

**Trend in the arrival of migratory birds in Kulik Wildlife Sanctuary, West Bengal,  
India during 2010-2020**

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**Abstract :**

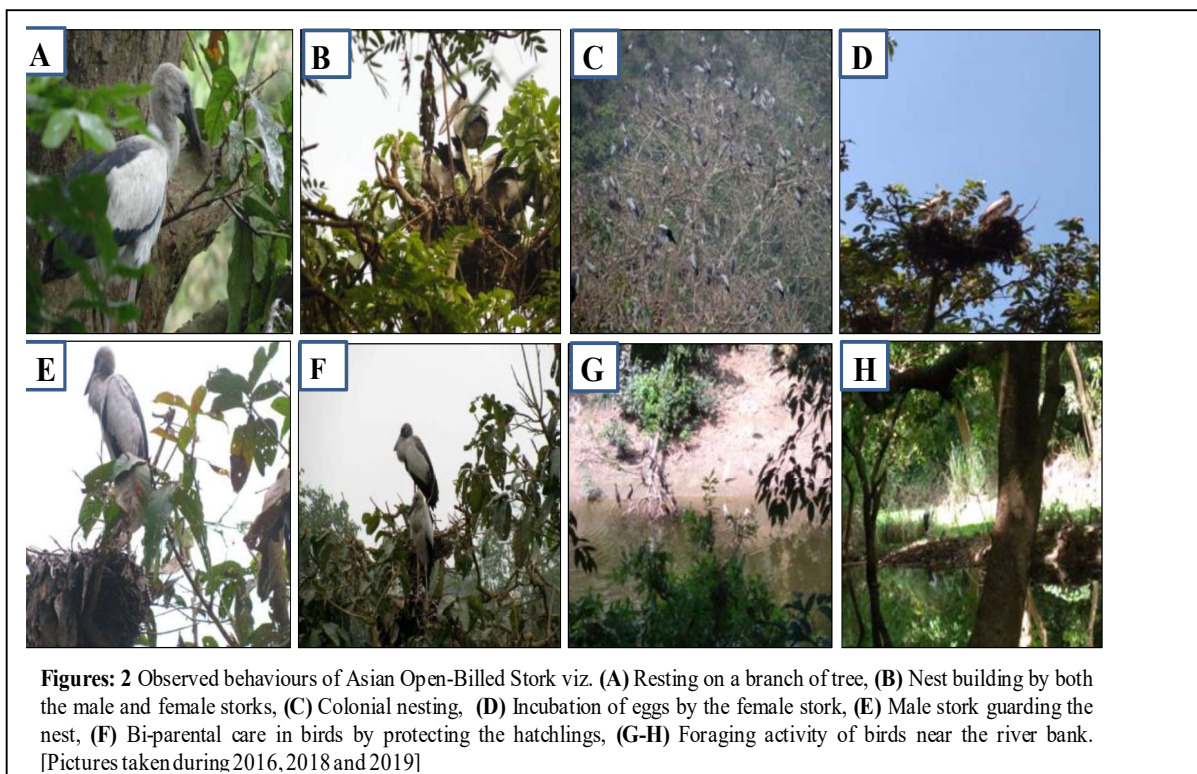
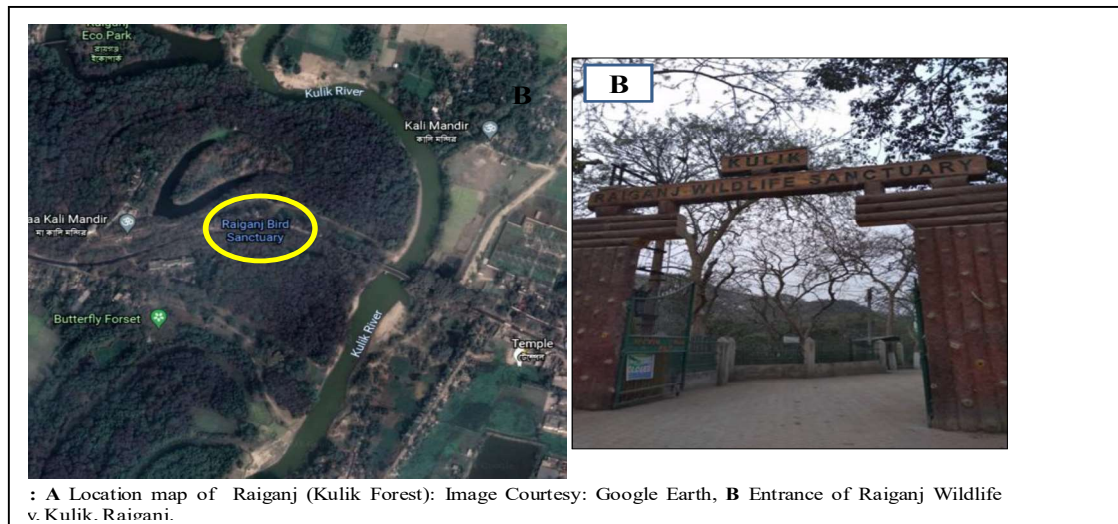
The official migratory bird count data of Kulik Wildlife Sanctuary had been studied and analyzed to understand the numerical fluctuations of migratory birds' arrival with respect to ecosystem health for the last decade. The general trend of a gradual increment is seen among the overall migratory bird count. Amongst the four migratory bird species (Egret, Little Cormorants, Night Herons, and Open billed Stork) studied, Open billed Stork was maximum in number every year. The overall maximum increase (23.57%) in the bird population was seen during 2015 while a decline by 11.76% of bird arrival was noted during 2012. However, Open billed stork being environmental stress-tolerant, arrived at an increasing rate and remained the highest among all four migratory species in spite of frequent environmental disasters. In the pandemic year 2020 also the Open billed stork was found to be highest (68%) as the migratory bird count showed a similar trend as evident from the results of ANOVA tests ( $p < 0.001$  ).

