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## Importance of artificial water bodies in maintaining a balanced food web and freshwater biodiversity in an urban park

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### Abstract

The survey was performed from May 2020 and May 2022 in lake and Pakhibitan's pond. Both are the main carrier of the freshwater life in Ecopark. Pakhibitan's pond is very small in size in compare to the lake but quite undisturbed. During the study period, a total of 27 species of fishes belonging to 6 orders, 12 families were recorded also as per IUCN out of 27 species, 24 are Least Concern (LC), 1 species is in Vulnerable (VU), 1 species is in Not Evaluated (NE) and 1 species is in Data Deficient (DD) category. A total of 4 species of phylum Mollusca belonging to 3 orders, 4 families were recorded also, all are Least Concern. The lake and Pakhibitan's pond region help to preserve the freshwater ecology. Both contributed to the development of a food web and the flourishing of all ecological organisms.

**Keywords:** Ecopark, freshwater biodiversity, food web, urban park, ecosystem

### 1. Introduction

Freshwater ecosystems provide a diverse range of goods and ecological services for human well-being, including drinking water, sanitation, and irrigation (Green *et al.*, 2015; Harrison *et al.*, 2010) <sup>[1, 2]</sup>. Furthermore, while occupying less than 1% of the Earth's surface, freshwater ecosystems are incredibly rich, supporting approximately 10% of all known living species and one-third of vertebrates (Strayer and Dudgeon, 2010; Winemiller, 2018) <sup>[3, 4]</sup>. Millennium Ecosystem Assessment (2005) <sup>[5]</sup> state that freshwater biodiversity dropped by 55% from 1970 to 2002, while terrestrial and marine biodiversity declined by 32% each. Given the gap in the taxonomic database on freshwater biodiversity, one has to infer that the true figure for continental waters was much greater (Balian *et al.*, 2008) <sup>[6]</sup>. So, urban lakes and ponds have become important part of any city as well as the country. Since they provide a habitat for aquatic species (Chester & Robson, 2013) <sup>[7]</sup>, support with sustainable water management (Novotny, 2008) <sup>[8]</sup>, and provide essential blue space for wildlife and humans, urban ponds and lakes have a high scientific and sociological value (White *et al.*, 2010; Higgins *et al.*, 2019) <sup>[9, 10]</sup>. Urban freshwater ecosystems are a complex mosaic of ecosystems that have been influenced by anthropogenic concerns such as residential development, habitat degradation, water pollution, flow regime disruption, ineffective management approaches, and species invasion (Hassall, 2014) <sup>[11]</sup>.

In this study, we give a comprehensive case study of the ecological state, biodiversity, and community dynamics of urban waterbodies in Ecopark (Kolkata, West Bengal, India). The principal purposes are to (i) present a foodweb perspective on the biodiversity and community structure of macrofauna, and (ii) determine if indicators based on trophic status, biodiversity, and community structure of foodweb components (avifauna, ichthyofauna, herpetofauna, odonates and aquatic macroinvertebrates) are useful tools for assessing the ecological status of urban water bodies.

## 2. Materials and Methods

### 2.1 Study area

The survey was performed from May 2020 and May 2022 in lake and Pakhibitan's pond by using direct observation method. The study areas are in an urban park called Ecopark

(Fig 1), located in Kolkata. Lake and Pakhibitan's pond are the main carrier of the freshwater life in Ecopark. The area of the lake is 104 acres which is approx one fourth of the 480 acres in Ecopark where the pond in Pakhibitan is very small in size in compare to the lake but quite undisturbed.

