

**IMPACT OF CONSTRUCTION OF HIGH RISE TOWERS ON MIGRATION OF  
FAUNA INCLUDING AVIFAUNA - BENGAL N R I TOWNSHIP PROJECT  
(URBANA), ANANDAPUR**

Final report

Arun P R, Rajah Jayapal & Murugesan M



Salim Ali Centre for Ornithology and Natural History, Coimbatore- 641 108

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# 1 INTRODUCTION

## 1.1 BACKGROUND

The Bengal NRI Complex Limited approached SACON in September 2012 requesting us to undertake the present study on the impact of high-rise residential towers on the migration of fauna, especially avifauna. An Environmental Impact Assessment (EIA) Study on the project was already under way for the project. As the East Kolkata Wetlands (EKW) is located towards eastern side, bordering the site, it was desired that the potential impact of these towers on the migration of avifauna be conducted by SACON covering the important migratory season of birds. Accordingly a rapid one season study was conducted by SACON from November 2012 to January 2013.

## 1.2 THE URBANA PROJECT

The Bengal NRI complex Ltd. is in the process of establishing a predominantly residential complex spread over a land area of about 65 acres, with a total built-up area of 6,50,000 m<sup>2</sup> in the eastern suburban Kolkata called 'URBANA'. The Urbana complex would comprise of 9 Towers, a series of bungalows and associated recreational facilities. The maximum height of the towers from the ground level is about 200 metres. The towers 4, 5 & 9 are located at 65, 53, and 435 meters respectively from the designated boundary of East Kolkata wetland complex. However the nearest open water area is about half a kilometre away from the URBANA site and the intervening space is already significantly built up (Figure 2 & Figure 4.)



Figure 1 Master plan of URBANA site

Table 1 Urbana Project - Salient features

PARAMETER	
Land Area	65.542 Acres
Maximum building height	200 m
Total Built-up Area	648,331.99 m <sup>2</sup>
Ground Coverage	65,516 Sq. m.
Paved Area	62,534 Sq. m.
Landscaped Green Area	107,261 Sq. m.
Water Area	4,132.64 Sq. m.
Expected Population	10,100 people (Residential- 9,900 & Commercial - 200)

### 1.3 THE EAST KOLKATA WETLANDS

East Kolkata Wetlands, spread across North and South 24-Parganas districts of West Bengal between 22° 25'N to 22° 40'N and 88° 22'E to 88° 55'E over an area of 12,700 ha (Figure 4, Appendix 4, Appendix 5), are a complex of natural drainages and wetlands that are formed largely by the urban waste and sewage from Kolkata City and partly by monsoon waters. These mosaics of wetlands are intensively put to multiple uses by humans, which include commercial fish culture and paddy and vegetable farming. The ecosystem services and environmental benefits of these wetlands are believed to be worth USD 38.54 million per year, with 1.54 lakh people directly dependent on them for their livelihood (Bhattacharyya et al., 2008). For these reasons, East Kolkata Wetlands were designated as a wetland of international importance (Ramsar Site No. 1208) in the year 2002.



Figure 2 View of of East Kolkata Wetlands.

Though these wetlands used to harbor exceptional diversity of fauna and flora in the past, massive urbanization pressure and associated human disturbance and habitat fragmentation (Figure 2) coupled with unsustainable exploitation of the wetland ecosystem for fish and vegetables have seriously affected the biodiversity value of the system. In order to halt further deterioration of this ecosystem, East Kolkata Wetlands (Conservation and Management) Act, 2006, a state Act was enacted to regulate multiple land use patterns and protect the wetlands. The State Legislation of 2006; the East Kolkata Wetlands (Conservation and

Management) Act; envisages to sustainably manage the East Kolkata Wetlands. As per this act, the East Kolkata Wetlands Management Authority (EKWMA) has been entrusted with the responsibility of conservation and management of the EKW area (Anonymous 2012). The main task of the authority is to maintain and manage the existing land use along with its unique recycling activities for which the Wetlands has been enlisted under the Ramsar List of Wetlands of International Importance.

EKW also sustains one of the world's largest resource recovery systems involving a combination of agriculture and aquaculture, supporting livelihoods of large, economically underprivileged population. Around 20,000 families depend upon the various wetland products, primarily fish and vegetables from EKW.

#### 1.4 THE PRESENT STUDY

The present short-term study was conducted covering the major migratory season of birds from November 2012 to January 2013. Extensive field surveys were conducted to record the avifauna of the region especially the migratory avifauna. The study then examined the potential risks for the migratory avifauna based on our current knowledge on the subject.

