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ASSESSMENT OF FISH BIODIVERSITY IN AMOCHHU RIVER BASIN

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ABSTRACT: Baseline data collection on fish biodiversity assessment in Amochhu river basin within Amochhu Land Development and Township Project was conducted in 2019-2020. Roughly nine kilometer stretch of Amochhu river (Torsa) was segmented using global positioning system coordinates into six sampling sites that stretched right from the Indo-Bhutan border. Two of its tributaries, Lowrichhu and Omchhu were also sampled for this study. The survey recorded 46 fish species under five orders, 14 families and 35 genera. The highest number of fish species was recorded for Cypriniformes (S = 31). Fishes recorded in the study were grouped under global categories in accordance to the International Union for Conservation of Nature. Three fish species were found to be endangered, three deemed vulnerable, three near-threatened and 28 the least concerned. However, four species were declared data deficient and five were not evaluated. The fish biodiversity in Amochhu river basin is highly susceptible to anthropogenic activities. Thus, appropriate conservation policy measures must be put in place to mitigate impact on fish biodiversity from anthropogenic activities.

Keywords: Amochhu river basin; conservation status; fish species; fish biodiversity.

1.INTRODUCTION

Amochhu river, colloquially termed as Torsa river, is the smallest riverine system in Bhutan (358 km length of which 145 km is in Bhutan). It is a transboundary river that flows from the Chumbi valley (Tibetan Plateau) through Sombaykha Dungkhag (Haa district) into the southern foothills of Phuntsholing (Chhukha district), then to Cooch Bihar (West Bengal, India), before eventually joining the Brahmaputra basin in Bangladesh (Savada 1991). Amochhu is known as Torsa river on the Indian side.

The Amochhu Land Development and Township Project (ALDTP) has begun under the supervision of Phuntsholing Thromde with rationales to develop aesthetic urban infrastructure facilities, expand the currently clustered settlements and minimize the risks of floods and erosions. Present ALDTP activities have been, in one way or other, posing threats to aquatic biodiversity. Some of the threats related to urban infrastructure development and modification of river flows include fragmentations and losses of aquatic habitats, disturbance to spawning routes and blockage of fish migrations (Environment Impact Assessments [EIA] 2017).

The Amochhu river is one of the major tributaries of the Brahmaputra River basin and possesses the topographical and vegetational components similar to that of Northeast India. These regions are recognized as one of the global hotspots for biodiversity including fish (Das 2015; Acharjee et al. 2012). Torsa river alone boasts of 107 indigenous fish species from 30 families (Dey and Sarker 2015). Thus, this study is designed to evaluate that the upstream of Torsa (Amochhu river) may also house a large proportion of aquatic biodiversity.

Ichthyofaunal diversity of the Amochhu has been evaluated by other researchers too yet with

limited scientific data on specific diversity and necessary conservation measures. The National Research and Development Center for Riverine and Lake Fisheries (NRDCRLF) provides a baseline assessment of fishes in western Bhutan (NRCRLF 2017), with the primary focus on ecological status and overall species distributions in the region. The study by NRDCRLF recorded 49 fish species including two exotic species. Norbu et al. (2020) subsequently reported 37 fish species belonging to 14 families. These evaluations provide baseline data on fish biodiversity in the Amochhu catchment area.

The current study was an assessment of fish diversity in the Amochhu River, particularly in the proximity of Amochhu Land Development and Township Project (ALDTP) area. The ultimate data generated from the study will serve as an important baseline which in return shall gauge future collection efforts while also providing a framework to corroborate the findings of the fish species records as reflected in the project Environment Impact Assessments (EIA 2017).

2.1 Survey area

The study area falls within the ALDTP which includes 160 hectares (ha) of riparian land, stretching from the Indo-Bhutan border under Phuntsholing gewog under Chhukha district and extending up to Tading gewog under Samtse district (26°52'32.38"N, 89°22'16.38"E).

2.2 Sampling sites

Sampling sites were selected based on the Environmental Impact Assessments report (EIA 2017), and the same sites were sampled to ensure repeatability and comparison. Six segments were identified starting from Indo-Bhutan border to the bridge connecting Chhukha and Samtse district. The assessment segments were assigned using global positioning system (GPS) coordinates. The length of each segment ranged from 0.82 – 2.18 km (Figure 1) The study included a total river length of 10.88 km of the Amochhu, and one kilometre stretch each of the two tributaries (i.e., Omchhu and Lowrichhu).

