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A Critical Study on Status of East Kolkata Wetlands with Special Emphasis on Water Birds as Bio-Indicator

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ABSTRACT

In the year 2002 East Kolkata Wetlands has been recognized a wetland of international significance (Ramsar site No. 1208) to understand the concept of *"wise use"*. In the past it was a rich abode of wilderness and was well-known for its rich floral & faunal diversity. Today this valuable natural asset is highly threatened due to the phenomenon of urbanization. The paper mainly discuses about understating the state of wetland habitat using water bird as the biological indicator. Technological inputs of Geographic Information System & Remote Sensing along with water quality studies, social survey's results supplemented by the results of statistical analysis on secondary data of water birds, helped to understand the knotty issues regarding this wetland.

Living organisms are sensitive to the changes in the state of their environment. The changes in their abundance are used to analyze the state of the environment in the study area. Monitoring the presence, abundance as well as nature of birds species in the study area not only tells us about the current state of an environment but repeated monitoring showed a drastic change in this wetland ecosystem. To act as indicators of ecological changes, three sets of secondary data on water birds are taken from the study area on three different periods spanning over last four decades. Frequency tables for three different periods are prepared. The data also indicates that there is a change/ destruction in the wetland habitat for which the human activities are chiefly responsible. Landuse/landcover data shows highly fragmented wetlands in the core zone. Number of locally extinct species of water birds is substantially high followed by species which are migrant & fairly common. Alteration in structure i.e., fragmentation of wetlands into relatively smaller patches, draining of water bodies and release of urban waste water (including industrial waste water) has resulted in changes in wetland habitat. Water birds are now mostly found in the relatively undisturbed and protected pockets of this wetland, which also includes ecotourism spots. In some instances it was found that the nearby areas with natural vegetative cover and big water bodies even at the heart of the urban areas are attracting the water birds away from the wetlands.

Keywords: East Kolkata Wetlands, Biological Indicator, Ramsar Site No.1208

INTRODUCTION

East Kolkata Wetlands (EKW) is like a lotus in the city of concrete jungles. The 12,741 hectares of land declared as Ramsar site in November 2002 have been delivering environmental benefits worth $38.54 million. It also supports livelihood of 1.5 lakh (Approx) inhabitants directly with a sex ratio of about 919:1000. EKWL is situated in the eastern fringes of Kolkata city approximately between latitude 22° 25' to 22°40' North and longitude 88° 22' and 88° 55' east. Primarily it serves as Flood control plain, Waste recycling region and as high productive area.

The EKW area falls under the south Bengal ecotone. This region is a part of the mature delta of river Ganga, the tributaries, distributaries and re-distributaries of which were once active in this area. The EKWL now remain as remnants of the vast stretches of the Salt Lakes, which once extended beyond the present international boundary of Bangladesh. There are four major types of land use patterns prevalently seen in these man made wetlands covering 37 mouzas. They are 1) Substantially water body oriented area (primarily sewage fed fisheries)- 5852.14 ha, 2) Agricultural Area:- 4718.56 ha. 3) Productive Farming Area (garbage dumping, Dhapa):- 602.78, 4) Urban and Rural settlement:- 1326.52 ha.

Fascinating as the wetland system is, even more fascinating is the way the flow of traditional knowledge takes place from one generation to another that resulted in evolving of the outstanding practices that are practied today. The fish growers in the substantially water body area grow 3000 tonnes of fish per year in 364 sewage fed fishery ponds , vegetable

growers in the productive farming area are well known for their phenomenal traditional knowledge of growing vegetables over garbage supplying 150 tonnes of vegetables per day. The paddy is also cultivated with the water which is available as the overflow of fish ponds (bheri's). The sewage water entering the EKW system through DWF channels (Bantala gate) reaches the bheris through several secondary canals. These bheris have a depth ranging from 0.7 meter to 3 meters and fish is cultivated in these areas. They also act as big natural oxidation pond and the waste water undergoes natural treatment process. This process also provides Kolkata city free sewage treatment facility without building a STP. The oxidation pond overflow water reaches through its natural flow to agriculture area where paddy is cultivated and the final run off from the paddy fields gets collected at the far end of DWF and finally gets released in Kulti river. Figure 1 explains the process of natural waste water treatment system pictorially.

