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Investigation on Ichthyofaunal Assortment and Water Quality Parameters in the Ranganadi River of North-East India

Seuj Dohutia[1,2], Jai Dayal Mali[3], Pavitra Chutia[1], S.P. Biswas[2]

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ABSTRACT

Background: The north-eastern region of India well known its innumerable natural resources. Flanked by two of the biodiversity hotspots of Indian subcontinent, North-East India has rich biological diversity of flora and fauna in its every corner. The present study has undertaken to assess the ichthyofaunal resources and physico-chemical parameters of Ranganadi river which will contribute to the scientific knowledge domain and aid in the planning of much needed conservation strategies.

Methods: The ichthyofauna and water quality parameters has been studied from February 2021 to January 2022 on a monthly basis in the three different terrains of Ranganadi river.

Result: The study revealed 76 fish species belonging to 9 different orders and 26 families. The major share contributed by the order cypriniformes (47.36%) followed by siluriformes (23.68%), Perciformes (13.15%), Synbranchiformes (5.26%), Anabantiformes (3.94%), Clupeiformes (2.63%), Tetradontiformes (1.31%), Anguilliformes (1.31%) and Beloniformes (1.31%) constitutes total ichthyofaunal composition of Ranganadi river recorded in the survey. During the survey, occurrence of fishes from Endangered (EN), Vulnerable (VU), Near Threatened (NT) category also documented in the river basin. The water quality parameters were found to be in the suitable ranges in contrast to parameters of healthy aquatic bodies.

Key words: Biodiversity hotspots, Conservation, Ichthyofauna, Physico-chemical parameter.

INTRODUCTION

India is blessed with nearly 2,118 fish species (8.60%) out of the 24,618 species of the world and a database on these fishes made at National bureau of fish genetic resources (Shahnawaz *et al*., 2010). In regard of North-East India, one of the most recent comprehensive study states that it harbours 422 species of fish from 133 genera (Goswami *et al*., 2012). Likewise, the ichthyofauna of north eastern region India has influence of Indo-Gangetic floodplains and to some amount Burmese and South Chinese region (Kalita and Sarma, 2015). The Ranganadi River of north-east India is one of the tributaries of river Subansiri which is one of the main tributaries of the mighty river Brahmaputra. Ranganadi River (27°11′11″N, 094°03′54″E) originates from Himalayan foothills of Arunachal Pradesh at an altitude of 3,400 m, flows through the Lesser Himalaya, Outer Himalaya and ultimately joins river Subansiri (Mali and Chutia, 2019). Also, a hydroelectric dam of 405 MW (neepco.co.in) is already operational in the basin of Ranganadi river which partaking undesirable in regard of aqua-faunas (Kaushik and Bordoloi, 2016). Dams apparently seems to alter the of natural flow of a river and disrupt the exchange of water and sediments within the river and with its riparian spaces (Poff *et al*., 1997). The downstream impacts of dams do not stay limited to the river hydrology and morphology alone, but also outspread towards the socio-economic conditions of the riparian communities of the affected area (Cernea, 2004). Aquatic ecosystems greatly rely on the water quality parameters and biological diversity (Zhang *et al*., 2019). The fish faunas are critically reliant on by the physico-chemical parameters of water, more over ichthyofaunal diversity is also vital indicator of aquatic ecosystem's health and management (Gogoi *et al*., 2015). The current study has been taken up in to assess the current ichthyofaunal resources in accordance with the analysis of the water quality parameters.

[1]P.G. Department of Life Sciences, Debraj Roy College, Golaghat-785 621, Assam, India.
[2]Department of Life Sciences, Dibrugarh University, Dibrugarh-786 004, Assam, India.
[3]Department of Zoology, Sadiya College, Sadiya-786 157, Assam, India.

Corresponding Author: Seuj Dohutia, P.G. Department of Life Sciences, Debraj Roy College, Golaghat-785 621, Assam, India. Email: seujdohutia@gmail.com

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MATERIALS AND METHODS

Study site

Three different zones of Ranganadi river has been selected for study and analysis of ichthyofaunal inventorization, physico-chemical parameters of water, *viz*
I) Kimin (27°19′37″N, 94°58′55″E)
II) Pahumora (27°12′42″N, 94°03′10″E)
III) Pokoniaghat (27°01′46″N, 94°06′12″E)

Research period

The on-site field study was conducted from February 2021 to January 2022, the year based on seasonal changes. The figures are embedded into three different seasons of the year, namely pre-monsoon, monsoon and post-monsoon. Data collection were carried out from 6:00 AM- 9:00 AM in three sites of the Ranganadi river basin.

