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Piscine diversity and its status in East Kolkata Wetlands, a Ramsar site of West Bengal, India

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Abstract
The East Kolkata Wetlands, a Ramsar Site, nurtures the world's largest wastewater fed aquaculture system. The present study was carried out from September 2016 to May 2017 to study piscine diversity of selected wetlands of East Kolkata. The fish fauna collected from East Kolkata Wetlands (EKW) consisted of 39 species belonging to 9 orders and 19 families, among the families encountered Cyprinidae dominated with 33% followed by Channidae (11%). Fish species were found to be both food and ornamental valued. Maximum fish species found in EKW were carnivores (53%), followed by omnivores (29%) and remaining (18%) were herbivores. Nine exotic species were recorded during the study period. Conservation status of fish species was ascertained as per IUCN Red list.

Keywords: Kolkata, East Kolkata Wetlands, piscine diversity, conservation status

Introduction
The East Kolkata Wetlands (Latitude 22˚33' - 22˚40'N; Longitude 88˚25' - 88˚35'E), the only Ramsar site in the State of West Bengal India, is a unique ecosystem and friendly water regime with a composite of natural and human-made wetlands lying east of the Kolkata city. The East Kolkata Wetlands (EKW) was declared as Ramsar site on 19th August 2002 by Ramsar Convention Bureau. The multifunctional wetland ecosystem consists of an area of 12,500 hectares [20] comprising 250-300 sewage fed fisheries units, small agricultural plots, solid waste farms, besides, some built up areas. The EKW nurtures the world's largest wastewater fed aquaculture system too. The goods and services provided by this wetland include a very cheap, efficient and eco friendly system of solid waste and sewer treatment system for the city of Kolkata, habitat for waterfowl and abode for a large flora and fauna including ichthyofauna. Number of fish species reported from the EKW varying from 36 to 58, which include wild and commercially important varieties having either aquaculture or ornamental values [5, 15, 17]. However, because of increasing anthropogenic pressure owing to urbanization, change in the quality and quantity of the solid waste and sewer human neglect, this Ramsar site is under threat [16]. The traditional practice of utilizing wastewater into fish pond is a unique example of sustainable socio-economic development pertaining to resource recovery in the EKW [20].
Understanding biological diversity in terms of the processes by which ecosystems and their components function, is critical to informing its sustainable use and safeguarding it for the benefit of future generations. Given that biological diversity is dynamic and subjected to biotic and abiotic stress, it is necessary to record temporally and spatially its status quo and, subsequently, monitor that status quo in order to identify changes and assess their impacts. Crucially important is the need to identify species present in areas of natural habitat ahead of any changes in land use in order to assess what diversity may be lost from a locality. The present study is, therefore, carried out to study the current fish species diversity status of East Kolkata Wetlands.

Materials and Methods
The present study was carried out to assess the current status of piscine diversity of selected water bodies of East Kolkata Wetlands (Latitude 22°25' N to 22°40' N and 88°20' E to 88°35' E) ecosystem for a period of nine months from September 2016 to May 2017. The East Kolkata Wetlands, lying east to the Kolkata city is situated in the districts of 24 Parganas North and 24 Parganas South districts of West Bengal extending up to a part of Sundarbans.

The wetlands cover a total of 12,500 ha and total water area of about 5800 ha which include salt marshes and salt meadows, as well as sewage fed fish farms and settling ponds. Nine sampling stations (Figure 1) viz., i) Kantipota (Latitude 22°28'39.35"N; Longitude 88°26'5.87"E), ii) Ranabutia (Latitude 22°28'37.34"N; Longitude 88°25'18.11"E), iii) Nayabad (Latitude 22°29'4.23"N; Longitude 88°24'29.03"E), iv) Atghara (Latitude 22°28'51.90"N; Longitude 88°25'24.20"E), v) Bhagabanpur (Latitude 22°29'48.37"N; Longitude 88°25'40.82"E), vi) Deara (Latitude 22°29'50.47"N; Longitude 88°26'47.34"E), vii) Mukundapur (Latitude 22°29'29.84"N; Longitude 88°24'47.28"E), viii) Tihuria (Latitude 22°28'37.19"N; Longitude 88°27'0.24"E), ix) Nalban (Latitude 22°34'3.36"N; Longitude 88°25'41.02"E) were surveyed and sampled to study the ichthyofaunal diversity.