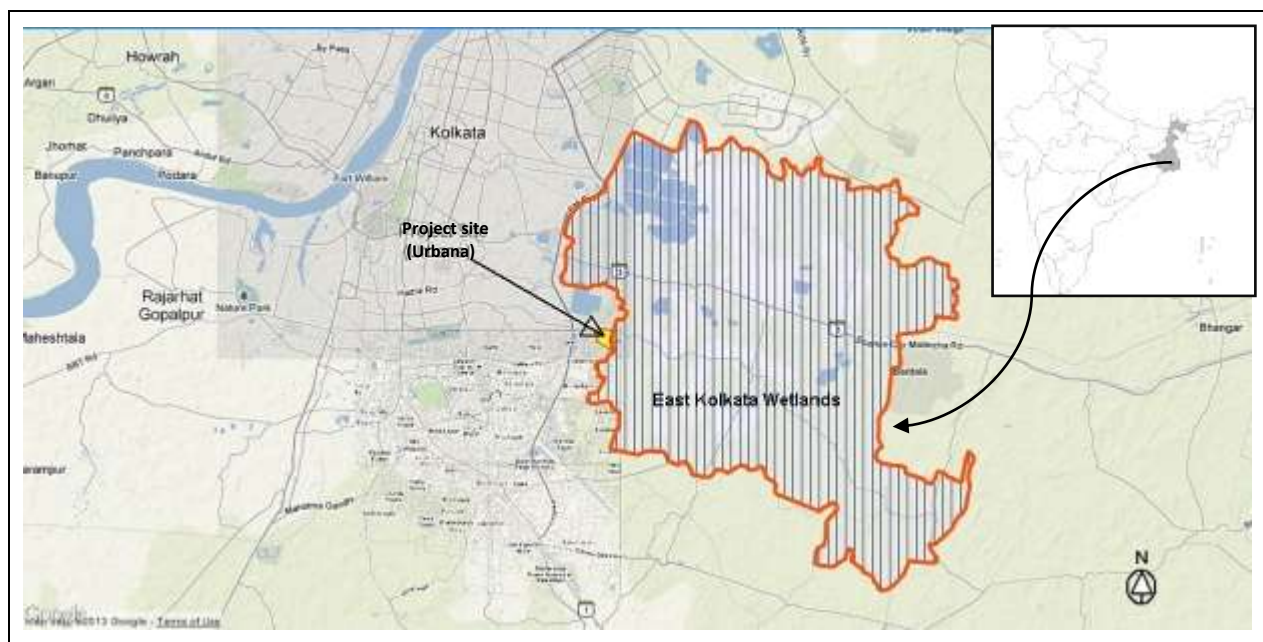


Figure 3 Location map

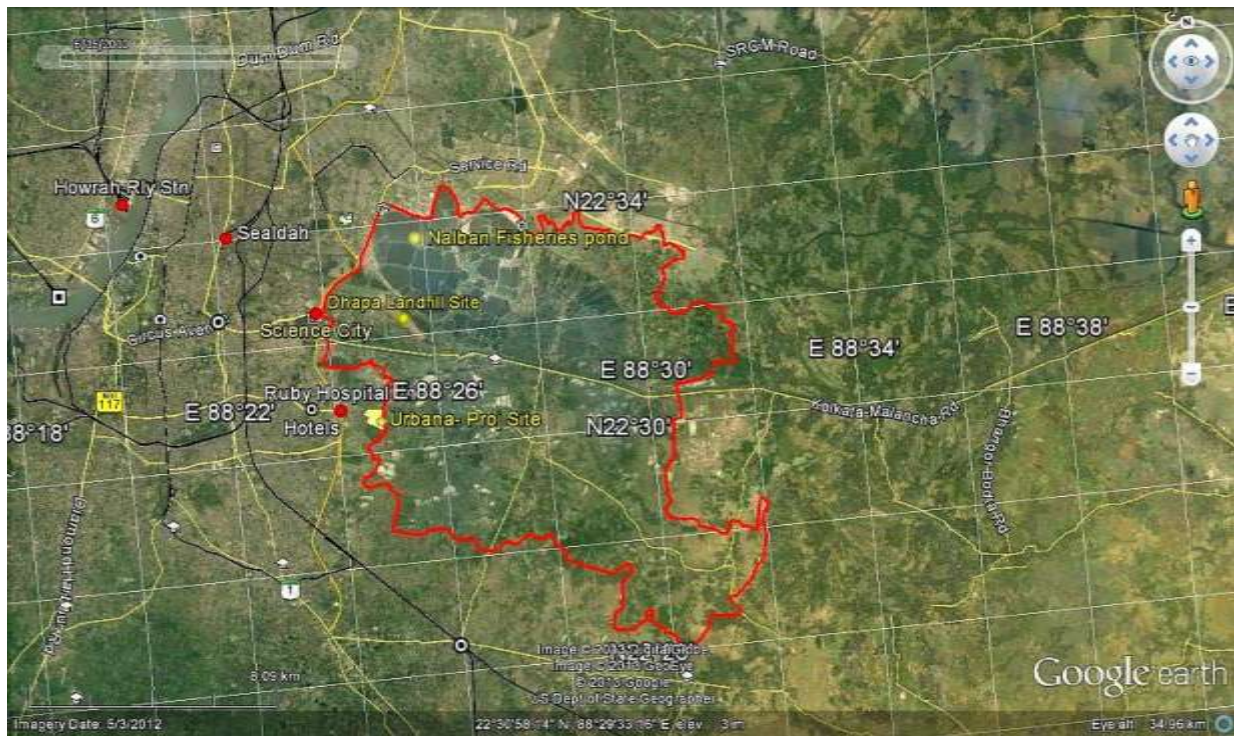


Figure 4 Satellite map of the area (from Google earth)

## 2 METHODOLOGY

The general methodology comprises two approaches: first was the field survey to collect primary data on bird populations and species diversity in East Kolkata Wetlands along with a general appraisal of the habitat quality of the wetlands. The survey was also meant to inspect the upcoming artificial structures including tall buildings. Secondly, extensive literature survey was done to gather information on the past status of birdlife of the wetlands and to gain insights into the changing trends in wetland use patterns and concomitant changes in bird diversity. Focus was particularly on migratory birds of the region, which chiefly wintered in the suburban wetlands and some of which might also use these wetlands as stopover sites along their migratory routes.

The field survey was undertaken in two phases: the first visit was during 19-23 November, 2012 followed by another follow-up survey during 22-25 January, 2013. A circular area of 10 km radius around the Urbana project site was the focus of our intensive bird survey, though wetlands beyond this circle were also covered as part of the survey. Thus, East Kolkata Wetlands as bound by Anandapur - Mundapara - Dhapa - Kolkata Leather Complex - Sonarpur - Narendrapur - Mukundapur - Anandapur formed the intensive survey area. In addition, we also surveyed wetlands of Nalban Fishery Farm (of West Bengal State Fisheries Development Corporation), located close to Salt Lake City c.10 km northwest of East Kolkata Wetlands; this wetland complex, though heavily used for fishing, is known to harbour good population of migratory ducks. Though Nalban forms the northern boundary and often considered as part of the present landscape of East Kolkata Wetlands, we surveyed Nalban complex avifauna separately as it is quite distinct from other parts of EKW in terms of human disturbance, management regime, and geolocation settings. Santragachi jheel in Howrah, about 18 km northwest of the Urbana project site was also covered during the present survey, as this wetland was popular for its exceptional number of waterbirds and could possibly represent the original birdlife of East Kolkata Wetlands before urbanization and associated human disturbances including intensive fish-farming and agriculture activities altered this natural landscape.

Data on bird species inventories from East Kolkata Wetlands were compared and contrasted with that from Nalban and Santragachi wetlands to assess the current status of birdlife of the former. The primary aim of the survey was to record all the birds both resident and migratory found in the region; since it was not possible to undertake any population census of birds within this short span of time, it was decided to go in for systematic species inventory data through repeated samples.

