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SPECIES DIVERSITY AND CONSERVATION STATUS OF BIRDS, MAMMALS, AND REPTILES IN TPL MANGROVE BIODIVERSITY PARK, KORANGI CREEK KARACHI

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ABSTRACT

The TPL Mangrove Biodiversity Park is nestled within the large mangrove ecosystem surrounding Korangi Creek, a vital part of the Indus Delta's ecologically sensitive region. From Korangi Creek to Sir Creek, seventeen major creeks form a specialized and fluctuating ecosystem, supporting exceptionally rich regional biodiversity, most notably in the Korangi Creek area. A Base line study of Vertebrate Fauna was conducted to create a comprehensive inventory of Vertebrate Fauna in the TPL Mangrove Biodiversity Park and its surroundings. The study aimed to document the diversity, distribution, and conservation status of vertebrate fauna, particularly birds, mammals, and reptiles. Field surveys were conducted from September 22 to December 31, 2024, to develop a comprehensive inventory of these vertebrate groups. Our comprehensive field survey and literature review revealed a remarkable array of species, comprising 70 Avian species, 9 Mammalian species, 9 Reptilian species, and 14 Floral species. The present study documented a total of 70 bird species. Out of 70 bird species, 31 are Migratory and 39 are Resident of the area. Out of total recorded species, 45 are Common, 2 Abundant and 23 are Less Common bird species in the project area. Out of total recorded 70 species, 13 are Protected under the Sindh Wildlife Protection Act, 2020 (SWPA), 4 are on IUCN Red List, 13 and 7 are Listed on Convention on the Conservation of Migratory Species of Wild Animals (CMS) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) appendices respectively. The surveys also revealed a modest diversity of Mammals and Reptiles. Nine Mammalian Species were identified in and around the project area, with 6 Classified as Common and one as Less Common. One Species is Protected under the Sindh Wildlife Protection Act, 2020 (SWPA), and 3 are Listed on CITES Appendices. Our study recorded a total of 9 Reptilian Species, with one Protected under the SWPA and 3 Listed on CITES Appendices. None of these Reptilian species are Listed on the IUCN Red List. In this study, we also conducted a floristic survey within the park and its surroundings, documenting a total of 14 distinct plant species. The Korangi Creek mangrove forest faces severe aquatic pollution due to the influx of untreated municipal and industrial wastewater. The water is contaminated with industrial discharge, sewage, and domestic waste. During low tide, the park area is largely comprised of polluted water with minimal seawater presence. In contrast, high tide brings a visible mixture of both polluted and seawater. Marine plastic and micro plastic materials are likely present in plastic debris, posing risks to all living beings and leading to environmental complexities. Previous research studies have documented chemical pollution from heavy metals in the area. If we address and mitigate these physical and chemical pollutants by treating sewage and industrial wastewater, we can alleviate many pollution-related problems, enhance aesthetic value, and prevent future environmental complexities.

Keywords: Indus delta, creek, chemical pollution, vertebrate fauna, migratory birds.

INTRODUCTION

Pakistan's coastline stretches approximately 990 kilometres, divided into two distinct regions: the Sindh Coast (270 km) and the Makran Coast (720 km). The Sindh coastal region is situated in the country's south-eastern part, bordered by the Indian border at Sir Creek to the east and the Hub River along the Balochistan coast to the west.

The Sindh Coast features a unique ecological landscape, with the Indus Delta being its most prominent feature. This vast deltaic region is characterized by a network of tidal

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creeks, mudflats, and mangrove vegetation, forming one of the world's largest arid mangrove forests.

The Indus Delta Creek area spans approximately 64,000 hectares (Meynell, 1995), extending from Korangi Creek to Sir Creek, and features a diverse landscape of tidal channels, sandy islands, mangrove swamps, and mudflats. Seventeen major creeks form a unique and dynamic ecosystem, supporting rich regional biodiversity, particularly evident in the Korangi Creek area (MMF, 2016).

The Indus Delta, a renowned Ramsar Site, ranks fifth globally in terms of size and vulnerability, and is home to the world's seventh-largest mangrove ecosystem (IUCN, 2003; Sohl *et al*., 2006; Khan and Akbar, 2012; Baig *et al*., 2017).

The Indus Delta provides a vital sanctuary for 95% of Pakistan's mangrove forests, serving as a crucial habitat for both resident and migratory bird species, including those that travel from Siberia (Giri *et al*., 2015). Pakistan's coastal regions initially hosted eight mangrove species, but now only four species remain: *Avicennia marina*, *Rizophora mucronata*, *Aegiceras corniculatum*, and *Ceriops tagal* (Damhoureyeh and Ghalib, 2014; Forest Department, 2024). Notably, *Avicennia marina* predominates, comprising an impressive 97% of the mangrove population (WWF, 2007).

The Indus Delta mangrove is a unique and resilient ecosystem that supports large number of animals and plants species. The Indus Delta mangrove ecosystem, found in Asia, is uniquely adapted to thrive in arid conditions, demonstrating remarkable resilience to extreme temperatures, high seawater salinity, and scarce rainfall (DasGupta and Shaw, 2013). The Indus Delta Creek area is a vital component of the region's biodiversity. A key feature within this area is the Korangi Creek, a significant tidal creek characterized by exceptionally high salinity levels comparable to seawater (Haq, 1976). This creek supports lush mangrove forests, providing essential habitats for a diverse array of Species, including Cetaceans, Water birds, Waders (Herons, Egrets, Redshank, Godwits, Curlews, Whimbrel, Stints, Gulls, and Terns). TPL Mangrove Biodiversity Park, situated adjacent to the Indus Delta Mangroves near Korangi Creek, is coastal ecosystem (Figs. 1 and 2) providing a crucial habitat for a diverse array of marine and terrestrial species.

