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Bird Watching as an Eco-Health Indicator: A case study of Kulik Wild life Sanctuary, Uttar Dinajpur District, West Bengal, India

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Abstract: *The paper is an attempt to identify the importance of bird watching as a determinant of environmental health. To critically understand the eco-health of the habitat, the trend of arrival, food and habitat of bird population in Kulik Wildlife Sanctuary of West Bengal have been analyzed and results indicate that flood in the river Kulik very adjacent to that sanctuary is the foremost cause of decline in the arrival of certain species. Apart from the flood, the changing climate, deforestation and anthropogenic factors are also probable factors responsible for such decline. Therefore, such analysis or approach of study does not only reveal the spatio-temporal conditions of the concerned habitat but also signify the state of that habitat- whether it is lowering down or stable or recuperating.*
Keywords: *Environmental changes, Eco-Health indicator, Kulik Wildlife Sanctuary, Bird watching*

I. Introduction:

Kulik wildlife Sanctuary is claimed to be the second largest bird sanctuary in Asia and perhaps the largest abode of Asian Open Bill population in the world. It is a natural home of Asian Open Bill (*Anastomus oscitans*), Black Crowned Night Heron (*Nycticorax nycticorax*), Great Egret (*Casmerodious albus*) and Little Cormorant (*Phalocrocorax niger*). The ecology of bird species in Kulik Wildlife Sanctuary of Raiganj has been depicted in few researches [1]. The changes of bird population in any specific locality can be utilized to measure the dynamicity of the ecosystem. Suitable parameters must be devised to understand the eco-health of any habitat. The ornithological characteristics can be utilized in evaluating the eco- condition of Kulik Wild Life Sanctuary [2]. The compilation of K. N. Dare reveals records of ecology and behaviour of most species of Indian birds that exist in the text of ancient India [3].

Bird watching has strong link with biodiversity of an area that acts as potential indicator of environmental quality [4]. It has two main advantages compared with non-biological monitoring. First, it is possible to detect environmental changes which cannot be observed or predicted by measuring a limited set of pre-selected physical or chemical parameters, and second, to detect and monitor biological, often cumulative and non-linear consequences of many environmental changes acting simultaneously.

Four fold aspects of biological monitoring given by Zonneveld (1993) and Koskimies (1987 ; 1989) highlights that environmental changes can not determined by a single factor or observation or by a host of factors due to complexities and anomalous result but bird watching is relatively easier, more authentic and less expensive.

Bird Watching is one of the eco-health indicators which are sensitive to natural or human-caused change in the environment. Eco-health indicator is defined as an organism so strictly associated with the particular environmental conditions that its presence is indicative of the existence of certain conditions [5]. Good indicators are specialized in their habitat needs, thus reacting rapidly to changes. Birds have been considered to the most useful eco health indicator because they are ecologically versatile and live in all kind of habitats as herbivore, carnivore and omnivores [6],[7]. The ecology of birds is well known, and census and other study materials are well developed compared with those used for other biological taxa.

Furthermore, bird watching is relatively inexpensive because voluntary bird watcher can gather the field data [8]. Birds respond to quantitative and qualitative changes in their environment, usually they are not the indicator of the primary cause of this change [5]. Birds most often respond to secondary changes brought about by the primary causes.

Generally, birds are quite consistent in their habitat preferences [9].Often the changes in the abiotic regime of an ecosystem, or cause variables, may be overlooked, be too subtle, or be of no interest to be monitored directly [8]. Bird watching and monitoring of its population is necessary for several purposes of describing environmental conditions. Birds count is required to examine habitat issues or environmental threats [10].