The field surveys were typically conducted using extensive road network that marked the East Kolkata Wetlands. A separate species inventory was maintained for each session that lasted from morning to evening. Surveys were repeated for days ranging from two to four, depending on the total area of the wetland complex.

We used species accumulation curve, a measure of the rate at which new bird species are added to the avifauna, to assess the current bird diversity of East Kolkata Wetlands and since the sampling effort was not standardized, we then used rarefaction curves using species richness values estimated through resampling ( $n = 1000$  bootstrapped randomizations). The rarefaction curves were used to compare the bird diversity of all the three wetland complexes surveyed.

## **2.1 AVIFAUNA**

Random walk and opportunistic observations were used for documenting the birds with the aid of a pair of binoculars. The bird samplings were carried out mostly during morning (06:00 to 11:00 hrs) and evening (17:00 to 19:00 hrs) hours. Point count method was used for enumerating the avifauna of the area using direct sightings as well as calls were used for recording the birds. Ali and Ripley (1987) and Grimmet et al. (1998; 2001) were referred for the identification of birds. Grimmet et al. (1998; 2001) is followed for nomenclature.

## **2.2 OTHER FAUNA**

Presence of other wild faunal elements such as mammals and herpetofauna were very low in this human dominated landscape. However, other faunal groups were also recorded opportunistically whenever they were encountered during the field surveys. The results indicated relatively poor butterfly fauna (Appendix 3).

## 3 OBSERVATIONS

### 3.1 GENERAL ENVIRONMENT

Wetlands are important bird habitats, especially for waders and migratory waterfowl. The East Kolkata Wetlands (EKW), once covered a vast landscape east of Hooghly has now reduced to around 12,500 ha and there has been a concurrent qualitative degradation of this wetland and its environments as well.

### 3.2 BIRD FAUNA

Our observations during the present study supported by relevant literature surveys and discussions with local people revealed that the EKW harbours a poor bird fauna both in terms of diversity and abundance compared to wetlands of comparable dimensions. There are extensive piscicultural activities going on in these wetlands and as a result the piscivorous birds such as Cormorants are



Figure 5 Wires over the wetland; A commonsight at EKW that prevent the bird movements

attracted to this area. It has resulted in severe competition between fish farmers and birds for the fish resource. As a result the fish farms have adopted ingenious methods to keep the birds away. The fine mesh layers over most of the fish farms prevent any bird from landing in these wetland areas. Also there are physical interruptions strategically placed in these wetlands to deter the birds from using these wetlands. However these deterrents along with other environmental factors appear to have caused the birds to desert this area for better pastures and consequently effected severe decline in the bird diversity of the area.

## 4 RESULTS

In total, 66 species of birds were recorded in the survey; more specifically, we documented the presence of 45 bird species in East Kolkata Wetlands, 37 in Nalban, and 39 in Santragachi [see Appendix 1 for the list of bird species recorded in the present survey in all the three sites]. No threatened species was, however, found during our surveys. Given its geographical spread, East Kolkata Wetlands with an expanse of over 12,000 ha in area were extremely poor in terms of bird species diversity. In comparison, Nalban with 20 ha and Santragachi with only 5 ha in area were far superior in their birdlife component.

Of the 66 species of birds recorded throughout the survey, only 12 migratory species were noted to be present. While East Kolkata Wetlands had 6 species of migratory birds, 7 were seen in Nalban and 5 in Santragachi [see Appendix 1 for the list of migratory birds observed in all the three sites].

When we compared the species accumulation curves of avifauna of East Kolkata Wetlands with that of Santragachi, it became very clear that the rate of increase in number of birds in East Kolkata Wetlands was markedly slower inferring a much poorer species pool despite a much higher sampling effort (Figure 6). In contrast, Santragachi recorded a steady increase in number of birds, a pointer to its avifaunal richness.

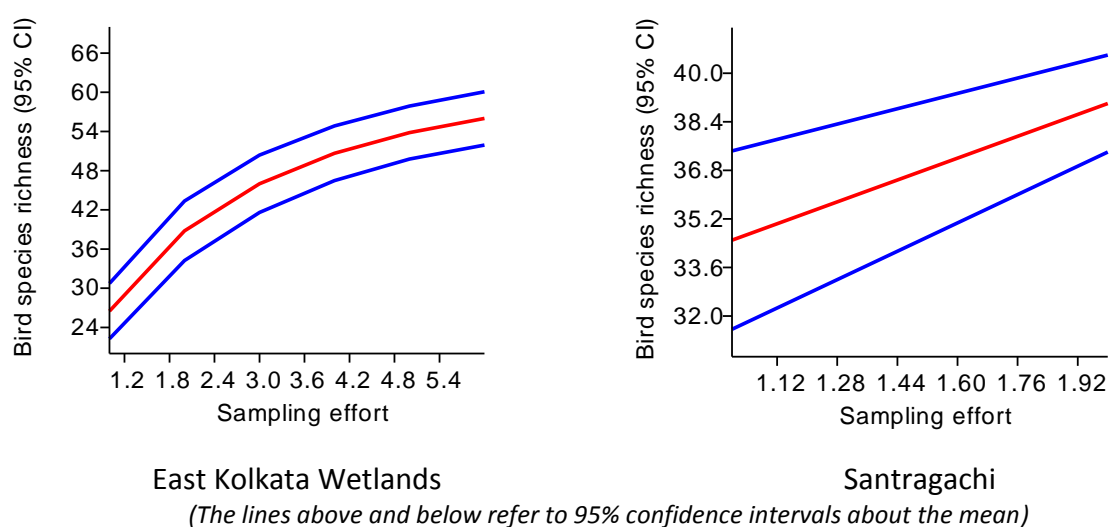
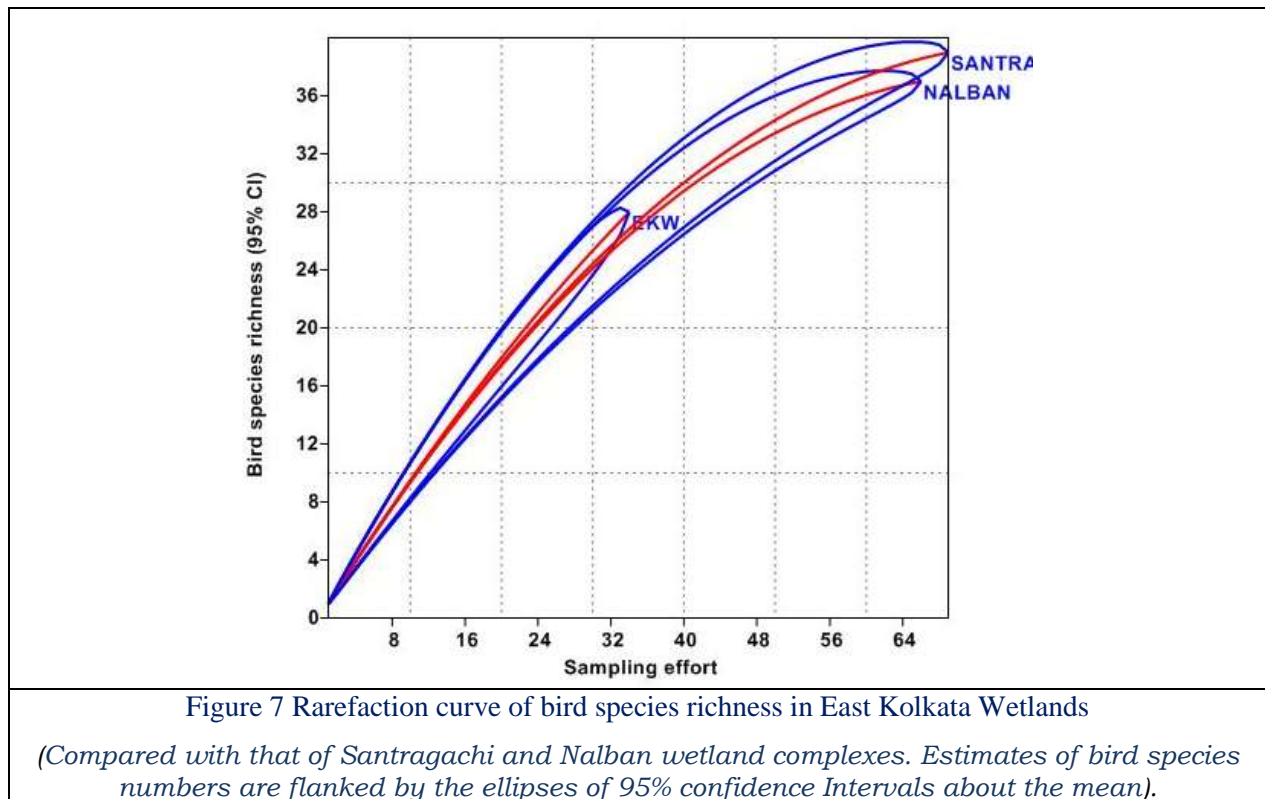


