

# Seasonal abundance and factors influencing the population of Asian Open-Billed Stork (*Anastomus oscitans*) in the Raiganj Wildlife Sanctuary, West Bengal, India

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## ABSTRACT

The Open-billed stork, *Anastomus oscitans* in the Raiganj wildlife sanctuary, preferred the core region than buffer region of the sanctuary for nesting as though core region was relatively undisturbed and rich in food for stork. In two breeding seasons, the fledgling success was greater at the nests that were located in the core region than in the buffer region of the sanctuary. The availability of food in the nearby areas and protection from the predators were the main factors for rising storks' population. The Open-billed stork built more nest in the year 2008 than in the year 2007. They selected 599 trees for nesting of which 249 trees were *Lagerstroemia speciosa* in the year 2007 which increased to 615 trees for nesting of which 280 trees were *Lagerstroemia speciosa* in the year 2008. The percentage of unhatched eggs, damaged eggs by predation, storm and heavy rain was higher in the year 2007 than in the year 2008. The nestlings death mainly caused by storm and heavy rain, by dropping during first flight and by predation. The main natural predators of the species in the sanctuary were House crow (*Corvus splendens*) and Bengal monitor (*Varanus bengalensis*). The overall hatching success and fledgling success were 91.71% and 83.96% in the year 2007 which increased to 94.86% and 87.95% in the year 2008 respectively. The breeding behavior of Open-billed stork was disturbed by visitors and villagers activities and by vehicles during breeding season in the sanctuary. The villagers also invaded to collect fire wood into the buffer region as well as core region of the sanctuary during breeding season. As though the Open-billed stork can tolerate this type of disturbances, so they can breed in the sanctuary. But disturbed birds may show increased failure rates despite their lack of immediate behavioural responses to human pressure. The number of stork population was increased from 44816 to 58920 in the year 2007 and 2008 in the Raiganj Wildlife Sanctuary. It may be due to the availability of nesting trees, nesting materials, availability of safe nesting zone and availability of food of this particular bird species. But proper management should be taken to increase their successful breeding.

**Key words:** Open-billed stork, Raiganj wildlife sanctuary, rain and storm, visitors disturbance, fledgling, hatching

## INTRODUCTION

Birds contribute most significantly to the diversity of terrestrial vertebrates. It is equally important to acknowledge the fact that the bird populations are affected due to pesticide use, poaching and intensive agricultural practices of the locals around the protected areas or sanctuaries (Patra, 2005).

Baker (1938) introduced the term "ultimate causes" which had been altered by Thomson (1950) into "ultimate factors". The most important ultimate factors for most bird species are the quality and the quantity of food supply. Great need for food occurs during the whole breeding season, especially after hatching of young, since parents need not only finding food for themselves but also for their chicks. Food shortages can reduce or stop egg production, and thus clutch size may be affected by inefficiency of food supply (King, 1973; Ricklefs, 1974).

DuBowy (1988, 1991) emphasized on seasonal environment as the cause of waterfowl community fluctuation. Lovvorn (1989 b) studied the effect of weather and habitat jointly on the distribution of

ducks. Placement of the nest may affect the nest microclimate and thus breeding success of the pairs due to factors such as being in or out of the sun, shade or wind or safe from predators (Gill, 1994). Effects of weather on habitat selection of waterfowls have been pointed out by Jorde *et al.* (1984) and Lovvorn (1989b). McIntyre (1988c) studied about the impact of water levels on feeding ecology of blue-winged teal.

Climate has its greatest influence on bird numbers through indirect effects on changes in vegetation and food supply. A water body's tropic status is a major factor influencing bird species abundance and richness (Nilsson and Nilsson, 1978; Murphy *et al.*, 1984; Brown and Dinsmore, 1986). Bird abundance and species richness is increased on eutrophic lakes because productive lakes have greater food resources (Hoyer and Canfield, 1994).

