E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2022; 10(1): 119-124

www.fisheriesjournal.com
Received: 09-11-2021
Accepted: 12-12-2021

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Ichthyo-Diversity in different rivers of West Bengal, India: Status and conservation strategy

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DOI: https://doi.org/10.22271/fish.2022.v10.i1b.2630

Abstract
West Bengal is surrounded by many rivers. Rivers plays a decisive role in freshwater habitat and connects with ocean. But fish diversity knowledge is inadequate in different rivers of West Bengal. West Bengal provides 7.5% of resources of water of the country. West Bengal is fulfilled with many resources of water like, beel, pond, rivers. Freshwater diversity in rivers may loss due to anthropogenic effect and also by pollution. Besides this exploitation and change of climate are another major cause of biodiversity loss. Decreasing trend of fish diversity is a aggregate approach to conservation of fish diversity. For this reason riverine fishes are the threatened taxa. But less effort have been dedicated for conservation of river fishes this review helps to understand fish species in south and north Bengal rivers in West Bengal.

Keywords: Diverse, management, cryopreservation, fish safe zone, keystone, flagship, sustainability

Introduction
Fishes are most common and have diverse group. Lévêque *et al*., (2008) [14] showed fish related research in India are exploratory stage. Fish base have 34700 species of fish and provides information to the researcher (Fish base). In West Bengal river Ganga is divided into two parts North Bengal and South Bengal. Southern part of West Bengal is called South Bengal. Some districts of South Bengal are Nadia, Howrah, Hooghly, East Midnapore, West Midnapore, etc. Some districts of Northern Bengal are Alipurduar, South Dinajpur, Coochbehar, etc. South Bengal and Northern Bengal have hotspot of fishes. Swain (2008) [32] identified freshwater ornamental habitats in India. Sarkar *et al*., (2015) [26] studied diversity of ornamental fish in Torsa river and Gargharia river. Agriculture and rivers are directly interlinked in West Bengal. West Bengal act as rivers land. Due to irrigation from tributaries of the river Ganga, number of fish species have been decreased (Payne *et al*., 2004) [22]. Lakra *et al*., (2010) [13] showed from river Ganga 29 fish species were recorded as threatened category.
Freshwater fish species mainly loss due to Industries (Gibbs 2000) [9] and they are the menace group (Darwall and Vie 2005) [4]. Management of fish habitats is a challenge now days (Dudgeon *et al*., 2006) [7]. Researcher showed ichthyofaunal diversity in many reservoirs and lakes (Patra 2006, Mahapatra 2003) [19, 17]. Different estuarine system provides significant production of fisheries (Sugunan and Sinha 2001) [30]. In India conservation and management of rivers have insufficient information. Proper planning of conservation is essential to save freshwater biodiversity (Pusey *et al*., 2010, Lipsey and Child 2007) [23, 15].

Rivers in West Bengal
Many important river flows inside the West Bengal. Some of them are Bhagirathi Hooghly, Dwarakeshwar, Churni, Barakar, Jaldhaka, Mahananda, Kangsabati, etc. West Bengal consists of many rivers. Bhagirathi Hooghly and Ganga Padma rivers tributaries are the major rivers in West Bengal. Some Himalayan rivers that flows through West Bengal are Tista, Mahananda Jaldhaka, Torsa, etc. From the Chotonagpur plateau some river arises. They are Damodar, Rupnarayan, Ajay, Haldi, Subarnarekha, etc. Some tidal river like Matla flows through West Bengal. In West Bengal tidal rivers are present in Sundarban area like, Gosaba, Kultali, etc. Main problem of tidal river is they overflow bank during the high tide.