Figure 6 Species accumulation curves of bird species richness

Rarefaction analysis of the birds of all the three sites (after standardizing the sampling effort across the sites) also showed similar trends in bird species richness (see Figure 2). While both Santragachi and Nalban wetland complexes showed higher bird species richness, East Kolkata Wetlands remained relatively poor with a much truncated avifaunal diversity.



## 5 DISCUSSION

High-rise buildings reportedly can cause various negative effects on the environment, for they not uncommonly generate air turbulence and downdrafts in their immediate vicinity; they can be also a source of unpleasant reflections and some adjacent areas may remain permanently overshadowed. Illuminated facades and large glass fronts can be a hazard for certain flying birds as reported from certain other countries of the world such as United States (Evans Ogden 1996, Klem et al. 2009, Manville 2008 Klem 2008) As a result there were recent legislations such as 'Federal Bird-Safe Buildings Act of 2010' that proposes bird safe building guidelines for US. It is reported that collisions with clear and reflective sheet glass and plastic on tall structures cause the deaths of more birds than any other human-related avian mortality factor (Manville 2008). From published estimates, upto 1 billion annual bird kills in the U.S. alone is reported (Klem 2008). Wind turbines and microwave and radio-transmission (for mobile communication and television broadcasting) towers are more serious threat to birds than buildings; in a long-term study conducted by A. Clark over 29 years at three television towers in Buffalo, NY (Morris et al. 2003), a drastic decrease in the number of birds killed at the towers was noted – ranging from a high of 4787 in 1982 to a low of 6 in 1992 (Manville 2008) attributed to various reasons. However, there are no such serious reports from India on the bird mortality from tall structures. Even at wind turbines the mortality rates are minimal compared to USA and Europe (Ramesh Kumar et al 2012, Samsoor Ali et al. 2012, Pande et al. 2013).

Before we deliberate on the possible impacts of the Urbana project on wetland birds and their migration, it is imperative to assess the current status of their population in East Kolkata Wetlands and habitat quality. Our survey findings that East Kolkata Wetlands, over the years, have become depauperate in terms of bird diversity were consistent with some of the recent studies as well (e.g. Bhattacharyya et al., 2008). Incidentally, several species that were recorded regularly during 1960s and 1970s are no longer found there (Appendix 2.) For example, birdlists from erstwhile Salt Lake wetland complex (which was then part of East Kolkata Wetlands before their reclamation for the Bidhannagar Satellite Township) prepared by Zoological Survey of India and NGOs like Prakriti Samsad included bird species like Chestnut

Bittern, Black Bittern, Yellow Bittern, Ruddy Shelduck, Spot-billed Duck, Comb Duck, Ruddy Crake, Slaty-breasted Rail, Brown Crake, Pacific Golden Plover, Spotted Redshank, and Common Greenshank [See Appendix 2 for a list of bird species recorded between 1960s and 1990s, but not recorded by our survey]. Sadly, none of these species (most of which are migratory) are found today in East Kolkata Wetlands. Analyzing the frequency trends in the avifauna of East Kolkata Wetlands, Bhattacharyya et al. (2008) found that it was the migratory birds that formed the major component of birds that were locally lost since 1990s.

There are several factors believed to have led to this apparent paucity of birds in East Kolkata Wetlands and our own observations in the field also concur with published literature in this regard. Since 1990s, a large part of the wetlands have been converted to production landscape with massive expansion of fish farms, vegetable cultivation, and human settlements. According to 2005-06 estimate, there are over 1,50,000 people living amidst these wetlands. Heavy use of fertilizers and pesticides in vegetable farms has also contributed to severe degradation of water quality leading to radical changes in physico-chemical properties of water and subsequent habitat loss for most species of birds. We also observed widespread practice of covering the wetlands with closely spaced cross wires (PLATE III), staking the shallow wetlands with slender but sharp twigs and branchlets, and erecting black rags as effigies over the water surface all evidently to keep cormorants and other fish-eating birds away. We strongly suspect that this increased degree of conflict between humans and birds would have further exasperated the observed paucity of birds in East Kolkata Wetlands.

