

**Final Report**  
**CLP project ID: 2369**

**Enabling the Coexistence of People and Greater Adjutant in India**

Host Country, site location and dates in the field

Assam, India

Project Start Date: 1<sup>st</sup> July, 2015, Project End Date: 31<sup>st</sup> May, 2018

Names of any institutions involved in organizing the project or participating

Aaranyak ([www.aaranyak.org](http://www.aaranyak.org))

**The overall aim of the project**

Greater Adjutant becomes one of the flagship species in wildlife conservation in Assam. Government Forest Department adopts a long term action plan in partnership with people around the State of Assam. CBOs continue their actions in the field for a long term towards securing the future of this bird.

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Date which the report was completed: January 2020



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Photo credits: As mentioned. Otherwise project team.

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## **Section 1:**

### **Summary:**

Co-existence of the nest tree owners and communities with greater adjutant in the nesting colony locations is the key for securing the future of the endangered Greater Adjutant in Assam, India. With an estimated global population of about 1200 birds, about 80% of it's distributed in Assam. For the last several years this project team is working closely with the communities around the nesting colony locations to develop an ownership feeling towards to the bird and the team is successful upto a great extent. Nest numbers and population of this bird have taken an upward trend now. In Kamrup District of Assam, where the maximum population of this bird could be found, the nest numbers have increased to 250 in 2019-20 from just 28 nests in 2007-08. It was indeed a great effort to highlight the conservation need of this bird in a landscape where majority of the conservation agenda are towards the so called charismatic species like tiger, rhino and elephant etc. The project team is also closely working with the lawmakers and government forest department to take this bird to the mainstream conservation agenda. It was fruitful and government authority has taken the conservation need of this bird on priority now. The conservation action plan prepared during this project is under consideration by the authority. Hand-in-hand support and cooperation of the community and government policy makers will assuredly secure the future of this bird in Assam.

### **Introduction:**

The Greater Adjutant Stork *Leptoptilos dubius* is an endangered stork (for various IUCN Red List criteria under A2bcd+3bcd+4bcd; C2a ) and the population is in decreasing trend. The Greater Adjutant Stork (GAS) was once very widely distributed in India, South and South East Asia, but currently known to distribute

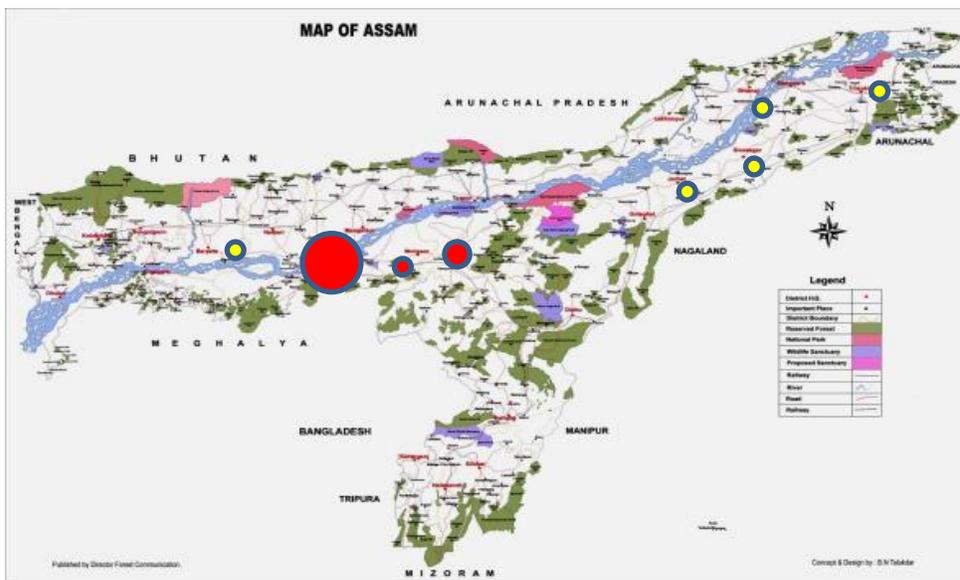
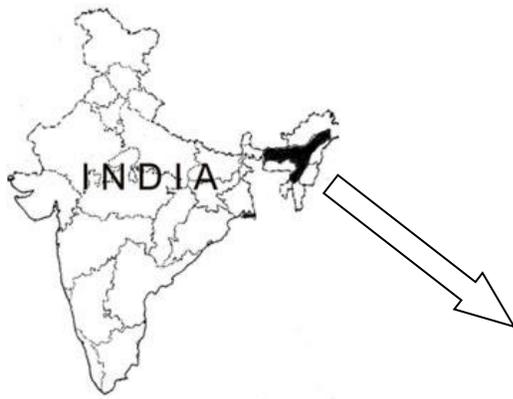
only in Assam and Bihar in India (Saikia and Bhattacharjee 1989, Rahmani, 1989, Rahmani *et al.* 1990, Choudhury 2004, Hancock *et al.* 1992, and Arvind and Mandal, 2009) and a very few South East Asian countries (Luthin, 1987, Campbell *et al.* 2006, Clements *et al.* 2007). The Greater Adjutant (*Leptoptilos dubius*) belonging to stork family Ciconiidae and order Ciconiiformes have suffered a massive decline of its population and currently known to breed in Assam of India and Cambodia (BirdLife International, 2018). Out of its total estimated global population of about 1000-1200 birds (Birdlife International, 2018), about 800 birds have been found in Assam and considered as a global stronghold.

Brahmaaputra valley of Assam (India) is considered as the last stronghold for endangered Greater Adjutant (locally known as *Hargila*). **Currently 80% of its global population could be found in only few breeding colonies in Assam.** This colonial nesting six feet tall big bird make their nesting colonies in privately owned tall trees within the thickly populated human habitation areas. That is the problem and there lies the solution too. The bird generally chooses the same trees years after year to make their nests. But cutting down of nesting trees by tree owners, wetland habitat loss and poaching stood as the major threats for the birds. Willingness and support of the nesting tree owners is the key for saving the breeding habitats. Easy livelihood income by cutting the trees and dirty feeding habits of the birds making the campus of the tree owners' unhygienic has proved to be the major cause which made the tree owners cutting down the trees. Direct cash benefit is strictly opposed by the experts and awareness and ownership is the key for a sustainable model. The project team has generated mass awareness to build the community support but realized that a fully planned livelihood support mechanism to the tree owners' female members could be a sustainable model for saving these bird in these villages. The proponent with support from Government has experimentally provided some weaving tools and preliminary training to weave

clothes with stork motif to 70 women from tree owners' family and named them as '*Hargila Army*' (protector of the bird and trees). The result was very encouraging and now more than 10,000 women from different villages too joined as pledged members of Hargila army. In Hargila army now 400 women play as forefront leaders in participating, organising programs, livelihoods trainings etc. The women with this small support could come with stork motif in handloom products that could have a good market potential too. The women power of "*Hargila Army*" in return saved this bird in these villages and motivated their male counterpart too. Hargila army all women team have been now recognised as the first such huge women led massive woman led community conservation movement for an endangered bird. The idea is highly appreciated by experts and conservationists suggested if this effort could be stressed with a larger resource with more professional manner. Regular awareness campaigns like biodiversity classes, nature tour exposures, health check up camps for the nest tree owners will also prove to be very effective in this mechanism.

Through this project, we initiated a community conservation programme where we successfully established a massive community conservation movement in Assam with strong sense of ownership building towards the bird among communities. We celebrated breeding season of the birds in every year in a much participatory and innovative way. We celebrate hargila baby shower to celebrate the breeding season of the bird. Hargila festival was organised in the breeding seasons merging traditions and cultures of the village. Our conservation was inspired by traditions, cultures, folk, songs of the villages and the idea was to establish hargila as a sacred bird. Happy hatching ceremony was celebrated every year involving women communities of the village in the prime breeding locations of Assam. The project team also leads a spiritual environment education program for the pregnant women of the village where she describes them about the myth stork carries babies, life cycle of Hargila birds, requesting them to observe the parenting of Hargila birds on the nests, hugging trees, nature based songs etc. Communities have responded to the conservation of this bird and now this bird is protected by the villagers in these nesting colonies. In the return, population has increased now it is estimated that the population in Assam has increased by double. It was also estimated the nests numbers

increased by 10 folds in Assam and gone upto 370 recorded nests in Assam now. In Assam recently 950 to 1000 individuals were counted in a survey (Barman, 2020)..Till last decades, Nagaon District breeding colony of this bird used to be biggest nesting colony in Assam (Singhaet *al.* 2003),however its Kamrup breeding colony is now the biggest nesting colony of this bird. Again breeding colony in Nalbari District is also missing. In one breeding colony of Dadara-Pacharia-Singimari villages of Kamrup District of Assam we recorded about 650 numbers of individuals in the month of December 2016 and this could be considered as the highest number of this bird in any of its breeding colony recorded elsewhere.