Physico-chemical parameters of water

The water quality parameters were analysed following APHA (2005).

Preservation and identification of specimens

The fish specimens were captured with the help of local fish folks and further preserved in 10% formaldehyde solution for identification to genus and species level following Talwar and Jhingran (1991).

Off-site research and analysis

The off-site research and analysis was mainly carried out at the PG Department of Life Sciences of Debraj Roy College aided by Department of Life Sciences, Dibrugarh University.

RESULTS AND DISCUSSION

The water quality parameters are depicted in Table 1 and the data regarding the fish composition of the Ranganadi river presented in the Table 2, Fig 1 and 2. The survey revealed occurrence of 76 species of fish belonging to 9 orders, 26 family and 54 genera. On the basis of species composition, the Cypriniformes order were dominant having 36 species

Table 1: Seasonal variation of physico-chemical parameters of water in the Ranganadi river.

Parameters (Units)	Pre-Monsoon (Feb-May)	Monsoon (June-Sept)	Post-Monsoon (Oct-January)
Air-temperature (°C)	21.5-25.7	28.5-31.5	20.2-21.7
Water-temperature(°C)	19.5-22.5	21.5-26.5	15.2-20.3
Transparency (cm)	23.5-30.5	16.7-22.5	27.2-34.6
Water-level (cm)	36-80	65.7-175.8	44-90
Current flow(m/s)	0.34-0.58	0.50-0.98	0.27-0.39
pH	7.07-7.34	7.32-7.45	7.25-7.37
D.O (mg/L)	8.12-8.35	8.45-.8.91	6.21-7.55
Free CO_2 (mg/L)	4.5-4.9	4.6-4.7	4.1-4.5
Hardness (mg/L)	70.9-72.3	50.25-58.7	52.4-81.44
TDS (mg/L)	24.4-28.7	36.25-40.1	38.78-47.9
TSS (mg/L)	170.3-203.7	233.2-252.4	100.1-122.8

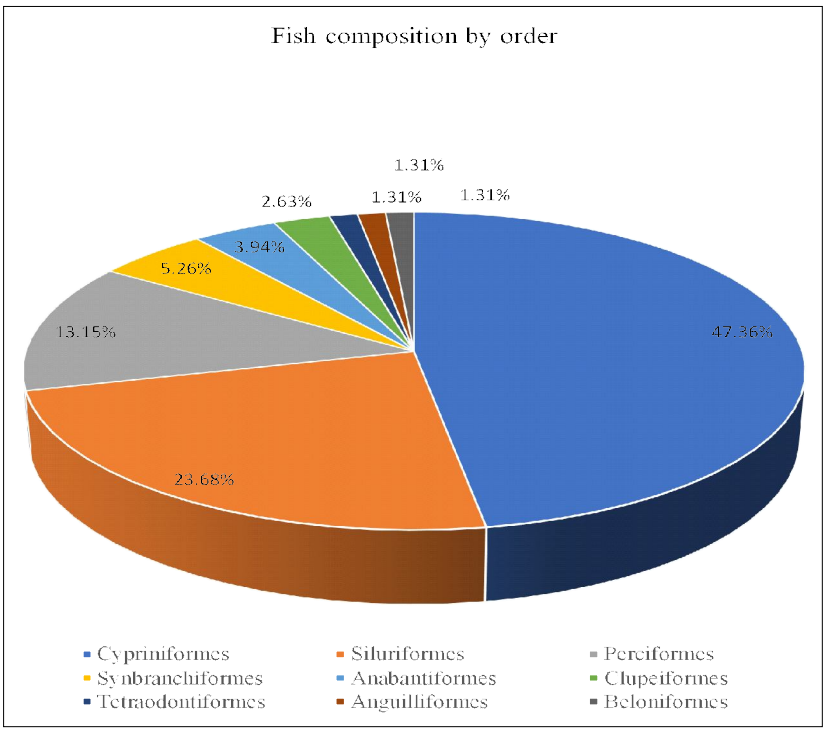

Fig 2.1: Pie-chart 1 (Composition of recorded fish species in terms of order).

Table 2: Records of various fish species noted during the field visit.