Conservationists have long been concerned about the effect of human disturbance on wildlife (Carney and Sydeman, 1999). Among the numerous reported effects, it has been suggested that disturbance can prevent successful breeding (Giese, 1996). The effects of unmanaged visitors access or breeding birds and

mammals can be devastating with total failure of breeding colonies and substantial population declines occurring in many cases (Anderson, 1988; Stevens and Boness, 2003). Unfortunately, disturbance research has been of varying quality and many conclusions are now in doubt (Hill *et al.*, 1997; Nisbet, 2000; Gill *et al.*, 2001). Mortality and egg losses as a direct consequence of humans are widespread (Madsen and Fox, 1995). Several species apparently show little or no behavioral response to human disturbance and yet still suffer proper breeding success (Carney and Sydeman, 1999). Such high visitor numbers and the presence of large numbers and the presence of large numbers of breeding seabirds present on ideal situation for the study of human disturbance. The effect of humans on breeding success is a direct consequence of disturbance (Colin and Monaghan, 2004). It is also reported that human disturbance effects are related to perceived predation risk (Colin and Monaghan, 2004).

In Kittiwake, *Rissa tridactyla* breeding success apparently linked to heavy visitor pressure has been reported (Beale and Monaghan, 2004). The increase in nest failure may be mediated by increases in heart-rate in response to humans as observed in other species (Nimon *et al.*, 1995; Wilson and Culik, 1995). Higham (1998) found that the breeding success of a colony of Northern Royal Albatrosses declined with increasing visitor numbers, despite provision of visitor facilities at a distance previously identified as 'safe'.

The rapid growth of ecotourism worldwide is putting increasing pressure on wildlife in areas that have historically been isolated and / or protected. Most breeding failure occurred prior to hatching (Bouton *et al.*, 2005). The open – billed stork showed considerable tolerance towards man but direct human interference severely hampered its nesting success (Datta and Pal, 1993). Good examples of birds at risk include tree sparrow *Passer montanus* and house sparrow *Passer domesticus*, species strongly associated with human settlements (eg. Tryjanowski and Kuczynski, 1999; Summers-Smith, 2005). Bhanumathi and Thirumurthi (1995) and Pilo *et al.* (1995) studied about the effect of industrial pollution on avifauna of aquatic habitat. Sammaiah and Singh (2004) indicated the species diversity of water birds as a pollution indicator. But no systematic and comprehensive report is available on the factors affecting the number of open-billed stork population in the Raiganj Wildlife Sanctuary. The objective of the present study was also to determine the reason for density and distributional variations of open-billed stork within the sanctuary, to point out the factors for hatching success and fledging success of open-billed stork and to assess the factors that affecting the number of open-billed stork population in the Raiganj Wildlife Sanctuary.

## MATERIALS AND METHODS

Data were collected from the nest of Asian Open-billed stork *Anastomus oscitans* of the Raiganj Wildlife Sanctuary, Raiganj, Uttar Dinajpur, West Bengal, India for two breeding seasons 2007 and 2008. The observations were made at daytime (06.00 –18.00 hrs). The area was visited twice a week during breeding season and once a week

during non-breeding season. The breeding behavior of active pairs of open bills was studied by monitoring the nest site from early morning to late evening for consecutive days. Fieldwork was undertaken in two colonies one is the core region and another is the buffer region comprising on average 500 individuals, 250 breeding pairs, 250 nests, 700 eggs and 250 chicks in one breeding season. Each nest was observed throughout the breeding season from a nearby cliff top (between 5 to 10 m away) and the nest contents were recorded whenever possible to determine nest success. The numbers of observed nesting trees were 599 in 2007 and 615 in 2008. All types of activities like aerial display, pair formation, copulation, nest building, egg laying, incubation, hatching parental care, antagonistic behavior of the open-billed stork were recorded using by 10 x 50 binocular, 30x telescope and relevant photographs were taken by Kodak easy share digital camera (C713). Some of the behavioral activities were recorded with a movie camera for analysis later on. Observational data were recorded in the tally sheets prepared separately for different breeding activities and a separate note book was also maintained for special activities of breeding birds which were analyzed in detail after field work. The nesting trees were marked by small numbered labels placed at the lower part of each nesting tree. The number of nests of each bird species was counted separately within the sanctuary (both core and buffer region) for each nesting tree (Ayas, 2008). The nest density was calculated on the number of nests per tree (Kazantzidis *et al.*, 1997).