**Key words :**

*Raiganj Wildlife Sanctuary, Bird Population, Ecosystem - health.* The Raiganj Wildlife Sanctuary located in Kulik (25° 37'N to 25° 62'N and 88° 07'E to 88° 12'E), Uttar Dinajpur, West Bengal is well known for its avifaunal diversity. Rich floral composition and habitat heterogeneity attract different migratory bird species. This biodiversity hub stands on an area of 1.3 square kilometers. The river Kulik fringes the South-Eastern part of this sanctuary (Pramanik et al., 2010; Sharma 2001, 2007)(Fig-1) and supports many piscivorous birds. The broad-leaved deciduous trees, like- *Ficus bengalensis*, *Acacia auriculiformis*, *Tectona grandis*, *Anthocephalus indicus*, *Barringtonia acurangula*, *Eucalyptus sp*, etc make perfect nesting place for migratory birds like Asian Open billed stork (Pramanik et al., 2010) that comes here from Southern part of Asia. The Asian Open billed storks arrives at the end of June for approximately six months and leave by the end of every year. During their stay in Kulik, they build their nest using leaves and twigs, on way of executing reproductive behaviors (Fig-2) to ensure deposition of eggs (Fig-2). Generally, bi-parental care is evident in this species (Pramanik et al., 2009, Anam et al., 2016). Other migratory birds like Night Heron, Egret, and Little Cormorant are also common here (Forest official data of Raiganj Wildlife Sanctuary). The resident birds include woodpeckers, drongos, kingfishers, flycatchers, kites, and crows (Datta and Pal, 1993). The sanctuary has a hot and humid climate with an average rainfall of 1600 mm (Pramanik et al., 2010).

Sometimes, natural calamity or anthropogenic interferences may create significant variation in bird count (Pramanik et al., 2014, Datta 1992). The environmental changes affect all the components of an ecosystem. Conversely, ecosystem health is the indicator of environmental status. The variation on avifaunal count every year portrays the ecosystem health of the area studied. The flood, for an instance, caused their sharp decline in arrival during 1993 (Basu

Roy and Shah, 2013). However, natural disturbances have both positive and negative impacts on different bird species (Basu Roy and Shah, 2013). The authors visited Kulik in 2016, 2018 and 2019 and collected data regarding the arrival of migratory birds from 2010-2020. This bird survey has been compared with respect to ecosystem health to understand the implication of natural calamity and migratory birds' arrival each year.