Some of the direct impacts of high-rise buildings and tall towers on migratory birds include collision with the parts of buildings (esp. glass panels and glazed walls) and blockage and disruption of migration / flight path of birds (as tall prominent buildings are often known to alter the established landmarks with which birds navigate locally). In this context, the following findings of a recent comprehensive study in US (adopted as San Francisco Standards for Bird-Safe Buildings) have implications elsewhere too (Klem et al., 2009):

1. It is the combination of factors such as location, open space availability, vegetation structure, composition of migratory bird population, window panel sizes and glasses used that control the collision rate of migratory birds along with building height.
2. The frequency of bird collisions is reported to be higher where there is lush green vegetation just outside reflective glass panels of windows.

3. A majority of collisions happen during the day, though a large number of birds prefer nights for migration.
4. High-rise buildings and night light pose less risk than large glazed windows (either transparent or reflective) of size over 1X2 m.
5. The relative proportion of the expanse of the wetland or any other open habitat to the plinth area occupied by the buildings also matter.
6. Buildings located within the clear-sight zone of 300 ft (c. 100 m) range from the edge of open habitats like wetlands or grasslands are more prone to bird collisions.

As the structural design of Urbana project does not involve extensive glazed wall or glass exteriors (which is, however, more common even in many non-residential buildings located in close proximity to the wetlands in many parts of EKW area; (See PLATE III)) and the entire project site occupies relatively smaller built-up area (c. 6 ha) as compared to 12,700 ha expanse of the East Kolkata Wetlands, the proposed buildings are less likely to affect the birds and their flight movements. Though the Urbana site is located c. 500 m close to the wetlands, there are numerous tall buildings that have already occupied the clear-zone area of 100m from the edge and as such, Urbana towers are unlikely to interrupt the flight movement of birds.

An indirect impact of urbanization on wetlands relate to habitat deterioration through dumping of solid and liquid urban wastes into wetlands and natural drainages. The entire gated community of Urbana, once fully occupied, is expected to generate an average of 4.75 tonnes of solid waste per day and 1,155 KLD of Waste Water (to be treated in the STP). The Project management may also take up an in-house solid waste management system to reduce the impact on the wetland ecosystem.

## 6 CONCLUSION

Given the extreme low diversity of birds that has now come to characterize the East Kolkata landscape, the putative impacts of the upcoming high-rise towers on bird populations of the wetlands are, at worst, minimal. Considering the fact that the East Kolkata avifauna has just 13% true migratory species and has no globally threatened species reported in recent times, we do not foresee any major negative repercussions on bird populations from the proposed housing project in near future. Further, some of our own field observations on the current status of the East Kolkata Wetlands (which remain biologically barren with irreversible changes in habitat quality due to unsustainable human interventions) mean that there is little scope for any resuscitation of wetland quality for the birds to return in the days to come. Being a peri-urban wetland, the areas surrounding the project site are already heavily urbanized with tall residential and commercial buildings. Another observed fact relevant to the present study was the absence of any serious bird hazard reports so far from the Kolkata Airport situated close to the East Kolkata Wetlands. The present flight path of aircrafts landing at the busy Netaji Subhash Chandra Bose International Airport of Kolkata passes through and converges right above these wetlands and there had been no any serious bird hit incidences reported from this airspace. This by itself indicates the absence of any significant mass movement of migratory bird over these wetlands which include the environs of URBANA. Hence it could be considered as a proxy indicator pointing to the lower risk potential for migratory birds from any high rise structures in this area as well.

The best predictor of strike rate is the density of birds in the vicinity. While our assessment shows that the impacts of Urbana project would be of marginal nature for the bird fauna, as bird populations themselves are very low in East Kolkata Wetlands. However, the trend can get reversed in future as demonstrated elsewhere (eg:- the case of flamingos that started thronging to Sewri mudflats, Mumbai in mid 1990s.). However, such a prospect seems highly unlikely in the near future, though hypothetically possible (For example, if the EKW is restored back to its natural state through future conservation efforts). Even in such an alternative, worst-case scenario, where migratory birds start visiting afresh this area in high numbers at

some point of time in future, there are reasons to believe that the impacts would be of much less significant especially from existing structures at that point of time.

## 6.1 RECOMMENDATIONS

Given the present status of the East Kolkata wetlands in terms of pollution load, water quality and disturbance levels from urbanization and aquaculture; there is little potential for this wetlands as a safe or healthy habitat for migratory birds. Results of the present rapid study clearly indicated that, the vast expanse of East Kolkata Wetlands harbour very poor avifaunal diversity, especially for migratory birds. As a result there is no potential mass movement of migratory avifauna in or across this area at an elevational profile within the range of proposed towers (~ 200m from ground level). However, going by the precautionary principle considering the reports from elsewhere, the following recommendations are made for further minimizing any unforeseen risk for birds that might arise in future.

- Avoid/ Minimise the use of reflective and transparent glass on the exteriors of the towers
- Raising tall green vegetation against reflective glass panels should be avoided
- The night lightings on the towers may be minimised and avoid the use of exterior floodlighting especially during the spring and autumn migratory seasons (from September to November and from April to June)
- Shields may be installed on night light sources (except those necessary for air traffic) to direct the light downward.
- As a positive gesture towards the environment, the project proponents may develop a programme to document and monitor bird movements and collisions, through bird population studies around the site involving relevant experts for enhancing our knowledge on the impacts of tall buildings on birds as well as to minimise response time in case of any unforeseen future exigencies.