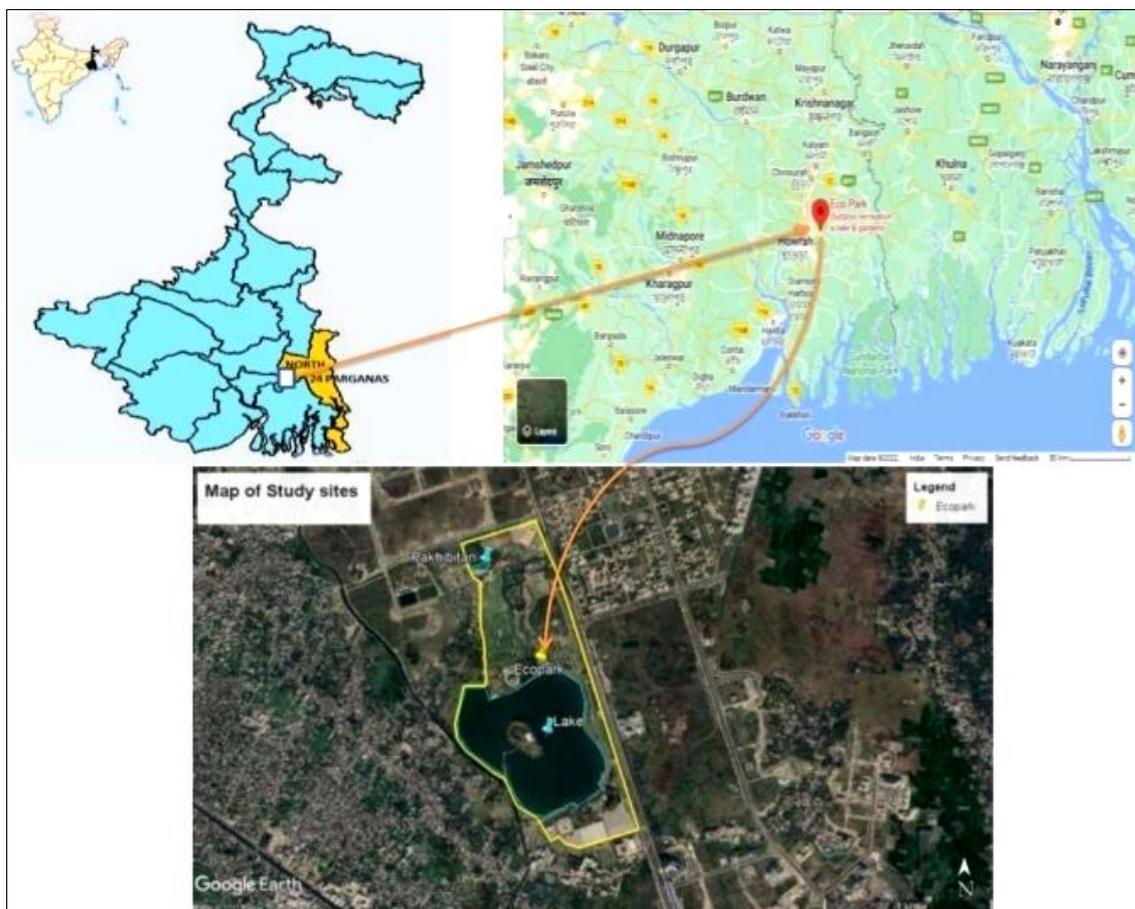


Fig 1: Map of the study site

For photography of the species Nikon Coolpix P900 and P600 were used. For identification of the fishes, mollusks and crabs were done with the help of these guidebook "Classification and Identification of Freshwater Fishes" (Hiware *et al.*, 2020)<sup>[12]</sup> and "The Mollusks: A Guide to Their Study, Collection, and Preservation" (Sturm *et al.*, 2006)<sup>[13]</sup> respectively.