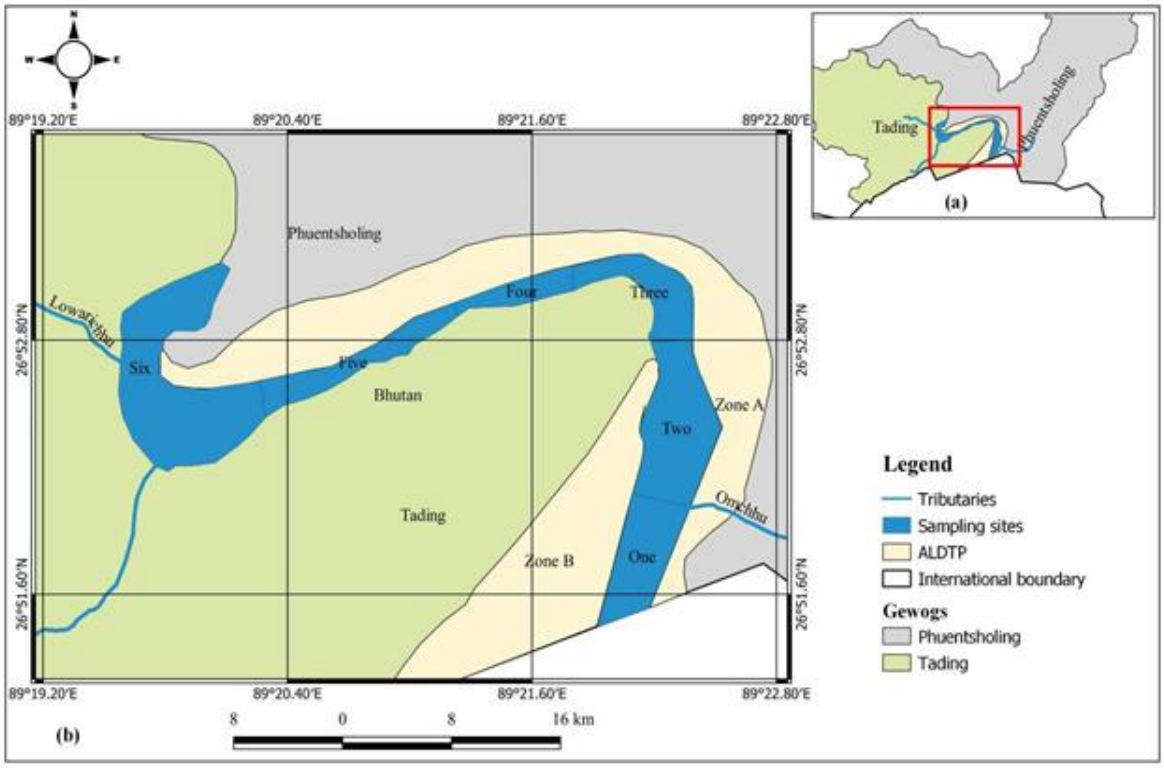

Figure 1: Amochhu sampling area. Panel (a) shows two gewogs Phuntsholing under Chhukha district and Tading under Samtse district, whereas (b) shows the Amochhu Land Development and Township Project (ALDTP) Zone A and B, two tributaries and six sampling sites assessed in this study.

2. MATERIALS AND METHODS

2.3 Fish sampling method

Fishes were collected using a backpack electro-shocker (Model ELT62-2D; Grassl, Germany; DC 3KV) that pulses direct current (DC).

2.4 Water quality

The physiochemical characteristics of water play an important role in supporting the types of fish diversity in freshwater ecosystems (Basavaraja et al. 2014). Basic water parameters (water Temperature, pH, and dissolved oxygen) at all sampling sites were recorded using Hanna 98194 multiparameter.

2.5 Data collection

Data were collected over one year, starting May 2019 through July 2020. Seasonal species diversity estimates were obtained twice in the pre-monsoon period (March 2019, and May 2020), and once each for the post-monsoon period (September 2019) and also during the Monsoon (July 2020).

