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Current status of fish diversity in Rudrasagar Lake, Tripura, India with a note on its ornamental fish resources

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ABSTRACT

Lake Rudrasagar in the northeast Indian state of Tripura is a Ramsar designated wetland of international importance. To assess the fish diversity of this important lake, a comprehensive investigation was undertaken during 2017-2018. The study revealed the occurrence of 55 fish species belonging to 39 genera, 21 families and 8 orders. Out of the total number of 55 species recorded during the study, 38 species may be listed as potential species of ornamental value. According to IUCN, 41 species were enlisted as Least Concern (LC), 7 species as Near Threatened (NT), 1 listed as Vulnerable (VU), 1 species listed as Endangered (EN), 3 species as Not Evaluated (NE) and 2 species were listed as Data Deficient (DD). A total of 9 fish species out of the total species collected in the investigation belonged to the threatened categories of IUCN.

1. Introduction

Wetlands are regarded as one of the most productive ecosystems. These systems are diverse forms of aquatic ecosystems in the form of swamps, marshes, bogs, lakes, floodplains, shallow open water bodies, *etc.* Wetlands offer several functions and benefits with regard to aquifer recharge, flood control, reduction of sediment loads and wastewater treatment (Anon, 2007). They are also the repository for a rich diversity of flora and fauna as well as life support systems for a huge human population. Wetlands act as nurseries and feeding grounds for a diverse population of food-fishes and ornamental fishes. The north-eastern region of India is one of the 34 freshwater biodiversity hotspots of the world (Mittermeier and Mittermeier, 1997). Majority of the fishes of the region have high aesthetic values and have high demand in the international ornamental fish market due to their attractive colouration pattern, peculiar body morphology and graceful behaviour (Sinha, 1994). Tripura is a North-eastern state of India (22° 56' and 24° 22' N and 91° 0' and 92° 20'E latitude) located in the sub-Himalayan region (Anon, 1975). The state represents the western fringe of the typical ridge and valley structural province of the late Tertiary fold mountain belt, generally known as the Indo-Burmese Ranges (Barman, 2004). This province is unique due to its geographical location at the confluence of Indo-Myanmar, Indo-Malayan and parts of Indo-China geographical regions with close proximity to Bangladesh (Tardof *et al.,* 2012). The location of Tripura and its varying geographical features have contributed a diverse fish fauna. The ichthyofauna collected from the sub-Himalayan region of Tripura from 1976 to 1981 revealed the presence of 93 species of fish belonging to 26 families and 11 orders (Lipton, 1983). Barman (2004) mentioned the existence of 129 fish species in the waters of the state. During a study of the distribution of fishes in major rivers of Tripura, Kar and Sen (2007) reported 28 species in Manu river, 22 species in Khowai river, 53 species in Gomati river, and 22 species in Feni river. Goswami *et al.* (2012) reported the presence of 199 fish species in Tripura after

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reviewing available literature, out of which 101 were food fishes and 98 were ornamental fishes. Bhattacharjee (2013) reported the occurrence of a total of 103 fish species belonging to 12 orders, 27 families and 63 genera during a study of the fish faunal availability in Tripura during 2009-10. A majority of the fish species of Northeast India which were once abundant has depleted from the wild waters. The degradation and loss of habitats, unsustainable fishing practices and unauthorized collection of fishes at an unprecedented rate are the main factors for depletion of these fish resources from their natural habitats (Biswas *et al.,* 2015). The availability of indigenous ornamental fishes in natural water bodies is also perceived to be declining rapidly which needs to be addressed at the earliest (Talukdar, 2004). Mandal and Barman (2014) reported that the indigenous ornamental fishes of Tripura have not been fully explored due to lack of scientific information.

Rudrasagar Lake, situated between 23º29'10" to 23º32'52" N Latitude and 91º17'23" to 91º20'04" E Longitude is the largest wetland of Tripura. The lake has a perennial connection with Gomati River, one of the major rivers of the state facilitating the natural breeding ground of several indigenous fishes. The main provisional services provided by the lake include food (aquatic plants and fishes), fuel wood and timber whereas; the cultural services include boat ride service and tourism. During the period of 2010-2015, the provisional and cultural services of the lake provided 40810 US$ and 33929 US$ per year respectively (Taran and Deb, 2017). The hydrology of Rudrasagar lake, at present, is under threat from various human-induced changes which may endanger its fish diversity. Increased use of the lake for human habitation, intensified deforestation, increased agricultural use of land has caused a higher rate of siltation (Deka, 2010; Barman *et al.,* 2013). The continuous siltation within the lake is resulting in loss of its water area every year. The lake has now shrunk to around 100.46 hectares only due to encroachments and is slowly turning into a paddy field (Saha, 2015). Owing to these problems faced by the lake, the present study was conducted to record the lake's fish diversity and ornamental fish diversity in particular.