Despite its ecological importance, the Indus Delta region lacks comprehensive research on faunal vertebrate biodiversity to date, particularly in the Korangi Creek area and its surroundings. This study fills this gap with an in-depth analysis, offering a comprehensive assessment of vertebrate fauna in the TPL Mangrove Biodiversity Park and surrounding regions. The purpose of this study was to catalogue and assess the vertebrate biodiversity of the area, evaluate the conservation status of key species, and identify potential threats to the ecosystem.

MATERIALS AND METHODS

Desk Study/ Literature Search

Relevant literature was reviewed to gather background information on similar studies conducted regarding the distribution of avifauna in lower Sindh, with a specific focus on the areas adjacent to the project site.

Fauna Assessment Methodology

Field surveys were conducted from September 22 to December 31, 2024, to document avian, mammal, and reptile species. Point transects and line transects were employed to ensure thorough documentation (Fig. 3). The team utilized standard ornithological equipment, including binoculars and high-resolution cameras, for visual and photographic documentation.

Point Transect Method

This method involves establishing observation points at suitable locations for viewing birds and their habitats. Point counts (Ralph *et al*., 1993) require an observer to stand in one spot and record all birds seen within a fixed or unlimited distance. Each count point was observed for 15 minutes, focusing on bird habitats and identification using binoculars. Photographs were also taken.

Line Transect Method

Line transects are a common method in bird surveying, involving recording birds while walking along a predefined route within a survey unit (Gregory *et al*., 2004). Suitable for extensive, open, and uniform habitats, line transects are ideal for large and conspicuous species found in the study area. Each sample area was traversed separately, with birds searched for on both sides of a 300-meter-wide strip (150 meters per side). Binoculars were used for species identification and counting. Compared to point transects, line transects cover more ground quickly, record more birds, minimize double counting, and are suitable for mobile and conspicuous species.

Species Identification / Taxonomical work

For Species identification, we referred to several Avian Fauna books and field guides, specifically: Ali and Ripley (1987), Ali *et al*. (2001), Roberts (1991, 1992), Grimmett and Inskipp (2001), Mirza (2007), Grimmett *et al*. (2008a) and Grimmett *et al*. (2008b). During the present survey, we also observed and documented the flora within the park and its surroundings.



Fig. 1. Location of the TPL Mangrove Biodiversity Park.



Fig. 2. High Resolution Satellite Imagery of TPL Mangrove Biodiversity Park.



Fig. 3. GPS Tracks Illustrating the Geospatial Orientation of the Line and Point Transects conducted by the Survey Team.

RESULTS AND DISCUSSION

Biological Environment

The Mangrove Biodiversity Park is nestled within the extensive mangrove ecosystem surrounding Korangi Creek in Karachi. As part of the Indus Delta, this area has ecological significance due to its unique blend of terrestrial and marine habitats. Strategically located at the intersection of land and sea, the park boasts a distinctive combination of habitats that support a diverse array of species. Within a 2-kilometer radius of the park, following key habitats have been identified:

Mangrove Forests

Mangrove forests dominate the park's landscape, featuring dense stands of mangrove trees. These forests provide critical breeding and nursery grounds for aquatic species, as well as habitats for birds and small terrestrial animals.

Mudflats

Located along the edges of the mangrove forest and creek, these intertidal zones are uncovered at low tide and submerged during high tide, serving as crucial foraging grounds for wading birds and a variety of invertebrates.

Tidal Channels and Creeks

These shallow, winding waterways form the marine component of the ecosystem, connecting the mangrove forest to the open sea. They provide a habitat for a diverse range of species, including fish, crabs, and mollusks, and play a vital role in nutrient exchange.

Coastal Sandy Plains

Situated on the landward side of the park, these sparsely vegetated sandy areas offer a habitat for reptiles and small mammals.

Saline Wetlands

Low-lying areas are prone to inundation by seawater; these saline wetlands are essential for both marine and terrestrial species. They act as buffers against storm surges and coastal erosion, providing a crucial ecosystem service.

Selected Photographs of the TPL Mangrove Biodiversity Park and its Surrounding Habitats








Water Quality and Environmental Status of the TPL Mangrove Biodiversity Park

The Mangrove Biodiversity Park at Korangi Creek has the potential to become a premier site for learning, scientific research, and entertainment in the Karachi city. However, addressing environmental factors is crucial to maintain its ecological integrity and ensure the long-term sustainability of the mangrove ecosystem and its associated biological and physical components.

The water of the part is polluted and having untreated industrial discharge, sewage water, and domestic waste. At this time when we visited there is low tide and the park area is almost comprising such dirty water and having very little sea water. However, at the high tide times there is a visible mixture of both types of water.

Eutrophication (algal masses are visible due to excessive nutrients). Sunlight hardly penetrates the water, which affects submerged seaweeds. Consequently, fish and other marine living creatures are fewer in number due to reduced photosynthesis and lower subsurface temperatures.