### 3. Result

During the study period, a total of 27 species of fishes belonging to 6 orders, 12 families were recorded (Table 1). In this study, as per IUCN (2022)<sup>[14]</sup> out of 27 species, 24 are

Least Concern (LC), 1 species is in Vulnerable (VU), 1 species is in Not Evaluated (NE) and 1 species is in Data Deficient (DD) category (Table-1). Order Cypriniformes was most dominant (13 species), followed by Perciformes (8 species), Osteoglossiformes (2 species), Siluriformes (2 species), Cyprinodontiformes (1 species), Synbranchiformes (1 species) (Table-2, Figure-2). Cyprinidae is the most abundant family, contributing 44.82% of the ichthyofauna of the Ecopark. The family Channidae is second most abundant with 10.34% of the total species (Table-3, Figure-3).

Table 1: Checklist of observed fish species with order, family and IUCN status

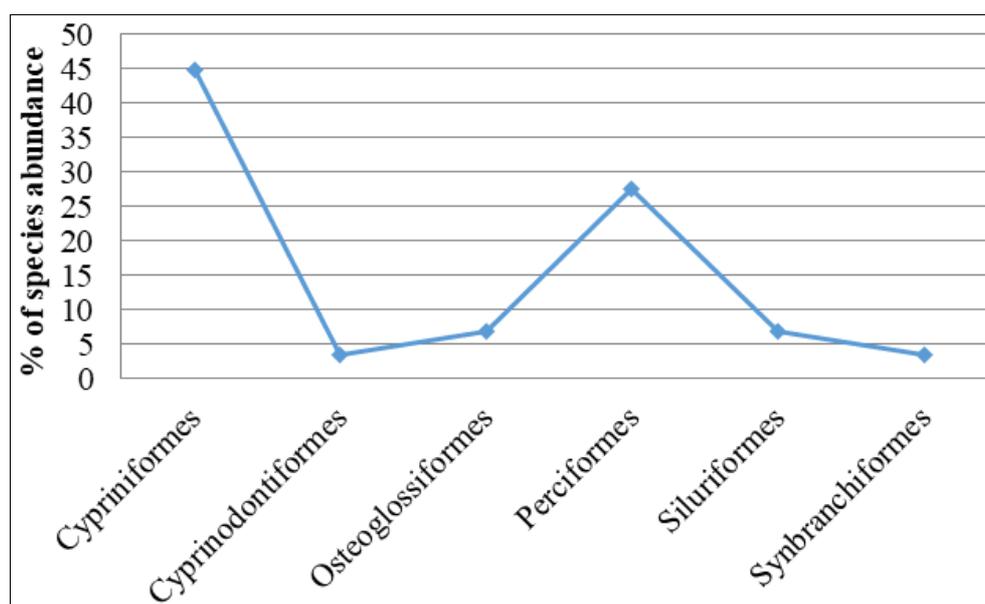
SI No.	Local Name	Scientific Name	IUCN Status
<b>Order: Cypriniformes</b>			
<b>Family: Cyprinidae</b>			
1	Rui	<i>Labeo rohita</i> (Hamilton, 1822)	LC
2	Katla	<i>Catla catla</i> (Hamilton, 1822)	LC
3	Mrigal	<i>Cirrhinus mrigala</i> (Hamilton, 1822)	LC
4	Bata	<i>Labeo bata</i> (Hamilton, 1822)	LC
5	Bata	<i>Cirrhinus reba</i> (Hamilton, 1822)	LC
6	Kalbose	<i>Labeo calbasu</i> (Hamilton, 1822)	LC
7	Sarpunti	<i>Puntius sarana</i> (Hamilton, 1822)	LC
8	Titpunti	<i>Puntius ticto</i> (Hamilton, 1822)	LC
9	Punti	<i>Puntius sophore</i> (Hamilton, 1822)	LC
10	Silver Karp	<i>Hypophthalmichthys nobilis</i> (Richardson, 1845)	DD
11	Grass Karp	<i>Ctenopharyngodon idella</i> (Valenciennes, 1844)	NE