The EKW supports a population of approximately 1,50,000 and the sex ratio equals to 919 with a literacy rate of 71.18%. Most of the EKW dwellers have their own fish ponds or lands for piscicultue or agriculture respectively. The labourers are about 31.15% who don't have their own piece of land out of which 8.11% are females. The Socio Economic Profile of the people who are directly dependent on the EKWL is shown in the Table 1.

Table 1. Socio-Economic Profile of EKW Dwellers, 2005-2006.

Sl.No.	Parameters	Total/Overall (Estimated on available data)
1	Population	1,50,000 (aprox.)
2	Population density	5985
3	Decadal growth rate	-
4	Sex ratio	919
5	Child sex ratio	964
6	Literacy rate	71.18
7	% working population	31.15
8	% main worker to total population	26.91
9	% cultivators to total workers	14.22
10	% female workers to total population	8.11

These wetlands are haven for many biological resources that maintain the ecological equilibrium of this system. Productivity and food chain, bio-geo-chemical cycling, water purification, maintaining O_2-CO_2 budget are the major environmental role of biodiversity inhabiting in the wetland system. Apart from the environmental implication, wetland biodiversity are responsible for socio-economic upliftment. A good number of biological resources of this EKWL are used as food, fodder, fuel, vegetables, pulses, oils, paper-pulp, thatching material, medicine and other wetland based cottage industries.

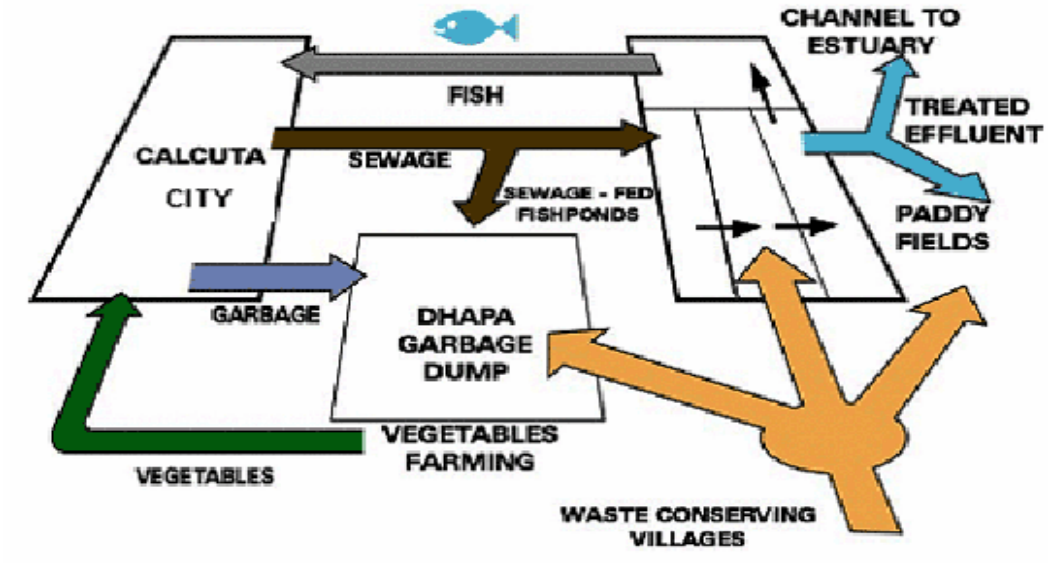

Figure 1. Technologies for Wastewater and Stormwater Management, of East Kolkata Wetlands, UNEP 2000.

Aquatic vegetation in the sewage fed ponds are mainly dominated by some floating macrophytes. Sometimes, at the edge some emergent macrophytes also cover the wetlands, which are not used in the fishery purposes harbor mixed types of wetland vegetation with major growth forms. Majumder recorded 38 species of dicots from 19 families, 62 species of monocots from 12 families and 3 species of ferns from 3 families of aquatic plants from Kolkata and adjacent localities.

In the East Kolkata Wetland 14 aquatic, 12 semi-aquatic and 11 species of non-aquatic birds, 4 aquatic and 6 semi-aquatic species of reptiles, 6 species of amphibians, 40 species of fish, 11 species of prawns, 3 species of crabs, 20 species of molluscs and 26 species of insects were recorded (De *et. al.,* 1989).

East Kolkata Wetlands & Biodiversity

Before going on with stating the loss of biodiversity (species diversity) in the study area in terms of birds and fish species composition as biological indicators, we need to precisely understand what biodiversity is. Biodiversity is an attribute of an area and specifically refers to the variety within and among living organisms, assemblages of living organisms, biotic communities, and biotic processes, whether naturally occurring or modified by humans.