Fig 1: Map showing sampling stations in East Kolkata Wetlands

Fish species were collected either once a month to ascertain the ichthyofaunal species composition. Fish samples were cleaned thoroughly, preserved in 8-10% formalin and brought to the laboratory of Department of Fisheries Resource Management, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata for further identification [7, 12, 25]. The nomenclature followed is after Froese and Pauly [7]. Information regarding their abundance was ascertained during harvesting and also collected from local fishers and fish vendors. Subsequently, fishes were grouped into four categories based on their abundance viz. 1. Abundant (++++) – assigned when species was recorded in 7-9 samples; 2. Moderate (+++) - assigned when species was recorded in 5-6 samples; 3. Low (++) - assigned when species was recorded in 3-4 samples; 4. Very low (+) - assigned when species was recorded in 1-2 samples. Feeding habits and trophic levels of the fish species were noted down from the available literatures and Froese and Pauly [7]. Their conservation status is ascertained with the help of IUCN Red list [11]. The fishery importance was noted down considering the local importance.

Results and Discussion

The fish fauna collected from selected water bodies of East Kolkata Wetlands comprised of 39 species belonging to 9 orders and 19 families (Table 1). Among the families encountered Cyprinidae dominated with 13 species followed by Channidae (four species), Mastacembelidae (three species), Cichlidae, Clariidae and Bagridae (two species each), Miscellaneous families included Nandidae, Osphronemidae, Anabantidae, Ambassidae, Heteropneustidae, Siluridae, Pangasiidae, Belonidae, Synbranchidae, Notopteridae, Serrasalmidae, Aplocheilidae, Gobiidae (one species each) (Figure 2).

The commercially important fishes of East Kolkata Wetlands were *Labeo bata*, *Labeo rohita*, *Gibelion catla*, *Cirrhinus mrigala*, *Hypophthalmichthys molitrix*, *Channa striata*, *Channa punctata* and *Pangasianodon hypophthalmus.* Most important fish species in the 'abundant group' included *Oreochromis niloticus*, *Gibelion catla*, *Hypophthalmichthys molitrix* and *Labeo rohita* which contributed about 10% of the total species collected during the present study. Notable species in 'moderate group' were *Labeo bata*, *Cirrhinus mrigala*, *Cyprinus carpio*, *Channa punctata*, *Pangasianodon hypophthalmus*, *Ctenopharyngodon idella* etc., which accounted for about 16% of total species recorded during the present study. Important species in 'low group' comprised of fishes like *Pethia ticto*, *Heteropneustes fossilis*, *Ctenopharyngodon idella*, *Systomus sarana*, *Labeo calbasu*, *Oreochromis mossambicus*, *Channa striata*, *Channa punctata*, *Anabas testudineus*, *Clarias batrachus*, *Ompok pabda*, *Clarias gariepinus*, *Mystus bleekeri etc.* The 'low group' contributed about 34% of the total species recorded during the present study. Fishes of the 'very low group' were *Amblypharyngodon mola*, *Salmophasia bacaila*, *Channa orientalis*, *Glossogobius giuris*, *Nandus nandus*, *Trichogaster fasciata*, *Chanda nama*, *Mystus tengara*, *Strongylura strongylura*, *Macrognathus pancalus*, *Macrognathus caudiocellatus* etc. Its contribution was 40% of the total species recorded during the present study.