2.6 Fish identification

Each captured fish was identified on-site and photographed live using a photarium as a repository and using a high-resolution Digital Single-Lens Reflex (DSLR) camera for photography. All fishes were sampled in strict compliance with data collection technique as described by (Bagra and Das 2010) and were safely released back into the water. Those fishes not identified on-site were euthanized in clove oil and subsequently preserved in 10% formalin and transferred to NRDCRLF laboratory. Morphological measurements and counts were based on procedures described by Ng and Kottelat (2007). Fishes were subsequently confirmed to species level by employing procedures described by Talwar and Jhingran (1991), Jayaram (1999), and Viswanath (2000). Valid taxon name was based on FishBase (http//www.fishbase.org) and the conservation status was assigned as per the IUCN red list (http//www.iucnredlist.org).

2.7 Data analyses

The following methods were employed to analyze the survey data

2.7.1 Fish diversity

Fish species can be defined as the number represented in a particular sampling unit, such as a section of a river, an aquatic community, a river system, country and so on. Species richness is simply an enumeration of species present, without taking into consideration their abundances (Gorman and Karr 1978).

2.7.2. Species abundance

Species abundance records how common or rare species are relative to other species in a defined location. It may also refer to the frequency distribution of individuals among species in a community. Two communities may be equally rich in numbers of species but differ in their relative abundances within species.

2.7.3 IUCN red list species

The conservation status of fish species was assigned as per the International Union for Conservation of Nature (IUCN) Red List (http//www.iucnredlist.org).

2. RESULTS AND DISCUSSIONS

3.1 Fish diversity

The assessment recorded 46 different fish species which fell across 5 orders, 14 families and 35 genera. Similar data were recorded by NRCRLF (2017). The most dominant families were Cyprinidae (S = 24); Nemacheilidae (S = 4); Channidae, Amblycipitidae and Sisoridae (S = 3). In addition, a single species was recorded for Anguillidae, Balitoridae, Cobitidae, Olyridae, Psilorhynchidae, Badidae, Erethistidae, Siluridae and Mastacembelidae (Table 1).

3.2 Species abundance

Eight fish species were recorded as being the most abundant and were collected at all assessment sites throughout the seasons as species abundance indicated by (+++). Nevertheless, 26 fish species were recorded at some assessment sites with the number of specimens collected for each was relatively less and were indicated by (++).Further, several species were rarely found and not collected in more than two locations in the study area. Thus, the number of specimens for thes these species were considerably less and were indicated by (+) in Table 1.

Table 1: Diversity and relative abundance of fishes in Amochhu. Acronyms are: EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = Least concerned, DD = Data deficient, NE = Not evaluated

Order	Families	Genus	Species	IUCN status	Species Abundance
Anguilliformes	Anguillidae	*Anguilla*	*Anguilla bengalensis*	NT	+
Cypriniformes	Balitoridae	*Balitora*	*Balitora brucei*	NT	+
	Cobitidae	*Lepidocephalichthys*	*Lepidocephalichthys guntea*	LC	++
	Cyprinidae	*Aspidoparia*	*Aspidoparia morar*	LC	++
		Bangana	*Bangana dero*	LC	++
		Barilius	*Barilius bendelisis*	LC	+++
		Barilius	*Barilius vagra*	LC	+++
		Chagunius	*Chagunius chagunio*	LC	+++
		Crossocheilus	*Crossocheilus latius*	LC	++
		Danio	*Danio rerio*	LC	++
		Devario	*Devario aequipinnatus*	LC	++
		Garra	*Garra annandalei*	LC	+++
		Garra	*Garra gotyla*	LC	++
		Labeo	*Labeo dyocheilus*	LC	++
		Neolissochilus	*Neolissochilus hexagonolepis*	NT	+++
		Neolissochilus	*Neolissochilus dukai*	DD	+
		Opsarius	*Opsarius barna*	LC	+++
		Oreichtys	*Oreichtys crenucliodes*	DD	++
		Pethia	*Pethia conchonius*	LC	++
		Pethia	*Pethia ticto*	LC	++
		Pethia	*Pethia* sp.	NE	++
		Puntius	*Puntius sophore*	LC	++
		Raiamas	*Raiamas bola*	LC	+
		Schizothorax	*Schizothorax progastus*	LC	++
		Schizothorax	*Schizothorax richardsonii*	VU	+
		Cyprinion	*Cyprinion semiplotus*	VU	+++
		Tor	*Tor putitora*	EN	+
Perciformes	Psilorhynchidae	*Psilorhynchus*	*Psilorhynchus balitora*	LC	+++
	Nemacheilidae	*Aborichthys*	*Aborichthys* sp.	NE	++
		Paracanthocobitis	*Paracanthocobitis abutwebi*	NE	++
		Schistura	*Schistura beavani*	LC	++
		Schistura	*Schistura reticulofasciata*	VU	++
	Badidae	*Badis*	*Badis badis*	LC	++
	Channidae	*Channa*	*Channa punctata*	LC	++
		Channa	*Channa gachua*	LC	++
		Channa	*Channa melanostigma*	LC	++
Suliformes	Amblycipitidae	*Amblyceps*	*Amblyceps apangi*	LC	+
		Amblyceps	*Amblyceps arunchalensis*	EN	+
		Amblyceps	*Amblyceps cerinum*	NE	+
	Erethistidae	*Pseudolaguvia*	*Pseudolaguvia shawi*	DD	++
	Olyeridae	*Olyra*	*Olyra longicaudata*	LC	+
	Siluridae	*Pterocryptis*	*Pterocryptis barakensis*	EN	+
	Sisoridae	*Glyptothorax*	*Glyptothorax* sp.	NE	+
		Glyptothorax	*Glyptothorax panda*	DD	++
		Pseudocheneis	*Pseudocheneis sulcata*	LC	++
Synbranchiformes	Mastacembelidae	*Mastacembelus*	*Mastacembelus armatus*	LC	++