**Figure 1: Project location**

## Project team members:

Name	Age and Qualification	Responsibilities
<p>Ms.Purnima Devi Barman</p> 	<p>39years.</p> <p>Master in Zoology and specialized in Animal Ecology and Wildlife Biology. Recently cleared her Ph.D work on Greater Adjutant.</p>	<p>Team Leader. Responsible for coordination, planning and execution of the project activities. Community conservation works, scientific data collection and analysis and government coordination.</p>
<p>Ms.MadhumitaBarthakur</p> 	<p>39 years</p> <p>Bachelors in Geography</p>	<p>Organising field events and stakeholder relationship building</p>
<p>Mr.Ajoy Kumar Das</p> 	<p>39 years</p> <p>Law Graduate. Specialized in India Wildlife Laws</p>	<p>Coordination with decision making bodies. Planning and participation on field activities.</p>

<p><b>Mr.Mridul Bora</b></p> 	<p>34 years</p> <p>Master in Mass Communication</p>	<p>Communication and documentation of project activities.</p>
<p><b>RichaBarua</b></p> 	<p>30 years</p> <p>MED degree holder</p>	<p>Assisting in a few awareness, environment educational activities and documenting the project</p>



Photo: Anupam Nath

## **Section 2:**

### **Aim and objectives:**

Presence of so called charismatic mega herbivores and carnivores *e.g.* tiger, elephant, rhino etc, has pushed the other lesser known but important wildlife to the backstage in the conservation scenario in Assam, India. If the conservation fraternity does not address the need of these lesser known endangered animals with a priority, then we might push these species to more problems. Greater Adjutant is such an important endangered bird which mainly depends upon the community conservation model of protection with an appropriate support from the Government conservation authority. The all previous efforts to save this birds through various initiatives have proven this again and again. The current project was aimed at to take this bird to the limelight of conservation fraternity so that it attracts attention of various authorities and in returns get protection through various mechanisms. The main objective were: a) to frame a conservation action plan to have a roadmap for this bird protection and conservation, b) To investigate global status and breeding success of Greater Adjutant in Assam, Bihar and Cambodia. c) To celebrate Greater adjutant conservation festival each year in breeding colonies in Assam, d) To establish community conservation facility at Kamrup to highlight the community conservation model for Greater Adjutant conservation.

### **Changes to the original project plan:**

Majority of the activities could be done as planned except the population estimation in Cambodia and the preparation of monograph on the bird. We felt that a monograph would need more investigations especially on the bird habitat and the species across its distribution ranges. However, the effort to prepare a monograph will be continued through various other initiatives by the project team.

## **Methodology:**

A survey was done to find out the major foraging grounds of the Greater adjutant stork in Assam. The survey was conducted opportunistically taking into consideration of the logistics. We considered the nest as successful one which was found with hatchling. Number of nests, adults and chicks were counted by direct observation on nesting colonies, roadsides, garbage dump and wetlands. Interior places were visited to find nests. Literature review of Saikia and Bhattacharjee (1996), Singha *et al* (2003), Goswami and Pator (2007) were considered for finding earlier historical breeding colonies. The survey was conducted in 8 districts *i.e* Kamrup, Nagaon, Morigaon, Sibsagar, Jorhat, Barpeta, Tinsukia and Dibrugarh. We followed Singha *et al*(2003) method and we counted the numbers twice in a month in the breeding season in the nesting colony and in the garbage dump. All the important locational points were stored in a Garmin GPS. A map of the important foraging grounds were prepared. Aerial distance ranges between each nesting tree of the nesting colonies and major wetlands were estimated by taking the help of GIS laboratory of Aaranyak. Behavioural data were collected using the focal animal sampling technique of Altman (1974). The pattern of observation in each time block was as follows: each hour was divided into three 15-minute continuous monitoring periods, followed by a 5-minute break. During each 15-minute period, only one bird was monitored, and the same bird was monitored throughout the day. When the bird disappeared from our sight, another individual was selected and monitored. The GAS is not sexually dimorphic, so we did not differentiate the data between sexes. The time spent performing different activities was determined each month, and from these values, the percentage of time spent was estimated for each activity during the different time blocks of the day. The egg-shells of Greater Adjutant were collected from the ground of nesting trees. Pre-incubation, incubation and post incubation egg shells fallen below the grounds were collected. The samples were cleaned by scrapping with a PVC

scalpel and washed with distilled water and air dried at ambient temperature for further spectroscopic and microscopic analysis. Moist soil samples (quadruplicate) from the ground near the site of egg shell find were collected, air dried for physicochemical analysis. Scan electron microscopy (SEM) was done on dried egg shell both in outer and inner side of the eggs. EDAX analysis, SEM and microanalysis on carbon, hydrogen and nitrogen (C,H and N) were carried out from NEHU, Shillong.

We designed the community conservation activities to motivate nest tree owners based on the pre-campaign survey results. For community conservation activities, we followed the same proven method of the previous CLP follow up project. We identified various key groups in the villages who could influence the nest tree owners to allow Greater Adjutant to make nesting colonies in their private trees. We approached young students, women folks, elderly respected persons from the locality to generate an “ownership feeling” among the villagers for having Greater Adjutant in their villages. “*Hargilaarmy*” (protectors of Greater Adjutant), formed during the previous project was the backbone of this this present project to motivate the nest tree owners and the communities around of the all nesting colony locations. *Hargila army* was encouraged to prepare : “*gamosa*” (traditional Assamese towel) and other household clothing with *hargila* motif to financially benefit the community around the nesting colony areas. Tree plantations was organised in all nesting colony villages. Several other methods like public felicitation of the nest tree owners, house to house meeting with the nesting and roosting tree owners, visit of influential and socially respected people to the nest tree owners house etc were employed to boost up the morals of the nest tree owners so that they continue their support to the Greater adjutant in their own house campus. To save the nest fall chicks, nylon nets were placed under the nesting colonies. Nest fall chicks were then handed over to Assam State Zoo and rescue and rehabilitation facilities. Frontline forest personnel were trained to

rescue and rehabilitation of nest fall chicks and on other related conservation activities for Greater adjutant stork. Several workshops were organised to draft the conservation action plan for the species. Experts from various ornithological institute participated in these workshop.

## **Outputs and Results**

### **Scientific studies:**

Various scientific studies were carried out on the Greater adjutant during the project tenure. Breeding success, EDAX study etc were our priority as planned in the proposal.