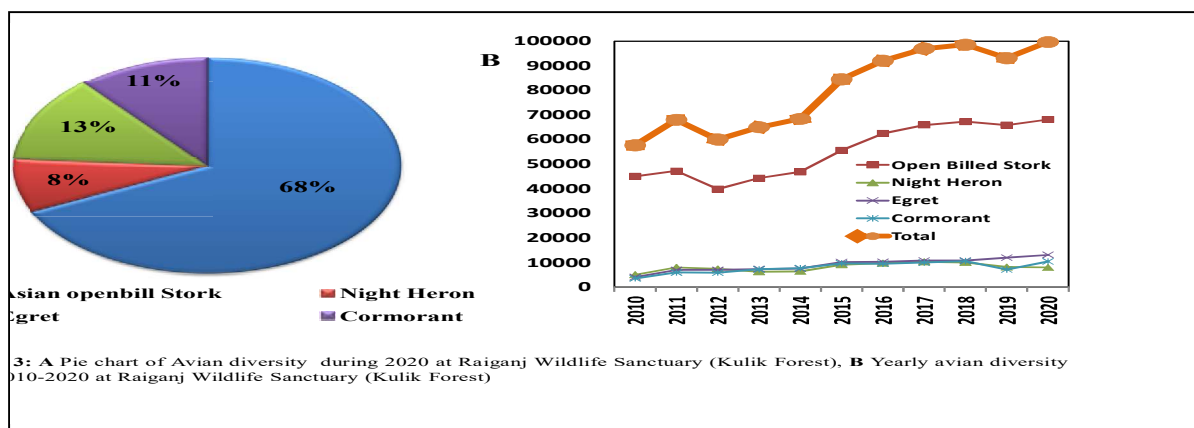


### Materials and Methods:

This study is based on the field visits to Kulik Raiganj Wildlife Sanctuary during the year, 2016, 2018-2019. The birds were identified using field guide books (Ali 2002; Grimmett 2011). The 2020 bird population data had been obtained from the official documents of the

Kulik forest department as entry was restricted due to the global Covid-19 pandemic followed by a local bird flu epidemic. The obtained information had been used by the authors for this meta-analysis and compared to the bird count data of previous years which was also obtained from official records of the Kulik forest department. A single factor ANOVA was done by using Microsoft Excel 2007 to justify the variance in the number of arrival of migratory birds between groups and within groups.

**Results and Discussion:** The official migratory bird count data for the last decade as provided by Kulik forest office clearly shows an increase in overall bird count in the year 2020 as compared to the previous years (Table 1).



Among the migratory birds, the maximum percentage of individuals was Open billed stork for the decade including 2020 (Fig-3) where Open billed stork was 68% of the total birds and Egret, Little Cormorants and Night Herons were 13%, 11%, and 8% respectively. Overall migratory birds count increased over the last decade and a single factor ANOVA [Table-2] showed significant variance in count between the individual migratory bird populations [ $F > F_{crit}$ ]. However, between groups variance is insignificant. The maximum percentage increase (23.57%) in the overall bird population is seen during 2015. A decline in percentage (11.76%) of bird arrival was noted during 2012. The lowest rate of arrival was seen during 2018 (1.67%) [Table-3].

Year	Asian openbill stork ( <i>Anastomus oscitans</i> )	Night heron ( <i>Nycticorax nycticorax</i> )	Egret ( <i>Egretta garzetta</i> )	Cormorant ( <i>Phalacrocorax fuscicollis</i> )	Total
2010	45000	5000	4062	3544	57606
2011	47180	8000	6912	5908	68000
2012	39836	7356	6932	5876	60000
2013	44299	6192	7325	7185	65000
2014	46842	6387	7487	7677	68393
2015	55634	9098	10124	9655	84511
2016	62486	9740	10262	9482	91970
2017	65935	10262	10791	9957	96945
2018	67270	9990	10748	10554	98562
2019	65864	8124	11970	7130	93088
2020*	68159	7956	13094	10422	99631

**Table-1: Yearly census of different migratory bird populations in Kulik wildlife sanctuary (2010-2020). Data collected from forest department Kulik, Wildlife Sanctuary. \*Covid 19 pandemic.**

## SUMMARY OF ANOVA

Groups	Count	Sum	Average	Variance
White Billed Stork	11	608505	55318.63636	118880189.5
Great Heron	11	88105	8009.545455	2861162.673
Wetland	11	99707	9064.272727	7277050.618
Worm-eating Warbler	11	87390	7944.545455	5138960.073

## ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	18216800776	3	6072266925	181.0490844	2.6E-23	2.838745
Within Groups	1341573628	40	33539340.7			
Total	19558374404	43				

Table 2: Results of Single factor ANOVA test between different migratory bird populations in 2010-2020.