II. Study Area:

This study was conducted in the Kulik Wildlife Sanctuary, which is located along the western bank of the river Kulik between $25^0$35' to $25^0$57' N latitude and $88^0$07' to $88^0$17' E longitude and 2 km away from the Raiganj town in North Dinajpur District in West Bengal, India. The bird sanctuary is located in both the sides of N.H. 34 or Kolkata-Siliguri Highway. The area of this sanctuary is around 1.30 km^2. The core area is about 0.14 km^2 and the rest is buffer area. The sanctuary has a thick canopy of the deciduous trees, which provides the nesting place for Open Billed Stork, Black Crowned Night Heron, Great Egret, Little Cormorant etc. The river Kulik, a tributary of Mahananda River, via the river Nagar, flows round a part of the sanctuary and acts as the boundary in its eastern and western parts. The sanctuary has a network of artificial canals connected with the river Kulik [11]. Annual precipitation range varies from 1200 mm to 1550 mm, mean winter temperature from 09^0C to 23^0C and summer temperature from 21^0C to 25^0C, and humidity more or less 75 were recorded [12].

III. Database and Methodology

The entire frame of the study has been categorically built on rigorous field survey based on observation in particular. In addition, data has been collected from the secondary sources like official documents of respective departments. However, along with it, some secondary sources of data like books and journals, etc have also been consulted to prepare the paper. The data has been collected from 1985 to 2009. The long term data is important because in maximum time, it is noticed that short term data collection is misleading or inadequate. Obtained information has been mathematically calculated to derive the results.

IV. Biodiversity of Kulik Wildlife Sanctuary

4.1. Plant communities

There is a galaxy of species of trees around the river Kulik and this diversity is also found within the town to a limited extent. The keen relationship between soil and climate has given birth to diverse floristic mosaic in this region. Initially, almost 800 species of angiosperms were found in the area. The four different bird species prefer different plant species for reproduction and nest building like *Ficus bengalensis,Acacia auriculiformis, Tectona grandis, Anthocephalus indicus, Barringtonia acurangula, Eucalyptus* sp. *Ficus glomerata, Terminalia arjuna, Dalbergia sisoo, Bambusa tulda, Bombax ceiba, Alstonia scholaris, Streblus asper, Lagerstoemia speciosa, Trewia nudiflora* etc [13]. Among these plants species, Open-Billed Stork mainly built their nests on the tree, *Lagerstoemia speciosa*, because these trees are branched, hard and bushy type, help to construct nest properly [12]. Great Egret prefers mainly *B. tulda* tree. Though, Black Crowned Night Heron and Little Cormorants built their nest mainly on *B. acurangula, L. speciosa, B. tulda* trees [13].

4.2. Birds Communities

The resident birds of this area are kites, flycatchers, owls, kingfishers, woodpeckers, drongoes, etc. But, the basic attraction of Kulik Wildlife Sanctuary is the seasonal congregation of different migratory birds which arrive here each year from South Asian countries and coastal regions. They start arriving from June. Their number and diversity are most amazing. The migratory species includes open-bill storks, egrets, Black Crowned Night Herons and Cormorants , their range and habitat as well as temporal shelter are mentioned (Table 1).

Table 1: Habitat and foods of birds

Sl. No.	Name of birds	Scientific Names	Range and habitat	Major Plant species used for building nest
1.	Open Bill Stork	*A. oscitans*	OR	*F. bengalensis, A. indicus, A. scholaris, B. acurangula, B. tulda, T. arjuna, S. asper, D. sisoo, T. nudiflora,* etc.
2.	Black Crowned Night Heron	*N. nycticorax*	Central NA to Southern NT, southern WP, EP to AF.	
3.	Great Egret	*C. albus*	NA, NT, AF, EP, OR,AU	
4.	Little Cormorant	*P. niger*	OR	

Abbreviations used in the table stand for: WP- Western Palaearctic including northern Africa & middle East; EP- Eastern Palarctic including Japan & Northern China; AF- Aftropical region including Red Sea; OR- Oriental region including Himalayas, Phillipines & up to Wallace's line; AU- East of Wallace's line to Eastern New Guinea, Australia & New Zealand; NA- Near Arctic south of Rio Grande; NT- Neotropical, America & West Indies.

