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Greater Adjutant Storks *Leptoptilos dubius* Gemlin 1789: Breeding and Foraging Distribution in Kamrup District, Assam, India

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ABSTRACT

District Kamrup in the Brahmaputra valley of Assam holds the largest breeding population of the world Endangered (EN) Greater Adjutants (Leptoptilos dubius) presently breeding in India and Cambodia. The species nested on 33 numbers of trees that supported 109 nests of which 95 (87.15%) nests were found successful and fledged 156 juveniles in two breeding colonies. Both the colonies were outside the protected area. L. dubius colonized near human settlements in thickly populated urban and sub-urban areas often 9.5-10.5 Km away from city garbage centre an important feeding ground of the population. Though partial feeding habitat (Deepor Beel Wildlife Sanctuary) is protected. The L. dubius nested on three species trees Anthocephalus cadamba (63.63%), Bombax cebia (33.33%), and Gmelina arborea (3.03%).

Keywords: Greater Adjutant Stork, Leptoptilos dubius.

INTRODUCTION

South and South-East Asia have the richest stork diversity of the world which extends from India eastward to Vietnam and southwards to Indonesia [1]. Out of the 11 stork species which occur in the area, eight are resident and three are migrant [1]. Nine species of storks were found in India [2] presently only eight [3] of which six are resident [4].

The Brahmaputra river along with its tributaries create the flood plains of the Brahmaputra valley (56,700 Km², Coordinates: $25^{\circ}44'$ - $27^{\circ}55'$ N and $89^{\circ}41'$ - $96^{\circ}02'$ E) that moves downward and westward. *L. dubius* is a semicolonial or colonial species [4] breeding year after year since the time immemorial along with its congener *L. javanicus* throughout the valley [1, 2, 4-11]. Previously *L. dubius* breeding colonies were distributed throughout South and Southeast Asia. Extensive habitat alteration throughout its distribution ranges including deforestation, wetland destruction, cultivation and alteration of marginal land have been identified as the major factors responsible for the general degradation of quality of the stork habitat [1, 9, 12]. The drastic population decline from their earlier stronghold areas has placed the species almost in the verge of extinction past three decades back.

The *L. dubius* have suffered a massive decline over the following hundred years that however left two very small and highly disjoint breeding populations, one in India and the other in Cambodia [1, 2, 4-11]. The *L. dubius* nests in tall trees about 27- 30 m above the ground, in the low lying forest patches within rural areas often near villages [13, 9].

MATERIALS AND METHODS

Description of Study Area

Kamrup district is located within the geographical Coordinates: 25°46'- 26°49'N and 90°48'- 91°50'E and is bounded by Udalguri & Baska districts in the North, the Meghalaya state in the South, Darrang district in the East,

and Goalpara & Nalbari districts in the West. The climate of the area is Humid Mesothermal Brahmaputra type like other parts of Brahmaputra valley, experiencing minute local variations [14]. Average annual rainfall is around 1500 mm. The maximum rainfall occurs during summer (June to August) due to influence of strong monsoon [14]. It is a part of the two hotspot areas the Himalayas and Indo- Burma region among the 25 biodiversity hotspots of the world [15]. Vegetation is mainly moist deciduous and semi- evergreen type [16].

A survey was conducted during February to May 20, 2011 for the nesting/breeding sites while the foraging and roosting sites were continued to September 20, 2011 up till the onset of new breeding season.

Position of each nests tree location has been noted down using GPS (Garmin eTrex® H). The tree on which nests were constructed has been identified for all individual trees. The height of the nesting trees were measured using trigonometric hypsometry [17, 18]. The first dominant (Y1) and second dominant (Y2) trees within 50 m² area of the nest tree were listed out. The canopy area coverage (CAC) of the nesting trees were also calculated using Crown Diameter Technique [19, 20]. The Diameter at Breast Height was also calculated using measuring tape [19, 18]. Continuous monitoring of *L. dubius* population were done at the municipality garbage center situated at Boragaon (F2; Figure 1), garbage heaps within the city as well as available feeding ground including the wetlands and agricultural lands (F1 & F3, Figure 1; F & E, Figure 2).