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## 8 APPENDICES

Appendix 1 List of bird species recorded during the survey

No	Common Name	Scientific Name	EKW	Nalban	Santragachi
1	Ashy Prinia	<i>Prinia socialis</i>	1	1	1
2	Asian Pied Starling	<i>Sturnus contra</i>	1	1	1
3	Asian Koel	<i>Eudynamys scolopacea</i>	1	0	1
4	Asian Openbill	<i>Anastomus oscitans</i>	1	1	0
5	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	1	1	0
6	Baya Weaver	<i>Ploceus philippinus</i>	0	1	0
7	Black Drongo	<i>Dicrurus macrocerus</i>	1	1	1
8	Black Kite	<i>Milvus migrans</i>	1	1	1
9	Black-hooded Oriole	<i>Oriolus xanthornus</i>	1	1	1
10	Black-rumped Flameback	<i>Dinopium benghalense</i>	1	0	0
11	Blue-throated Barbet	<i>Megalaima asiatica</i>	1	1	0
12	Blyth's Reed Warbler*	<i>Acrocephalus dumetorum</i>	1	1	1
13	Bronze-winged Jacana	<i>Metopidius indicus</i>	0	0	1
14	Brown Shrike*	<i>Lanius cristatus</i>	1	1	0
15	Cattle Egret	<i>Bubulcus ibis</i>	1	0	1
16	Chestnut-tailed Starling	<i>Sturnus malabarica</i>	0	1	0
17	Citrine Wagtail*	<i>Motacilla citreola</i>	1	0	0
18	Clamorous Reed Warbler	<i>Acrocephalus stentoreus</i>	0	1	0
19	Common Kingfisher	<i>Alcedo atthis</i>	1	1	0
20	Common Moorhen	<i>Gallinula chloropus</i>	1	0	1
21	Common Myna	<i>Acridotheres tristis</i>	1	1	1
22	Common Tailorbird	<i>Orthotomus sutorius</i>	1	1	1
23	Darter	<i>Anhinga melanogaster</i>	0	0	1
24	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	0	1	0
25	Gadwall*	<i>Anas strepera</i>	0	1	1
26	Garganey*	<i>Anas querquedula</i>	0	0	1
27	Great Cormorant	<i>Phalacrocorax carbo</i>	1	1	1
28	Great Egret	<i>Casmerodius albus</i>	0	1	1
29	Greater Coucal	<i>Centropus sinensis</i>	1	0	0
30	Green Sandpiper*	<i>Tringa ochropus</i>	1	0	0
31	Grey Heron	<i>Ardea cinerea</i>	1	1	1
32	House Crow	<i>Corvus splendens</i>	1	1	1
33	House Sparrow	<i>Passer domesticus</i>	1	0	1
34	House Swift	<i>Apus affinis</i>	1	0	0
35	Indian Cormorant	<i>Phalacrocorax fuscicollis</i>	1	1	1
36	Indian Roller	<i>Coracias benghalensis</i>	1	0	0
37	Jungle Babbler	<i>Turdoides striatus</i>	1	0	0
38	Jungle Crow	<i>Corvus macrorhynchos</i>	1	0	0
39	Jungle Myna	<i>Acridotheres fuscus</i>	1	1	0

No	Common Name	Scientific Name	EKW	Nalban	Santragachi
40	Lesser Whistling-Duck	<i>Dendrocygna javanica</i>	0	0	1
41	Little Cormorant	<i>Phalacrocorax niger</i>	1	1	1
42	Little Egret	<i>Egretta garzetta</i>	1	0	1
43	Little Grebe	<i>Tachybaptus ruficollis</i>	0	0	1
44	Little Heron	<i>Butorides striata</i>	0	0	1
45	Long-tailed Shrike	<i>Lanius schach</i>	0	1	0
46	Mallard*	<i>Anas platyrhynchos</i>	0	0	1
47	Oriental Magpie Robin	<i>Copsychus saularis</i>	1	0	1
48	Paddyfield Warbler*	<i>Acrocephalus agricola</i>	0	1	0
49	Plain Prinia	<i>Prinia inornata</i>	1	1	0
50	Pond Heron	<i>Ardeola grayii</i>	1	1	1
51	Purple Heron	<i>Ardea purpurea</i>	0	0	1
52	Purple Moorhen	<i>Porphyrio porphyrio</i>	0	1	1
53	Red-throated Flycatcher*	<i>Ficedula albicilla</i>	1	1	1
54	Red-vented Bulbul	<i>Pycnonotus cafer</i>	1	1	1
55	Red-wattled Lapwing	<i>Vanellus indicus</i>	1	1	0
56	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	0	0	1
57	Rock Pigeon	<i>Columba livia</i>	1	1	1
58	Rose-ringed Parakeet	<i>Psittacula krameri</i>	0	0	1
59	Rufous Treepie	<i>Dendrocitta vagabunda</i>	1	0	1
60	Small Green Be-eater	<i>Merops orientalis</i>	1	0	0
61	Spotted Dove	<i>Streptopelia chinensis</i>	1	0	0
62	Tufted Duck*	<i>Aythya fuligula</i>	0	1	0
63	White Wagtail*	<i>Motacilla alba</i>	1	0	0
64	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	1	0	1
65	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	1	1	1
66	Yellow Wagtail*	<i>Motacilla flava</i>	0	1	0

*Include all species recorded from East Kolkata Wetlands, Nalban fishery farm, and Santragachi jheel. Species marked \* are migratory*

Appendix 2 List of bird species recorded in East Kolkata Wetlands between 1960s and 1990s, but NOT recorded during our survey during November 2012 and January 2013.