The Greater Adjutant is a carnivorous and a scavenger bird. In India, a very few study has been done so far on this scavenging bird. The Greater Adjutant is a large, carnivorous, scavenger species of bird which is always a good model for ecological studies simply because it can be easily seen and counted. Since environmental toxins, particularly pesticides, travel fast along aquatic food chains by bio magnification, piscivorous birds exhibit early signals of contamination and therefore their study assumes a special significance. The laboratory result of analyzing the kidney and liver of 27 birds died in Deepar Beel Ramsar site from 24<sup>th</sup> January to 1<sup>st</sup> February 2017 reveals the presence of pesticides like Organophosphorous and Organochlorine. In liver samples (n=6), the composition of organophosphorous found to be detected are  $\alpha$ HCH (182.44 $\pm$  12.62) ;  $\beta$ HCH(4167.43 $\pm$ 21.62);  $\gamma$  HCH (397.24 $\pm$  53.3);  $\delta$  HCH(397.24 $\pm$ 53.3) Chlorophyton (76.85 $\pm$ 8.37); PP-DDE(3387.38 $\pm$ 17.48); PPDDE(3387.38 $\pm$ 17.48); PP DDD(587.99 $\pm$ 11.64); OP DDD(70.10 $\pm$ 12.67) PPDDT(60.10 $\pm$ 5.93). In Kidney (n=6), the composition of Organophosphorous (ng/g of tissue) detected as  $\alpha$ HCH(353.36 $\pm$ 13.48),  $\beta$ HCH(353.36 $\pm$ 13.48) ;  $\gamma$  HCH(500.45 $\pm$ 62.16),  $\delta$  HCH(131.67 $\pm$ 17.14);  $\delta$  HCH (240.61 $\pm$ 16.59), Chlorophyton (213.21 $\pm$ 9.47),

PPDDE(366,71±8.33), nOPDDD, 0.101, PPDDT (82.1577.87±5.93). Again, the composition of Organochlorine in liver in ng/g of tissue are: Dichloros (2249.88±12.05); 4bromo2Chlorophenol (26615.80±22.87); Chloropyrfos Methyl (18988.82±21.34), Paratrion Methyl (18988.82±21.34), Fenitriothin (303.61±2.34), Phronte Sulphoxide (2666.1.47), Phenophos (<0.0001), Ethion (<0.001), Trigophos (3530.45±22.33). The composition in kidneys are Dichloros (<0.001), 4bromo 2 Chlorophenol (7726.0±22.34), Ch(oloropyrfos Methyl(<0.0001), Paratrion Methyl( 58767.00±12.56), Fenitriothin (81.76±23.98 ), PhronteSulphoxide ( 607.42±12.58, Quinol phosphate(1880.98±34.56 Phenophos (<0.0001), Ethion (425.55±9.65 ), Trigophos (1791.95±2.34). The liver and kidney shows high composition organochlorine and organophosphorous components and it indicates the presence of toxicity in the food chain.

**Table 1: : Pesticide (Organo phosphorus) detected in the liver and kidney of died GAS during January 2017 at DeeparBeelRamsar site (ng/g of tissue)**

Pesticide	Liver (n=6)	Kidney (n=6)
αHCH	182.44±12.62	353.36±13.48
βHCH	4167.43±21.62	353.36±13.48
γ HCH	397.24±53.3	500.45±62.16
δ HCH	131.67±17.14	240.61±16.59
Chloropyhyton	76.85±8.37	213.21±9.47
PP-DDE	3387.38±17.48	366,71±8.33
PP DDD	587.99±11.64	0000
OP DDD	70.71±12.67	<0.1001
PP DDT	60.10±5.93	82.1577.87±5.93

**Table2: Pesticide detected (Organochloride)in the liver and kidney of died GAS during January/2017 at DeeparbeelRamsar site (ng/g of tissue)**

Components	Liver (n=7)	Kidney (n=7)
Dichloros	2249.88±12.05	<0.001
4bromo 2 Chlorophenol	26615.80±22.87	7726.0±22.34
Choloropyrfos Methyl	16040.10±32.44	<0.0001
Paratrion Methyl	18988.82±21.34	58767.00±12.56
Fenitriothin	303.61±2.34	81.76±23.98
PhronteSulphoxide	646.11±12.23	607.42±12.58
Quinolphospahte	26661.47±12.42	1880.98±34.56
Phenophos	<0.0001	<0.0001
Ethion	<0.0001	425.55±9.65
Trigophos	3530.45±22.33	1791.95±2.34

Presence of heavy metal in the liver and kidney is not a very good sign for this bird. It was suspected that consequence of food poisoning due to toxic material is happening because of its foraging in a rubbish dump near Guwahati city. Greater adjutant is well known for its foraging habits in ports and near the butcher house etc. In Assam, rubbish dump is a major foraging ground of this species due to easy availability of food items. However, there is no proper method of garbage segregation and chemicals, hospital waste, laboratory wastes and all other materials are reported to be dumped together. Well plan garbage segregation specially for toxic materials and hospital waste needs to be done at the first place. Several government and non-government initiatives are in place for this however this might take a slightly longer time to a complete segregation of garbage at the sources.

### **Breeding success:**

The breeding success of Greater Adjutant stork was extensively studied during this project tenure. This is the first time someone did the extensive studies of breeding success of this bird in Kamrup District, Assam. The breeding success of GAS in Kamrup District of Assam were designed keeping in mind all these following factors

- 1) The comparison of nest numbers or nesting success with other colonies in Assam
- 2) Nesting tree availability in studied colony comparing them with non-nesting tree parameters.
- 3) To investigate the possible parameters that made the species to select the studied nesting colony of Kamrup.
- 4) To know the breeding parameters like mating pattern, incubation, clutch size, hatching success, nesting success, Fledgling success, productivity of the colony, Parental investment and other important breeding behaviour.

- 5) To know if any changes are happening in egg shells relating to their feeding behaviour on garbage dump and to know the status of egg shells composition etc.

The breeding season of Greater Adjutant Stork starts from the month of September and commence on end of April. However, it was found that every year, three pairs of Greater Adjutant Stork appears as advance on either 18<sup>th</sup> or 19<sup>th</sup> August to a particular *Dewa* tree in Dadara village. Then another six to seven pairs comes by 25<sup>th</sup> of August. The other pairs follow to occupy the colony in September. The present study found that the eggs were laid in the first week of October observed at least in 100 nests. Saikia and Bhattacharjee (1996) also mentioned that the birds congregate in the colony in September and October. However, in the present study, the birds start coming from mid of August and the whole colony is occupied in September. This suggests that there might be a change of time in congregation in the breeding colony of Greater Adjutant Stork. They congregate in the colony and occupy the nesting trees and shows territorial behaviour by defending their tree from other storks. In the present study, observations were done from a 85 feet bamboo platform in three tall trees every year and the other nests were studied either from ground or building. The first hatchlings in the colony comes out on 2<sup>nd</sup> to 6<sup>th</sup> of November every year.

All the nesting colonies of Greater Adjutant were found in villages or in semi urban areas in Assam with close proximity to human habitation. There is no record of nesting locations in protected areas in Assam in the current survey. Saikia and Bhattacharjee (1989a) did a preliminary survey and found 11 nesting colonies in Assam out of which one colony was reported from Kaziranga National Park. Singha *et al.*, (2003a) also did not report any Greater Adjutant Stork colony from protected areas of Assam. During this study, though no nesting colony was

recorded in protected area but a flock of birds were often observed in Kaziranga during month of March 2013, 2014 and 2015.

The selection of nesting site by the birds is for those sites or trees which increase its breeding success, protection from predators and relying on their past experience, birds re-use these nesting site like the colonial breeders (Butler *et al.*, 1995). The major factors for the selection of nesting site in the studied area were found to be height of the trees, DBH, the canopy spread, water source, availability of nesting materials etc. All the nesting trees were tall with large DBH and dense canopy spread which provided protection from predation. The Principal component analysis revealed that DBH, tree canopy, water sources are the important factors for selection of nests by Greater Adjutants Stork. In mixed heronary also, it is found that the birds generally prefer taller trees and avoid human disturbances and large species nest at high level (Venkatraman,1996). The birds select a tree for nesting by looking at the tree structure and its proximity to feeding sites and human disturbance, so that no predator can easily access the nest (Maheswaran and Rahmani, 2002). Burger (1985) believes that the advantages of nesting high in mixed species colonies for heron are 1) increased ability to see predators from a distance, 2) easy flight access to and departure from the nest, 3) maximum distance from ground or water predators and 4) maximum distance from the threat in flooding in low lying colonies. In our case too GAS uses the high nesting tree and causes may be similar to these points other than the thermo regulation for the chicks. It can be assumed that Greater Adjutant also select the tall trees to reduce the chance of predation, easy flight access and to increase the distance from the ground in order to avoid any disturbance factor.

Nesting trees in Dadarara-Pachariya-Singimari colony comprises of *Anthocphalus cadamba*, *Artocarpus lakoocha*, *Pithecellobium monadelphum*, *Bombax ceiba*, *Tamarindus indica*, *Trewia nudiflora*, *Linnaea grandis* etc.