Analysis

The mean crown diameter of a plant was calculated using the following formula [19]-

$$\overline{D} = \sum_{i=1}^{n} Di$$

Where,

D = mean diameter D_i = a single measurement of diameter N = number of diameters measured

When the diameter is being used as an intermediate variable for calculating area or cover, the plant's outline approximates an ellipse; the largest and smallest diameters have been measured to calculate the geometric mean by using the formula [19]-

$$D = \sqrt{D1} D2$$

Where, \overline{D} = mean diameter D1= Largest diameter of the nest tree D2= Smallest diameter of the tree

The height of the nesting tree and nests were calculated using the formula [17] when the base of the plant is at eye level

$$\mathbf{H} = \mathbf{D} (\tan \theta)$$

Where,

H = height of the plant to be calculated D = distance in meter from the plant base to the vintage point tan θ = measured angle

The height of the nesting tree and nests were calculated using the formula [17] when the middle of the plant is at eye level

$$\mathbf{H} = \mathbf{D} \left(\tan \theta \mathbf{1} + \tan \theta \mathbf{2} \right)$$

Where, H = height of the plant to be calculated

D = distance in meter from the plant base to the vintage point tan $\theta = measured$ angle

The height of the nesting tree and nests were calculated using the formula [17] when the middle of the plant is at eye level

$$\mathbf{H} = \mathbf{D} \left(\tan \theta \mathbf{1} - \tan \theta \mathbf{2} \right)$$

Where, H = height of the plant to be calculated

D = distance in meter from the plant base to the vintage point

 $\tan \theta = \text{measured angle}$

The diameter at breast height of the plant was calculated for individual plant using following formula [19]-

 $D = \frac{C}{\pi}$

Where, D = diameter of the plant to be calculated C = circumference of the plant at breast height

The correlations between the number of nests and the other variables including Crown Diameter, DBH, tree height, and total number of juveniles fledged were calculated using SPSS 16.0 version.

RESULTS AND DISCUSSION

Based on the field surveys, two breeding colonies were found in Kamrup district. First colony (C1; figure 1) comprising villages Dadara, Singimari and Pachoria, while the second colony (C2; figure 1) was at Rangmahal which was newly recorded in the study area during the survey. The *L. dubius* nested on 33 nest trees of which 29 were in C1 and four were in C2. Among the 29 nest trees in C1 20 were on *Anthocephalus cadamba*, eight were on *Bombax cebia* and one was on *Gmelina arborea* tree that supported 91 nests of which 80 (87.91%) nests were found successful and fledged 122 juveniles. Colony C2 having four nest trees, three were on *B. cebia* and one was on *A. cadamba* that supported 18 nests of which 15 (83.33%) nests were successful that fledged 34 juveniles. A total of 14 unsuccessful, comparatively smaller and vacant nests were recorded, 11 (12.09%) were in C1 and three (16.66%) were in C2. The total number of juveniles shows significant correlations at the 0.01 level (2-tailed) with the number of nests.



Figure 1: Study area: Map of the Kamrup district, locator map of India and Northeast India (map source: Classroom Clipart).



Figure 2: Photos: [A] Adult bird with breeding plumage, [B] Juvenile bird on nest along with bamboo patches, [C] Typical nests with Juveniles attended by parents, [D] Juveniles on nests showing the clutch size, [E] Foraging habitat being shared with the congener, [F] Foraging population at the Garbage dumps.

The study revealed that both the breeding colonies (C1 & C2) were in and/or along the human settlements in semiurban areas of the Brahmaputra Valley. Most of the nesting trees were *A. cadamba* and *B. cebia* along with bamboo plantations within the radius of 20 m² as the dry bamboo sticks were used to construct the outer lining of the nest platform [9, 10]. It is difficult to count all the breeding populations and their nestling in the study area due to its short duration of the study during the active breeding period. As the stork construct the nests at the top canopy with high foliage height density in the middle and lower canopy [4, 9-10] camouflaged the nests, visible from a considerable distance. Moreover there is always a possibility of missing some of the nests in the entire study area.

This study suggests the present breeding and foraging habitats of *L. dubius* and their distribution in the study area that will be helpful for the future conservation and research of the species. The nesting colony C1 was found to comprise more number of birds in comparison to the colony C2 and have the important feeding ground, city garbage dump center at Boragaon 9.5-10.5 Km from the breeding colonies. The breeding colony C2 newly described is also one of the important potential of *L. dubius* breeding situated at the bank of river Brahmaputra in semi urban area encompasses all necessary principal components as such tall trees with bamboo clumps, nearer to a garbage dump centre and associated feeding habitats.

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