Fish diversity in Damodar River

Saha and Patra (2013) [25] showed fish diversity in Damodar river. In Daomodar 46 species of fishes were present during January 2011-2012 (Saha and Patra, 2013) [25]. Saha and Patro (2013) [25] reported 38 % fish belongs to order Cyprinidontiforms, 30% fish belongs to order Perciformes, 26 % fish belongs to order Siluriformes in Damodar river. Highest fish diversity Index was observed in Barsul (0.97) followed by Krisak setu (0.96) and Palla (0.95) (Saha and Patra, 2013) [25]. Oranamenta fish diversity in Damodar river have been identified by Sarkar L (2020) [29].

Fish diversity in Churni river

In river Churni 48 species have been reported which belongs to 18 families, 29 genera, 8 orders (Bhakta and Bandyopadhyay, 2007) [2]. Highest population of fish that were present in river Churni are *Oreochromis mossambicus*, *Cyprinus carpio* and lowest population fish is *Clarias gariepinus* (Bhakta and Banyopadhyay, 2007) [2]

Fish diversity in Kangsabati River

n Kangsabati river, 46 fish species have been recorded including 17 families, 29 genera, 8 orders during August 2013 to January 2015 (Kar *et al*., 2016) [12]. According to Kar *et al*., (2016) [12] in Kangsabati river 41 % fish species were Cypriniformes, 18% fish species were Perciformes, 28% fish species were Siluriformes. Highest fish diversity Index was observed in Pathra River Bank (3.30) followed by Sal Dahari river bank (3.26), Balishira river bank (3.04), Payraguri river bank (2.92), Najargunj (2.66) (Kar *et al*., 2016) [12].

Table 1: Annual estimated discharge (mcm) of some rivers in West Bengal (Rudra, 2016) [24]

River	Estimated discharge (mcm)
Teesta	29947
Mahananda	23129
Jaldhaka	17212
Torsa	23097
Ganga at Farakka	513100

Table 2: List of fish species found in Hooghly river (Nath and Patra, 2015) [18]

Scientific name	Frequency occurrance
Rhinomugil corsula	30-40% in the catch
Sicamugil cascasia	Occur very occasionally
Channa Punctatus	5-10 % in the catch
Channa orientalis	5-10 % in the catch
Pseudambasis ranga	1-5 % in the catch
Jhonius gangeticus	5-10 % in the catch
Trichogaster fasciatus	5-10 % in the catch
Glossogobius giuris	30-40% in the catch
Periopthalmodon sp.	Occur very occasionally
Pseudapocryptes lanceolatus	30-40% in the catch
Odontamblyopus rubicundus	30-40% in the catch
Apocryptes bato	5-10 % in the catch
Platycephalus indicus	30-40% in the catch
Datnioides quadrifasciata	Occur very occasionally
Macrognathus aral	Occur very occasionally
Macrognathus pancalus	Occur very occasionally
Mastacembelus armatus	Occur very occasionally
Sillaginopsis panijus	10-30% in the catch
Badis badis	Occur very occasionally
Eleotris fusca	10-30% in the catch
Acanthopagrus latus	Occur very occasionally
Nandus nandus	Occur very occasionally
Polynemus paradiseus	Occur very occasionally
Scatophagus argus	Occur very occasionally
Tilapia nylotica	Occur very occasionally
Etroplus suratensis	Occur very occasionally
Lates calcarifer	Occur very occasionally
Ompok pabda	Occur very occasionally
Wallago attu	Occur very occasionally
Mystus cavasius	10-30% in the catch
Mystus vittatus	1-5% in the catch
Mystus bleekari	Occur very occasionally
M gulo	1-5% in the catch
Sperata aor	1-5% in the catch
Sperata seeghala	1-5% in the catch
Rita rita	5-10% in the catch
Rita gogra	30-40% in the catch
Gagata gagata	Occur very occasionally
Gagata sexualis	Occur very occasionally
Gagata cenia	Occur very occasionally
Bagarius bagarius	Occur very occasionally
Glyptothorax telchitta	Occur very occasionally
Entropichthys vacha	30-40% in the catch
Silonia silonida	1-5% in the catch
Eutropichthys murius	Occur very occasionally