Marine plastic material and micro plastic material are very likely to present in plastic debris, which further effect all living being and lead to complexities.

Chemical pollution of heavy material is reported in a few previous reports and research papers. The heavy metals may be iron, Sulphur, nitrates, mercury, and others are likely to present, beside various enzymes and other pollutants of area also reported. These metals enter food chain with its likely consequences. If we address to mitigate these physical and chemical pollutants, and to treat the water of sewage and industrial waste, then we can navigate out of many of problems of pollution and aesthetic sense and get rid of future complexities.

An environmental assessment of the water is necessary, involving testing to ascertain various physical parameters. Furthermore, increased water pollution can have devastating effects on mangroves, potentially leading to a decline in their health, disease, and even death.

Birds of TPL Mangrove Biodiversity Park

Species Overview

The project area, TPL Mangrove Biodiversity Park is characterized by a dense mangrove forest, with *Avicennia marina* being the most dominant species. The dense mangrove patches in the area serve as vital breeding grounds for shrimps and fishes. The muddy terrain provides an ideal habitat for inter-tidal Mudskippers. These mangrove forests offer crucial shelter to coastal populations and human settlements, protecting them from sea storms. Local communities in the area heavily rely on the mangroves for fuel wood, fodder for cattle, and building materials for their homes. Furthermore, the mangrove forests in the Korangi Creek study area support a diverse range of vertebrate fauna, while the large channels in the area are home to a variety of shrimps and finfish species.

Mangrove ecosystems, characterized by their unique combination of terrestrial and marine influences, provide critical habitats for a diverse array of avifauna. The Mangrove Biodiversity Park, with its winding water channels and dense vegetation, supports a wide range of bird species that rely on the park for breeding, foraging, and shelter. The observed diversity of bird species, including migratory, resident, and endangered species, serves as a key indicator of the ecological health and resilience of the park's mangrove ecosystem.

In the present study, habitats of the TPL Mangrove Biodiversity Park and its surrounding areas were surveyed. Field surveys were conducted during September 22, 2024, to December 31, 2024, for the identification and recording of vertebrate fauna species. Additionally, we observed and recorded the species of flora in the park and its surroundings. A summary of the results of the present study on the baseline of vertebrate fauna is presented in Table 1.

Table 1. Summary of Flora and Vertebrate Fauna of the TPL Mangrove Biodiversity Park and its Surrounding Areas.

S. No.	Plant/ Fauna	Number of Species Recorded/ Reported
1	Flora	14
2	Birds	70 (31 Migratory and 39 Resident Species)
3	Mammals	9
4	Reptiles	9

The present study documented a total of 70 bird species (Table 2), comprising 31 Migratory species (Table 3) and 39 Resident species. Out of total recorded species, 45 are Common, 02 Abundant and 23 are Less common species in the project area. Out of total recorded 70 species, 13 are Protected under the Sindh Wildlife Protection Act, 2020 (SWPA), 04 are on IUCN Red List (Table 4), 13 and 07 are Listed on Convention on the Conservation of Migratory Species of Wild Animals (CMS) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) appendices respectively.

In the early morning, a large population of birds was noted in and around the mangrove area facing the seaside, in shallow water, where they primarily rest and roost, along with adjacent backwater areas.

Table 2. List of Bird Species Observed in and around TPL Mangrove Biodiversity Park.

No.	Common Name	Scientific Name	Status		Occurrence				Listing			
			Migratory	Resident	Common	Abundant	Less Common	Rare	SWPA	IUCN Red List	CMS Appendix	CITES Appendix
1.	Bank Myna	*Acridotheres ginginianus*		x		x						
2.	Bay-Backed Shrike	*Lanius vittatus*		x	x							
3.	Black Crowned Sparrow Lark	*Eremopterix nigreceps*		x	x							
4.	Barn Swallow	*Hirundo rustica*		x	x							
5.	Black Drongo / King Crow	*Dicrurus macrocercus*		x	x							
6.	Black Kite	*Milvus migrans*		x	x				x			II
7.	Black Headed Gull	*Larus ridibundus*	x		x							
8.	Black Tailed Godwit	*Limosa limosa*	x				x			NT	II	
9.	Black winged Stilt	*Himantopus himantopus*	x		x							
10.	Blue Rock Pigeon	*Columba livia*		x	x							III
11.	Brahminy Kite	*Haliastur indus*		x	x				x			II
12.	Caspian Tern	*Sterna caspia*	x				x				II	
13.	Cattle Egret	*Bubulcus ibis*		x	x				x			III
14.	Chiffchaff	*Phylloscopos collybita*	x		x							
15.	Collared Dove	*Streptopelia decaocto*		x	x							
16.	Common Babbler	*Turdoides caudatus*		x	x							
17.	Common Kingfisher	*Alcedo atthis*		x	x							
18.	Common Ringed Plover	*Charadrius hiaticula*	x				x				II	
19.	Common Sandpiper	*Actitis hypoleucos*	x		x							
20.	Common Redshank	*Tringa totanus*	x		x						II	
21.	Crested Lark	*Galerida cristata*		x	x							
22.	Dunlin	*Calidris alpina*	x				x					
23.	Eurasian Curlew	*Numenius arquata*	x				x			NT	II	
24.	Eurasian Oystercatcher	*Haematopus ostralegus*	x				x			NT		
25.	Great Cormorant	*Phalacorcorax carbo*	x				x		x			
26.	Great Grey Shrike	*Lanius excubitor*		x	x							
27.	Great White Egret	*Ardea alba*	x				x		x			
28.	Common Green Shank	*Tringa nebularia*	x				x				II	
29.	Grey Heron	*Ardea cinerea*	x		x				x			
30.	Gull Billed Tern	*Gelochelidon nilotica*	x		x							
31.	Herring Gull	*Larus argentatus*	x				x					