Biodiversity does not just refer to the biological variation of species and protection of the threatened ones but covers the whole spectrum of the natural environment. Biodiversity refers to the variability among living organisms from all sources including, inter-alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which here a part; this includes diversity within species, between species and ecosystems (Rio Earth Summit, 1992). Productivity and food chain, bio-geo-chemical cycling, water purification, maintaining O_2-CO_2 budget are the major environmental role of biodiversity inhabiting in the wetland system. Apart from the environmental implication, wetland biodiversity are responsible for socio-economic upliftment. A good number of biological resources of this EKWL are used as food, fodder, fuel, vegetable, pulses, oils, paper-pulp, thatching material, medicine and other wetland based cottage industries.

Biodiversity can be measured in terms of genetic diversity and the identity and number of different types of species, assemblages of species, biotic processes and the amount (e.g, abundance, biomass, cover, rate e.t.c) and structure of each. It can range from micro sites and habitat patches to the entire biosphere.

Fewer species are able to persist in a number of small habitat fragments than in the original unfragmented habitat, and this can result in the extinction of species (MacArthur & Wilson,1967). If we go by these concepts then it is clear that variety of living organisms along with their assemblages, biotic process and amount has drastically changed in this highly fragmented wetlands ecosystem of EKW. The species richness of the site is lost as compared with the past.

Status of East Kolkata Wetland Ecosystem

An attempt has been made in this paper to use water birds species as indicators of the state of the wetland habitat and of human induced changes to this habitat. Using organisms to indicate the state of the environment and the changes in environment has numerous tried and tested applications. There are three distinct uses of the term “indicator species” in research ecology and biodiversity. They are a species, or a group of species, that do the following:

_ Reflect the biotic or abiotic state of an environment

_ Reveal evidence for, or the impacts of, environmental changes

_ Indicate the diversity of other species, taxa, or entire communities within an area

The focus is mainly laid on various species of water birds based in and around the East Kolkata Wetlands (EKW) and the changes it shows. It is a fact that living organisms are sensitive to the state of their environment. Pollution from human activities kills many species and reduces the abundance of others. These changes in abundance are used to analyze the state of the environment in the study area. Monitoring the presence, abundance as well as nature of birds species in the study area not only tells us about the current state of an environment but repeated monitoring showed a drastic change in this wetland ecosystem.

There is a rapid change in bird biodiversity in recent years. Zoological Survey of India recorded 248 species of birds from Salt Lakes in 1960’s (Ghosh, 1999). Prakriti Samsad also recorded 123 species of birds from Salt Lakes during the period of 1978-83. It is also found that due to reclamation of Salt Lakes and changes inflicted on aquatic and other species which resulted in absence of larger species of birds like the Openbill Stork, Spoonbill and many other species of ducks and teals including the Pintail, Shovlers, Redcrested Pochard, Turfed Pochard, the Baer’s Pochard, the shelduck, the Brahminy Duck, the Comb Duck, the Barheaded Goose etc. Also the birds of prey like Brahminy Kite, Pallas’s Fishing Eagle, Osprey and Laggar Falcon (and now Vultures) which used to be common in recent past are now no longer seen as reported by Prakriti Samsad. (personal communication, March, 2005).

METHODOLOGY

To act as indicators of ecological changes, three sets of secondary data on water birds are taken from the study area on three different periods spanning over last four decades (Table 1) from secondary sources. Frequency tables for three different periods are prepared and presented in tables 2, 3 and 4 (including a checklist) along with the graphical results of the analysis in the figures 3 and 4. Subsequently a detailed field visit was undertaken to identify areas rich in biodiversity and understand the sightings of the water birds in 2005 .