12	Morala	<i>Amblypharyngodon mola</i> (Hamilton, 1822)	VU
13	Darkina	<i>Esomus danricus</i> (Hamilton, 1822)	LC
Order: Cyprinodontiformes			
Family: Poeciliidae			
14	Techokha	<i>Poecilia reticulata</i> W. Peters, 1859	LC
Order: Osteoglossiformes			
Family: Notopteridae			
15	Chital	<i>Chitala chitala</i> (Hamilton, 1822)	LC
16	Folui	<i>Notopterus notopterus</i> (Pallas, 1769)	LC
Order: Perciformes			
Family: Ambassidae			
17	Chanda	<i>Chanda nama</i> (Hamilton, 1822)	LC
Family: Anabantidae			
18	Koi	<i>Anabas testudineus</i> (Bloch, 1792)	LC
Family: Channidae			
19	Lata	<i>Channa punctata</i> (Bloch, 1793)	LC
20	Shol	<i>Channa striata</i> (Bloch, 1793)	LC
21	Chang	<i>Channa gachua</i> (Hamilton, 1822)	LC
Family: Cichlidae			
22	Tilapia	<i>Oreochromis mossambica</i> (Peters, 1852)	LC
23	Nile Tilapia	<i>Oreochromis niloticus</i> (Linnaeus, 1758)	LC
Family: Osphronemidae			
24	Khohse	<i>Trichogaster fasciata</i> (Bloch and Schneider, 1801)	LC
Order: Siluriformes			
Family: Clariidae			
25	Magur	<i>Clarias batrachus</i> (Linnaeus, 1758)	LC
Family: Heteropneustidae			
26	Singi	<i>Heteropneustes fossilis</i> (Bloch, 1794)	LC
Order: Synbranchiformes			
Family: Synbranchidae			
27	Kuche	<i>Monopterus albus</i> (Hamilton, 1822)	LC

IUCN (International Union for Conservation of Nature and Natural Resources) Red list: LC: Least Concern, VU: Vulnerable, NE: Not Evaluated, DD: Data Deficient

**Table 2:** Name of the order and number of species and % of abundance

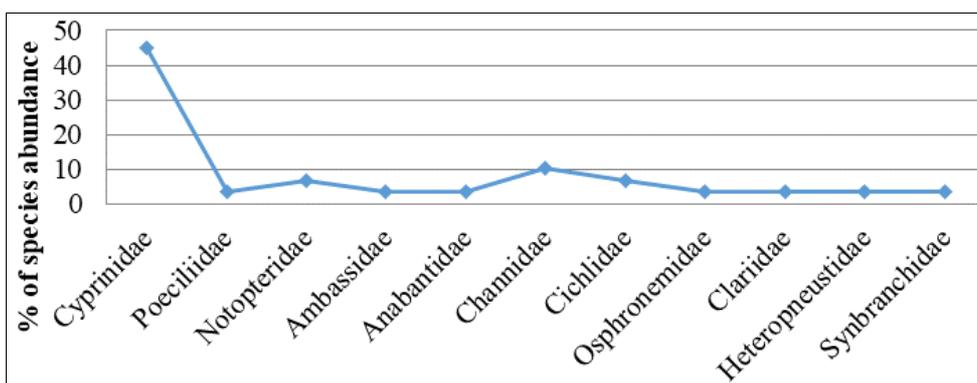
SI No.	Order	Number of species	% of species abundance
1	Cypriniformes	13	44.82
2	Cyprinodontiformes	1	3.44
3	Osteoglossiformes	2	6.89
4	Perciformes	8	27.58
5	Siluriformes	2	6.89
6	Synbranchiformes	1	3.44



**Fig 2:** Relationship among order and species abundance

**Table 3:** Name of the family and number of species and % of abundance

Sl No.	Family	Number of species	% of species abundance
1	Cyprinidae	13	44.82
2	Poeciliidae	1	3.44
3	Notopteridae	2	6.89
4	Ambassidae	1	3.44
5	Anabantidae	1	3.44
6	Channidae	3	10.34
7	Cichlidae	2	6.89
8	Osphronemidae	1	3.44
10	Clariidae	1	3.44
11	Heteropneustidae	1	3.44
12	Synbranchidae	1	3.44



**Fig 3:** Relationship among family and species abundance

A total of 4 species of phylum Mollusca belonging to 3 orders, 4 families were recorded (Table 4). In this study, as per IUCN (2022) [14], all are Least Concern (LC) category

(Table-4). Order Architaenioglossa was most dominant (2 species), followed by Stylommatophora (1 species), Unionida (1 species) (Table-4).