No.	Common Name	Scientific Name	Status		Occurrence				Listing			
			Migratory	Resident	Common	Abundant	Less Common	Rare	SWPA	IUCN Red List	CMS Appendix	CITES Appendix
32.	House Crow	*Corvus splendens*		x	x							
33.	House Sparrow	*Passer domesticus*		x		x						
34.	Indian Myna/Common Myna	*Acridotheres tristis*		x	x							
35.	Indian Pond Heron	*Ardeola grayii*		x	x				x			
36.	Indian Robin	*Saxicoloides fulicata*		x	x							
37.	Indian Roller	*Coracias benghalensis*		x	x							
38.	Indian Tailor Bird	*Orthotomus sutorius*		x			x					
39.	Intermediate Egret	*Egretta intermedia*	x				x		x			
40.	Kentish Plover	*Charadrius alexandrinus*	x				x				II	
41.	Lesser Sand Plover	*Charadrius mongolus*	x				x				II	
42.	Little Brown Dove	*Streptopelia senegalensis*		x	x							III
43.	Little Grebe	*Tachybaptus ruficollis*		x	x							
44.	Little Cormorant	*Phalacrocorax niger*	x		x				x			
45.	Little Egret	*Egretta garzetta*		x	x				x			
46.	Little Green Bee-eater	*Merops orientalis*		x	x							
47.	Little Ringed Plover	*Charadrius dubius*		x	x						II	
48.	Little Stint	*Calidris minuta*	x		x						II	
49.	Little Tern	*Sterna albifrons*	x				x				II	
50.	Long-Tailed Grass Warbler	*Prinia burnesii*		x			x			NT		
51.	Marsh Harrier	*Circus aeruginosus*	x		x				x			II
52.	Osprey	*Pandion haliaetus*	x		x				x			II
53.	Pied Bushchat	*Saxicola caprata*		x	x							
54.	Pied Kingfisher	*Ceryle rudis*		x	x							
55.	Purple Sunbird	*Nectarinia asiatica*		x	x							
56.	Red Vented Bulbul	*Acrocephalus agricola*		x	x							
57.	Red-Wattled Lapwing	*Vanellus indicus*		x	x							
58.	Reef Heron	*Egretta gularis*		x	x				x			
59.	Striated Babbler	*Turdoides earlei*		x	x							
60.	Temminck's Stint	*Calidris temminckii*	x				x				II	
61.	Terek Sandpiper	*Xenus cinereus*	x				x					
62.	Whimbrel	*Numenius phaeopus*	x				x				I/II	
63.	Whiskered Tern	*Chlidonias hybridus*		x			x					
64.	White Breasted Kingfisher	*Halcyon smyrnensis*		x	x							
65.	White Wagtail	*Motacilla alba*	x				x					
66.	White-Cheeked Bulbul	*Pycnonotus leucogenys*		x	x							
67.	White Browed Fantail	*Rhipibura aureola*		x	x							
68.	White Browed Wagtail	*Motacilla maderaspatensis*	x				x					
69.	Indian White Eye	*Zosterops palpebrosus*		x			x					
70.	Yellow Wagtail	*Motacilla flava*	x		x							

Table 3. List of Migratory Bird Species Observed in and around TPL Mangrove Biodiversity Park.

No.	Common Name	Scientific Name	Status		Occurrence				Listing			
			Migratory	Resident	Common	Abundant	Less Common	Rare	SWPA	IUCN Red List	CMS Appendix	CITES Appendix
1.	Black Headed Gull	*Larus ridibundus*	x		x							
2.	Black Tailed Godwit	*Limosa limosa*	x				x			NT	II	
3.	Black Winged Stilt	*Himantopus himantopus*	x		x							
4.	Caspian Tern	*Sterna caspia*	x				x				II	
5.	Chiffchaff	*Phylloscopos collybita*	x		x							
6.	Common Ringed Plover	*Charadrius hiaticula*	x				x				II	
7.	Common Sandpiper	*Actitis hypoleucos*	x		x							
8.	Common Redshank	*Tringa totanus*	x		x						II	
9.	Dunlin	*Calidris alpina*	x				x					
10.	Eurasian Curlew	*Numenius arquata*	x				x			NT	II	
11.	Eurasian Oystercatcher	*Haematopus ostralegus*	x				x			NT		
12.	Great Cormorant	*Phalacorcorax carbo*	x				x		x			
13.	Great White Egret	*Ardea alba*	x				x		x			
14.	Common Green Shank	*Tringa nebularia*	x				x				II	
15.	Grey Heron	*Ardea cinerea*	x		x				x			
16.	Gull Billed Tern	*Gelochelidon nilotica*	x		x							
17.	Herring Gull	*Larus argentatus*	x				x					
18.	Intermediate Egret	*Egretta intermedia*	x				x		x			
19.	Kentish Plover	*Charadrius alexandrinus*	x				x				II	
20.	Lesser Sand Plover	*Charadrius mongolus*	x				x				II	
21.	Little Cormorant	*Phalacrocorax niger*	x		x				x			
22.	Little Stint	*Calidris minuta*	x		x						II	
23.	Little Tern	*Sterna albifrons*	x				x				II	
24.	Marsh Harrier	*Circus aeruginosus*	x		x				x			II
25.	Osprey	*Pandion haliaetus*	x		x				x			II
26.	Temminck's Stint	*Calidris temminckii*	x				x				II	
27.	Terek Sandpiper	*Xenus cinereus*	x				x					
28.	Whimbrel	*Numenius phaeopus*	x				x				I/II	
29.	White Wagtail	*Motacilla alba*	x				x					
30.	White Browed Wagtail	*Motacilla maderaspatensis*	x				x					
31.	Yellow Wagtail	*Motacilla flava*	x		x							