Wetlands are, generally, the rich sources of biodiversity as they are one of the most ecologically favourable habitats due to immense role of microorganisms in enhancing the bioavailability of nutrients. It has been reported that fresh water wetlands form an adobe for more than 40% of the global species and 12% of all animal species [26]. The East Kolkata Wetlands are essentially a part of the mature Gangetic delta. The wild fish species composition recorded in the present study is comparable with that of fishes of Gangetic delta. The earliest known record of the EKW described this as a marshy salt lake. Subsequently mouth of the river Bidyadhari opened into Bay of Bengal through the river Matla and when the Bidyadhari River silted up, the EKW became a vast swamp or salt-water lakes [8] were used for brackish

water pisciculture [9]. At this juncture, the ichthyofauna in the EKW included both brackish water and fresh water forms. Among them the most common cultured fishes were *Lates calcarifer*, *Chelon parsia*, *Chelon planiceps* and prawn, *Macrobrachium rosenbergii* [9].

Table 1: Ichthyofaunal diversity of East Kolkata Wetlands during the study period

Sl. No.	Name of the species	English common name	Local name	Feeding Habit	Trophic* Level	Fishery importance	Abundance	IUCN Redlist category**
A. Order-Cypriniformes ; (a) Family - Cyprinidae								
1	*Labeo bata* (Hamilton, 1822)	Bata labeo	Bata	H	2.0 ± 0.00	FF	+++	LC
2	*Labeo rohita* (Hamilton, 1822)	Rohita	Rui	H	2.2 ± 0.12	FF	++++	LC
3	*Gibelion catla* (Hamilton, 1822)	Catla	Catla	H	2.8 ± 0.22	FF	++++	LC
4	*Cirrhinus mrigala* (Hamilton, 1822)	Mrigal	Mrigal	O	2.2 ± 0.20	FF	+++	LC
5	*Hypophthalmichthys molitrix* (Valenciennes, 1844)	Silver carp	Silver carp	H	2.0 ± 0.00	FF; Ex	++++	NT
6	*Pethia ticto* (Hamilton, 1822)	Ticto barb	Chenaputhi	O	2.2 ± 0.00	FF; OF	++	LC
7	*Hypophthalmichthys nobilis* (Richardson, 1845)	Bighead carp	Big head	O	2.8 ± 0.33	FF; Ex	++	DD
8	*Amblypharyngodon mola* (Hamilton, 1822)	Mola carplet	Mourala	H	3.2 ± 0.40	FF	+	LC
9	*Cyprinus carpio* Linnaeus, 1758	Common carp	Common carp	O	3.1 ± 0.00	FF; Ex	+++	VU
10	*Ctenopharyngodon idella* (Valenciennes,1844)	Grass carp	Grass carp	H	2.0 ± 0.00	FF; Ex	++	NE
11	*Salmophasia bacaila* (Hamilton, 1822)	Large razorbelly minnow	Chela	O	3.2 ± 0.40	FF; OF	+	LC
12	*Systomus sarana* (Hamilton, 1822)	Olive barb	Sar puti	O	2.9 ± 0.20	FF; OF	++	LC
13	*Labeo calbasu* (Hamilton, 1822)	Orangefin labeo	Kalbose	O	2.0 ± 0.00	FF; OF	++	LC
B. Order-Peciformes; (a) Family - Cichlidae								
14.	*Oreochromis mossambicus* (Peters, 1852)	Mozambique tilapia	Tilapia	O	2.2 ± 0.00	FF; Ex	++++	VU
15.	*Oreochromis niloticus* (Linnaeus, 1758)	Nile tilapia	Nilotica	O	2.0 ± 0.00	FF; Ex	++	LC
(b) Family - Channidae								
16.	*Channa striata* (Bloch, 1793)	Striped snakehead	Shoal	C	3.4 ± 0.45	FF; OF	++	LC
17.	*Channa punctata* (Bloch, 1793)	Spotted snakehead	Lata	C	3.8 ± 0.70	FF	++	LC
18.	*Channa orientalis* Bloch & Schneider,1801	Walking snakehead	Cheng	C	3.8 ± 0.59	FF; OF	+	VU
19.	*Channa marulius* (Hamilton, 1822)	Great snakehead	Gajal	C	4.5 ± 0.80	FF; OF	+++	LC
(c) Family - Anabantidae								
20.	*Anabas testudineus* (Bloch, 1792)	Climbing perch	Koi	C	3.0 ± 0.40	FF; OF	++	LC
(d) Family - Nandidae								
21.	*Nandus nandus* (Hamilton, 1822)	Gangetic leaffish	Nadus	C	3.9 ± 0.63	FF; OF	+	LC
(e) Family-Osphronemidae								
22.	*Trichogaster fasciata* Bloch & Schneider,1801	Banded gourami	Kholiana	H	3.1 ± 0.30	OF	+	LC
(f) Family - Ambassidae								
23.	*Chanda nama* Hamilton, 1822	Elongate glass-perchlet	Chanda	C	3.6 ± 0.54	FF; OF	+	LC
C. Order-Siluriformes (a) Family - Clariidae								
24.	*Clarias batrachus* (Linnaeus, 1758)	Philippine catfish	Magur	C	3.4 ± 0.50	FF; OF	++	LC
25.	*Clarias gariepinus* (Burchell, 1822)	North African catfish	Thai magur	C	3.8 ± 0.40	FF; Ex	+	LC
(b) Family - Heteropneustidae								
26.	*Heteropneustes fossilis* (Bloch, 1794)	Stinging catfish	Singhi	C	3.6 ± 0.30	FF; OF	+++	LC
(c) Family - Bagridae								
27.	*Mystus bleekeri* (Day, 1877)	Day's mystus	Tengra	C	3.3 ± 0.40	FF; OF	++	LC
28.	*Mystus tengara* (Hamilton, 1822)	Tengara catfish	Singorah	C	3.2 ± 0.40	FF; OF	+	LC
(d) Family - Siluridae								
29.	*Ompok pabda* (Hamilton, 1822)	Pabdah catfish	Pabda	C	3.8 ± 0.60	FF; OF	++	NT
(e) Family - Pangasiidae								
30.	*Pangasianodon hypophthalmus* (Sauvage, 1878)	Striped catfish	Thai pangus	O	3.1 ± 0.46	FF; OF; Ex	+++	EN
D. Order-Beloniformes; (a) Family - Belonidae								