3.3 Seasonal distribution of fish species in the Amochhu

The assessment found 31 fish species during the monsoon season (July 2021), of which, 27 were recorded in each of the pre-monsoon seasons (March 2019 & May 2020). Only 24 species were recorded in the post-monsoon season (September 2019). Species recorded in different seasons are listed in Table 2. Few migratory fishes noted were: *Labeo dyocheilus*, *Bangana dero*, *Mastacembelus armatus*, and young juveniles of *Tor putitora* (maximum size =190 mm). These fishes were found in high riffles, running water and often migrate upstream to reach spawning areas during the breeding season, except juvenile *Tor putitora*. The assessment habitually found cyprinid fishes within fast water and pool habitat. Others, such as *Glyptothorax panda*, *Balitora brucei*, *Pseudocheneis sulcata* and *Garra gotyla* were found in torrential waters. Similar observations were reported in (Sarker and Pal 2018).

Table 2. Species distributed by season in the Amochhu; ✓ = Present and X = Absent

Fish species	Pre-Monsoon March 2019	Post-Monsoon (Sept 2019)	Pre-Monsoon (May 2020)	Monsoon (July 2020)
Anguilla bengalensis	X	X	X	✓
Balitora brucei	X	X	X	✓
Lepidocephalichthys guntea	✓	✓	✓	X
Aspidoparia morar	X	X	✓	X
Bangana dero	X	X	X	✓
Barilius bendelisis	✓	✓	✓	✓
Barilius vagra	✓	✓	✓	✓
Chagunius chagunio	✓	✓	X	✓
Crossocheilus latius	✓	✓	✓	X
Danio rerio	✓	✓	X	X
Devario aequipinnatus	✓	X	X	X
Garra annandalei	✓	✓	✓	✓
Garra gotyla	✓	✓	✓	✓
Labeo dyocheilus	X	✓	X	✓
Neolissochilus hexagonolepis	✓	✓	✓	✓
Neolissochilus dukai	X	✓	✓	✓
Opsarius barna	✓	✓	✓	✓
Oreichtys crenucliodes	✓	X	X	X
Pethia conchonius	X	X	X	✓
Pethia ticto	✓	✓	✓	✓
Pethia sp.	✓	X	X	X
Puntius sophore	X	X	X	✓
Raiamas bola	X	X	X	✓
Schizothorax progastus	✓	✓	✓	✓
Schizothorax richardsonii	X	✓	X	✓
Cyprinion semiplotus	✓	✓	X	✓
Tor putitora	✓	X	✓	✓
Psilorhynchus balitora	✓	✓	✓	✓
Aborichthys sp.	✓	✓	✓	X
Paraconthocobitis abutwebi	X	X	✓	✓

Schistura beavani	✓	✓	✓	✓
Schistura reticulofasciata	X	X	✓	✓
Badis badis	X	X	✓	✓
Channa punctatus	X	X	✓	X
Channa gachua	✓	✓	✓	X
Channa melanostigma	✓	✓	✓	X
Amblyceps apangi	X	✓	✓	X
Amblyceps arunchalensis	✓	X	X	X
Amblyceps cerium	X	X	✓	X
Pseudolaguvia shawi	X	X	X	✓
Olyra longicaudata	X	✓	X	✓
Pterocryptis barakensis	X	X	✓	X
Glyptothorax sp.	✓	✓	✓	✓
Glyptothorax panda	✓	✓	✓	✓
Pseudocheneis sulcata	X	X	✓	✓
Mastacembelus armatus	✓	✓	X	✓

3.4 IUCN Red list status of species at assessment sites

An insight into the conservation status of fishes (per the IUCN) is presented in Figure 2.