Table 4. IUCN Red Listed Near Threatened Bird Species (IUCN, 2024) in TPL Mangrove Biodiversity Park.

S. No.	Common Name	Scientific Name
1	Black Tailed Godwit	*Limosa limosa*
2	Eurasian Curlew	*Numenius arquata*
3	Eurasian Oystercatcher	*Haematopus ostralegus*
4	Long-Tailed Grass Warbler	*Prinia burnesii*

Fluctuations in bird populations were observed across multiple surveys (September 22 to December 31, 2024) conducted at different times, resulting in varying total numbers recorded. Specifically, our surveys revealed the following most common and widespread species in the area:

Black Kite, Common Sandpiper, Green Bee-Eater, Little Stint, House Crow, Black-Wing Stilt, Kentish Plover, Red-Wattled Lapwing, Lesser Sand Plover, Common Tern, Little Tern, and Eurasian Curlew.

The subsequent section provides an overview of the provincial and international authorities responsible for protecting of wild animals and flora, along with the conservation status of species documented at TPL Mangrove Biodiversity Park.

The Sindh Wildlife Protection, Preservation, Conservation and Management Act, 2020 (SWPA)

The SWPA, 2020 is a significant legislation aimed at safeguarding wildlife in the province of Sindh. This act provides a framework for the protection, conservation, preservation, and sustainable use of wildlife, as well as the establishment, management, and maintenance of protected areas. The Act also includes two schedules (First and Second) that list protected wild animals.

IUCN Red List of Threatened Species

The International Union for Conservation of Nature (IUCN, 1964) Red List of Threatened Species, established become the world's most authoritative and comprehensive source of information on the global extinction risk status of animal, fungal, and plant species (IUCN, 2024).

As a powerful catalyst for biodiversity conservation and policy reform, the IUCN Red List provides critical data on species' ranges, population sizes, habitats, ecology, uses, trade, and threats. This invaluable information informs and guides necessary conservation decisions, ultimately safeguarding the natural resources essential for human survival. Species are classified into the following nine Red List Categories:

Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern, Data Deficient and Not Evaluated.

The Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The CMS provides a global framework for conserving migratory animals and their habitats. By uniting Range States, CMS facilitates internationally coordinated conservation efforts across entire migratory ranges. CMS has two appendices that identify the migratory species protected under the Convention.

Appendix I: Endangered Migratory Species

This appendix Lists migratory species considered endangered throughout their entire range or a significant portion of it, based on thorough assessments.

Appendix II: Migratory Species Conserved through International Agreements

Appendix II encompasses migratory species with unfavorable conservation statuses that necessitate international cooperation for effective conservation and management. It also includes species that would significantly benefit from collaborative international efforts (CMS, 2024).

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement aimed at ensuring that global trade in wild animals and plants does not threaten the survival of the species. CITES categorizes protected species into three appendices, providing varying levels of protection against over-exploitation (CITES, 2024).

Appendix I: Lists the most endangered species, threatened with extinction. International trade in these species is prohibited, except for non-commercial purposes, such as scientific research.

Appendix II: Includes species that, while not currently threatened, may become so if trade is not regulated. This appendix also covers "look-alike species" that are easily confused with protected species. International trade in Appendix-II requires export permits or re-export certificates, ensuring that trade does not harm wild populations. To issue permits or certificates, authorities must verify that trade will not harm the species' survival. While no import permit is mandatory under CITES for Appendix-II species, some countries have implemented stricter measures requiring additional permits.

Appendix III: Lists species that are regulated by a specific country to prevent unsustainable or illegal exploitation. At the request of that country, these species are included in Appendix III to encourage international cooperation. International trade in Appendix-III species is permitted only with the required permits or certificates.

The Indus Flyway: A Vital Migration Route

Every year, Pakistan welcomes a vast influx of migratory birds from Central Asian states, which travel along the Central Asian Flyway (CAF), one of the world's eight primary flyways (Bird Life International, 2019). These migratory water birds embark on an arduous journey from Siberia and Kazakhstan, crossing over the Karakorum, Hindukush, and Suleiman mountain ranges, before following the Indus River downstream to the Indus Delta.

This scenic route is aptly named the Indus Flyway. The Indus Delta is a safe and welcoming place for migratory water birds to spend the winter. It has a mild climate and a suitable habitat, making it an ideal spot for them to rest, refuel, and thrive (IPCC, 2022).