List of Water Birds in the Ekw Area

No.	Name	Genus/Species	1964-69	1978-83	1984-97	Status	Area
1	Little Grebe	Podiceps ruficollis	-	-	-	R/f	N,B
2.	Grey Pelican	Pelecanus philippenis	-	-	-	Ix	
3.	Cormorant	Phalacrocorax Carbo	-	-	-	M/u	N
4.	Indian Shag	Fuscicollis	*	*	*	R/f	N,B
5.	Little Cormorant	Phalacrocorax niger	*	*	*	R/c	N,B
6.	Darter	Anhinga Rufa	*	*	*	Ix	
7.	Grey Heron	Andea cinerea	*	*	*	R/u	N
8.	Purple Heron	Ardea purpurea	*	*	*	R/u	N
9.	Pond Heron	Ardeola grayii	*	*	*	R/u	N,B,K
10.	Cattle Egret	Bubulcus ibis		*	*	R/c	G
11.	Large Egret	Ardea alba	*	*	*	R/u	N,B
12.	Smaller Egret	Egretta intermedia	*	*	*	R/u	N,B
13.	Little Egret	Egretta garzetta	*	*	*	R/u	N,B
14.	Night Heron	Nycticorax nycticorax	*		*	R/F	G
15.	Chestnut Bittern	Lxobrychus cinnamoneus	*	*		R/r	N,B
16.	Yellow Bittern	Lxobrychus sinensis	*	*		R/r	N,B
17.	Black Bittern	Lxobrychus flavicollis	*	*		R/r	N,B
18.	Openbill Stork	Anastomus oscitans	*			R/u	N,B
19.	Spoonbill	Platalea leucorodia	*			Ix	
20.	Greyleg Goose	Anser anser	*			Ix	
21.	Barheaded Goose	Anser indicus	*			Ix	
22.	Lesser Whistling Teal	Dendrocygna javanica	*			R/f	S
23.	Ruddy Shelduck	Tadorna ferruginea	*			Ix	
24.	Common Sheldcuk	Tadona fadoma				M/v	N
25.	Pintail	Anas acuta					
26.	Common Teal	Anas Crecca	*	*	*	M/u	N
27.	Spotbilled Duck	Anas Poecilorhyncha	*			lx	
28.	Mallard	Anas platyrhynchos	*			lx	
29.	Gadwall	Anas srepera	*	*	*	M/f	N
30.	Wigeon	Anas Penelope		*	*	M/u	N
31.	Garganey	Anas querquedula	*		*	M/f	N
32.	Shoveler	Anas clypeata			*	M/f	N
33.	REdcrested Pochard	Netta rufina	*			lx	
34.	Common Pochard	Aythya ferina			*	M/u	N
35.	White Eyed Pochard	Aythya nyroca		*	*	M/u	N
36.	Baer's Pochard	Aythya baeri	*			lx	
37.	Tufted Pochard	Aythya fuligula	*	*	*	M/f	N
38.	Cotton Teal	Nettapus coromandelianus	*	*	*	R/r	N,B
39.	Comb Duck	Sakidiomis melanotos	*			lx	
40.	Redbreasted merganser	Mergus serrator	*			lx	
41.	Marsh Harrier	Circus aeruginosus	*	*	*	M/u	N
42.	Crested Serpent Eagle	Spilornis cheela	*		*	R/v	K
43.	Osprey	Pandion heliaetus	*	*	*	M/r	N
44.	Common Bastard Quail	Tumix suscicator	*			lx	
45.	Water Rail	Rallus Aquaticus	*	*		?	S,B
46.	Bluebreasted Banded Rail	Rallus striatus	*			?	S,B
47.	Banded Crake	Rallina eurizonoides	*			?	S,B

48.	Baillon's Crake	Porzana pusilla	*			?	S,B
49.	Spotted Crake	Porzana porzana	*			?	S,B
50.	Ruddy Crake	Porzana fusca	*			?	S,B
51.	Brown Crake	Amauromis akool	*			?	S,B
52.	Whitebreasted waterhen	Amauromis phoenicurus	*	*	*	R/f	N,B
53.	Watercock	Gallicrex cineres	*		*	R/u	S,N
54.	Moorthen	Gallicrex cineres	*	*	*	R/f	N,B
55.	Purple Moorthen	Porphyrio porphyrio	*	*	*	R/u	N,B
56.	Coot	Fulicata atra	*	*	*	M/u	N,B
57.	Pheasant-tailed Jacana	Hydrophasianus chirurgus	*	*		R/r	N
58.	Bronzewinged Jacana	Metropidius indicus	*	*	*	R/u	N,B
59.	Greyheaded Lapwing	Vanellus cinereus	*	*		?	
60.	Redwattled Lapwing	Vanellus indicus	*	*	*	R/u	
61.	Spurwinged Lapwing	Vanellus spinosus	*			lx	
62.	Yellow-wattled Lapwing	Vanellus malabaricus	*			lx	
63.	Grey Plover	Pluvialis Squatarola	*			lx	
64.	Eastem Golden Plover	Pluvialis dominica	*	*		M/r	N
65.	Ringed Plover	Charadrius hiaticufa			*	M/v	N
66.	Little Ringed Plover	Charadrius dubius	*		*	M/u	N
67.	Kentish Plover	Chandrius alexandrinus			*	M/u	N
68.	Curlew	Numenius arquata	*			lx	
69.	Blacktailed Godwit	Limosa limosa			*	M/r	S
70.	Spotted Redshank	Tringa erythropus	*			lx	
71.	Marsh Sandpiper	Tringa stagnatilis	*		*	M/r	N
72.	Greenshank	Tringa nebularia	*			?	N