Ailia colia	30-40% in the catch
Clupisoma garua	30-40% in the catch
Neotropius atherinoides	1-5% in the catch
Secutor ruconis	5-10% in the catch
Heteropneustes fossilis	5-10% in the catch
Pangasius pangasius	Occur very occasionally
Gerres oyena	1-5% in the catch
Esomus damricus	Occur very occasionally
Amblypharyngodon mola	1-5% in the catch
Puntius conchonius	5-10% in the catch
Puntis ticto	Occur very occasionally
Ostebrama cotio cotio	Occur very occasionally
Laubuca laubuca	Occur very occasionally
Cirrhinus reba	Occur very occasionally
Cirrihinus mrigala	10-30% in the catch
Salmophasia phulo	10-30% in the catch
Salmophasia bacaila	10-30% in the catch
Labeo calbasu	5-10% in the catch
Hypophthalmichtys molitrix	Occur very occasionally
Labeo rohita	Occur very occasionally
Labeo bata	5-10% in the catch
Catla catla	Occur very occasionally
Rasbora sp.	Occur very occasionally
Chagunius chagunio	Occur very occasionally
Lepidocephalichthys guntea	Occur very occasionally
Tenualosa lisha (juvenile)	30-40% in the catch
Tenualosa ilisa (adult)	1-5% in the catch
Gudusia chapra	5-10% in the catch
Corcia soborna	30-40% in the catch
Setipinna phasa	30-40% in the catch
Xenentodon concila	Occur very occasionally
Hemiramphus far	Occur very occasionally
Aplocheilus panchax	Occur very occasionally
Pisodonophis boro	10-30% in the catch
Anguilla bengalensis bengalensis	5-10% in the catch
Amphipnous cuchia	Occur very occasionally
Cynoglossus cynoglossus	5-10% in the catch
Euryglossa orientalis	10-30% in the catch
Microphis cuncalus	Occur very occasionally
Tetradon cutcutia	Occur very occasionally
Notopterus notopterus	Occur very occasionally
Notopterus chitala	Occur very occasionally
Crocodile fish Pterygoplichthys sp.	Occur very occasionally

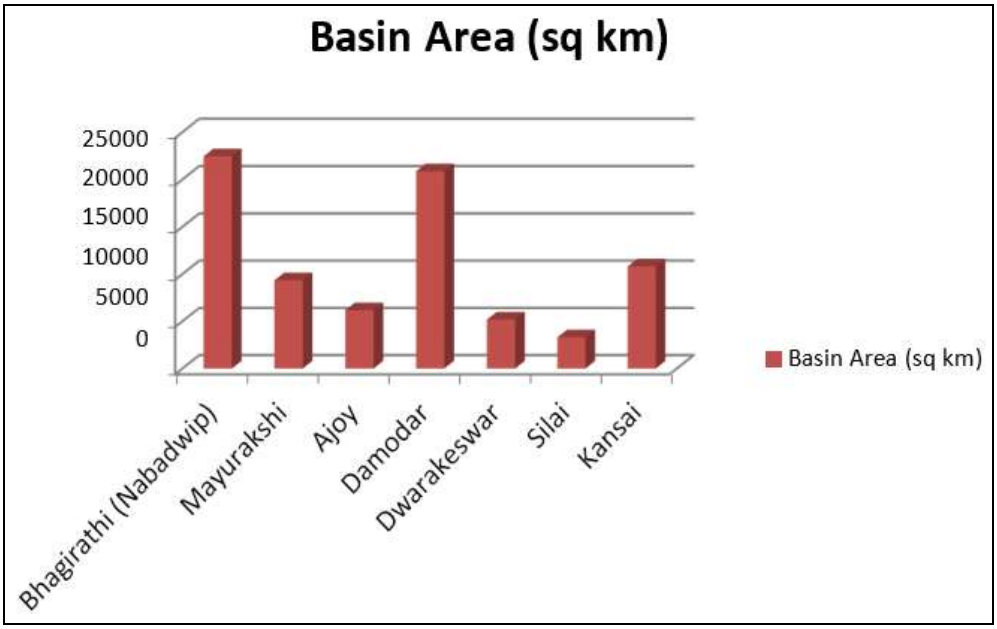

Fig 1: Basin area (sq. km.) of Bhagirathi (Nabadwip), Mayurakshi, Ajoy, Damodar (Jamalpur), Dwarakeswar, Silai, Kansai (Rudra. 2016) [24]