31.	*Strongylura strongylura* (van Hasselt, 1823)	Spottail needlefish	Soborno-khorica	C	4.2 ± 0.73	FF	+	NE
E. Order-Synbranchiformes; (a) Family - Mastacembelidae								
32.	*Mastacembelus armatus* (Lacepède, 1800)	Zig-zag eel	Baim	C	2.8 ± 0.27	FF; OF	++	LC
33.	*Macrognathus caudiocellatus* (Boulenger, 1893)	Onestripe spiny eel	Tara baim	C	3.3 ± 0.40	FF; OF	+	NE
34.	*Macrognathus pancalus* Hamilton, 1822	Barred spiny eel	Pankal baim	O	3.5 ± 0.51	FF; OF	+	LC
(b) Family - Synbranchidae								
35.	*Monopterus cuchia* (Hamilton, 1822)	Cuchia	Kuchia	C	3.8 ± 0.64	FF; OF	++	LC
F. Order-Osteoglossiformes; (a) Family- Notopteridae								
36.	*Notopterus notopterus* (Pallas, 1769)	Bronze featherback	Chital	C	3.5 ± 0.00	FF; OF	++	LC
G. Order-Characiformes; (a) Family - Serrasalmidae								
37.	*Piaractus brachypomus* (Cuvier, 1818)	Pirapitinga	Pacu	O	2.5 ± 0.22	FF; Ex	++	NE
H. Order-Cyprinodontiformes; (a) Family – Aplocheilidae								
38.	*Aplocheilus panchax* (Hamilton, 1822)	Blue panchax	Kanpona	C	3.2 ± 0.40	OF	++	LC
I. Order-Gobiiformes; (a) Family - Gobiidae								
39.	*Glossogobius giuris* (Hamilton, 1822)	Tank goby	Belay	C	3.7 ± 0.20	FF; OF	+	LC

FF - Food fish; OF - Ornamental fish; CI - Commercially important; H - Herbivore; O - Omnivore; C - Carnivore; Ex - Exotic
++++ : Abundant ; +++ : Moderate ; ++ : Low ; + : Very low.
IUCN = International Union for Conservation of Nature and Natural Resources;
EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; NE = Not Evaluated.
*Trophic level was as per Froese and Pauly [7]; ** IUCN Redlist category was as per IUCN [11].