The hatching success and fledging success of Open-billed storks were calculated by using the following formula (Asokan *et al.*, 2010) :

Hatching success (%) = (No. of eggs hatched / total no. of eggs laid) x 100

Fledging success (%) = (No. of nestlings fledged / total no. of nestlings hatched) x 100

The visitors and villagers who entered into the sanctuary during breeding season were counted and recorded in the record book mostly by direct observation. Visitor numbers and distribution were studied on the sanctuary as described fully by Beale and Monaghan (2004). Number of vehicles passed on National Highway -34 at three different time periods (6.00-8.00, 11.00-13.00, 16.00- 18.00) of the day during breeding season were counted by direct observation and recorded in the data sheet. All the data were calculated with the help of Windows spread sheet programme Excel – 2007. All the values are provided with the mean  $\pm$  SD of the mean.

## RESULTS

The Open-billed stork used to build their nests on 599 trees in 2007 and on 615 trees in 2008 in the Raiganj Wildlife Sanctuary. The total number of nests of Open-billed stork was 8970 in 2007 and which increased as 11784 in 2008. The maximum number of nests of stork (34.85 % in 2007 and 35.00% in 2008) was built on the tree *Lagerstroemia speciosa* in this sanctuary. The nest density of stork was recorded 14.97 in 2007 and 19.16 in 2008. A total of 44816 storks were counted in 2007 which raised to 58920 storks in 2008 ( Table 1 ).

**Table 1.** Total number of nesting trees, number of nests, nest density and number of Open-billed stork population recorded in the Raiganj Wildlife Sanctuary in the year 2007 and 2008.

Year	Total number of nesting trees	Total number of nests	Nest density	Total number of Open-billed storks
2007	599	8970	14.97	44816
2008	615	11784	19.16	58920

Breeding occurred in all the nests that were constructed in the core region and in the buffer region of the sanctuary, but the average number of fledged young on nests at different locations was different in 2007 (Table 2) and in 2008 (Table 3). In two breeding seasons, the fledgling success were greater at the nests that were located in the core region (2.96 in 2007 and 3.07 in 2008) than in the buffer region ( 2.43 in 2007 and 2.77 in 2008) of the sanctuary.

Clutch size varied from 2 to 5 eggs but most clutches contained 3 to 4 eggs. In the year 2007, the percentage of hatching success was 95, 92, 93 and 89.2 and the percentage of fledging success was 94.74, 91.30, 81.72 and 76.68 for 2, 3, 4 and 5 clutch sizes respectively (Table 4). The percentage of hatching success was recorded as 98, 96, 95, and 92.8 and the percentage of fledging success was 95.92, 93.75, 85.79 and 82.76 for 2, 3, 4, and 5 clutch sizes in 2008 respectively (Table 5). For both years, the percentages of hatching success and fledging success were more in small clutches than in larger ones.

The reasons for different hatching success were mainly unhatching (Figure 4), predation (Figure 5), storm and heavy rain. The percentage of unhatched eggs (4% in 2007 and 3% in 2008) was more than other causes of egg loss in both year 2007 and 2008 (Figure 1). The causes of mortality of nestlings were bad weather (storm and heavy rain) (Figure 7) predation and fall down during first flight (Figure 9). The percentage of nestlings' death caused by predation, bad weather (storm and heavy rain) and fall down during first flight were 3.27, 8.09 and 4.67 in 2007 and which decreased as 2.26, 6.32 and 3.46 in 2008 respectively (Figure 2). The legs and wings of chick were broken by falling down from the nest during first flight, storm and heavy rain (Figure 8). A total of 1029 chicks were died and 1764 chicks were injured in the month of August and September, 2007 and 586 chicks were died and 947 chicks were injured in the month of September 2008 by heavy rain and storm respectively. The main natural predators of the species in the sanctuary were House crow (*Corvus splendens*) (Figure 6) and Bengal monitor (*Varanus bengalensis*). House crows were opportunistic in plundering the eggs from the nest or carry away the newly hatched chicks when both the parents were away from the nest.