Order	Family	Scientific name	Common name	Local/ Vernacular name	IUCN status	Economic value
Anabantiformes	Anabantidae	*Anabas testudineus* (Bloch, 1792)	Climbing gourami	Kawoi	LC	Food/ornamental
	Osphronemidae	*Trichogaster fasciata* (Bloch and Schneider, 1801)	Banded gourami	Kholihona	LC	Food/ornamental
		Trichogaster labiosa (Day, 1877)	Thick-lipped gourami	Kholihona	LC	Food/ornamental
Anguilliformes	Anguillidae	*Anguilla bengalensis* (Gray, 1831)	Indian longfin eel	Bami	NT	Food
Beloniformes	Belonidae	*Xenentodon cancila* (Hamilton, 1822)	Freshwater garfish	Kokila	LC	Food/ornamental
Clupeiformes	Notopteridae	*Chitala chitala* (Hamilton, 1822)	Indian featherback/ Indian knifefish	Chital	NT	Food
		Notopterus notopterus (Pallas, 1769)	Bronze featherback	Kandhuli	LC	Food
Cypriniformes	Cyprinidae	*Amblypharygodon mola* (Hamilton,1822)	Mola carplet	Mua	LC	Food/ornamental
		Barilius bendelisis (Hamilton, 1807)	Indian hill trout	Borolia	LC	Food/ornamental
		Barilius vagra (Hamilton, 1822)	Vagra baril	Borolia	LC	Food/ornamental
		Cabdio morar (Hamilton, 1822)	Morari		LC	Food
		Cabdio jaya (Hamilton, 1822)	Jaya	Jaya	LC	Food
		Chela cachius (Hamilton, 1822)	Silver hatchet chela	Laupati	LC	Food
		Cirrhinus reba (Hamilton, 1822)	Reba carp	Lachim	LC	Food
		Cirrhinus mrigala (Hamilton, 1822)	Mrigal carp	Mirika	LC	Food
		Crossocheilus latius (Hamilton, 1822)	Stone roller/ gangetic latia	Bato	LC	Food
		Danio rerio (Hamilton, 1822)	Zebrafish	Anju	LC	Food/ornamental
		Esomus danricus (Hamilton, 1822)	Indian flying barb	Dorikona	LC	Food/ornamental
		Garra annandalei (Hora, 1921)	Annandale garra/ Tunga garra	Ghar poa	LC	Food/ornamental
		Garra gotlya (Gray, 1830)	Sucker head	Ghar poa	LC	Food/ornamental
		Labeo rohita (Hamilton, 1822)	Rohu	Rou	LC	Food
		Labeo gonius (Hamilton, 1822)	Kuria labeo	kurhi	LC	Food
		Labeo calbasu (Hamilton, 1822)	Orangefin labeo	Kaliara/Mali	LC	Food
		Labeo bata	Bata	Bhangon	LC	Food

Table 2: Continue...

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		(Hamilton, 1822)				
		Labeo pangusia (Hamilton, 1822)	Pangusia labeo	Bholung	NT	Food
		Labeo dyocheilus (McClelland, 1839)	Kali	Ghora mas	LC	Food
		Bangana dero (Hamilton, 1822)	Kalabans	Hilgharia	LC	Food
		Neolissochilus hexagonolepis (McCleland, 1839)	Copper mahaseer	Pakhiranga	NT	Food
		Neolissochilus hexastichus (Mccleland, 1839)	N/A	N/A	NT	Food
		Osteobrama cotio (Hamilton, 1822)	Cotio	Hafo	LC	Food/ornamental
		Puntius sophore (Hamilton, 1822)	Pool barb/spotfin swap barb/stigma barb	Puthi	LC	Food/ornamental
		Pethia ticto (Hamilton, 1822)	Ticto barb	Puthi	LC	Food/ornamental
		Raiamas bola (Hamilton, 1822)	Trout barb	Bhol	LC	Food/ornamental
		Rasbora daniconius (Hamilton, 1822)	Slender rasbora	Dorikona	LC	Food/ornamental
		Tor tor (Hamilton, 1822)	Mahaseer	Pethia	DD	Food
	Cobitidae	*Botia derio* (Hamilton, 1822)	Bengal loach/ queen loach	Ranibotia	LC	Food/ornamental
		Botia rostrata (Gunther, 1868)	Twin banded loach/ Gangetic loach	Botia	VU	Food/ornamental
		Canthophrys gongota (Hamilton, 1822)	Gongota loach	kukurbotia	LC	Food/ornamental
		Lepidocephalus guntea (Hamilton, 1822)	Guntea loach	Balibotia	LC	Food/ornamental
	Nemacheilidae	*Aborichthys kempi* (Chaudhuri, 1913)	Stone loach	N/A	NT	Food/ornamental
		Acanthocobitis botia (Hamilton, 1822)	Mottled zipper loach	Bilturi	LC	Food/ornamental
	Psilorhynchidae	*Psilorhynchus arunachalensis* (Nebeswar *et al*., 2007)	Torrent minnow	N/A	DD	Food/ornamental
		Psilorhynchus balitora (Hamilton, 1822)	Balitora minnow	Balitora	LC	Food/ornamental
Perciformes	Ambassidae	*Chanda nama* (Hamilton, 1822)	Elongate glassy perchlet	Chanda	LC	Food/ornamental
		Psuedambasis ranga (Hamilton, 1822)	Indian glassy perch/ Indian X-ray fish/ Indian glassy fish	Chanda	LC	Food/ornamental
	Badidae	*Badis badis* (Hamilton, 1822)	Blue perch Badis	Randhoni N/A	LC NE	Food/ornamental Food/ornamental