*Anthocephalus cadamba* was the dominant nesting tree every year. Singha(1998) in his study found that *Alstonia scholaris*, *Anthocephalus cadamba* and *Bombax ceiba* were frequently used as nesting trees and *Alstonia scholaris* was the dominant species. Barooah (1991) reported that *Bombax ceiba* and *Alstonia scholaris* were the nesting trees found in colony of Sibsagar district. Bhattacharjee and Saikia (1996) found 13 tree species as the nesting tree for Greater Adjutant Stork. The nesting material consisted of dry branches of *Bambusa species*, fresh twigs of *Anthocephalus cadamba*, *Gmelina arborea*, *Bombax ceiba*, *Linnea grandis*, *Alstonia scholaris*. Since *Anthocephalus cadamba* is the dominant species, it is assumed that the selection of nesting trees also depends on the availability. It is seen that in most of the nesting tree colonies of Greater Adjutant Stork, the nearest plantation is the thick bamboo. It is studied that 75% of the nearest tree and other vegetation includes *Bambusa species*. So it indicates that the Greater Adjutant Stork prefers the areas where they can get enough bamboo sticks for their nest constructions. Dadara-Pachariya-Singimari villages are historically famous for farming. The villages are surrounded by paddy fields which are adjoined with wetlands. This may be one reason that the Greater Adjutant Stork prefers this area due to the presence of enough paddy field wetlands which not only serves foods but also provide nesting materials.

The present study shows that average 6 active nests were supported by nesting trees but at the initial months one tree supported 9 to 10 nests. 10 nests in a *Dewa tree (Artocarpus lakoocha)* are seen every year in the colony with 95% nesting success till the end of the breeding seasons. The maximum number of nests per tree most likely depict the nesting capacity of a particular tree.

In Greater Adjutant Stork, more nests are found in the top canopy of the tree. Martin and Roper, 1988; Kendeigh, 1963; Saikia and Bhattacharjee (1996) also mentioned that nest building in canopy helps the species to get the required temperature for incubation.

Kamrup has 250 nests now and an average 600 to 650 Greater Adjutant Stork were counted. Nests were considered active when first egg was laid and successful when at least one young was raised to an age at which they were capable of escape by walking. On the other hand, Nagaon District which happened to be one of the healthy colony (Singha,1998) has now left with only two trees with average 18nests. Morigaon has now only 8 trees with average 30 nests and Sivsagar has only one nesting 1 tree with average 3 nests. The study reveals that Kamrup has the highest concentration of Greater Adjutant Stork supporting the largest nesting colony in the Assam. However the villages are now under industrialisation and lots of developmental activities are happening. Habitat degradation for urban development, cutting of nesting trees, poaching for meat, pesticides used in agricultural activities, might have caused population declines in this species from its entire historical distribution range. Given the agrarian nature of most surveyed villages, a possible decline due to pesticides deserves further investigation. Samuel *et al.*, 2012, in their study on Abdim's Stork found that the coexistence of this species with human was evident as all records of the birds were within human settlements, with more nests and birds recorded in the larger villages. The slightly higher number of nests observed on trees fenced within compounds rather than outside also seems to suggest that this association with humans may be of some benefit to the species (Samuel *et al.*, 2012). The current study also showed that selecting nesting trees by Greater Adjutant Stork in close proximity of human habitation area may have been beneficial for the species. The possible factor towards selection of nesting trees in the vicinity of human compound may be many as discussed above but another one may be due to chances of decrease of predation in human areas. Nest predation has a significant role in evolution of many aspects of avian nesting behaviour (Lack, 1968; Burger, 1982). Among ciconiiformes, there is almost no group or individual nest defence behaviour and even low predation apparently is capable of destroying very large

colonies (Baker, 1940; Sheilds and Pamell, 1986; Rodgers, 1978). Nest predation is an important ecological factor influencing reproductive success in birds reported by Urfi (2011). In Dadara-Pachariya-Singimari, except Rhesus macaque, no other predator was found. Singha (1998) did not find any predator in his study in Haibargaon in Nagaon District.

During the entire breeding period, the Greater Adjutant Stork was observed to bring nest material of fresh *Cadamba*, *Gmelina arborea* and other fresh leaves which they put over the dry branches. According to Rodgers *et al.*, (1988) the nest with fresh greenery had higher insulative value during the early hours of the incubation. Nest insulation depends on the materials used in nest construction, which depends on availability (Skowron and Kern,1980, Rodgers *et al.*, 1988).

The selection of nest-site by the birds is for those sites which increase its reproductive success, protection from predators and relying on their past experience, birds re-use these nesting site like the colonial breeders (Butler, 1994). Samuel *et al.*, (2012) reported that *Ciconia abdimii* in Nigeria reused nests repeatedly (not necessarily by the same pair). But current study shows that the birds never reused an existing nest. It was observed that when the breeding cycle ended, either one of the parents break the nest and throw the materials on the ground and leave the place. This behaviour is not reported so far and needs more study on this. However, in some particular cases, during the initial months of breeding seasons, two pairs vacated the nest and was not observed to come back.

A behavioural ethogram was constructed of Greater Adjutant Stork describing 36 behaviours (Barman and Sharma, 2017). All storks show a number of ritualized social display during the period of pair formation and courtship (Kahl,1971a, 1971b). The storks show the greatest number of ritualized social displays during the period of pair-formation and courtship. Many such displays are species-specific and presumably largely genetically determined. Certainly they

appear as valuable information in assessing relationships and differences between species and genera as are morphological characters. Even a hatchling comes out itself from the egg shell, the parents perform the up-down display as a greeting ceremony (Tortosa *et al.*, 1999). This behaviour was also observed in Greater Adjutant Stork during the present study.

In most aspects of display and behaviour, the species of *Leptoptilos* might be similar to other species of storks (Kahl, 1966). Yet during courtship, and occasionally later, females typically land near lone male on nest sites and approach them in the balancing posture. In this display, a female Greater Adjutant Stork stands with its body nearly horizontal bill pointed downward, and wings held widely spread was observed. It has also been found that female bends her legs, lowers her head and neck, and clatters the mandibles loudly five to six times while lifting the bill forward and upward with a slight “scooping ” motion. After pair-formation, all three species of *Leptoptilos* give frequent up-downs whenever one member of the pair returns to the nest after an absence. In the Marabou, the bird first throws its head upward with the bill nearly vertical and utters a series of loud, high pitched squeals and deep-throated “moo’s” (Kahl, 1966). The courtship behaviour in the present study was avoided from the bamboo platform to avoid possible disturbances. However, it was observed from ground during the initial stages of courtship behaviours.

It was found that the copulation period varies from 30 to 35 seconds (n=50). In one particular case, male stood over the female for at least one minute and then the copulation was rejected. The male tried for copulation for at least three times and every time it was rejected by the female.

After the pair formation, nest is formed by both the sexes. The Greater Adjutant Stork takes at least 3 to 5 days to form a nest. As soon as the formation of nest done copulation begins. The Greater Adjutant Stork were also seen to

perform copulation in branches before the nest is formed on the month of September. In a particular observation, the male tried to copulate the female many times and once the male got over the female, the female rejected and the male got down. In at least 10 observations, it was observed that the male defecate before getting over the female for mounting. The male often preens the female in at least 12 observations. After copulation, the Greater Adjutant Stork starts egg laying and incubation. Both the male and the female participate in the incubation and participation of female is more than the male.

Incubation period varied from 28 days to 35 days. Colonially nesting waterbirds like storks species typically begin incubation prior to the completion of laying, which results in asynchronous hatching (Owen, 1960 ;Blaker, 1969).

The Greater Adjutant laid eggs asynchronously. Asynchronous hatching has been reported in many other avian species (Watson, 1957), Crows (Lockie, 1955) and swifts (Lack 1956). Lack (1956) considered asynchronous hatching to be a mechanism that allows brood size to be reduced to the number that parents can raise successfully, depending on food availability. The evolutionary significance of hatching phenomenon, patterns etc is poorly understood and need more studies (Clark and Wilson, 1981). Synchronous hatching pattern of eggs in birds was considered to be favourable (Lack, 1956) partly because of brood of nestlings that are a similar age may be more easily cared for once they have left the nests (Lack 1968). Lack (1947, 1954, 1966) also proposed that asynchronous hatching may be beneficial during periods of food crisis or shortage because of young nestlings can be rapidly eliminated without too much loss of already invested energy (the brood reduction hypothesis, Ricklefs 1965). This hypothesis has already won early acceptance among bird ecologists and some support has been found (Hahn 1981; Slagsvold 1982; Fujioka 1985).