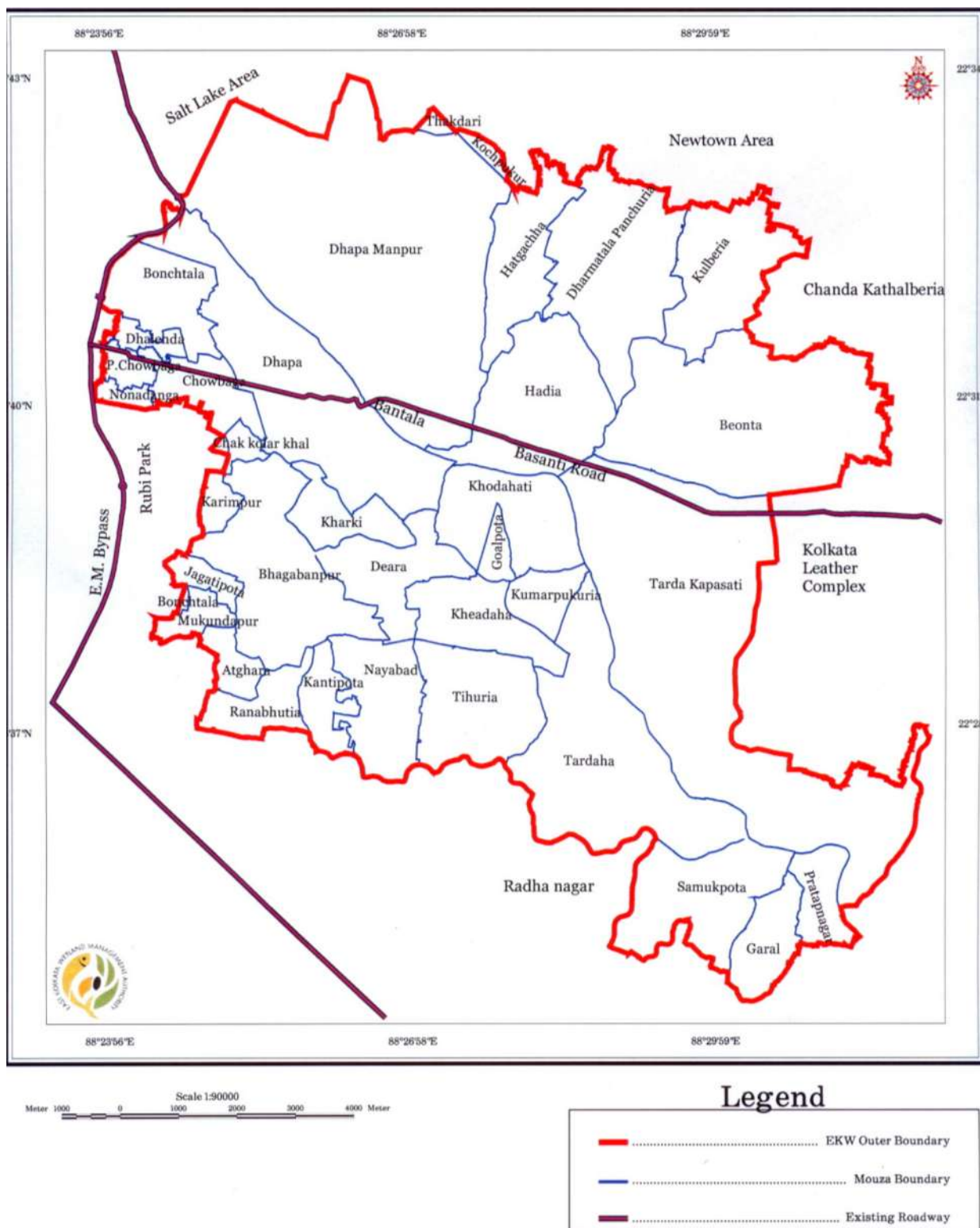
No	Common Name	Scientific Name
1	Baillon's Crane*	<i>Porzana pusilla</i>
2	Slaty-legged Crane*	<i>Rallina eurizonoides</i>
3	Bar-headed Goose*	<i>Anser indicus</i>
4	Black Bittern	<i>Ixobrychus flavicollis</i>
5	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>
6	Brown Crane	<i>Amaurornis akool</i>
7	Chestnut Bittern	<i>Ixobrychus cinnamomeus</i>
8	Comb Duck	<i>Sarkidiornis melanotos</i>
9	Common Greenshank*	<i>Tringa nebularia</i>
10	Common Teal*	<i>Anas crecca</i>
11	Curlew	<i>Numenius arquata</i>
12	Eurasian Spoonbill	<i>Platalea leucorodia</i>
13	Grey-headed Lapwing*	<i>Vanellus cinereus</i>
14	Greylag Goose*	<i>Anser anser</i>
15	Lesser Whistling Duck	<i>Dendrocygna javanica</i>
16	Little Ringed Plover	<i>Charadrius dubius</i>
17	Mallard*	<i>Anas platyrhynchos</i>
18	Oriental Darter	<i>Anhinga rufa</i>
19	Pacific Golden Plover*	<i>Pluvialis fulva</i>
20	Purple Heron	<i>Ardea purpurea</i>
21	Red-breasted Merganser*	<i>Mergus serrator</i>
22	Red-crested Pochard*	<i>Netta rufina</i>
23	Ruddy Shelduck*	<i>Tadorna ferruginea</i>
24	Ruddy-breasted Crane	<i>Porzana fusca</i>
25	Slaty-breasted Rail	<i>Rallus striatus</i>
26	Spot-billed Duck	<i>Anas poecilorhyncha</i>
27	Spotted Redshank	<i>Tringa erythropus</i>
28	Water Rail*	<i>Rallus aquaticus</i>
29	Watercock	<i>Gallicrex cinereus</i>
30	White-eyed Pochard	<i>Aythya nyroca</i>
31	Wigeon*	<i>Anas penelope</i>
32	Yellow Bittern	<i>Ixobrychus sinensis</i>

Species marked \* are migratory.