**Table 4:** Checklist of observed Mollusca with order, family and IUCN status

Sl No.	Local Name	Scientific Name	IUCN Status
<b>Order: Architaenioglossa</b>			
<b>Family: Ampullariidae</b>			
1	Channeled Apple snail	<i>Pomacea canaliculata</i> (Lamarck, 1819)	LC
<b>Family: Viviparidae</b>			
2	Common banded Pond Snail	<i>Filopaludina bengalensis</i> (Lamarck, 1822)	LC
<b>Order: Stylommatophora</b>			
<b>Family: Achatinidae</b>			
3	African Giant Snail	<i>Lissachatina fulica</i> (Férussac, 1821)	NE
<b>Order: Unionida</b>			
<b>Family: Unionidae</b>			
4	Freshwater mussel	<i>Lamellidens marginalis</i> (Lamarck, 1819)	LC

IUCN (International Union for Conservation of Nature and Natural Resources) Red list: LC: Least Concern, NE: Not Evaluated

Only 2 types of freshwater crabs were recorded both are Least Concern (LC), one is *Sartoriana spinigera* (Wood-Mason, 1871) and other is *Varuna litterata* Fabricius (1798).

**4. Discussion**

27 species of fish, 4 species of the phylum Mollusca, and 2 varieties of freshwater crabs were identified during this survey. The freshwater ecosystem, which includes fish, molluscas, and crabs, is crucial to preserving because it contains valuable resources for food, recreation and ornament. People occupy the “beel” local name of the large water body, region for agricultural purposes as population density rises, 'putting massive pressure on the wetlands, which are then converted to croplands. It is obvious that a significant fish population was decimated in this case because Ecopark was

constructed over a portion of the East Calcutta wetland. Making a large body of water in Ecopark and Pakhibitan’s pond aided in the preservation of a healthy freshwater ecology, as well as allowing many cormorants to perch in the lake's boating area and many migratory birds to rest on occasion. In addition to helping to shape aquatic bottom environments, mollusks play a crucial role in ecosystem engineering by providing a variety of other taxa with habitat, protection, and food (Fortunato, 2015) [15]. Additionally, because they are important calcareous organisms with a rich fossil record, they can shed light on significant past climate and oceanic changes, which will help us better understand anticipated future changes (Fortunato, 2015) [15]. Crabs also serve a part in cleaning the bottom by consuming decomposing plant and animal debris.

Out of 171 bird species belonging to 57 families were recorded in Ecopark (Chatterjee *et al.*, 2022) [16], family Anatidae, Podicipedidae, Ardeidae, Phalacrocoracidae,

Rallidae, Jacanidae, Rostratulidae, Scolopacidae, Alcedinidae and some species of family Motacillidae mostly depended on freshwater as they forage near the pond or take fish in their diet. Also rest of the bird species are also depend on the freshwater indirectly as they quench their thirst or forage other species found near freshwater.

In previous paper we had mentioned that, 26 species of herpetofauna including 21 species of class Reptilia and 5 species of class Amphibia were observed in Ecopark, where class Reptilia, 9 snake species, 3 types of monitor lizard, 2 types of turtle, 1 pond Terrapin and in class Amphibia 1 Common Asian Toad and 4 types of toad were depended on freshwater (Roy *et al.*, 2022) <sup>[17]</sup>. Herpetofauna is crucial in preserving freshwater ecosystems because Amphibians spend a portion of their lives in freshwater and are eaten by snakes. Terrapins and turtles act as scavengers in the ecosystem, eating aquatic vegetation and so limiting its growth and contributing to the health of water body. Monitor lizards are likely to spend the majority of their lives near water. Pakhibitan's pond region is a spectacularly quiet spot for herpetofauna to live due to the lack of human disturbance.