Majority of the members of Order Ciconiiformes forms Heronry. There are very few heronries in India, particularly those that are well protected against human greed. The heronry is the place where various species of water birds breed or roost symbiotically. It is defined as the habit of nesting colonially [14]. Ornithologically, Kulik Wildlife Sanctuary is a very important heronry. As per the breeding population data of Asian open bills,

the sanctuary reveals that it regularly supports 32 - 40 percent of the existing population of Asian open bills of South Asia. A heronry, which supports such a high percentage of Asian open bills, is not only nationally important heronry but also an internationally significant. The time of formation of heronry is July to December. Asian Open Bill Stork generally starts nesting during mid of June, though the migration depends upon the Rain. It is seen that if monsoon starts early, the Asian Open bill also comes early. It is commonly known as Samukh (snail) khol because it mainly feeds on Molluscs (the main diet is *Pila globasa*), sometimes on frogs, lizards and fish [14]. The Black Crowned Night Heron generally starts nesting during late March and early April. The Black-crowned Night-herons are a generalist predator with a varied diet, which includes fish, molluscs, crustaceans, mammals, amphibians, reptiles, invertebrates, vegetation and bird eggs and chicks [15],[16]. As per the Atlas of Breeding Bird of Alberta published by Federation of Alberta Naturalist, Canada, the breeding time of this bird is ranging from May to August, although varies spatially. A large stick – platform nest is made by Great Egret in bushes or on a horizontal tree limb in late April through June [17]. The little Cormorant generally starts nesting in the beginning of April [18]. Such species is found mostly in the south of Asia and builds nests around lakes, rivers and feeds on fishes, tadpoles, crustaceans [19].

Birds are the key mobile links and as the most mobile of them all, migratory birds contribute to the function of diverse eco-system. This makes migratory bird's prime witnesses to global climate change [20]. The rhythmic patterns of arrival of birds are phenomenal as well as very much seasonal.

Table 2: Trends of arrival of different birds

Years	**Asian Open Bill Stork** *A. oscitans* **Systematic position:** Class- Aves Order- Ciconiiformes Family- Ciconiidae Genus- *Anastomus* Species- *A. oscitans*	**Black Crowned Night Heron** *N. nycticorax* **Systematic position:** Class- Aves Order- Ciconiiformes Family- Ardeidae Genus- *Nycticorax* Species-*N .nycticorax*	**Great Egret** *C. albus* **Systematic position:** Class- Aves Order- Ciconiiformes Family- Ardeidae Genus- *Casmerodious* Species- *C. albus*	**Little Cormorant** *P. niger* **Systematic position**: Class- Aves Order-Suliformes Family- Phalacrocoracidae Genus- *Phalocrocorax* Species- *P. niger*	**Total**
1985	24240	5168	2596	4044	36048
1989	39996	8052	3012	6476	57536
1993	21640	1362	1692	6455	31238
1997	30908	7844	4608	6360	49720
2001	56148	6512	3448	10448	76556
2005	51448	9284	6744	7792	75268
2009	72680	12720	12716	11908	110024

Source: Kulik Wildlife Sanctuary

If orders and associated families of each bird species is analyzed, it comes into notice that the Asian Open Bill Stork (*A. oscitans*), that occupies highest number in the bird population in the study area comes under order ciconiiformes and ciconiidae family and reflects the healthy wetlands [21]. Similarly, Black Crowned Night Heron (*N. nycticorax*) and Great Egret (*C. albus*), come under order ciconiiformes and ardeidae family respectively. The third prominent migratory bird in this area is Little Cormorant (*P. niger*) which comes under order suliformes and family phalacrocoracidae (Table 2).