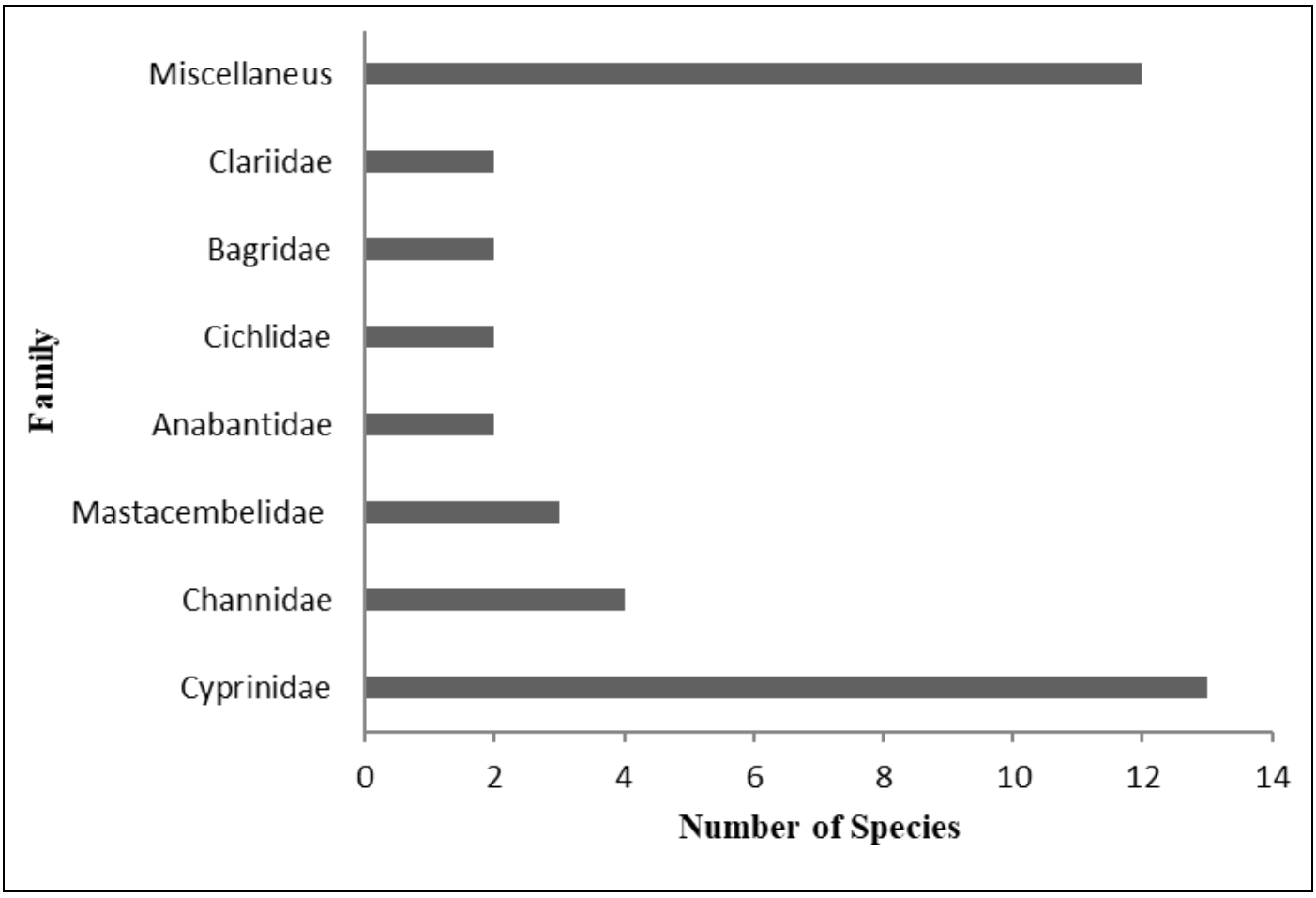

Fig 2: Number of fish species in different families in East Kolkata Wetlands

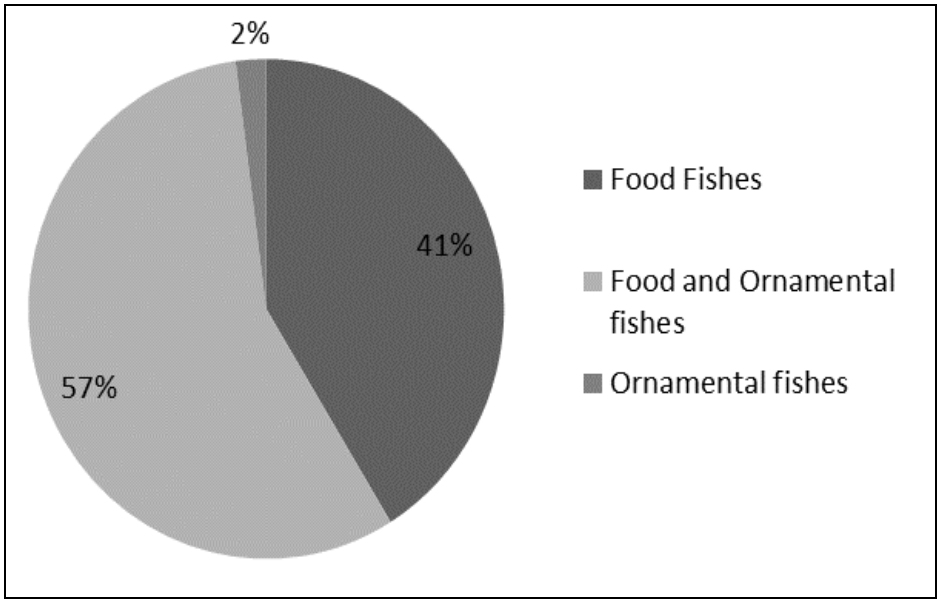

Fig 3: Percentage composition of fish species having food and ornamental values in East Kolkata Wetlands

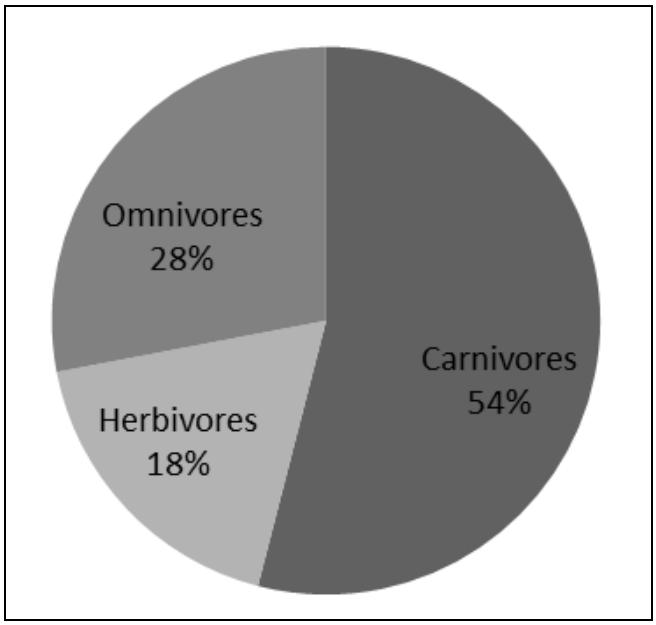

Fig 4: Percentage composition of fish species with different feeding habits in East Kolkata Wetlands

After the flow of tidal water is stopped into this area, Kolkata city sewage was considered as an alternate water source for utilization in the fish ponds besides achieving the objective the sewage treatment. Gradually, the EKW transformed from brackish water lakes to sewage-fed fish farms and the large areas were converted for human settlements and agriculture development [10]. These transformations in the ecosystem have resulted in drastic changes and / or reductions in floral and faunal diversity [10]. Could not record indigenous species such as *Nandus nandus* and *Xenentodon cancila* which were abundant during 1980s in these wetlands. He stated that these species were disappeared from this ecosystem. In the present study we could not record *Xenentodon cancila* but recorded *Nandus nandus* under the category very low group which is in accordance with Kumar *et al*. [14].