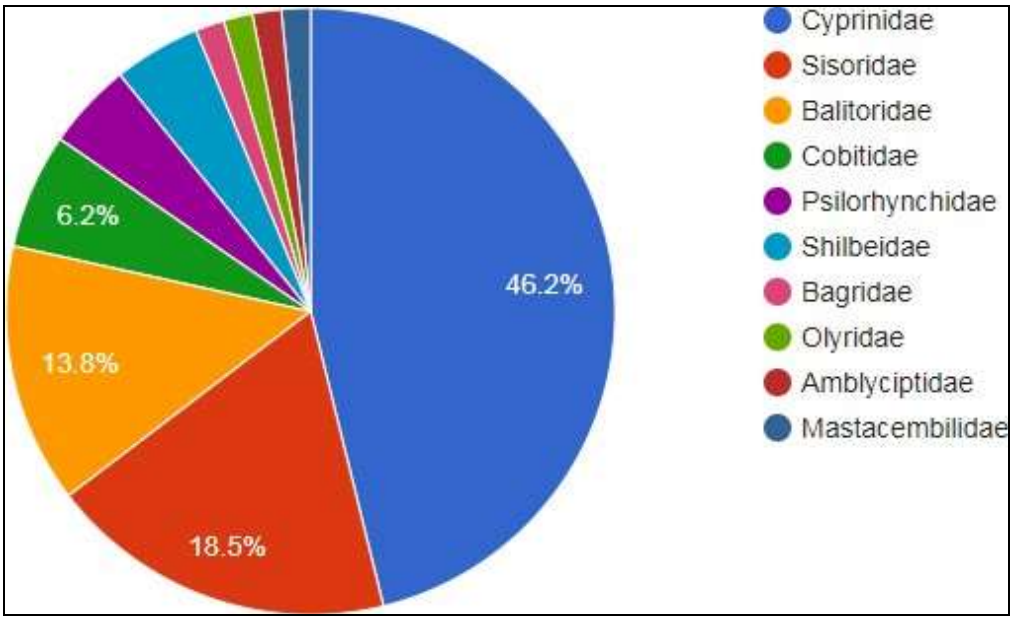

Fig 2: Family wise distribution of fish species in Teesta river (Acharjee and Barat, 2013) [1]

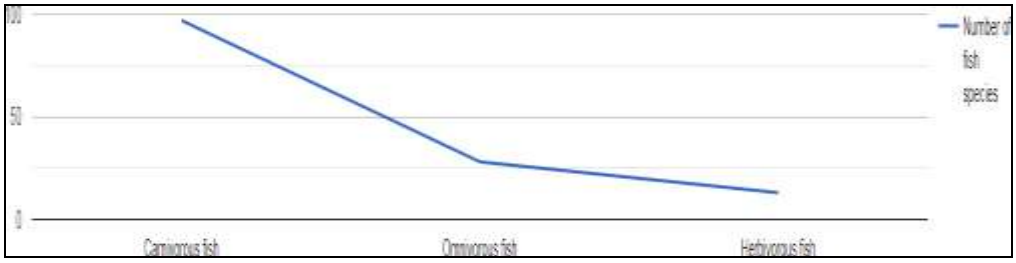

Fig 3: Economic importance of fish species in Kaljani river (Dey *et al*., 2015) [5, 6]