It is observed that in the year 1985, the total number of birds in the study area was 36048, out of which 24240, 5168, 2596, 4044 was Open Bill Storks, Black Crowned Night Heron, Egret and Cormorant respectively. In the year 1989, the total number of birds in the study area was 57536, out of which 39996, 8052, 3012, 6476 was Open Bill Storks, Black Crowned Night Heron, Egret and Cormorant respectively. After three years that is in the year 1993, the total number of birds in the study area was 31149, out of which 21640, 1362, 1692, 6455 was Open Bill Storks, Black Crowned Night Heron, Egret and Cormorant respectively. In the year 1997, the area experienced a total of 49720 bird population, out of which 30908, 7844, 4608, 6360 was Open Bill Storks, Black Crowned Night Heron, Egret and Cormorant respectively. In the year 2001, a total of 76556 bird population was found. Out of the total birds in that year Open Bill Storks, Black Crowned Night Heron, Egret and Cormorant were 56148, 6512, 3448, 10448 respectively. In the year 2005, the total number of birds in the study area was 75268, out of which the number of Open Bill Storks, Black Crowned Night Heron, Egret and Cormorant were 51448, 9284, 6744, and 7792 respectively. Similarly in 2009, the total bird population as found

was 110024, out of which the number of Open Bill Storks, Black Crowned Night Heron, Egret and Cormorant were 72680, 12720, 12716, 11908 respectively (Table 2).

V. Results and Interpretation

It is found that there is positive growth that is 59.60% in bird population of the study area in the year 1989, if compared with the total number of birds in 1985. But in the year 1993, there is negative growth in bird population that is 45.70% if compared with the total number of birds in 1989. But, there is positive growth that is 59.10% in bird population of the study area in the year 1997, if compared with the total number of birds in 1993. There is again a positive growth that is 53.90% in bird population of the study area in the year 2001, if compared with the total number of birds in 1997. In the year 2005, there is negative growth in bird population that is 1.60% if compared with the total number of birds in 2001 (Table 3). In the year 2009, there is a positive growth of 46.10% in comparison with the year 2005. It is amazing to note that there is also negative variation in the arrival of the birds, particularly in the years 1993 and 2005. The negative trend in bird population is coincident with the occurrence of flood by the river Kulik. In the year of flood hazard, the arrival of bird's evidenced massive negative trends, except these years, the area experienced very positive trends in the arrival of those birds. Climate change as witnessed worldwide has compelled several water birds to migrate from adversely affected wetlands to other habitable wetlands for breeding [22]. The changes in the bird population are more than two fold increases over the time span.

Table 3: Percent Difference in Number of Birds between Years

							% difference of number of birds between the years					
1985	1989	1993	1997	2001	2005	2009	N1-N2/N1*100	N2-N3/N2*100	N3-N4/N3*100	N4-N5/N4*100	N5-N6/N5*100	N6-N7/N6*100
No. of birds observed												
N1	N2	N3	N4	N5	N6	N7						
36048	57536	31149	49720	76556	75268	110024	59.60%	45.70%	59.10%	53.90%	1.60%	46.10%

Source: Computed by authors

From the table 2, we can calculate the rate of change in arrival of migratory birds in the study area.

$$R = \frac{(P_1 - P_0)/t}{(P_1 + P_0)/2} * 100$$

Here 'R' = Rate of change is a function of mathematical relationship among the population size at one point of time (P_0) to the base population at the later point of time (P_1) and the number of years over the period (t).

Table- 4, Rate of Change in bird population from 1985-2009

Rate of change (R)	Open Bill Stork	Black Crowned Night Heron	Great Egret	Cormorant	Total
From 1985 to 1989	9.8	8.73	2.97	9.25	9.18
From 1989 to 1993	11.91	28.42	11.22	0.065	11.85
From 1993 to 1997	7.08	28.16	18.51	0.29	9.13
From 1997 to 2001	11.6	3.71	5.76	9.73	8.50
From 2001 to 2005	1.74	7.02	12.93	5.82	0.31
From 2005 to 2009	6.84	6.25	12.27	8.36	7.50