The rate (R) of change in arrival of migratory birds in the study area was calculated by the formula  $R = \left[ \frac{(P1-P0)/t}{\{(P1+P0)/2\}} \right] * 100$ , where 'R' = Rate of change as a function of mathematical relationship among the population number at one point of time (P0) vs. the number of individuals of population at the later point of time (P1) and the time lapse between is 't'. Here, avian population is compared between each year, hence t=1. The years that marked maximum positive growth rate on total count of bird populations of Kulik were during 2015 (23.57%) followed by 2011(18.04%). However the maximum decline in total bird population was evidenced during year 2012 (8.3%) followed by (2019) (5.5%) [Table-4].

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Number of birds observed										
N1 57606	N2 68000	N3 60000	N4 65000	N5 68393	N6 84511	N7 91970	N8 96945	N9 98562	N10 93088	N11 99631
Difference in % in the number of birds between the years	$\{(N1-N2)/N1\} * 100$	$\{(N2-N3)/N2\} * 100$	$\{(N3-N4)/N3\} * 100$	$\{(N4-N5)/N4\} * 100$	$\{(N5-N6)/N5\} * 100$	$\{(N6-N7)/N6\} * 100$	$\{(N7-N8)/N7\} * 100$	$\{(N8-N9)/N8\} * 100$	$\{(N9-N10)/N9\} * 100$	$\{(N10-N11)/N10\} * 100$
	18.04%	11.76%	8.33%	5.22%	23.57%	8.83%	5.40%	1.67%	5.55%	7.03%

Table 3: Percentage differences in the number of migratory bird populations between years from 2010-2020. N (1-11)=Total migratory bird count at different years.

While considering the rate of change in individual migratory bird population [Table-3], the highest positive rate in individual bird population of Little Cormorant(50.0%), Egret (51.9%) and Night Heron (46.2%) was seen during the years 2010-2011. The maximum rate of arrival (17.2%) of Open-billed stork was noted during 2014-2015, which lead to a maximum rise in total bird count (21.1%) because during the last decade the Open billed stork remained maximum in number among all the migratory birds. Whereas, sharp decline in bird arrival rate was observed during 2011-2012 resulting in a decline of overall bird population arrival. Previous study showed that natural calamity like a flood was responsible for the sharp decline in bird population between years 1993-2005 (Roy and Sah, 2013). Similarly, the lowest rate of bird arrival was noted in the year 2017-18 viz. Asian Open-bill stork (2%), Night Heron (2.7%), Egret (0.4%), Little Cormorant(5.8) leading to the lower total rate of bird arrival (1.7%).