Various authors have reported fish species diversity and threatened status from different parts of the West Bengal [3, 18, 19, 24] has enlisted 239 freshwater fishes of this state out of which, 59 species are threatened fishes of India. According to Mogalekar *et al.* [19], 267 species of freshwater fishes inhabits in West Bengal (186 primary freshwater species, 81 secondary freshwater species), belonging to 12 orders, 40 families and 123 genera. Further, they reported that thirteen species of exotic fishes have been introduced to freshwater bodies of the state. The top order with diverse species composition was Cypriniformes (117 species, 46 genera and four families). The most diverse family was Cyprinidae with 84 species and 35 genera which also concurred with the present study (Figure 2). Fish fauna of the East Kolkata Wetlands reveals that about seven species are exotic while 37 are endemic to this region. The local people consider 45 species as food fish and 25 are ornamental or aquarium fish, 17 species are cultivable while others are stocked [5].

According to Mahapatra [17] the commercially important aquatic species in the EKW included 58 species of fish. Among the 58 species 10 were exotic and 48 were indigenous fish species. In the EKW, among the 58 species of fish, 17 were found to be cultured species and 41 were wild species. He also reported 45 indigenous and nine exotic fish species which have good ornamental potential in the EKW. In the present study also nine exotic species have been recorded (Table 1) [15] found that total 36 fish species including 14 cultured and 22 wild fish species are available in the East Kolkata wetlands [5] documented 37 species of fishes and among which 14 species were commonly cultured and 23 species were wild species. On the basis of usability and fishery importance it was found that 15 species (39%) were potential food fishes and whereas as many as 22 species (56%) could be considered as fishes with food and ornamental value. Two species (5%) were found to be having only ornamental value (Figure 3). Thus, it appears this unique ecosystem supports considerable ornamental fishery too. Another problem in ecosystem like this, is the overgrowth of plankton leading to algal bloom. It is at this critical phase of the ecological process that the fish plays an important role by grazing on the plankton [2].

The present study also revealed that maximum fish species found in selected EKW were carnivores (53%), followed by omnivores (29%) and remaining (18%) were herbivores (Figure 4) [14] also reported higher composition of carnivores than herbivores. The presence of invasive exotic fish species is posing great threats to the native fish diversity [10].

According to ZSI scientists, as many as 19 alien fish species are affecting the indigenous fauna and destroying the entire eco-system [11]. The Trophic level of the fish species recorded in the present study varied between 2.0 and 4.5. Majority of the fish species (23) had the trophic level between 3.0 and 4.0 suggesting the EKW has large number of secondary consumers. Only two species (*Channa marulius* and *Strongylura strongylura*) had the tophic level of more than 4.0 which are known to be piscivores [4, 13, 23]. Most ecosystems are dominated by omnivorous species with trophic level class of 3-3.5 [7].

The IUCN Red list categories of fish species from EKW suggested that one species was 'Endangered (EN)', three species were 'Vulnerable (V)' and two species were 'Near Threatened (NT)'. Twenty eight species were enlisted as "Least Concern (LC)', four species fell under the category 'Not Evaluated (NE)' and one species was found to be under the category 'Data Deficient' [3] reported 59 threatened species out of which 22 species have been designated as endangered species and 37 species have been designated as vulnerable species of India in West Bengal. Various threats such as intense encroachment, rapid urbanization, alterations of wetland habitats leading to habitual destruction, over exploitation, wanton destruction, aquatic pollution, invasive species, and diseases have been attributed for the reduction in fish diversity [1, 14, 17, 22].

Conclusion

The present study suggested that East Kolkata Wetlands harbours rich fish diversity and has potential for ornamental fish species, the value of which is yet to be explored. The study reflects pressing need of further documentation of evaluation of conservation value of fauna. In spite of the existing policies for conservation, this Ramsar Site is continuously under stress due to various threats. Determined and holistic approach, intensive management strategies with the active involvement of all stakeholders and public awareness are the need of the hour for sustainable utilization of this unique ecosystem.

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