Table 2: Continue...

Table 2: Continue...

		Badis singenesis (Geetakumari and Kadu, 2011)				
	Channidae	*Channa gachua* (Hamilton, 1822)	Dwarf snakehead	Chengeli	LC	Food/ornamental
		Channa punctatus (Bloch, 1793)	Spotted snakehead	Goroi	LC	Food/ornamental
		Channa stewartii (Playfair, 1867)	Assamese snakehead	Chenga	LC	Food/ornamental
		Channa striata (Bloch, 1793)	Striped snakehead	Hol	LC	Food
	Gobiidae	*Glossogobius giuris* (Hamilton, 1822)	Tank goby	Patimutura	LC	Food/ornamental
	Nandidae	*Nandus nandus* (Hamilton, 1822)	Gangetic leaffish	Gedgedi	LC	Food/ornamental
Siluriformes	Amblycipitidae	*Amblyceps arunachalensis* (Nath and Dey, 1980)	N/A	N/A	EN	Food/ornamental
	Bagridae	*Batasio batasio* (Hamilton, 1822)	Tista batasio	Bojori	LC	Food/ornamental
		Hemibagrus menoda (Hamilton, 1822)	Menoda catfish	Ghagla	LC	Food
		Mystus tengara (Hamilton, 1822)	Tengara catfish	Hingora	LC	Food/ornamental
		Mystus vittatus (Bloch, 1794)	Striped dwarf catfish	Hingora	LC	Food/ornamental
		Mystus cavasius (Hamilton, 1822)	Gangetic mystus	Bar-hingora	LC	Food/ornamental
		Sperata aor (Hamilton, 1822)	Long-whiskered catfish	Aari	LC	Food
		Sperata seenghala (Skyes, 1839)	Giant river catfish	Aari	LC	Food
	Chacidae	*Chaca chaca* (Hamilton, 1822)	Angler catfish	Kurkuri	LC	Ornamental
	Erthistidae	*Erithestes pusillus* (Muller and Troschel, 1849)	South Asian River catfish	Tinkaitiya	LC	Ornamental
	Siluridae	*Ompok bimaculatus* (Bloch, 1794)	Butter catfish	Pabho	NT	Food
		Wallago attu (Bloch and Schneider, 1801)	Helicopter catfish	Borali	VU	Food
	Schilbeidae	*Eutropiichthys vacha* (Hamilton, 1822)	Schilbid catfish	Bosa	LC	Food
	Sisoridae	*Bagarius bagarius* (Hamilton, 1822)	Devil catfish/ dwarf goonch	Gorua	NT	Food
		Gagata cenia (Hamilton, 1822)	Indian gagata	keyakata	LC	Food/ornamental
		Glyptothorax telchitta (Hamilton, 1822)	Catfish	Dhal magur	LC	Ornamental
	Heteropneustidae	*Heteropneustes fossilis*	Asian stinging	Hingi	LC	Food/ornamental

Table 2: Continue...