The reason behind this fall of avian species arrival rate during 2017-18 is undoubtedly the massive flood that hit Uttar Dinajpur causing severe human mortality and nearly shattered 300 villages (Saha and Mondal, 2020). Heavy rainfall in several areas was probably responsible for the sharp decline in bird arrival during 2011 (West Bengal flood report 2011) and excessive rain and water rise in the Mahananda river. In 2020, the Covid-19 pandemic affected every nook and corner of the globe and the biodiversity in totality (Corlett et al., 2020). The biodiversity is affected either positively or negatively by the current pandemic scenario. Some authors opined that pandemic has more negative impact than positive on biodiversity (Muhumuza and Balkwill, 2013; Corlett et al., 2020). While positive impacts may include less environmental pollution and improved air, water, and soil quality, and decreased human disturbances towards wildlife, similarly, Covid-19 led to the failure of many conservation programs in the protected due to scarcity of manpower for prolonged lockdown leading to deficiency in management (Corlett et al., 2020). The worldwide Covid 19 pandemic had lead to series of lockdowns and restricted human movements. Kulik sanctuary also refrained from any visitor entrance during this prolonged period. If we compare the total bird count with respect to other years 2020 shows the highest number of total bird arrival in comparison to the last ten years [Table-1], notably, they arrived earlier during the month of May during 2020. This increase in total bird count might be due to a lack of anthropogenic interference i.e almost no visitors for the past year. Moreover, a sudden bird flu outbreak during the beginning of 2021 (Times of India) compelled Govt. of West Bengal in the further prohibition of visitors to enter the sanctuary. Reduced Anthropogenic interference has led to reduced environmental pollution (Manucchi et al., 2020) and reduced pressure on wildlife. However, it is apparent that the migratory birds of Kulik Sanctuary are habituated to use the resources of the sanctuary strategically year after year, and the gradual increase in the rate of arrival of individuals, irrespective of species is obvious. Because the offspring of successive generations, in respect to study years under considerations would visit the sanctuary with their parents in the next and successive years. Except unforeseeable events like storm, flood, earthquake and outbreak of diseases that are considered for serious threats for their survival the natural increasing trend of appearance of bird individuals would be continued as long as the carrying capacity of the Kulik Sanctuary is admissible.

It is worth mentioning that; Asian openbill stork is environmental stress-tolerant as they can endure low oxygen (Liu et al., 2015). They can endure heavy rainfall; In fact, rainfall triggers the arrival of Asian Openbill Stork (Kumar and Kanaujia 2016). Asian openbill stork can stand anthropogenic interference too (Pramanik 2010).

<i>Rate of population change b/w years</i>	<b>Asian openbill stork</b> ( <i>Anastomus oscitans</i> )	<b>Night heron</b> ( <i>Nycticorax nycticorax</i> )	<b>Egret</b> ( <i>Egretta garzetta</i> )	<b>Cormorant</b> ( <i>Phalacrocorax fuscicollis</i> )	<b>Total</b>
<b>2010-2011</b>	+4.7	+46.2	+51.9	+50.0	+16.6
<b>2011-2012</b>	-16.9	-8.4	+0.2	-0.5	-12.5
<b>2012-2013</b>	+0.6	-17.2	+5.5	+20.0	+8.0
<b>2013-2014</b>	+5.6	+3.1	+2.2	+6.6	+5.1
<b>2014-2015</b>	+17.2	+35.0	+29.9	+22.8	+21.1
<b>2015-2016</b>	+11.6	+6.8	+1.4	-1.8	+8.5
<b>2016-2017</b>	+5.4	+5.2	+5.0	+4.9	+5.3
<b>2017-2018</b>	+2.0	-2.7	-0.4	+5.8	+1.7
<b>2018-2019</b>	-2.1	-20.6	+10.8	-38.7	-5.7
<b>2019-2020</b>	+3.4	-2.1	+9.0	+37.5	+6.8

**Table 4: Rate of change in number of migratory bird populations between years from 2010-2020. ‘+’ signifies positive growth rate, ‘-’ signifies negative growth rate.**

Above all, the area where Kulik sanctuary is located has many water bodies and harbors *Pila globosa*, the apple snail which is the main food source for these migratory birds (Sharma 2007), (Pramanik 2010).

#### **Conclusion :**

Customarily appearance of increasing number of migratory birds is the inherent trend concerning any habitat they could utilize to ensure their reproductive success. Since Kulik Sanctuary is yet to exceed threshold level of carrying capacity, except unpredictable natural threats, the trend of arrival of birds at an increasing rate, year after year would be continued. This is simply an inherent trend influenced by the successive generations of the same stock of bird populations. To maintain this trend the Sanctuary authority would be watchful to provide spaces to these guests, as per need in coming years.

#### **Acknowledgment :**

The authors acknowledge the Forest Officials and the Forest maintenance personnel, of Kulik, Raiganj Wildlife Sanctuary, for the valuable information regarding the data. The authors express their gratefulness to the Dept. of Zoology Bethune College for all the support to complete this work. The authors are also very thankful to Prof. S. K. Raut, Dept of Zoology of the University of Calcutta for his valuable suggestions during the preparation of the manuscript.

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