Clutch size of Greater Adjutant Stork varied from 1 to 4 eggs and 2 clutch size is very common. The mean average clutch size of Greater Adjutant Stork is  $2.51 \pm 0.51$  (56 nests). Saikia and Bhattacharjee(1996) has reported that 4 clutch size was not observed. But the present study reported four hatching success for five observations in 2014-15 and two observations in 2016-17 in two breeding seasons.

Up-Down display has been well described by Kahl (1971a, 1973) after continuously studying the social behaviour of storks for 11 years (Ishtiaq, 1998). In this spectacular up-down display behaviour, both the mates stand erect, facing each other, and spread their wings widely to the sides, so that their wing-tips are almost touching. The Greater Adjutant Stork performs similar up down display during the breeding period (Barman and Sharma, 2017).

In Greater Adjutant Stork, both the parents participated and devoted their time in nesting activities, parental care etc (Barman and Sharma, 2017). Except preening to young, wing stretching and watering to chicks, there was significance difference ( $P < 0.005$ ) in other activities between the male and the female storks. Male invested more time in nest material collection while female invested more time in incubation. The male invested more time in nest arrangement and feeding to young also.

Breeding success was mainly influenced by fledging success. The dates of fledgling success start from 12<sup>th</sup> of March to 28<sup>th</sup> March and then continues and end within 30<sup>th</sup> of April. However, a few fledgling of a few late breeders remained in the nest until June. This was observed at least in three cases in the current study.

The fledgling period continues from a minimum of 125 days to a maximum of 165 days and the mean average of fledgling period is  $155.45 \pm 5.23$ . There is no significance difference within and among the incubation period of different breeding seasons in different years. There was a negative correlation found

between the nest fall mortality and fledgling period. The young birds start moving, perching and standing only after 30 days. During this act, chicks often fall from the nest, but no adults show any interest to rescue them from the ground (Singha,1998).

The nest fall mortality found to be very high in Greater Adjutant Stork which varies from 45% to 73.07%. Post (1990) reported high nest fall mortality in colonial nesting birds. Kosicki (2012) reported that weather conditions have a bearing on nest survival in case of White Stork. In the present study also it was found high nest fall mortality during late March and April due to stormy weather conditions. Due to nest fall mortality, productivity of Greater Adjutant Stork is very low which is <50. Singha (1998) reported that the nest fall mortality is common in stork and at least 15% of chicks die due to nest fall mortality. But the rate is found to be higher in the present study than Singha (1998).

The eggshell significance is related to its function to resist physical and pathogenic challenges from the external environment, such as its function as an embryonic respiratory component, in addition to providing a source of nutrients, primarily calcium, for embryo development (Hunton, 2005). Moreover, eggshell quality is an essential criteria for egg production, for example in table eggs; shells must be strong enough to prevent failure during packing and transportation (Hunton 2005). EDAX study in pre incubation, incubation and post incubation birds in the study period reveals the presence of high level of Hg, Pb and Te and other heavy metals. At approximately 1.0 µg/g in bird blood, effects of methyl mercury exposure included altered bird breeding behaviours (Heath and Frederick, 2005; Tartu *et al.*, 2015); reduced breeding success of south polar skuas during the subsequent breeding season (Goutte *et al.*, 2014); reduced egg hatchability (LC50: lethal concentration where 50% mortality occurs) of highly-sensitive birds (Heinz *et al.*, 2009); an estimated 12% reduction in common loon productivity (Burgess

and Meyer, 2008); reduced egg hatchability (LC50) in thick-billed murre (Brauneet *al.*, 2012). At approximately 3.0 µg/g in bird blood, effects of methyl mercury exposure included impaired productivity (Barr, 1986), decreased immune competence in tree swallows (Hawley *et al.*, 2009); and decreased egg hatchability in ring-necked pheasants (Fimreite, 1971). According to a study by Pollentier (2007), mercury is extremely toxic particularly in the form of methyl mercury which reduces breeding in wild birds by disrupting their parenting behaviours and lead to homosexuality. The presence of high amount of mercury in Greater Adjutant Stork might be due to their scavenging habit in a non-segregated waste dump near Guwahati. In a long run, this might effect in the breeding biology of this bird. But this study need to be expanded in future.

Breeding success status of various parameters like no of nest, no of trees, mortality rate, fledgling success rate are depicted in the following table. Again the mean average value of successful fledglings living the colony are 33.75±13.79 (m±SD, n=599 nests). Analysis of variance was carried out among three variables of nest mortality, nesting numbers and fledgling success and the result is statistically significant. Average nestlings numbers recorded from 2012 to 2016 are 153.25±21.37, whereas average nest fall mortality is 90.25±13.79 and numbers of fledgling in the colony are 33.75±13.79.

Table 3: Status on average breeding success from Dadara, Pachariya, Singimari Colony from 2012-2016(n=599nests)

Parameter	m±SD
Nestlings numbers	153.25±21.37
Nest fall mortality	90.25±13.79
No of Fledgling	33.75±13.79

(ANOVA, df=2, df=287, F=919.85, P=0.001 significant P<0.005)

**A**



**B**



**C**

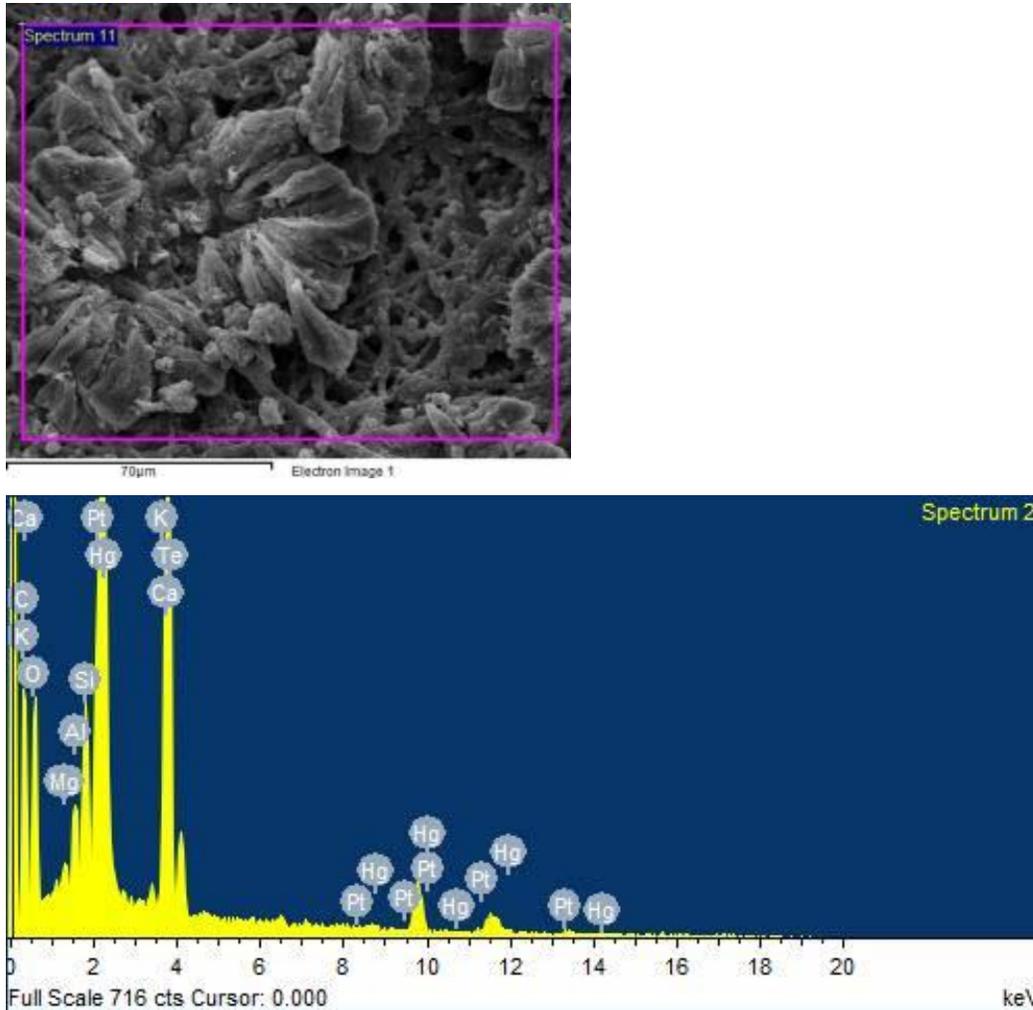
Plate No.1: A,B,C: Nest fall chicks of Greater Adjutant (different age groups).