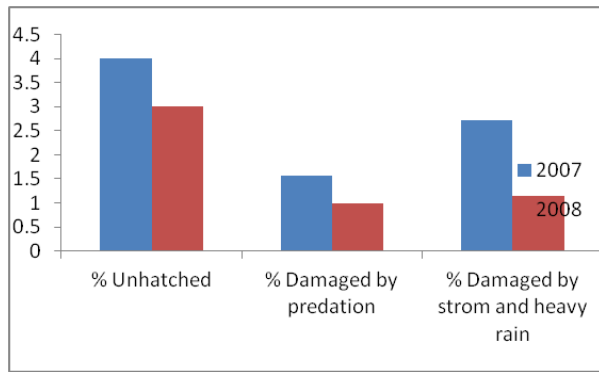
The breeding behaviour of Open-billed stork was also affected by entrance of visitors and villagers in the sanctuary. Sometimes the visitors disturb the breeding birds by throwing stones, by shouting and by taking photographs from the breeding nest of stork. The minimum and maximum average number of visitors / day entered into the buffer region of the sanctuary were  $52.15 \pm 1.565$  and  $135.35 \pm 2.110$  in the month of May and December of the year respectively (Table 6). But not a single visitor was observed in the core region of the sanctuary during breeding season. But the visitors enjoyed by doing picnic in close areas of the buffer region of the

**Table 2.** Breeding values of nests on different nesting places in the year 2007

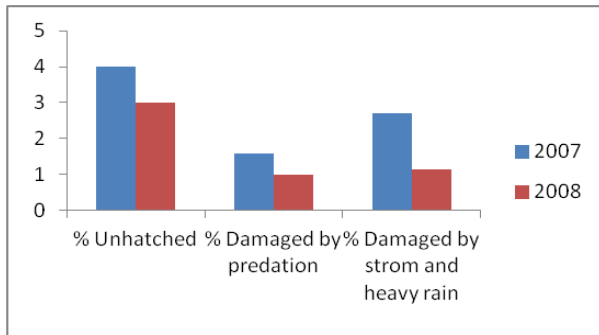
Nesting places	Number of nests occupied (A)	Number of nests with breeding (B)	% of nests with breeding (B/A)	Number of young fledged (C)	Average number of fledged young in different nesting places (C/B)
Core region	100	100	100	296	2.96
Buffer region	100	100	100	243	2.43

**Table 3.** Breeding values of nests on different nesting places in the year 2008.

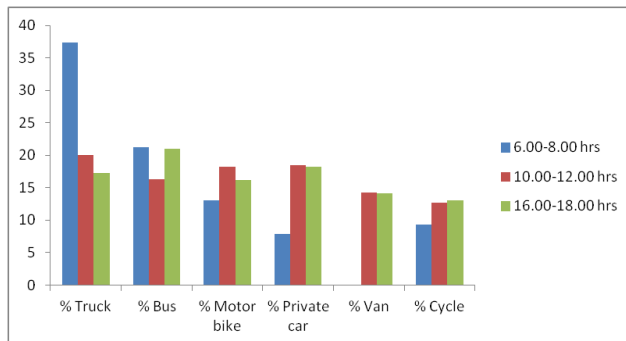
Nesting places	Number of nests occupied (A)	Number of nests with breeding (B)	% of nests with breeding (B/A)	Number of young fledged (C)	Average number of fledged young in different nesting places (C/B)
Core region	100	100	100	307	3.07
Buffer region	100	100	100	277	2.77



**Figure 1.** Percentage of unhatched eggs and damaged eggs of Open-billed stork in the Raiganj Wildlife Sanctuary in the year 2007 and 2008.



**Figure 2.** Percentage of nestlings death of Open-billed stork in the Raiganj Wildlife Sanctuary in the year 2007 and 2008.



**Figure 3.** Percentage of different types of vehicles passed on National Highway-34 adjoining the Raiganj Wildlife Sanctuary at different time of the day during the breeding season of Open-billed stork.