Source: Computed by authors

Temporal rate of change of each of the migratory birds coming in the area under study has been calculated to understand the trend in arrival of those birds and to identify the conditions of environmental quality required for their nesting, breeding and survival. Here, the common assumption is that if the rate of change in the arrival of migratory birds in the study area is lower, there seems to be a deficiency in environmental requirements or micro ecological imbalance and vice versa. From the table 5, if temporal trend in arrival of Open Bill Stork is analyzed it always indicates a fluctuating but positive rate of change although having lowest positive (1.74) rate of change from the year 2001 to 2005, which indicates some negative aspects related to this lower positive growth rate and practically while going into deep study, it comes into notice that those years experienced consecutive occurrence of flood which hindered the arrival of Asian Open Bill Stork because a large number of nest building trees were damaged and their foods like molluscs, amphibians, aquatic invertebrates etc were washed out. By analyzing the trend of arrival of Black Crowned Night Heron, it indicates positive and fluctuating growth rate which varies from 28.42 to 3.71. In the year 1997-2001, lowest positive growth rate (3.71) is noticed in Black Crowned Night Heron population in the study area. Similarly, population of Great Egret also shows positive rate of change although having lowest positive (2.97) from the year 1985 to 1989, which indicates also some negative aspects to this lowest positive growth rate. Therefore, breeding of birds is affected by flooding significantly [23].

Table -5, Impacts of floods on bird population in selected years

Year	Asian Open Bill Stork	Black Crowned Night Heron	Great Egret	Little Cormorant	Total
1992*	47052	5060	3892	7604	63608
1993**	21640	1362	1692	6455	31149
Percentage of decrease/Increase	- 4.50	- 3.58	- 0.69	+ 8.77	
1996*	36392	8176	3604	4124	52296
1997**	30908	7844	4608	6360	49720
Percentage of decrease/Increase	- 7.42	+ 0.15	+ 2.37	+ 4.91	

* Non- Flood year Source: Computed by authors

**Flood year

Let take a view on the impact of floods on the arrival of birds in the area under study. As per the result derived from the table-5, it is keenly realized that there is both positive and negative impact of flood on the bird species coming here to breed. The overall picture reveals the severe affect of flood on the Open Bill Stork in particular with a sharp decline in their arrival in the flood years. Results show that in 1992, the Asian Open Bill Stork contributed the largest share (47052) in the distribution of total bird population in the area, but declined (21640) sharply in 1993 due to severe flood as was experienced by that area, if total bird arrival is taken into consideration. Similarly, in 1996, the bird population of Open Bill Stork was 36392, that also got reduced (30908) for arrival of flood in 1997. Similar picture, although not so acute was found in case of Black Crowned Night Heron and Great Egret in 1992, but they revived and increased their population in 1997 despite having flood in that year, if compared their number with the figure of 1996. But flood did not affect little Cormorant and therefore interestingly, there is an increasing trend of their bird population.

VI. Conclusion:

Therefore, the overall result and discussion reveal that there is a keen relationship between arrival of birds and occurrence of flood. Flood being mostly a natural phenomenon restricts the arrival of bird population particularly the breeding of Open Bill Stork. This is because of the fact that the nest building trees along with the available food in that micro habitat are significantly damaged and washed out. During heavy rain, nests are destroyed; many nestlings fell down and become easy prey to ground predators. The affect of flood is also noticed in the arrival of Black Crowned Night Heron or Great Egret of Kulik Wildlife Sanctuary. But it is quite interesting that despite the flood occurrence, the Little Cormorant population breeds well and their number is also increasing as they can change their habitat elsewhere by virtue of their adaptation instinct built within them. So, some basic observations associated with such trends of birds arrival signify that the habitable environmental quality of Open Bill Stork goes down during flood time very significantly and is also applicable in case of Black Crowned Night Heron or Great Egret but not so acutely as is found in case of Open Bill population. On the other hand, decline of certain species during non flood years resembles the anthropogenic impact on birds consisting of deforestation, hunting, Poaching, killing and such other activities carried out in that sanctuary avoiding the prohibitions of those activities by the forest department in this part. Therefore, planning should be

oriented considering both the physical and man-made hazards and implemented in such a way so that these barriers cannot affect nesting and breeding of those species.

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