**Egg shell Analysis:**The main aim of the study was to determine the distribution of metals in egg contents and eggshells, with emphasis on the deposition of Sr in eggshells Concentrations of inorganic elements were determined in eggs of GAS collected during the breeding season and the same was subjected EDAX analysis. Eggs collected under the nests during October was considered as pre incubation period, during November, shell with tines of blood was as post incubated egg shell were analysed for metal analysis and shell surface ultrastructure. High percentage of Hg was detected in the egg shell along with the least known Te(Table :4)

**Table 4:EDAX for various 3 stages of eggshell development (P<sub>i</sub> = pre incubation period, I = Incubation period (I=9) (, P<sub>o</sub> = post Incubation period) [P<sub>i</sub>,(n) = 8, I,(n = 5), P<sub>o</sub> ,(n) =9]**

	P <sub>i=9</sub>	I=5	P <sub>o=5</sub>
Hg	6.56±1.85	5.29±1.67	4.83±1.56 (P=0.286)
Al	1.88±0.38	1.26±0.30	0.64±0.21
Mg	0.98±0.14	0.72±0.49	0.54±0.26
Ca	55.72±3.75	21.11±1.64 <sup>a</sup>	8.84±1.97 <sup>ab</sup>
O	34.48±2.07	27.97±4.41	34.28±4.42
C	57.15±5.36	20.79±2.60 <sup>a</sup>	10.13±2.33 <sup>ab</sup>
Fe	0.96±0.34	0.84±0.11	0.76±0.13
Sr	0.45±0.12	0.39±0.18	ND
P	2.42±0.19	2.65±0.64	2.84±0.28
Te	1.93±0.17	2.05±0.35	1.87±0.36

**Fig 1: Presence of Te and other Heavy metals in inner membrane of egg shell from a post incubated egg shell**



The eggshell significance is related to its function to resist physical and pathogenic challenges from the external environment, such as its function as an embryonic respiratory component, in addition to providing a source of nutrients, primarily calcium, for embryo development (Hunton, 2005). Moreover, eggshell quality is an essential criteria for egg production, for example in table eggs; shells must be strong enough to prevent failure during packing and transportation (Hunton 2005). EDAX study in pre incubation, incubation and post incubation birds in the study

period reveals the presence of high level of Hg, Pb and Te and other heavy metals. At approximately 1.0 µg/g in bird blood, effects of methyl mercury exposure included altered bird breeding behaviours (Heath and Frederick, 2005; Tartu *et al.*, 2015); reduced breeding success of south polar skuas during the subsequent breeding season (Goutte *et al.*, 2014); reduced egg hatchability (LC50: lethal concentration where 50% mortality occurs) of highly-sensitive birds (Heinz *et al.*, 2009); an estimated 12% reduction in common loon productivity (Burgess and Meyer, 2008); reduced egg hatchability (LC50) in thick-billed murre (Brauneet *et al.*, 2012). At approximately 3.0 µg/g in bird blood, effects of methyl mercury exposure included impaired productivity (Barr, 1986), decreased immune competence in tree swallows (Hawley *et al.*, 2009); and decreased egg hatchability in ring-necked pheasants (Fimreite, 1971). According to a study by Pollentier (2007), mercury is extremely toxic particularly in the form of methyl mercury which reduces breeding in wild birds by disrupting their parenting behaviours and lead to homosexuality. The presence of high amount of mercury in Greater Adjutant Stork might be due to their scavenging habit in a non-segregated waste dump near Guwahati. In a long run, this might effect in the breeding biology of this bird. But this study need to be expanded in future.

**Experimental artificial nest platform:**An experiment of an artificial nest platform was done to test if the bird successfully breeds on this. This is a first ever experiment of in situ nest platform for this bird. The result was very encouraging. A pair of Greater adjutant selected one of our artificial bamboo nest platform for the time in its historical record. A very huge old nesting tree including six other nesting tree suddenly uprooted due to natural calamities during the time of breeding period. We just selected a few such locations to build artificial breeding platform for the GAS. Our hypothesis was

- The GAS would select the place for nesting if the breeding platform is constructed based on the nesting characteristics merging with some new more ideas of colonial nesting behaviour.

Greater Adjutant successfully built nest over an artificial nest platform that we constructed applying the parameters of colonial nesting habitat. The GAS performed all the behaviour in artificial nest platform and incubation period was 31 days and one chick hatched. The chick died after 15 days and the GAS threw the chick in the ground which we studied. The experiment was performed late in the month of January when the chicks in other pairs were already about two months. We also recorded the breeding behaviour in the pair before it left the colony.

We continued this experiment beyond this project tenure and we are happy to inform that so far five pairs of Greater adjutant successfully bred in the artificial nest platform, chicks were raised and successfully left the nest platforms.

**Plate 2: A, B,C,D: An experimental artificial breeding platform where A pair of GAS bred, incubated and hatched.**



**A**



**B**



**C**



**D**



who campaign for conservation of this stork in these villages as well as works for alternative livelihood options for the villagers. There are about 10000 women members of this group and out of this 500 are super active. They celebrate the stork breeding season as “happy hatching ceremony” and “stork baby shower” symbolized the celebration when one of their own expecting family member. The project also could secure funding for giving sewing machine and 80 numbers of sewing machines were distributed to mainly nest tree owner’s family. Does, the nest tree owners get extra income through this. The women folk from Kamrup District colony is known for their expertise in handloom activities. The project supported them with yarns continuously so that they can produce some fine handloom products. As expected, they produced some extra fine products of ladies dress, Assamese hand towel (*gamosa*), bed sheets etc and all of them has the Greater adjutant motif embedded on it. These products were super hit and subsequently they were linked up with direct marketing company (<https://www.pashoopakshee.com/hargila-army>). We have not quantified the income generated by this to the community, but it is expected that community group “hargila army” members are getting a good income from this handloom activities. (see pictures of the products in the photo section).

Rescue of nest fall chick is a notable activity of our initiative. Nest fall chicks were rescued by just placing nets bellow the nesting trees and then transported to Assam State Zoo for treatment and care. All together 110 numbers of nest fall chicks were successfully rescued and released back to the wild. (please see pictures in the photo section)

Every year, nesting tree plantation programme during the pre-monsoon and monsoon is a regular event. We organised this with formal events in the World Environment Day on 5<sup>th</sup> June, 2016 and 2017 during this project tenure. More than 2000 numbers of nesting tree saplings were freely distributed to the villagers. This

nesting tree plantation programme continues till August every year. Social forestry section of Assam Forest Department provided the saplings of the nesting trees in free of cost.

All together, 20 numbers of conservation hoardings of various sizes were placed all over the nesting colony locations to raise the public awareness level on this endangered bird. This hoardings spread the conservation awareness to the local people, the conservation status of this bird and its rarity and also remind them not to disturb the bird specially during the breeding season.

Two video documentaries were produced and published during this project tenure on our works. One was in association with Corneal laboratory, USA and another was with the award winning videographer “Bedi brothers” <https://bedibrothersproductions.com>. Both these documentaries were released in two separate functions by the Hounrable Chief Minister of Government of Assam in a jam-packed hall our Capital complex. (see photo in the photo section). Copies of the Corneal documentary was already submitted to CLP and here is the link of the documentary by Bedi brothers <https://youtu.be/QQw1eyAgYZs>. These documentaries were screened in 20 schools and colleges and seen by more that 1000 students of it. During the interactions with the student the project team came to know that after seen the documentary the students are now more aware about the conservation need of this endangered bird. Both these documentaries were freely screened in the villages and the villagers were very happy when they see themselves in the screen !