Table 2. Frequency table for the period 1964-69

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N	12	10.3	10.3	10.3
	Y	105	89.7	89.7	100.0
	Total	117	100.0	100.0	

Area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	O	44	37.6	37.6	37.6
	B	1	0.9	0.9	38.5
	G	8	6.8	6.8	45.3
	K	1	0.9	0.9	46.2
	N	32	27.4	27.4	73.5
	N,B	19	16.2	16.2	89.7
	N,B,K	1	0.9	0.9	90.6
	S	3	2.6	2.6	93.2
	S, B	7	6.0	6.0	99.1
	S, N	1	0.9	0.9	100.0
	Total	117	100.0	100.0	

Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	?	12	10.3	10.3	10.3
	lX	35	29.9	29.9	40.2
	M/f	14	12.0	12.0	52.1
	M/r	10	8.5	8.5	60.7
	M/u	10	8.5	8.5	69.2
	M/v	3	2.6	2.6	71.8
	R/c	5	4.3	4.3	76.1
	R/f	9	7.7	7.7	83.8
	R/f	1	0.9	0.9	84.6
	R/r	6	5.1	5.1	89.7
	R/u	10	8.5	8.5	98.3
	R/v	1	0.9	0.9	99.1
	Status	1	0.9	0.9	100.0
	Total	117	100.0	100.0	

Table 3: Frequency table for the period 1978-83

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N	69	59.0	59.0	59.0
	Y	48	41.0	41.0	100.0
	Total	117	100.0	100.0	

Area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	O	44	37.6	37.6	37.6
	B	1	0.9	0.9	38.5
	G	8	6.8	6.8	45.3
	K	1	0.9	0.9	46.2
	N	32	27.4	27.4	73.5
	N,B	19	16.2	16.2	89.7
	N,B,K	1	0.9	0.9	90.6
	S	3	2.6	2.6	93.2
	S, B	7	6.0	6.0	99.1
	S, N	1	0.9	0.9	100.0
	Total	117	100.0	100.0	

Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	?	12	10.3	10.3	10.3
	lX	35	29.9	29.9	40.2
	M/f	14	12.0	12.0	52.1
	M/r	10	8.5	8.5	60.7
	M/u	10	8.5	8.5	69.2
	M/v	3	2.6	2.6	71.8
	R/c	5	4.3	4.3	76.1
	R/f	9	7.7	7.7	83.8
	R/f	1	0.9	0.9	84.6
	R/r	6	5.1	5.1	89.7
	R/u	10	8.5	8.5	98.3
	R/v	1	0.9	0.9	99.1
	Status	1	0.9	0.9	100.0
	Total	117	100.0	100.0	

Table 4: Frequency table for the period 1984-97.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N	58	49.6	49.6	49.6
	Y	59	50.4	50.4	100.0
	Total	117	100.0	100.0	

Area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	O	44	37.6	37.6	37.6
	B	1	0.9	0.9	38.5
	G	8	6.8	6.8	45.3
	K	1	0.9	0.9	46.2
	N	32	27.4	27.4	73.5
	N,B	19	16.2	16.2	89.7
	N,B,K	1	0.9	0.9	90.6
	S	3	2.6	2.6	93.2
	S, B	7	6.0	6.0	99.1
	S, N	1	0.9	0.9	100.0
	Total	117	100.0	100.0	

Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	?	12	10.3	10.3	10.3
	lX	35	29.9	29.9	40.2
	M/f	14	12.0	12.0	52.1
	M/r	10	8.5	8.5	60.7
	M/u	10	8.5	8.5	69.2
	M/v	3	2.6	2.6	71.8
	R/c	5	4.3	4.3	76.1
	R/f	9	7.7	7.7	83.8
	R/f	1	0.9	0.9	84.6
	R/r	6	5.1	5.1	89.7
	R/u	10	8.5	8.5	98.3
	R/v	1	0.9	0.9	99.1
	Status	1	0.9	0.9	100.0
	Total	117	100.0	100.0	

