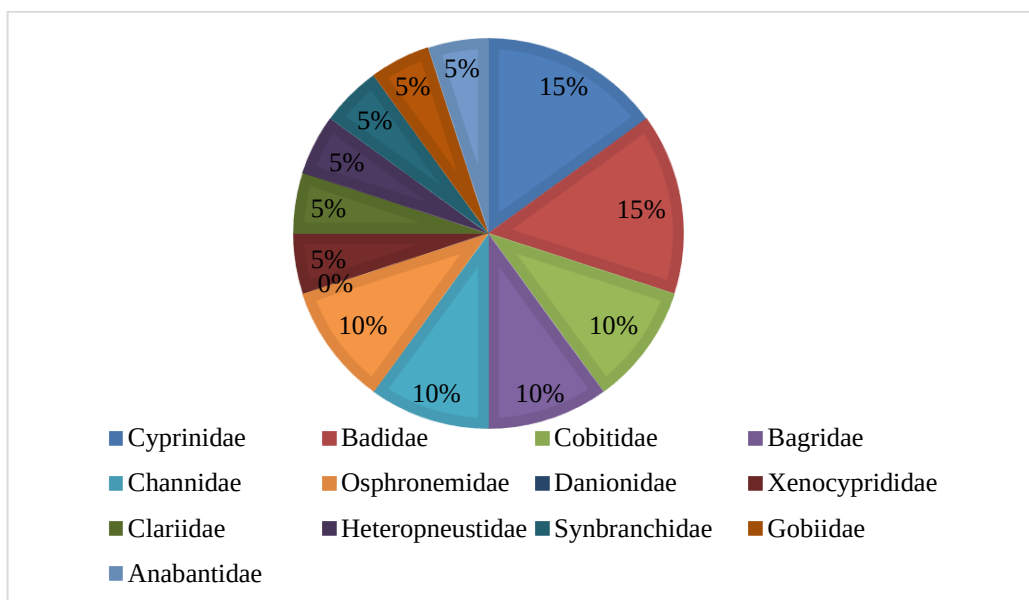


Figure-4: Percentage of species distribution of different families.



Mystus montanus (Jerdon 1849)³



Pethia punctata (Day 1865)



Trichogaster fasciata (Bloch & Schneider 1801)



Devario devario (Hamilton 1822)



Puntius terio (Hamilton 1822)



Puntius sophore (Hamilton 1822)



Ctenopharyngodon idella (Valenciennes 1844)



Ophichthys cuchia (Hamilton 1822)



Olyra longicauda (McClelland 1842)



Heteropneustes fossilis (Bloch 1794)



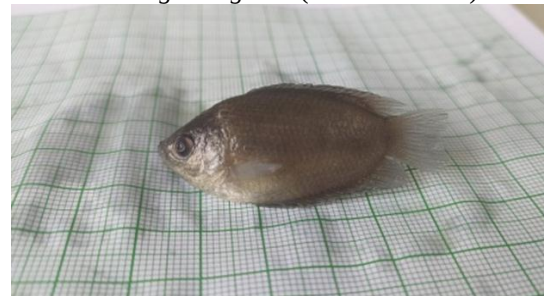
Anabas testudineus (Bloch 1792)



Glossogobiusgiuris (Hamilton 1822)



Channa gachua (Hamilton 1822)



Trichogasterchuna (Hamilton 1822)



Pethia punctata (Day 1865)



Channa punctata (Bloch 1793)



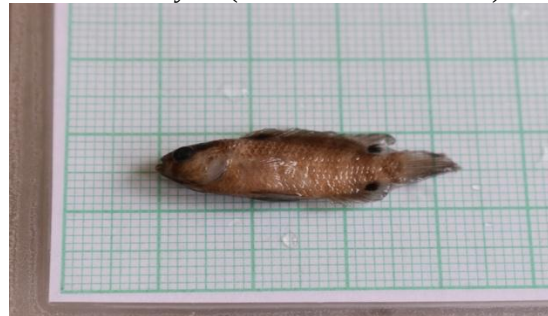
Lepidocephalichthys guntea (Hamilton 1822)



Badisblosyrus (Kullander & Britz 2002)



Badisbadis (Hamilton 1822)