Also in previous paper, 34 species of Odonates were recorded (Samanta *et al.*, 2022) <sup>[18]</sup> in Ecopark. As Odonates lay eggs in the water and their larva live in the water. Water is important for their lives to live and the larvae are also a food source of freshwater fish. As well as *Macrobrachium* sp. and mosquito larvae are live in water and become food source for freshwater fish.

## 5. Conclusion

Overexploitation, flow alteration, habitat degradation, invasion by foreign species, pollution, including the worldwide issue of eutrophication (Harrison *et al.*, 1999; Dudgeon *et al.*, 2006) <sup>[19, 20]</sup>, are all interconnected threats to fish biodiversity. Farmers also use various chemical fertilisers to increase crop production, which leads to eutrophication and lowers the level of dissolved oxygen in water bodies, harming the diversity of fish at the same time (Rathore *et al.*, 2016; Savci, 2012) <sup>[21, 22]</sup>. For Ecopark, the lake is properly maintained to catch fish, and it has occasionally been revealed that fish were caught illegally. While Pakhibitan's pond region attracts few people, the number of cases in this case is low. Fish is particularly important for the ecology since it provides food for many water birds such as cormorants, consumes a lot of mosquito larvae, and occasionally controls the growth of aquatic plants. The generally drab-colored and uninteresting freshwater species known as 'Mollusks,' which face the most significant threats and demand the most public concern and action, are in critical need of supporters.

Pakhibitan is designed for the birds' hideout and lake is also the place for many water birds' roosting site. Water birds and other bird species can be found near both Pakhibitan's pond and lake in their various activities, proving that freshwater plays an important role in bird's life and also helps to balance and maintain the freshwater ecology.

Freshwater crab conservation will be mostly dependent on keeping big enough natural forest areas to sustain the good water quality of the original streams. As a result, more nature reserves and national parks, as well as cautious planning and development, are required (Balian *et al.*, 2008) <sup>[6]</sup>. The relevance of the freshwater environment for amphibian population survival is crucial, and further research on the unique requirements of frogs in their aquatic, primarily larval phase is required to design integrated conservation strategies

(Balian *et al.*, 2008) <sup>[6]</sup>.

Monitor lizards are also extremely rare in any natural setting. Pakhibitan's pond is an amazing safe haven for monitor lizards, which may be found in numerous places. Turtles are extremely sensitive to environmental changes and are among the first vertebrates to disappear when a habitat is lost. Another issue is increased collection for food, ostensibly for medicinal reasons, and for the pet trade (Balian *et al.*, 2008) <sup>[6]</sup>. Turtles are not found naturally in any nearby pond because they were artificially introduced into the pond. They are extremely beneficial to the freshwater habitat. Most freshwater snake species are non-venomous as they play a vital role in the freshwater ecology by devouring other species and thus. Odonates have minimal economic worth, but they are used as food and as magical or medicinal resources on a local scale, and they may influence disease vector populations to an unknown level (Balian *et al.*, 2008) <sup>[6]</sup>. The number of Odonates is decreasing as more ponds are destroyed to make way for multistory buildings. The scavenger *Macrobrachium* sp. not only consumes algae and other debris, but also acts as a predator to sustain the food web as a component of freshwater ecology. The Ecopark protects the habitat while also offering a shelter for wildlife.

As explained previously, the lake and Pakhibitan's pond region help to preserve the freshwater ecology. As the population grows, open spaces such as ponds are being destroyed. Both contributed to the development of a food web and the flourishing of all ecological organisms.

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