RESULTS & DISCUSSION

Check list Status of Birds

R=Resident

M=Migrant

P=Partly Migrant

Present Abundance

c = common; seen in very high numbers and/or on many occasions in suitable habitat.

f = fairly common; seen on more than one occasion or in fairly high numbers.

u=uncommon; seen on one /two occasions and / or one or two individuals.

v = vagrant

lx = locally extinct

? = unknown

Area Code

N = Nalban bheri / North Saltlake wetland

B = Banabithan

K = Krishnapur canal

G = Applicable to all of urban bidhannagar

S = South Saltlake i.e., wetland and south of Dhapa, Bhangar road towards Basanti

O = Other surrounding areas

Note:

- 1964-69 data relates to sightings and bird species collected by Dr. Biswamoy Biswas, Zoological Survey Of India (ZSI).
- 1978-83 checklists of birds of CMDA observed.
- 1984-97 checklist is prepared by the team of Prakriti Samsad based on observations and sightings.

Statistical analysis of three sets of data (Table II, III & IV) shows that the number of extinct species is substantially high followed by species which are migrant & fairly common. Species which are Migrant & resident, Migrant & uncommon and Resident & uncommon species are moderately high followed by species of water birds which are Resident & fairly common.

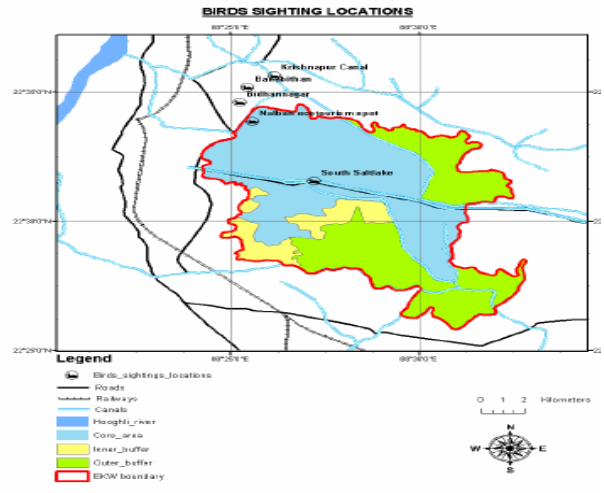

Figure 2. Water Birds Sightings Locations

Data shows that (Figure 3 & 4) the sightings are very high on particularly two locations i.e., Nalban and Banabithan. Nalban is an ecotourism site of about 20 hectares on the north-west corner of East Kolkata Wetlands. Initially developed for recreational purpose this site has now become a sanctuary for water birds. Adjoining areas are extensively used for fisheries and allied activities. This may have resulted into habitat degradation for water birds.