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		(Bloch, 1794)	catfish			
	Olyridae	*Olyra prestigiosa* (Ng and Ferraris, 2016)	Fighting catfish	N/A	N/A	Food/ornamental
Synbranchiformes	Mastacembellidae	*Mastacembelus armatus* (Lacepede, 1800)	Zig-zag eel	Bami	LC	Food
		Macrognathus aral (Bloch and Schneider, 1801)	One-striped spiny eel	Tura	LC	Food/ornamental
		Macrognathus pancalus (Hamilton, 1822)	Barred spiny eel	Tura	LC	Food/ornamental
	Synbranchidae	*Monopterus cuchia* (Hamilton, 1822)	Eel	Cuchia	LC	Food
Tetraodontiformes	Tetraodontidae	*Tetraodon cutcutia* (Hamilton, 1822)	Ocellated puffer fish	Gangatoop	LC	Ornamental

(where, LC= Least concerned, EN= Endangered, VU= Vulnerable, NT= Near threatened, NE= Not evaluated, D/D = Data deficient and N/A= Not available).

followed by siluriformes with 18 species, followed by Perciformes, Synbranchiformes, Anabantiformes and Clupeiformes respectively 10,4,3 and 2 numbers of species. Only 1 species from the order Anguilliformes, Beloniformes and Tetraodontiformes were recorded during the study period.

The water quality parameters and bionetwork of a particular water body have vital role in the growth and development of fish and ichthyofaunal diversities (Akhter *et al*. 2021). Such a way, temperature is viewed as one of the most important factors which effects the fish composition of that area. The water temperature recorded during the survey ranged from 15.2-26.5 (°C) which is suitable for the sustainability of the fishes recorded in the eastern Himalayan region (Sehgal, 1999).

Another important parameter of water is transparency which helps to assess the quality, transparency is directly related to dissolved oxygen content, sunlight penetration and plankton and macrophyte growth (Boyd and Lichtkoppler, 1979). During the study period, a range 16.7-34.6 cm transparency has been recorded which is give the impression to be adequate for fish health (Bhatnagar and Devi, 2013). However, seasonal variation of transparency is very much distinct in the river basin.

The water level of Ranganadi river found to be in the range of 36-175.8cm throughout the year from hilly stream of Kimin (Arunachal Pradesh) till the confluence (Assam) with the Subansiri river at the downstream. This diverse range of water level implies presence of hill stream species like *Glyptothorax telchitta*, *Batasio batasio, Erethistes pusillus* to big catfishes such as *Wallago attu*, *Sperata seenghala* and Indian Major Carps. The records of current flow of riverine water varies seasonally, with the advent of monsoon and monsoon period current flow increases drastically in the study sites. Although, the water current rate is provoked from the reservoir of the Ranganadi dam built on the upstream of the river. However, environmental flow is prominent in the all the study sites.

pH ranged in the study sites from 7.07 to 7.45, which indicates a healthy hydrogen ion concentration in the water bodies. According to Michael (1969), survival and growth of the fish species is best in the range of 7.3-8.4 which indicates it is in safe array.

Concentration of dissolved oxygen (D.O.) is one of the most important parameters of water which indicates the physical and biological processes prevailing in water. Comparatively higher range of D.O. was recorded during the monsoon season due to assimilation of water by heavy wind action and mixing of monsoon rains. During the investigation, the D.O. was found to be in the range of 6.21-8.91 mg/L. Higher content of dissolved oxygen level may be attributed to the hilly fast-flowing region of the Ranganadi river (Hamid *et al*. 2020).

According to Swann (1997), that fish can endure concentrations of 10ppm of free Carbon Dioxide on a condition that, D.O. concentrations are high and water supporting good fish populations usually contain less than 5 ppm of free CO_2. Bhatnagar *et al*. (2004), suggested 5-8 ppm is vital for photosynthetic activity; 12-15 ppm is sublethal to fishes and 50-60 ppm is fatal to fishes. Therefore, it is evident that free carbon dioxide in water supporting good fish population should be less than 5 mg/L. During the investigation, the range of Free Carbon dioxide from 4.1-4.7 mg/L from which it signifies that it is apposite for the ichthyofaunal species.

The hardness of water is principally dependent upon by the content of calcium and magnesium salts, combined with bicarbonates and carbonates with sulphates, chlorides and other anions of minerals (Devi *et al*. 2017). Hardness range of 35-80 mg/L said to be beneficial for fishes (Jhingran, 1988). The hardness level in the Ranganadi river basin during the study period was 50.25-81.44 mg/L.