### Appendix 3 Butterflies sighted during the study

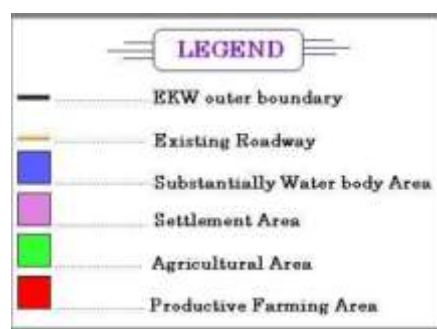
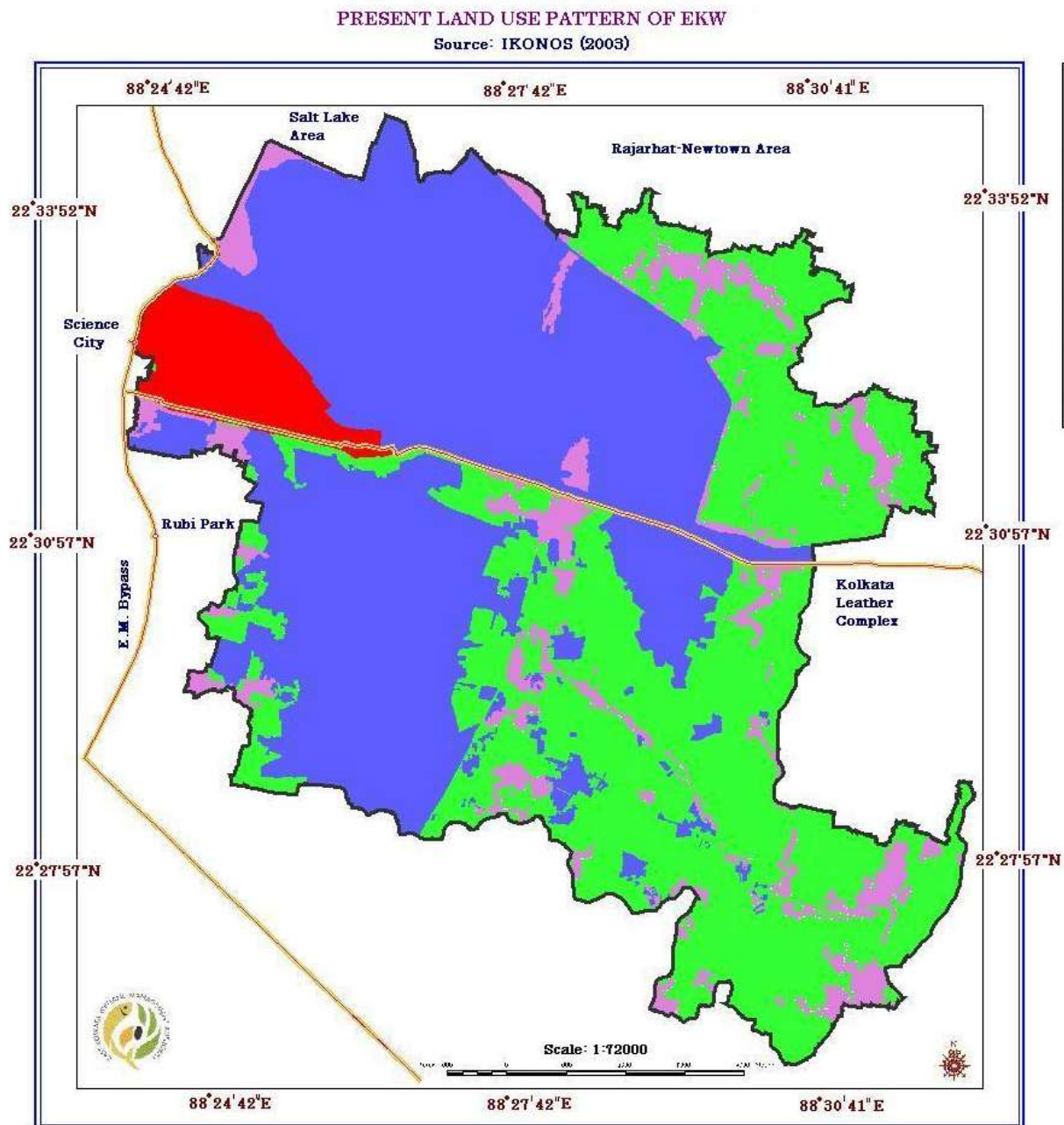
	Common Name	Scientific Name	Family
1	Common Castor	<i>Ariadne merione</i> Evans	Nymphalidae
2	Blue Pansy	<i>Precis orithya</i> Hubener	Nymphalidae
3	Chocolate Pansy	<i>Precis iphita</i> Cramer	Nymphalidae
4	Common Bushbrown	<i>Mycalesis perseus</i> Fabricius	Nymphalidae
5	Common Grass Yellow	<i>Eurema hecabe</i> Moore	Pieridae
6	Common Jay	<i>Graphium doson</i> (Felder)	Papilionidae
7	Common Mormon	<i>Papilio polytes</i> Linnaeus	Papilionidae
8	Common Palmfly	<i>Elymnias hypermnestra</i> Linnaeus	Nymphalidae
9	Common Rose	<i>Atrophaneura aristolochiae</i> Fabricius	Papilionidae
10	Common Sailer	<i>Neptis hylas</i> Moore	Nymphalidae
11	Danaid Eggfly	<i>Hypolimnas misippus</i> Linnaeus	Nymphalidae
12	Grey Pansy	<i>Precis atlites</i> (Johanssen)	Nymphalidae
13	Lemon Pansy	<i>Precis lemonias</i> Linnaeus	Nymphalidae
14	Lime Butterfly	<i>Papilio demoleus</i> Linnaeus	Papilionidae
15	Mottled Emigrant	<i>Catopsilia pyranthe</i> Linnaeus	Pieridae
16	Plain Tiger	<i>Danaus chrysippus</i> Linnaeus	Nymphalidae
17	Rice Swift	<i>Borbo cinnara</i> (Wallace)	Hesperiidae
18	Small Grass Yellow	<i>Eurema brigitta</i> (Cramer)	Pieridae
19	Spot Sword tail	<i>Pathysa nomius</i> Esper	Papilionidae
20	White Orangetip	<i>Ixias 26arianne</i> (Cramer)	Pieridae
21	Dark Evening Brown	<i>Melanitis phedima</i> Cramer	Nymphalidae
22	Common Castor	<i>Ariadne merione</i> Evans	Nymphalidae
23	The Commander	<i>Moduza procris</i> (Cramer)	Nymphalidae

Appendix 4 EKW map with Mouza boundaries (Source: EKWMA)



(Map Source: East Kolkata Wetland Management Authority)

## Appendix 5 Land Use Map of East Kolkata Wetland complex ((Source: EKWMA)



(Map Source: East Kolkata Wetland Management Authority)

## 9 PLATES

PLATE I. Some of the bird species recorded from EKW area



Pond Heron



Asian Pied Starling



White-throated Kingfisher



Citrine Wagtail



Long-tailed Shrike



Black Drongo

PLATE II. Snapshots of Avifauna from Sandracachi (a well- known bird haven outside EKW)



Lesser Whistling-ducks *Dendrocygna javanica*



Northern Pintail *Anas acuta*



Bronze-winged Jacana *Metopidius indicus*



Indian Cormorant *Phalacrocorax fuscicollis*



White-breasted Waterhen *Amaurornis phoenicurus*

PLATE III. Snapshots of EastKolkata Wetlands & associated fauna



Wetlands; netted to keep birds away !



Common Castor



Views of rapidly changing Wetland fringes (view near Nalban area)



Northern palm squirrel (*Funambulus pennanti*)



Grey Pansy *Precis atlites*



Commander- *Moduza procris*



Dark Evening Brown- *Melanites phedima*