A picture book was published on Greater adjutant for the school student. More than 2000 copies of this book was printed and freely distributed to the students of 25 schools specially in the nesting colony areas. In this book, we tried to explain

about Greater adjutant, conservation status and conservation need through a series of sketches and drawings.

### **Communication and Application of results:**

Government Forest Department is the key stakeholder and custodian of our wildlife under Indian Wildlife (Protection) Act, 1972. All project activities were planned such a way that Government forest department is always in the loop or a partner of the activities. This was planned so carefully so that authority can put conservation of Greater adjutant in their agenda. So, far their agenda was dominated by conservation of other so called charismatic species (Rhino, tiger and elephant only). But, after implementing this project, government has taken Greater adjutant conservation in their agenda now. This is one of the biggest successes of this project. All these were possible due to a daily update or discussion with the key forest officials on the key finding of the project activities. Conservation action planned prepared through this project has been submitted to the authority and it is in the approval process now. All scientific findings generated during the project tenures were communicated to the scientific communities as well. Scientific paper was published in the reputed peer reviewed journal(1. International Journal of Zoology Studies Volume 2; Issue 6; November 2017; 2.Ethnobiology Letters Vol 11 No 2 (2020)) and few other manuscripts are under communication with various scientific journals. A time to time update on our activities and results were updated on our social media handles. Regular updates and results were published in print and electronic media through which results were disseminated to the global audiences (please see Appendix III).

### **Monitoring and evaluation:**

A post project evaluation was done through two volunteers who interacted with the villagers in each nesting locations. Their finding was interesting. Handholding

and continuous mental support to the villagers was the key for protecting the nesting colony. The project team also invited many renowned bird experts and community conservation personnel who evaluated our activities and gave time to time feedback on our works. All experts and community conservation works were overwhelmed by the impact of our work. The project team has gathered various prestigious awards from various organisations including Government authorities. All these awards were the positive results of their independent evaluation of our works for conservation of GAS in Assam.

### **Achievements and impacts:**

Followings are the most important achievements and impacts of the project.

1. Greater adjutant population has increased about 15% in the State since we started working with CLP in 2008. This is only possible for the cooperation and participation of nest tree owners in the nesting colonies by not disturbing the nesting colonies as well as not cutting a single nesting tree.
2. Dadara-Singimari-pacharia nesting colony of kamrup has been included in the Important Bird Area (IBA) list. This location has also been listed as Community conservation (proposed) by Assam Forest Department.
3. Greater adjutant has become a conservation icon in Assam. This is very significant in a tiger, rhino and elephant dominated landscape.
4. The project leader and "*The hargila army*" were honoured separately with "India Biodiversity Award 2016" by United Nations Environment Programme (UNEP) and Government of India for implementing and leading a successful project to protect Greater adjutant stork in Assam.
5. **The project leader was honoured with President Award "Nari Shakti Award 2017" from the President of India.** This is the highest civilian honour for women in India.

6. The project leader was honoured with “RBS Earth Hero Award 2017” by Royal bank of Scotland for her successful work on Greater adjutant in Assam, India.
7. The project leader was honoured with “Green Guru award 2016” by Balipara Foundation for her successful community conservation initiatives.
8. Not a single nesting tree was cut by any villagers since we started this project in all nesting colony locations in 2015.
9. The Greater adjutant stork conservation initiative has become a household name in Assam and many parts of India as a successful story to tell in community conservation initiatives.
10. The communities around the nesting colony locations has accepted this bird like their family members and stop disturbing the bird in their campus.
11. Out of 36 rescued nest fall chicks, 28 numbers of nest fall chicks were successfully treated, cared and released back to the wild again to their habitat.
12. Greater adjutant made nest for the first time in an assisted breeding platform made out of bamboo platform.
13. For the first time, ethology of this bird was published in the peer reviewed journal.
14. Greater adjutant stork was selected as a mascot by Transport Department, Kamrup District Government of Assam. In a tiger, rhino, elephant or other so called charismatic animal dominated landscape, this was indeed a great impact !). This is absolutely an impact of the project as we lobbied with the State government during various meeting and workshops during the project to make them understand the importance and uniqueness of this bird.
15. Our Greater adjutant conservation work has been included in school curriculum school textbook as a school lesson. This is indeed a great honour to this project.

## **Capacity Development and Leadership capabilities:**

The present project has improved the community conservation skills of the project team a lot. We learned about the conflict resolution, managing and organising mass events through implementing various activities during the project. The project team also learned about the various scientific investigation procedures e.g. EDAX studies, bird ethology, breeding ecology study ect during this project. The project team members developed the skills of handling government authorities up to great extent and because of the many of our activities got government endorsement and support. Action plan preparation workshops were another tools to develop the team capacity on a number of subjects.

Other than team capacity development, a numbers of frontline forest department staffs (50 numbers) were trained through this project especially on the rescue and care of nest fall Greater adjutant chicks. They were also given the back knowledge on the other important wildlife of the region. About 100 frontline police personnel were trained in wildlife laws keeping Greater adjutant protection as main agenda of the training. Four numbers of interns works with the project team during the project tenure and learned about the project activities *in situ*.

## **Section 3:**

### **Conclusion:**

Community conservation initiative of Greater adjutant stork in Assam has become a very popular story to tell in India now. This is surely due to the dedication of the project team with a great cooperation from the all stakeholders at field. This project has proved that coexistence of Greater adjutant in the nesting colonies in Assam is the only way to secure its future. Conservation need of this bird has secured a place in the Government planning document. Having said that, there is nothing permanently secure in a human dominated landscape where people's need

and greed might change the mind of the key stakeholders at any time. A continuous hand holding is required to sustain this initiative in all the nesting colony areas. More focused efforts are always welcome to minimise the dependence on the nesting trees by the villagers for any of their survival needs. Hence and continuous effort to uplift the economic condition of the nest tree owners would be a welcome move in the coming days. This may be well conclude that after the present initiate, Greater adjutant has becomes one of the flagship species in Wildlife conservation in Assam. Government authority would adopt a long term effort through the conservation action plan prepared during this project and at last grass root community conservation organisation will take this forward to secure the future of this bird.

## **Problems encountered and lessons learnt**

1. Need for financial support to the nest tree owners is the main problem encountered in this project also like all previous efforts. We understood that livelihood issue is the prime need for these poor village people who can only think other issues once they could secure some food in their table. We tried to channelize various government livelihood initiatives through influencing the authorities and other donors and we were successful to pump some resources to these nesting villages. But still we felt this was not sufficient.
2. We understood that mortality of nest fall chick is a natural phenomenon for stork. But the villagers and nest tree owners were so attached to this bird now that they want to save each and every nest fall chick. Though this was good but saving each and every chick was not possible. Many times when a nest fall chick dies due to the gravity of the injury, some villagers tried to put this blame on the project team. We had hard time to make them understood that saving each and every nest fall chick was not possible.

- Though we put net under most of the nesting trees to save these nest fall birds, many times some bird falls outside the net and eventually dies due to injuries. Urgent veterinary care was another problem we faced. We can increase the chances of survival of nest fall bird if we have a permanent veterinary care cum rescue centre in the prime nesting locations. This is indeed a costly affair. The project team is on constant touch with many donors to have a semi-permanent rescue and rehabilitation facility for treatment and care of nest fall chicks in the prime nesting colony areas.
3. The members of “*hargila army*”, the all women warrior group to save the Greater adjutant stork in Kamrup district is increasing. Though this is a good sign again, but aspiration of the members to get something back in return is also seems to be increasing. Almost all members want financial benefit to support their families in return of their time to save this endangered bird in their villages. So far we have been able to support many of them directly or indirectly through additional resource generated through other donors.
  4. Securing the wetlands around the nesting colony locations has become challenge now. Due to the increasing developmental pressure, many wetlands are being converted to industrial areas. The project team has met many developmental planners and authorities and requested them to spare these wetlands for natural purpose.
  5. Extensive use of pesticides in agricultural fields is a cause of concern. During the project tenure at least two incidents of unintentional poisoning of birds in the agricultural fields were encountered. Authorities were made aware of the gravity of this situation.