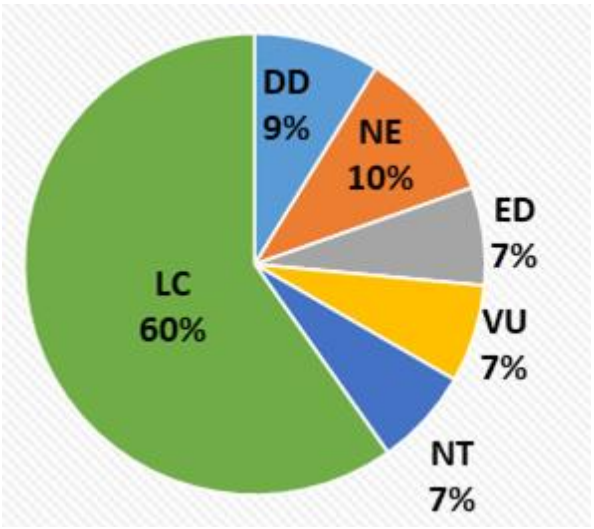

Figure 2. The overall composition of conservation status

Endangered species were recorded in segments sampling site one, site two, site three, and Lowrichhu, whereas vulnerable species were captured in sampling site two, site three, site four and site five. Near-threatened species such as *Anguilla bengalensis* were recorded in sampling site three, with *Balitora brucei* in site five, and *Neolissochilus hexagonolepis*, *Garra annandalei*, *Barilius bendelisis*, and *Barilius vagra* observed within all sampling sites (i.e., site one, site two, site three, site four, site five, Lowrichhu and Omchhu).

3.5 Water parameters recorded by season in the assessment area

The basic water parameters within sampling sites were deemed suitable to support fish populations per (Shukla and Singh 2013). The water parameters are presented in Table 3.

3.6 Anthropogenic activities

During the assessment, the project activities were found confined to Zone A (out of five zones). These activities were recorded as land filling and compaction, construction of flood protection walls, and river training. Additional project activities included extraction of sand/boulders from the river bed, as well as rampant gravel production and heavy vehicular movement.

More sediment deposition was observed in those areas near the project site and the international border. At these locations, fish habitats were disturbed due to modification of the river bed, the hydro-flow regime and the deposition of silt within the pool and low flow habitats.

Table 3. Seasonal water parameters presented as means and standard deviations

Assessment Sites	Parameters	Pre-Monsoon (March 2019)	Post-Monsoon (Sept 2019)	Pre-Monsoon (May 2020)	Monsoon (July 2020)
Amochhu	Temp(°C)	19.24 ± 1.71	15.98 ± 0.55	18.53 ± 1.20	22.52 ± 0.59
	pH	8.14 ± 0.25	7.69 ± 0.43	7.75 ± 0.12	9.31 ± 1.05
	DO (mg/l)	7.71 ± 0.46	8.46 ± 0.44	10.24 ± 0.60	8.56 ± 0.55
Omchhu	Temp°C	19.96	18.05	20	26.24
	pH	7.90	8.80	7.90	8.80
	DO (mg/l)	8.04	7.30	9.12	8.60
Lowrichhu	Temp (°C)	26.01	17.30	16.90	25.7
	pH	8.01	7.70	7.6	9.26
	DO (mg/l)	7.05	7.50	12.8	9.3

4. CONCLUSION

A total of 46 species of fishes were recorded in the Amochhu river basin in the current study. Among the ichthyofaunal diversity recorded, the family Cyprinidae was most dominant across all assessment sites. The study also recorded three endangered species, three vulnerable species, three near-threatened species and 28 least concerned species. Four fishes were designated as data-deficient and for five fishes, the status had not been evaluated. Therefore, pro-active conservation measures and interventions are required to protect their habitats and the fish diversity from potential extinction that usually results from unchecked anthropogenic activities.

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