2. Materials and Methods

The present study is based on monitoring the landing sites and nearby markets around the Rudrasagar lake at monthly intervals from 2017 to 2018. Fishes were also collected with the help of local fishers using traditional fishing gears *viz.* cast nets, drag nets, scoop nets, traps, *etc.* Fishes were identified on the spot and the fishes which could not be identified on spot were preserved in 10 % formalin and up to genus and species levels by following Talwar and Jhingran (1991), Jayaram (1999), Vishwanath (2002) and Vishwanath *et al.* (2007) and their nomenclatures were updated using Fishbase (www.fishbase.com). The conservation status was ascertained with the help of IUCN (2019).

3. Results and Discussion

During a survey of 8 wetlands of Tripura, a total of 62 fish species were reported out of which 17 species were from Rudrasagar lake (Venkataraman *et al.*, 2002). Surveys conducted during a JICA project revealed the occurrence of 53 fish species in the lake (Bhattacharjee, 2010). During the present investigation, a total of 55 fish species belonging to 39 genera, 21 families and 8 orders were recorded. All the fish recorded during the study are listed below with their economic importance and IUCN conservation status in Table 1. The findings revealed that order Cypriniformes contributed a maximum number of 20 fish species belonging to different families *viz.* Cyprinidae (18 species) and Cobitidae (2 species); order Siluriformes had 13 species belonging to different families *viz.* Clariidae (1 species), Heteropneustidae (1 species), Ailiidae (1 species), Schilbeidae (1 species), Siluridae (3 species) and Bagridae (6 species); order Perciformes had 12 species under different families *viz.* Anabantidae (1 species), Ambassidae (2 species), Badidae (1 species), Nandidae (1 species), Gobiidae (1 species), Channidae (3 species), Osphronemidae (2 species) and Cichlidae (1 species); order Synbranchiformes contributed 5 species under different families *viz.* Mastacembelidae (4 species) and Synbranchidae (1 species); order Osteoglossiformes contributed 2 fish species under family Notopteridae; order Clupeiformes had 1 species under Clupeidae; order Beloniformes had 1 species under Belonidae and order Characiformes contributed 1 species under Serrasalmidae.

Out of the total 55 fish species recorded in Rudrasagar lake during the study, 38 species had potential for the ornamental fish market. Srivastava *et al.* (2002) reported 82 potential ornamental fishes to record from Tripura. Biswas *et al.* (2015) mentioned that most potential ornamental fishes commonly found in floodplain wetlands (beels) were *Trichogaster spp., Botia spp., Channa spp., Lepidocephalichthys spp., Badis spp., Nandus, spp., Amblypharyngodon mola, Puntius spp., which were also recorded during the study in Rudrasagar lake. Fishes of the genera Mastacembelus, Macrognathus, Rasbora and Glossogobius recorded during the investigation are also regarded as potential ornamental fish.* Out of the total 55 species observed during the study, 41 species were enlisted

Table 1. List of fish species observed in Rudrasagar lake with their economic importance and IUCN status during 2017-2018