**Figure 4.** The unhatched egg of Open-billed stork dropped on the ground of the sanctuary.



**Figure 5.** The egg of Open-billed stork was damaged by predator in the sanctuary.



**Figure 6.** The crow was the common predator of Open-billed stork in the sanctuary.



**Figure 7.** The chick of Open-billed stork was died in the sanctuary during storm and heavy rain.

sanctuary during breeding season of the storks that hampered their breeding life. The villagers mainly came to collect fire wood from the sanctuary. They invaded in the core region in the month of May (  $02.85 \pm 0.587$  villagers/month ), June (  $02.65 \pm 0.745$  villagers/month ), July (  $01.75 \pm 0.716$  villagers/month ), November (  $02.45 \pm 0.605$  villagers/month ) and December (  $04.25 \pm 0.639$  villagers/month ) of the year. The open-billed stork become afraid and stood on the nest and sometimes leaved the nest for a moment and after that they returned again to their nest during breeding period, when the villagers and tourists came to the nest at a minimum 5ft distance. The minimum and maximum average

**Table 4.** Breeding success according to different clutch size of Open-billed stork in the year

Clutch size	Number of obser- vations		Number of eggs hatched	Number of young fledged	% of hatching success	% of fledging success
	Nests	Eggs				
2	50	100	95	90	95.00	94.74
3	50	150	138	126	92.00	91.30
4	50	200	186	152	93.00	81.72
5	50	250	223	171	89.20	76.68
Total	200	700	642	539	91.71	83.96

**Table 5.** Breeding success according to different clutch size of Open-billed stork in the year 2008.

Clutch size	Number of obser- vations		Number of eggs hatched	Number of young fledged	% of hatching success	% of fledging success
	Nests	Eggs				
2	50	100	98	94	98.00	95.92
3	50	150	144	135	96.00	93.75
4	50	200	190	163	95.00	85.79
5	50	250	232	192	92.80	82.76
Total	200	700	664	584	94.86	87.95

**Figure 8.** The chick of Open-billed stork was fallen down on the ground during storm and heavy rain and the legs of the chick were broken.**Figure 9.** The chick of Open-billed stork was fallen down on the ground during first flight and the chick was without parental care.

number of villagers per month entered into the buffer region was  $03.05 \pm 0.759$  and  $08.15 \pm 0.933$  in the month of July and December of the year (Table 7).

During breeding season, a huge number of vehicles like bus, truck, private car, motor bike, van and bicycles were passed on the Notional Highway-34 which is situated in the heart of the sanctuary. Among recorded vehicles, the highest percentage of trucks (37.3%) moved on the road in the morning but the highest percentage of buses (21.03%) was recorded in the evening of the day (Figure 3).

Sometimes the nesting materials were slipped down from the bills during the time of carrying (35.42%), and during nest building (28.81%). Due to the interferences of human and horn of the vehicles, proper incubation discontinued (15.36%), food capturing failed inside the canals of the sanctuary (6.79%), food fell down during feeding of their chicks (10.27%) and flight training of young storks hampered (3.35%) during the breeding period.

## DISCUSSION

After coming to the sanctuary, the Open-billed stork started to gather in the core region of the sanctuary for their breeding purpose from the last week of the month of May of the year. They were found nesting in the buffer region of the sanctuary even near human habitation and road side, when the core region was filled by the

**Table 6.** Average number of visitors / day entered into the Raiganj Wildlife Sanctuary during the breeding season of Open-billed stork in the year 2007 and 2008.

Months	Number of observations (days)	Average number of visitors / day	
		Buffer region	Core region
May	20	52.15 ± 1.565*	00.00 ± 0.000
June	20	53.35 ± 2.231	00.00 ± 0.000
July	20	55.85 ± 1.461	00.00 ± 0.000
August	20	66.75 ± 1.552	00.00 ± 0.000
September	20	86.45 ± 1.905	00.00 ± 0.000
October	20	105.65 ± 2.231	00.00 ± 0.000
November	20	116.85 ± 1.814	00.00 ± 0.000
December	20	135.35 ± 2.110	00.00 ± 0.000

\*: Mean±SD

**Table 7.** Average number of villagers / month entered into the Raiganj Wildlife Sanctuary during the breeding season of Open-billed stork in the year 2007 and 2008.