Conservation Concerns

The Mangrove Biodiversity Park's bird populations are facing numerous and escalating threats. Habitat destruction and degradation, primarily driven by industrial activities such as coastal development and oil spills, pose significant risks to avian habitats and populations. Pollution from nearby urban areas, including wastewater and plastic waste, further aggravates these environmental pressures. Furthermore, rising sea levels and climate change pose significant emerging threats to the mangrove ecosystem, including increased flooding, saltwater intrusion, and shifts in species composition.

Mammals of TPL Mangrove Biodiversity Park

Species Overview

Mammals play a vital role in maintaining the ecological balance of the mangrove ecosystem, contributing significantly to seed dispersal, nutrient cycling, and supporting the complex food chain. Although the Mammalian biodiversity in the Mangrove Biodiversity Park is relatively lower compared to the avifauna, several species were observed during the survey, highlighting the park's importance as a habitat for these animals.

The presence of nine mammal species underscores the importance of conserving the Mangrove Biodiversity Park as a habitat for these animals and highlights the need for continued monitoring and research to better understand the ecological roles of these species.

A total of nine mammalian species (Table 5) exist in and around TPL Park area. Out of these total 9 species, 8 are Common, one Less Common and none is Rare in the project area (Figs. 1 - 4). Out of total recorded species, 01 is Protected under the SWPA and 03 are Listed on CITES appendices.

Conservation Concerns

The limited mammal populations in the Mangrove Biodiversity Park face numerous threats, including habitat fragmentation. The destruction of mangrove habitats due to urbanization, aquaculture, and logging has reduced the available habitat and food sources for mammals. As a result, mammals are forced to venture into nearby human settlements, leading to conflicts, property damage, and potential harm to both humans and animals. Furthermore, chemical runoff and plastic pollution pose significant risks to mammal health and well-being.

Reptiles of TPL Mangrove Biodiversity Park

Species Overview

Reptiles play a crucial role in maintaining the ecological balance of mangrove ecosystems by regulating insect populations through biological control. The presence of reptiles was confirmed through indirect signs, such as burrows, footprints, and tracks, as well as a limited number of direct sightings.

A total of nine Reptilian species (Table 6) has been identified (Figs. 1 – 4) in the park area, including one species Protected under the Sindh Wildlife Protection Act, 2020 (SWPA) and three species Listed on the CITES appendices. Notably, none of these species are currently Listed on the IUCN Red List. Although the number of Reptilian species observed was relatively low, their presence is nonetheless vital for maintaining the overall health and resilience of the ecosystem.

Conservation Concerns

Local communities often reject the presence of reptiles, such as lizards, desert monitors, Bengal monitors, and venomous and non-venomous snakes, in their nearby residential areas, leading to widespread fear and intolerance. As a result, these animals are frequently killed on sight, posing a significant and unnecessary threat to reptile populations, and disrupting the delicate balance of the ecosystem.

Comparison of Faunal Diversity: Earlier Studies vs. Present Study

The Indus Delta region, despite its ecological significance, lacks comprehensive research on faunal vertebrate biodiversity to date. Specifically, the Korangi Creek area and its surroundings remain understudied, with a significant knowledge gap existing regarding the diversity, distribution, and abundance of vertebrate species in this region.

A study conducted by Ghalib *et al*. (2017) identified 159 bird species in Sindh's coastal regions. Another study Ghalib *et al*. (2018) produced a checklist of mammals, birds, reptiles, and amphibians of Sindh, reporting that 420 bird species, 82 mammal species, 103 reptile species, and 7 amphibian species have been recorded in the province. Following these studies, Khan *et al*. (2018) investigated vertebrate biodiversity in Korangi and Phitti Creeks along the Karachi Coast, documenting 134 bird species, 15 mammal species, 19 reptile species, three amphibian species, and 20 fish species.

In contrast to previous studies, the present research, conducted in a limited area of Korangi Creek from September 22 to November 9, 2024, documented 70 bird species, nine mammal species, and nine reptile species. Notably, most migratory birds were absent from the Creek area during this period, likely due to the study coinciding with their migratory season (Figs. 1- 47).

Table 5. List of Mammal Species Spotted/ Reported in TPL Mangrove Biodiversity Park.

No.	Common Name	Scientific Name	Occurance			Listing		
			Common	Less Common	Rare	SWPOA	IUCN Red list	CITES Appendix
1.	Asiatic Jackal	*Canis aureus*	x					III
2.	Asian House Shrew	*Suncus murinus*	x					
3.	Balochistan Gerbil	*Gerbillus nanus*	x					
4.	Five stripped-palm Squirrel	*Funambulus pennantii*	x					
5.	Indian Grey Mongoose	*Herpestes edwardsi*	x					III
6.	Indian Hedgehog	*Paraechinus micropus*		x				
7.	Indian Wild Boar	*Sus scrofa*	x					
8.	Small Indian Mongoose	*Herpestes javanicus*	x			x		III
9.	House Mouse	*Mus musculus*	x					

Table 6. Check List of Reptile Species Observed/ Reported in the TPL Mangrove Biodiversity Park.