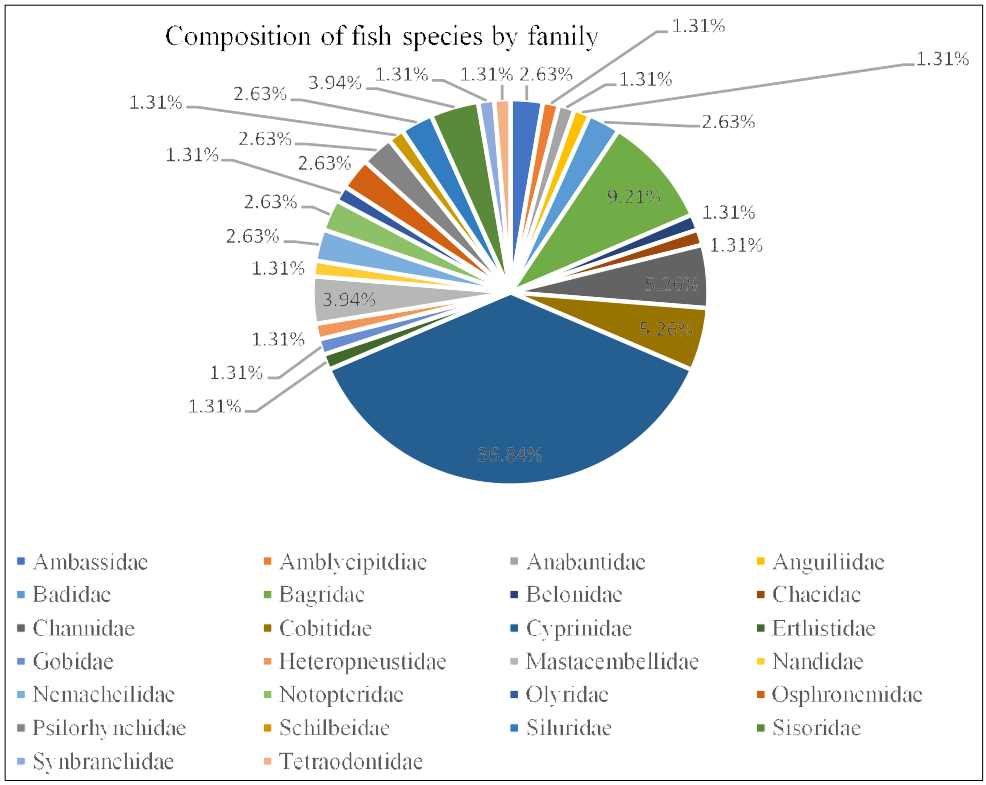

Fig 2: Pie-chart 2 (Fish composition of recorded species in terms of family).

Total dissolved solids (TDS)

The solids present in the water in the dissolved state which consists of inorganic salts and dissolved materials. TDS content below 400 mg/L is regarded as appropriate quality for better growth and survival for the aqua faunas (Munni *et al*., 2013). The TDS content ranged 24.4-47.9 mg/L during the survey.

Total Suspended Solids (TSS)

Indicator of the measure of wear and tear that took place in the upstreams. The TSS parameter ranged from 100.1-252.4mg/L during the yearlong survey. With the advent of pre-monsoon and monsoon season rise in TSS trends is very distinct which can be positively co-related with the increase precipitation, high sediment load, deterioration and mixing of rainwater (Bailung and Biswas, 2021).

Various previous studies on ichthyofaunal diversity and physico-chemical properties of water have been conducted in and around upper Brahmaputra basin and its tributaries, Bakalial *et al*., (2014), conducted studies on the nearby Subansiri river, which recorded 204 species from 34 families 101 genera. Also, investigation conducted by Boruah and Biswas (2002), lead to listing of 167 fish species from the upper Brahmaputra basin of north-east India. Considering the facts in regard of nearby waterbodies of Brahmaputra River, the fish composition of Ranganadi river is seems to be affected because of some anthropogenic factors like Hydel project, rampant fishing in an unsustainable matter which involves electrode fishing, lethal lime fishing *etc*. Similar effects on fish community because of man-made factors can be seen in the recent reports of Limbu *et al*., (2021) and Shao *et al*., (2019) conducted respectively Nepal and China.

CONCLUSION

The investigation was carried out the throughout the year, findings are recorded and presented in the seasonal basis. The three selected sites from different terrains were studied in a profound manner to fulfil the necessary objectives comprehensively. From present study it appears that Ranganadi river has sensible ichthyofaunal diversity with suitable condition for fish growth and development. However, constant threats will be always lurking to the riverine health because of the various anthological activities like sand and gravel mining, overfishing *etc*. Again, the Ranganadi dam at the upstream of the river always have the potential of wreaking havoc at the downstream of the river which extents will be felt in the downstream communities irrespective of man or aquatic lives. Specifically designed conservation strategy is very much need of the hour to protect the anthropological society and aqua species. However, it seems till today no such initiative has been taken by the stakeholders.

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