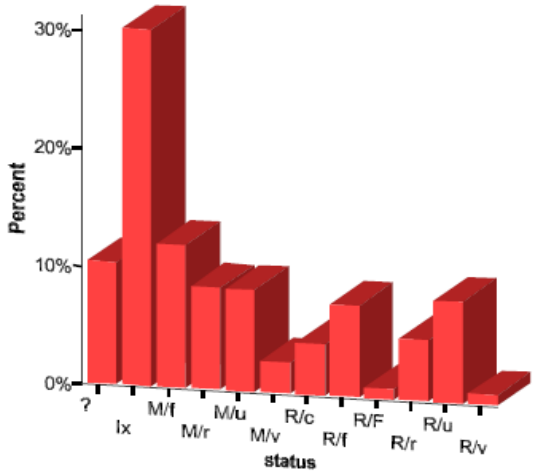

Figure 3: Status of Water Birds Sightings

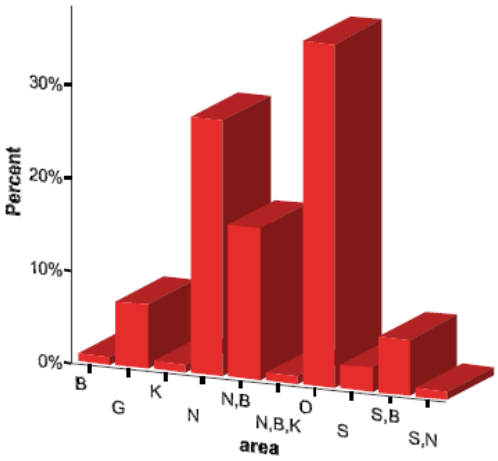

Figure 4: Abundance of Water Birds Sightings

Banabithan is another spot at the heart of Salt Lake City which is an abode of avifauna. As the entire Salt Lake City is reclaimed out of wetland, this site is naturally having good vegetative cover as well as huge natural water bodies along with high protection level. For last few years this site is also getting squeezed from many sides as more and more land is reclaimed for transport depots, parks, playgrounds and for few other urban development plans. Areas in and around the waste water canals also show the significant absence of number of water birds. Data shows that the areas which are either provided high level of ecological protection and/or kept at almost similar condition of natural wetlands are rich in water birds. It is felt that development of ecotourism spots on the perimeters of this wetland can provide a protective buffer as well as safe refuge for water birds along with promoting awareness and generating revenue. (Figure 2).

The fundamental difference between the present study and the past one is that today the site of observation is totally controlled by the human agencies. As the fisheries are controlled and fish species composition is regulated by humans for a few selected fish species and also very little vegetation is allowed to grow other than water hyacinth fringing the fish ponds (for waste water treatment, fish habitat and erosion control) along with complete absence of reed beds, the nesting sites, roosting grounds and thus shelters of water birds are lost. Only birds which adapt to the present level of pollution, to changed habitat and can match their food habits are able to survive and nest in the selected pockets of these wetlands which also overlap with the ecotourism spots of these wetlands like Nalban (20 hectares), a major ecotourism spot at the north-western edge of this wetland.

Other areas of good number of sightings overlaps with major canals and a patch of greenery in the center of the Salt Lake City i.e., Central Park (59.77hectares) and the entire urban area of Salt Lake City, which was again a reclaimed area out of this wetland in the past.

CONCLUSION

In some cases the complete disappearance of certain species and their local extinction can also be attributed to the following reasons:

_ Lack of niche due to reclamation and hunting.

_ Lack of food, which are again based on the presence or absence of other species.

_ Heavy usage of chemicals in agriculture and fisheries related activities.

The data on water birds, as a biological indicator, also indicates that there is a change in the wetland habitat and for which the human activities are chiefly responsible. Landuse/landcover data shows (figure 5) highly fragmented wetlands in the core zone. Number of locally extinct species of water birds is substantially high followed by species which are migrant & fairly common. Alteration in structure i.e., fragmentation of wetlands into relatively smaller patches, draining of waterbodies and release of urban waste water has resulted into changes in wetland habitat. Water birds are now mostly found in the relatively undisturbed and protected pockets of this wetland, which also includes

ecotourism spots. In some instances it was found that the nearby areas with natural vegetative cover and big water bodies even at the heart of the urban areas are attracting the water birds away from the wetlands.

So, under the pretext of *"wise use"* concept, the remaining pockets of East Kolkata wetlands with vast expanses of waterbodies and rich biodiversity should be brought under suggested green belts by USAID-ICMA-CEE- Conservation and management Plan of EKW. Protect the adverse impact on wetland ecosystem as a whole. In this perspective either particular attention is needed for this Ramsar site whose ecological character has changed as a result of technological developments, pollution or other human interference. Following actions were identified. Dr. Anirban Roy, Scientific officer, West Bengal Biodiversity Board agreed to provide necessary information pertaining to species, species diversity and Indigenous species. The following sites were screened during the field visit and suggested for

1. Land near Captain Bheri for Interpretation Centre. (near the E.M.Bypass).:

a. A triangular shaped piece of wetland measuring 5 acre aprox. on the side of E.M.bypass (Chingrighata bus stop) is very rich in biodiversity and most accessible to visitors. It was suggested by the Team members of the visit that this particular land can serve best for making Intrepretation centre. It also has several mangrove species and many waterfowls visit frequently. This site is also prone to encroachment as it is on the road side and easy accessibility.