Months	Number of observations (days)	Average number of villagers / month	
		Buffer region	Core region
May	20	05.85 ± 0.813*	02.85 ± 0.587
June	20	04.55 ± 0.945	02.65 ± 0.745
July	20	03.05 ± 0.759	01.75 ± 0.716
August	20	04.25 ± 0.639	00.00 ± 0.000
September	20	05.15 ± 0.813	00.00 ± 0.000
October	20	05.95 ± 0.887	00.00 ± 0.000
November	20	06.75 ± 0.967	02.45 ± 0.605
December	20	08.15 ± 0.933	04.25 ± 0.639

\*: Mean±SD

first comer storks. They preferred the core region than the buffer region for nesting, because core region encircled by water canals which were rich in food for storks and it was less disturbed zone. A good nesting site generally provides protection against predators, offers adequate stability and materials to support and construct the nest, and is located near adequate feeding areas (Thompson, 1977; Beaver *et al.*, 1980; Hafner and Britton 1983; Gibbs *et al.*, 1987; Hafner and Fasola, 1992).

In 2007, 599 trees were selected by the storks for nesting of which 249 trees were *Lagerstroemia speciosa* and in 2008, 615 trees were selected for nesting of which 280 trees were *Lagerstroemia speciosa*. It indicates that more number of Open-billed storks was aggregated in the sanctuary in the year 2008 than in the year 2007. The birds nesting in heronries prefer trees with

dense canopy cover (Pande and Mestri, 2002; Iyer, 2004; Bhatnagar *et al.* 2004). The *Lagerstroemia speciosa* tree species was most preferable nesting tree of storks because the trees are branched, busy type and hard, helps to construct the nest properly. The total number of nests and nest density were 8970 and 14.79 in the year 2007 and which increased as 11784 and 19.16 in the year 2008 respectively.

The main food species of open-billed stork's chicks was *Bellamya bengalensis* and the major food species of *globosa*. The foraging areas of this bird species were a flood plain area and rice growing area of the region dotted with many large water bodies like ponds, river beds and marshy areas which were full of their main food diet *Pila globosa* and *Bellamya bengalensis* (Sharma, 2007). The availability of these food species may be the cause of rising population of the Open-billed stork in the Raiganj Wildlife Sanctuary. Datta (1992) also reported these types of diet species of Open-billed stork. Pande and Dahanukar (2011) reported that productivity of Indian Eagle owl (*Buboo bengalensis*) was strongly correlated to the high relative abundance and percentage biomass of rodents.

The average number of fledged young on nests at different locations of the sanctuary was different in the year 2007 and 2008. In two breeding seasons, the fledging success was greater at the nests that were located in the core region (2.96 in 2007 and 3.07 in 2008) than in the buffer region (2.43 in 2007 and 2.77 in 2008) of the sanctuary. It can be suggested that core region was more preferred by the Open-billed stork than buffer region of the sanctuary due to minimum disturbance occurred by the visitors and villagers. Arendt and Arendt (1988) reported that nearly 53% of Cattle Egret nests to be core nests. Breeding birds require safe nesting site as well as sufficient quantity and quality of foraging habitat (Kallander, 1974; Ewald and Rohwar, 1982). Egrets preferring the core region of canopy for nesting have been reported also by Iyer (2004).

In the present study, the clutch size varied from 2 to 5 eggs and most of the nests contained 3 to 4 eggs. This variation of clutch size may be due to female's reproductive capacity, climatic condition and food supplies during breeding period. A decrease in food supplies and variation in climatic conditions result in a decrease in breeding performance (Lack, 1968). Jones and Ward (1976) also suggested that females inherit the ability to vary clutch size within a certain range and that the upper limit of clutch size is firmly fixed. The seasonal variation in food supplies during the breeding period in the colony site was also thought to be the reason for clutch and egg size differences between breeding attempts in House Sparrow (*Passer domesticus*) was observed by Aslan and Yavuz (2010). Clutch size influenced the hatching success and fledging success of Open-billed stork in the Raiganj Wildlife Sanctuary. The percentage of hatching success and fledging success were more in small clutches than in large clutches in both years i.e., 2007 and 2008. The overall hatching success of Open-billed stork was 91.71% and 94.86% in the year 2007 and 2008 respectively. The overall fledging success of Open-billed stork was 83.96% and 87.95% in the year 2007 and 2008 respectively. Asokan *et al.* (2010) reported that

lower clutch size of Small bee-eater was compensated by relatively high fledging success, thereby ensuring overall reproductive success of that species.