Order	Family	Species	Economic importance	IUCN status
Cypriniformes	Cyprinidae	*Labeo rohita*	Food	LC
		Labeo bata	Food	LC
		Labeo gonius	Food	LC
		Labeo calbasu	Food	LC
		Cirrhinus mrigala	Food	LC
		Gibelion catla	Food	LC
		Hypophthalmichthys molitrix	Food	NT
		Hypophthalmichthys nobilis	Food	DD
		Ctenopharyngodon idella	Food	NE
		Cyprinus carpio	Food	VU
		Amblypharyngodon mola	Food, Or	LC
		Esomus danricus	Food, Or	LC
		Danio rerio	Food, Or	LC
		Rasbora daniconius	Food, Or	LC
		Puntius sophore	Food, Or	LC
		Puntius chola	Food, Or	LC
		Pethia ticto	Food, Or	LC
		Pethia conchonius	Food, Or	LC
	Cobitidae	*Lepidocephalichthys guntea*	Food, Or	LC
		Botia dario	Food, Or	LC
Siluriformes	Bagridae	*Mystus tengara*	Food, Or	LC
		Mystus cavasius	Food, Or	LC
		Mystus bleekeri	Food, Or	LC
		Mystus gulio	Food, Or	LC
		Sperata seenghala	Food	LC
		Sperata aor	Food	LC
	Schilbeidae	*Ailia coila*	Food	NT
		Eutropichthyes vacha	Food	LC
	Siluridae	*Ompok bimaculatus*	Food, Or	NT
		O. pabda	Food, Or	NT
		Wallago attu	Food	NT
	Clariidae	*Clarius magur*	Food, Or	EN
	Heteropneustidae	*Heteropneustes fossilis*	Food, Or	LC
Perciformes	Anabantidae	*Anabas testudineus*	Food, Or	DD
	Channidae	*Channa striatus*	Food, Or	LC
		Channa marulius	Food, Or	LC
		Channa punctatus	Food, Or	LC
	Ambassidae	*Chanda nama*	Food, Or	LC
		Parambassis ranga	Food, Or	LC
	Badidae	*Badis badis*	Food, Or	LC
	Nandidae	*Nandus nandus*	Food, Or	LC
	Gobiidae	*Glossogobius giuris*	Food, Or	LC
	Osphronemidae	*Trichogaster fasciata*	Food, Or	LC
		T. lalius	Food, Or	LC
	Cichlidae	*Oreochromis mossambicus*	Food, Or	NT
Osteoglossiformes	Notopteridae	*Notopterus notopterus*	Food, Or	LC
		Chitala chitala	Food, Or	NT
Clupeiformes	Clupeidae	*Gudusia chapra*	Food	LC
Beloniformes	Belonidae	*Xenetodon cancila*	Food, Or	LC

Synbranchiformes	Synbranchidae	*Monopterus cuchia*	Food	LC
	Mastacembelidae	*Mastacembelus armatus*	Food, Or	LC
		Macrognathus aral	Food, Or	LC
		Macrognathus aculeatus	Food, Or	NE
		Macrognathus pancalus	Food, Or	LC
Characiformes	Serrasalmidae	*Piaractus brachypomus*	Food, Or	NE

*LC- Least Concern, NT- Near Threatened, VU- Vulnerable, EN-Endangered, NE- Not Evaluated, DD- Data Deficient; Or- Ornamental

as Least Concern (LC), 7 species as Near Threatened (NT), 1 listed as Vulnerable (VU), 1 species listed as Endangered (EN), 3 species as Not Evaluated (NE), 2 species listed as Data Deficient (DD) as per IUCN. *Piaractus brachypomus* (Red bellied Pacu), observed during the study is considered to be an illegal exotic fish in India. The findings revealed that a total of 9 fish species out of the total 55 species observed in the study belonged to the threatened categories of IUCN that draw serious conservation measures. Barman *et al.* (2013) mentioned that fish production in the lake has declined over the years. The surrounding plain areas around the lake are used for paddy cultivation by the locals. Over the years, due to continuous siltation, the lake area has shrunken to a mere area of around 100 hectares and the lake will slowly turn into a paddy field if not checked immediately. The degradation of this lake has put the livelihoods of nearly two thousand fisher families in grave danger. Overexploitation of the resources, construction works and dumping of construction materials, aquatic weed infestation are some of the recent problems observed in the lake which can be the prime reasons for the decline in the lake's fisheries and fish production. Saha (2015) in his study on perception of fishers on fish diversity and its conservation in Rudrasagar lake revealed that majority of the fishers felt that the availability of the fishes in the lake have decreased drastically during the last 15-20 years and cited problems such as siltation, use of pesticides in the surrounding agricultural fields, reduction in the flow of water through the major streams connecting the lake, lack of regulation to control pollution in the lake coupled with lack of sustainable fishery enhancement measures by the government as the major reasons for decline of fishery resources in the lake. The present study revealed that Rudrasagar lake is rich in indigenous fish diversity that has both food and ornamental values which may fade away due to these serious threats. A proper management policy needs to be conceptualized and implemented at the earliest for sustenance and optimum utilization of the resources of the lake. In-depth studies on habitat, biology and reproductive propagation of the different potential and important fish species of the lake need to be pursued with due importance for sustaining the fish diversity and productivity of the lake in the long run.

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