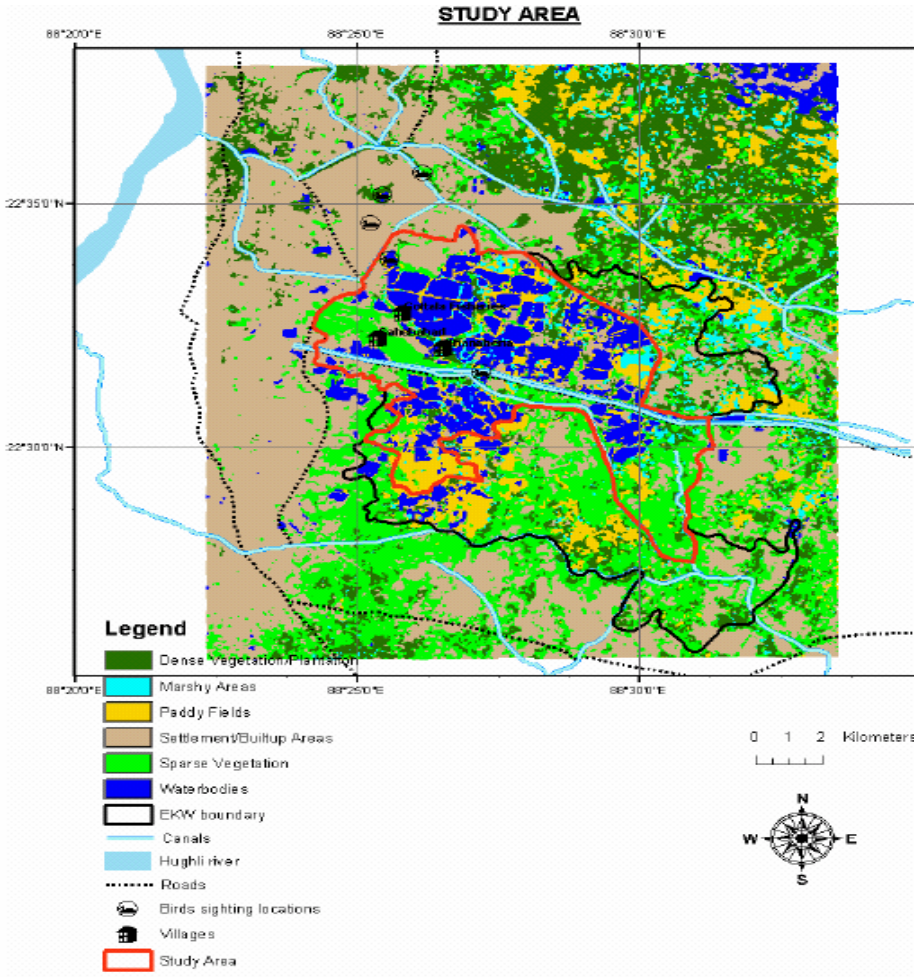

Figure 5. Landuse/Landcover Data Showing Highly Fragmented Wetlands

2. Harhare Bheri for Species conservation in wild. The area is much larger covering not less than 25-30 acers aprox. This area is much near to the old IWMED office within East kolkata wetlands core zone. Much of the biodiversity in the area is found within and around the old defunct STP build. Stretches of land in and around the canal flowing in the nearby bheri have retained old endemic species of plants, climbers, lichens etc. The area is rich in butterfly species and many other fauna. It is situated in the interiors of the core zone and the community living in and around are aware of the value of the land.
3. Behind Bantala football Ground for species conservation in wild.
   This area is adjacent to the above and constitutes the canal region.
4. Behind BIT- natural wetland non agricultural area.
   This area is quite big , not less than 40 to 50 acres. All the wetland species are intact found in their progressive succession stage. This area represents the parent wetland character which always use to prevail. Patches of mangroves, endemic species of plants, animals etc are also found.
5. Bamonghata fish co-operative for Ecotourism.
6. While moving more interior in to the wetlands nearing the border from east side, a unique biodiversity rich area lying in the periphery of core zone and inner buffer zone is best suited for developing nature tourism site involving communities living in there. The site is free from air & noise pollution, little interior to the main road passing through the wetlands pleasant and extremely beautiful. This area is also rich in biodiversity. Fish is cultivated in Bheris and there are 2 to 3 small dingis which are used for harvesting fish and also for taking visitors for ride in the bheri. Several visitors come catch their fish, cook and have it there itself. The Bheri owners or labors help them get it done. Its more like a day picnic spot. Further near to the same Bheri is a patch of old mangrove trees on the sides of canal which indicates that these wetlands were a part of Surdarbans. It is understood that such patches are found more through the canal sides while moving interior in EKWL.

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