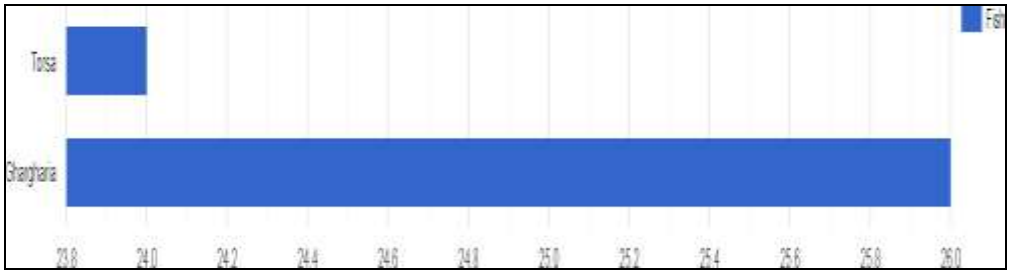

Fig 4: Ornamental fish species in Torsa and Ghargharia river (Sarkar *et al*., 2015) [26]

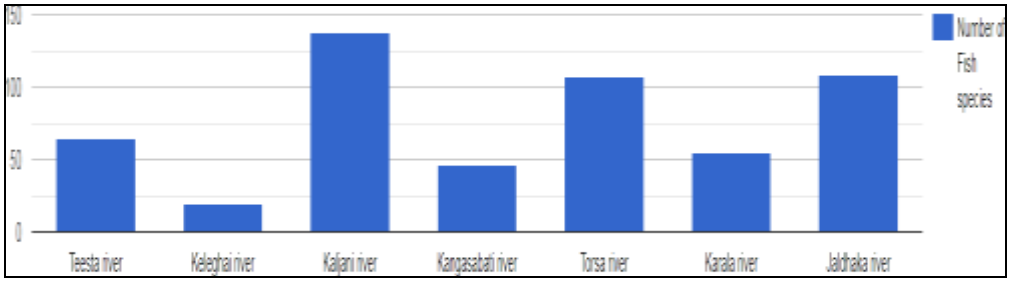

Fig 5: Fish species present in different rivers (Acharjee and Barat 2013, Jana *et al*., 2015, Dey *et al*., 2015, Kar *et al*., 2016, Dey and sarkar 2015, Patra *et al*., 2011, Sarkar and Pal 2018) [1, 11, 5, 6, 12, 26]

Conservation Strategy

Conservation of fish species in Guadiana River was reported by Filipe at al., (2004) [8]. Cooke *et al*., (2012) [3] showed some factors that hampers the conservation of endangered fish species in rivers. According to Madhavi *et al*., (2012) [16] some conservation strategy are

a) For conservation of gene by cryopreservation method gene bank plays a pivotal role.
b) Mass awareness among the common people must be increased.
c) For conservation of fish species application of Geographic information system must be expanded.

Freshwater Fish Safe Zone is an idea for maintenance of biodiversity and conservation (Gupta *et al*., 2014) [10]. Some important strategy for Freshwater Fish Safe Zone is as follows

(Gupta *et al*., 2014) [10]

a) To protect the habitat of fish species Freshwater Fish Safe Zone must be carefully maintained.
b) Freshwater Fish Safe Zone should be outlined into two parts; core area and buffer area.
c) Deforestation and agricultural practice should be stopped in the terrestrial area near the river.
d) Research and field study should meticulously maintain.
e) To identify the connection between Keystone and Flagship species with Freshwater Fish Safe Zone for Conservation purpose.

Conclusions

In this study we found many fish species in different rivers of Wet Bengal. Wet Bengal's river is regarded as hot spot of fish species. But due to pollution, flood fish diversity has been reduced. Besides this indiscriminate killing is another cause for threatening of freshwater biodiversity. Conservation helps to maintain freshwater biodiversity. So there is a need for conservation strategy to protect the freshwater diversity. In situ conservation is an key step for sustainability. Beside this proper planning and people's awareness are the important step to conserve biodiversity.

Acknowledgements

The Authors would like to show thanks to the authorities of Department of Zoology, University of Kalyani for their cordial support in carrying out the research.

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