Lack's hypothesis (1954, 1966) implies that the modal clutch size is more productive than other clutch sizes, whereas Klomp (1970), and Jones and Ward (1976) argued that birds are capable of laying clutches that vary in size and a modal clutch size can be smaller than the most productive one. The negative correlation between clutch size and breeding success in House Sparrow was observed by Aslan and Yavuz (2010).

In the present study, the hatching success depended on the number of unhatched eggs, eggs lost by predation, storm and heavy rain. The percentage of unhatched eggs, damaged eggs by predation, storm and heavy rain was higher in the year 2007 than in the year 2008. The nestlings death mainly caused by storm and heavy rain (8.09 % in 2007 and 6.32% in 2008) and by dropping during first flight (4.67% in 2007 and 3.46% in 2008). The nestlings also lost by predation (3.27% in 2007 and 2.26% in 2008). The main natural predators of the species in the sanctuary were House crow (*Corvus splendens*) and Bengal monitor (*Varanus bengalensis*). House crows were opportunistic in plundering the eggs from the nest or carry away the newly hatched chicks when both the parents were away caused by human activities in the sanctuary. This type of predation by House crow on Cattle Egret's nest was observed by Patankar *et al.* (2007). Jayson (2001) reported that House crow was the main predator of the eggs and nestlings of many species including the Little Cormorant. The chicks that survived the accidental falls during first flight from the nest were taken up for food by domestic cats and dogs in the sanctuary. As the nesting colony of the buffer region was located in front of office building, forest bungalow, visitor tower and tourist lodge with human activities throughout the day, the street dogs and cats regularly visited this area.

During heavy rain, many nestlings fell down and were easy prey to the ground predators (Subramanya and Moni, 1996; Jayson, 2001). Kopiciewicz *et al.* (1999) observed that very strong winds may cause considerable increase in egg and chick mortality. Keo (2008) reported that nests that had been protected with the predator-exclusion devices were more likely to be successful than unprotected nests.

Large colonies of nesting of Open-billed storks had recently become an important visitor's attraction in the Raiganj Wildlife Sanctuary. The minimum and maximum average number of visitors/ day entered into the buffer region of the sanctuary was  $52.15 \pm 1.565$  and  $135.35 \pm 2.110$  in the month of May and December of the year respectively. The villagers also invaded to collect fire wood into the buffer region as well as core region of the sanctuary during breeding season. It indicated that visits to this sanctuary were uncontrolled and there was growing concern about disturbance to the breeding storks.

Beside human disturbances, a huge number of vehicles like truck, bus, private car, motor bike, van and bi-cycle were passed through the heart of the sanctuary during breeding season as the National Highway-34 runs through the sanctuary. Nest failure may occur by human

interferences and noise pollution of the vehicles. Surprisingly, the open-billed storks bred with an increasing population in the year 2008 (58920 storks) than in the year 2007 (44816 storks) because this species can tolerate human interference and horn of the vehicles.

Bouton *et al.* (2005) reported that behaviour during disturbances was unrelated to the eventual effect of tourist disturbance in Wood stork. Patankar *et al.* (2007) observed that Cattle Egrets are one of those common birds seen around human settlement, in rural as well as in urban set up and seem to be not much bothered by human activities.

It is clear that there were many disturbances caused by human activities and vehicles during breeding season, though they can breed in this sanctuary because they can tolerate these types of disturbances. Availability of nesting trees, nesting materials, relatively safe nesting place and availability of food preferred by this particular species seem to be the only requirements for successful breeding of storks.

However, immediate measures should be taken for habitat improvement and minimize disturbances to increase the population of this particular bird species.

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