No.	Common Name	Scientific Name	Listing		
			SWPA	IUCN	CITES
1.	Garden Lizard	*Calotes versicolor*			
2.	Indian Cobra	*Naja naja naja*			II
3.	Indian Desert Monitor	*Varanus griseus*			I
4.	Indian Fringe Toed Lizard	*Acanthodactylus cantoris cantoris*			
5.	Indian or Bengal Monitor	*Varanus bengalensis*	x		I
6.	Saw Scaled Viper	*Echis carinatus pyramidum*			
7.	Yellow Bellied House Gecko	*Hemidactylus flaviviridis*			
8.	Sindh Sand-Boa	*Eryx conicus*			
9.	Yellow Sea Snake	*Hydrophis spiralis*			

Table 7. List of Flora Recorded in TPL Mangrove Biodiversity Park and Surrounding area.

S. No.	Common Name/Local Name	Scientific Name
1	Thimer/ Mangrove	*Avicennia marina*
2	Thimer/ Mangrove	**Rhizophora mucronata*
3	Fated Saltwort	*Salsola imbricate*
4	Desert Cotton/ Booh	*Aerva javanica*
5	Salt Heliotrope	*Heliotropium curassavicum*
6	Welaiti Keekar	*Parkinsonia aculeate*
7	Devi	*Prosopis juliflora*
8	Devi	*Prosopis glandulosa*
9	Rudravanti	*Cressa cretica*
10	Jar / Peroon	*Salvadora persica*
11	Kalar Garh	*Aeluropus lagopoides*
12	Ber	*Zizyphus mauritiana*
13	Ak	*Calotropis procera*
14	Neem	*Azadirachta indica*

*Re-introduced during our present study.

A previous study by Khan *et al*. (2018), conducted over three consecutive years in a larger area, including Phitti Creek, recorded several seasonal bird, mammal, and reptile species as part of a Ph.D. program. The present baseline study, conducted from September 22 to November 9, 2024, was limited to Korangi Creek and had a narrower temporal scope compared to the earlier study, which covered a wider area, including Phitti Creek and Rehri Creek.

As a result, some migratory birds and other species may have gone unobserved. A more comprehensive study covering the entire migratory season may yield a more extensive species record, providing a more accurate representation of the area's vertebrate biodiversity.

Flora of TPL Mangrove Biodiversity Park and its Surroundings

TPL Mangrove Biodiversity Park is home to a diverse array of mangrove species that play a vital ecological role in the coastal ecosystem. Mangroves are essential for stabilizing shorelines, reducing erosion, and providing habitat for a variety of marine and terrestrial species. The flora of Mangrove Biodiversity Park primarily consists of salt-tolerant plants adapted to the intertidal zones where freshwater meets the ocean.

The terrestrial flora of the surrounding area of the park mostly consists of different kinds of vegetation species and is dominated by shrubs followed by trees and grass, sub-shrubs and trees, whereas rest on the species consist of sedges, climbing-shrubs and trees.

In the present study, we observed and documented the flora within the park and its surroundings, recording 14 distinct plant species (Table 7). Notably, no Rare flora species were reported within the project area and its surroundings, and all recorded species exhibited a wide distribution range.

Reintroduction of Rizophora mucronata

During this study, we reintroduced another mangrove species, *Rizophora mucronata*, at four designated testing sites within TPL Park. On September 22, 2024, a total of 75 *Rizophora mucronata* plants were planted. Following a 53-day monitoring period, we assessed the status of the planted plants on November 15, 2024, and achieved a remarkable 100% survival rate.

CONCLUSION

The Mangrove Biodiversity Park ecosystem supports a complex food web, with mangroves providing food and shelter for resident and migratory birds, mammals, reptiles, fish, and invertebrates. These organisms, in turn, contribute to the functioning of higher trophic levels. The park's mangrove forests help protect the shoreline from erosion, storm surges, and the impacts of sea-level rise. Moreover, mangroves are highly efficient at sequestering carbon, making the park an important site for climate change mitigation.

This baseline study highlights the remarkable vertebrate biodiversity of TPL Mangrove Biodiversity Park and its surrounding areas, which encompass five distinct habitat types. Our comprehensive field surveys and literature review revealed an impressive diversity of species, including 70 bird species, 9 mammal species, 9 reptile species, and 14 plant species**.** Notably, we also recorded four IUCN Red List species classified as Near Threatened: The Black-tailed Godwit (*Limosa limosa*), Eurasian Curlew (*Numenius arquata*), Eurasian Oystercatcher (*Haematopus ostralegus*), and Long-tailed Grass Warbler (*Prinia burnesii*) (IUCN, 2024).

We reintroduced *Rizophora mucronata*, at four designated testing sites within the TPL Mangrove Biodiversity Park during the present study. On September 22, 2024, a total of 75 *Rizophora mucronata* plants were planted. Following a 53-day monitoring period, we assessed the status of the planted plants and observed satisfactory growth with a 100% survival rate. In the future, park management should consider enhancing the mangrove forest area with *Rizophora mucronata* at our tested sites.

We concluded that the TPL Mangrove Biodiversity Park exhibits a moderate to high level of biodiversity. However, significant threats persist, particularly those related to human encroachment, industrial pollution, and climate change impacts. The mangrove ecosystem is extremely fragile, and the loss of even one species could have far-reaching, cascading effects on the broader ecosystem.

This report highlights the urgent need for sustained conservation efforts to safeguard this unique ecosystem, not only for its ecological significance but also for its potential in education, research, and ensuring its preservation for future generations.