Badissingenensis (Geetakumari & Kadu 2011)

Discussions: It has been established from previous studies that the North-East Region (NER) of India having elements of Indo-Gangetic region and to some extent of Myanmar and South China region shares similar fish fauna with these regions⁴⁶. The result obtained in this study align with the high fish resource availability of the state with the Shannon index adding upto 2.75 which represents a relatively diverse habitat. For species diversity, the Shannon diversity index ranges typically from 1.5 to 3.5. From the site we had collected total of 61 samples with the variety of 21 species (Table-1). Out of 61 samples collected from river Kherem of Changlang district, 21 species belonged to 5 orders, 13 families and 15 genera (Table-1).

Among the fish order Cypriniformes and Anabantiformes represented highest diversity with 4 families each followed by Siluriformes including 3 families and finally Sybranchiformes and Gobiiformes with one family each (Table-1). Additionally family wise, family Cyprinidae and Badidae were most dominant with 3 species each (15%). Followed by 2 species each (10%) in the family of Cobitidae, Bagridae, Channidae and Osphronemidae. Others like Danionidae, Xenocyprididae, Clariidae, Heteropneustidae, Synbranchidae, Gobiidae and Anabantidae were among the least diverse family with 1 species each (5%) (Figure-4).

Fish species *Badisblosyrus* was most abundant with 8 individuals, 7 individuals of species *Trichogaster chuna* and *Channa punctatus* was collected. Subsequently common species consist of *Puntius sunctata* (5 individuals), *Trichogaster fasciata*, *Lepido chalisannadalai* and *Ctenopharyngodon idella* (4 individuals each); *Heteropneustes fossilis*, *Glossogobius giuris* and *Olyralongi-caudata* (3 individuals); *Puntius sophore* and *Puntius terio* with 2 individuals. Lastly the least abundant species at the site included *Lepidochalis guntea*, *Anabas testudineus*, *Channa gachua*, *Monopterus chuchia*, *Devario devari*, *Badisingenesis*, *Badisbadis*, *Mystus montanus*, *Clarias batrachus* with only single individual each.

The study also revealed the presence of an exotic carp species *Ctenopharyngodon idella* from Kherem river which might have swum its way from the fishery ponds nearby. The result shows equally distributed species from the study site with 0.9037 evenness value. Out of the 21 fish species reported 19 falls in the Least Concerned (LC) category constituting 90% and only 2 species in Not Evaluated (Nev) with 10% in the IUCN red list. Maximum new reports have been made from the Siang, Noa-Dihing, Dibang and Subansiri rivers and their tributaries and the collection sites mostly clustered around the lower altitude regions of these rivers²⁶. Previous species inventories from Noa-Dihing include *Pethia arunachalensis*³⁵, *Glyptothorax pantherinus*⁴⁷, *Bhavana arunachalensis*⁴⁸, *Kryptopterus indicus*⁴⁰, *Aborichthys tikaderi*²², *Devario horai*²², *Lepidocephalichthys arunachalensis*⁴⁹. Yet a comprehensive understanding of its fish fauna is missing.

Therefore, this study was an attempt to contribute on its fish faunal documentation which reveals that Kherem river, has rich has a rich potential in fish resources and forms an important tributary.

Conclusion

By virtue of its multiple topographical and climatic condition, Arunachal Pradesh harbours diverse species of flora and fauna, many of them being endemic to the state. Despite a major boost in taxonomic literature on new species unknown to science in recent times reflecting the undiscovered rich biodiversity of the region, many drainage systems still lack complete exploration²³.

The present river Kherem is no exception to this trend with any previous record of its fish fauna. On addition to that, increasing urbanization witnessed in the state is leading to biodiversity loss. Freshwater bodies are at greater risk from habitat degradation and pollution, overexploitation, unsustainable fishing and intensified water use due to extensive human activities resulting in exponential decrease in the number of catches in the last decade according to numerous fishermen¹⁸. Given the difficulty in determining ecosystem sustainability for each of the fish species⁵⁰, maintaining fish diversity becomes significant. Exploration and documentation of bio resources is preliminary and mandatory from the conservation point of view. Thus, the present study will act as an useful baseline knowledge on fish diversity of river Kherem for future projects in this field, conservation and preservation efforts.

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