RECOMMENDATIONS

The TPL Mangrove Biodiversity Park, along with its surrounding areas, serves as a vital habitat for a sizable population of resident and migratory birds, while also supporting a diverse range of mammal and reptile species. In this study, we did not conduct water quality assessments or measure pollution levels. However, earlier published literature and our current physical surveys have observed contaminated and polluted water in the park area.

Water pollution can have severe and far-reaching impacts on mangrove ecosystems. Pollutants like heavy metals, pesticides, and industrial chemicals can accumulate in mangrove tissues, causing toxicity and harm to the ecosystem. High levels of suspended sediments and pollutants can also reduce light penetration, affecting photosynthesis and mangrove growth.

By protecting mangroves and their inhabitants, conservation efforts at the TPL Mangrove Biodiversity Park will have a transformative impact on biodiversity. This, in turn, will yield numerous benefits, including the protection of fauna and flora for future generations. Moreover, the park will be preserved as a unique "Mangrove Biodiversity Reserve" in Karachi, providing a hub for entertainment, academic activities, and environmental education.

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Selected Avifauna of TPL Mangrove Biodiversity Park



Fig. 1. Barn Swallow (*Hirundo rustica*).



Fig. 2. Black-Crowned Sparrow-Lark (*Eremopterix nigriceps*).



Fig. 3. Black Drongo or King Crow (*Dicrurus macrocercus*).



Fig. 4. Black Headed Gull (*Larus ridibundus*).



Fig. 5. Black Winged Stilt (*Himantopus himantopus*).



Fig. 6. Brahminy Kite (*Haliastur indus*).



Fig. 7. Caspian Tern (*Sterna caspia*).



Fig. 8. Cattle Egret (*Bubulcus ibis*).


Fig. 9. Common Kingfisher (*Alcedo atthis*).


Fig. 10. Common Kite/ Black Kite (*Milvus migrans*).


Fig. 11. Indian Myna/ Common Myna (*Acridotheres tristis*).


Fig. 12. Common Sandpiper (*Actitis hypoleucos*).


Fig. 13. Crested Lark **(***Galerida cristata*).


Fig. 14. Eurasian Curlew (*Numenius arquata*).


Fig. 15. Dunlin (*Calidris alpine*).


Fig. 16. Common Greenshank (*Tringa nebularia*).



Fig. 17. Gull-billed Tern (*Gelochelidon nilotica*).



Fig. 18. Great White Egret (*Ardea alba*).



Fig. 19. Grey Heron (*Ardea cinerea*).



Fig. 20. Herring Gull (*Larus argentatus*).



Fig. 21. Pied Kingfisher (*Ceryle rudis*).



Fig. 22. Indian Pond Heron (*Ardeola grayii*).



Fig. 23. Kentish Plover (*Charadrius alexandrines*).



Fig. 24. Great Cormorant *(Phalacrocorax carbo*).


Fig. 25. Lesser Sand Plover (*Charadrius mongolus*).


Fig. 26. Little Cormorant (*Phalacrocorax niger*).


Fig. 27. Little Egret (*Egretta garzetta*).


Fig. 28. Little Stint (*Calidris minuta*).


Fig. 29. Marsh Harrier (*Circus aeruginosus*).


Fig. 30. Osprey (*Pandion haliaetus*).


Fig. 31. Purple Sunbird **(***Nectarinia asiatica*).


Fig. 32. Red Wattled Lapwing (*Vanellus indicus*).



Fig. 33. Common Redshank (*Tringa totanus*).



Fig. 34. Western Reef Heron (*Egretta gularis*).



Fig. 35. Terek Sandpiper (*Xenus cinereus*).



Fig. 36. White Wagtail (*Motacilla alba*).



Fig. 37. Whimbrel (*Numenius phaeopus*).



Fig. 38. Whiskered Tern (*Chlidonias hybridus*).



Fig. 39. White Breasted Kingfisher (*Halcyon smyrnensis*).



Fig. 40. White Browed Fantail (*Rhipidura aureola*).


Fig. 41. White-Browed Wagtail (*Motacilla maderaspatensis*).


Fig. 42. White-Cheeked Bulbul (*Pycnonotus leucogenys*).


Fig. 43. Indian White Eye (*Zosterops palpebrosus*).


Fig. 44. Yellow Wagtail (*Motacilla flava*)


Fig. 45. Bay-Backed Shrike (*Lanius vittatus*).


Fig. 46. Collared Dove (*Streptopelia decaocto*).


Fig. 47. Indian Roller (*Coracias benghalensis*).

Selected Mammal Species Spotted in TPL Mangrove Biodiversity Park



Fig. 1. Small Indian Mongoose (*Herpestes javanicus*).



Fig. 2. Balochistan Gerbil (*Gerbillus nanus*).



Fig. 3. Five Striped Palm Squirrel (*Funambulus pennantii*).



Fig. 4. Asiatic Jackal (*Canis aureus*).

Selected Reptile Species of TPL Mangrove Biodiversity Park



Fig. 1. Indian Desert Monitor Lizard (*Varanus griseus*).



Fig. 2. Indian or Bengal Monitor Lizard (*Varanus bengalensis*).



Fig. 3. Saw Scaled Viper (*Echis carinatus pyramidum*).



Fig. 4. Indian Cobra (*Naja naja naja*).

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