### **In the future:**

1. Systematic tourism activity to be started in the prime nesting colony villages. This would be in the line of “tour the village programme” where tourists will visit the village, sight this endangered bird and taste village

- food. This will give some financial benefit to the villagers in return. This would be plan in association with the “*hargila army*”.
2. “Adopt and nesting tree” is in plan for the future where people might support the nest tree owners with in kind supports for allowing this to nest in their campus.
  3. The project team have been trying to establish a permanent or semi-permanent nest fall chick rescue and rehabilitation facility in the nesting colony itself. We shall keep trying to gather resource for this in the near future.
  4. Mass plantation of nesting tree species will be continued in all nesting locations.
  5. Satellite tagging of this bird would help to understand its dispersal mechanism especially during non-breeding season. The project team will continue to search for this opportunity in the near future.
  6. Efforts on *in situ* assisted breeding for this bird in artificial bamboo platform will be continued.
  7. Awareness programme in schools and other educational institutes in the prime breeding colony locations will be continued.

## Financial Report:

Itemized expenses	Total CLP requested (USD)*	Total CLP used (USD)	% Difference	Explanation & Proposed Spending**
<b>PHASE I - PROJECT PREPARATION</b>				
Communications (telephone/internet/postage)	2000	1997.48	0%	
Field guide books, maps, journal articles and other printed materials	1000	1001.23	0%	
Insurance	2800	2796.48	0%	
Visas and permits	800	803.71	0%	
Team training	1600	1594.84	0%	
Reconnaissance	1000	996.46	0%	
Other (Phase 1)	0	0		
<b>EQUIPMENT</b>	<b>0</b>	<b>0</b>		
Scientific/field equipment and supplies	2000	1991.19	0%	
Photographic equipment	500	500.16	0%	
Camping equipment	0	0		
Boat/engine/truck (including car hire)	1000	1000.31	0%	
Other (Equipment)	1000	1004.72	0%	
<b>PHASE II – IMPLEMENTATION</b>	<b>0</b>	<b>0</b>		
Accommodation for team members and local guides	1500	1503.62	0%	
Food for team members and local guides	2600	2596.76	0%	
Travel and local transportation (including fuel)	6000	6018.84	0%	
Customs and/or port duties	0	0		
Workshops	3400	3384.82	0%	
Outreach/Education activities and materials (brochures, posters, video, t-shirts, etc.)	4500	4519.19	0%	
Other (Phase 2)	5350	5324.06	0%	
<b>PHASE III - POST-PROJECT EXPENSES</b>	<b>0</b>	<b>0</b>		
Administration	500	500.16	0%	
Report production and results dissemination	1000	1004.09	0%	
Other (Phase 3)	0	0		
<b>Total</b>	<b>38550</b>	<b>38538.13</b>		

## Section 4:

### Appendices:

#### Appendix I: CLP M&E measures

Output	Number	Additional Information
Number of CLP Partner Staff involved in mentoring the Project	3	We had regular interaction especially with Stuart, Christina. Action plan was edited by Kiragu.
Number of species assessments contributed to (E.g. IUCN assessments)	None	
Number of site assessments contributed to (E.g. IBA assessments)	None	
Number of NGOs established	200 SHG	All local women group from nesting colony locations consists of about 400 women members. Other than this, all women “hargila army” was formed who lead these SSG.
Amount of extra funding leveraged (\$)		New Zealand High commission, India WFN, GWC gave additional supports for Greater adjutant works
Number of species discovered/rediscovered	None	
Number of sites designated as important for biodiversity (e.g. IBA/Ramsar designation)	1	Dadara-pacharia-Singimari in Kamrup District, Assam was declared as IBA
Number of species/sites legally protected for biodiversity	None	As all these nesting colony locations are inside the village areas, legal protection under Indian wildlife act does not arise.
Number of stakeholders actively engaged in species/site conservation management	10	Kamrup Police, Kamrup district administration, Assam forest department, State Institute of Rural development, Gauhati University
Number of species/site management plans/strategies developed	1	Greater adjutant conservation action plan developed and submitted to Assam Forest Department for consideration.
Number of stakeholders reached	20	
Examples of stakeholder behaviour change brought about by the project.	10	<i>e.g.</i> Nest tree owners who used to hate this bird have become protector of this bird.
Examples of policy change brought about by the project	1	Greater adjutant is now a priority animal for State forest department
Number of jobs created	0	Though directly any job was created by this project, but nest tree owners and

		local villagers got additional livelihood support developed through this project
Number of academic papers published	1	
Number of conferences where project results have been presented	4	International Ornithological Conference, 2018 and Vancouver International Bird Festival, 2018 as Keynote speaker. Women in nature Network Symposium, 2018 Gyana and Women in nature network Symposium, 2019, Guwahati, India. ICCB, Malaysia, 2019.

**Appendix II:  
Project Activities photographs:**



**Greater Adjutant was selected as mascot for Transport Department Government of Assam**



Photo: AnupamNath

**Greater adjutant awareness class for the “*hargila* army”**



**Street play by communities**



**Awareness programme in Nagaon colony**



**Greater adjutant awareness programme through the nesting colonies.**



**School children trying their hand in Greater adjutant !**



**Felicitation of nest tree owner's children**



**Hargilamitra (Friends of Greater adjutant) award programme, Nagaon**



**Pledge for Greater adjutant conservation by Students of Nagaon**



**Weaving training centre inauguration at nesting colony location**



**Clothing materials with Greater adjutant motif prepared by community**



**A nest fall chick in the rescue net**



Photo: AnupamNath

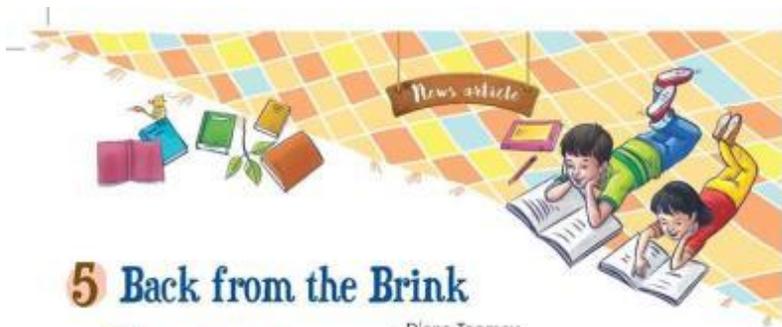
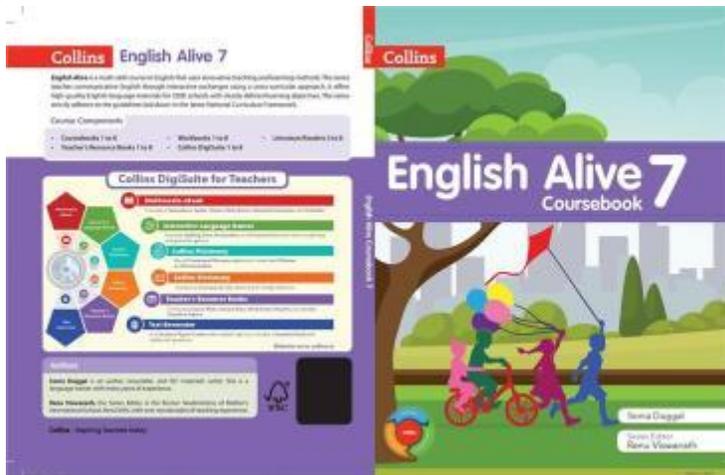
**Nets were fitted below the each nesting trees**



**Receiving President award from Honourable President of India**



**Project work was briefed to Honourable Prime Minister of India Mr.NarendraModijee**



## 5 Back from the Brink

—Diane Toomey

### OBJECTIVES

In this chapter, we will:

- read about the life story of an Assamese conservationist.
- make antonyms using prefixes, learn bird idioms and phrases, and learn more about spellings with long and short vowel sounds of a.
- study different types of sentences, and learn about determiners and their usage.
- listen and make notes, make suggestions in a group discussion, and learn to pronounce and spell words with silent letters.
- learn to write a news article.

### READING



**PR** (*abbr.*) short form for Public Relations which means creating and maintaining goodwill

**ornithologist**: a person who studies birds

**prodigy**: an outstanding example of a particular quality

**imposing**: grand and impressive in appearance

**stunning**: impressive, extraordinary

**wingspan**: the maximum extent across the wings measured from tip to tip

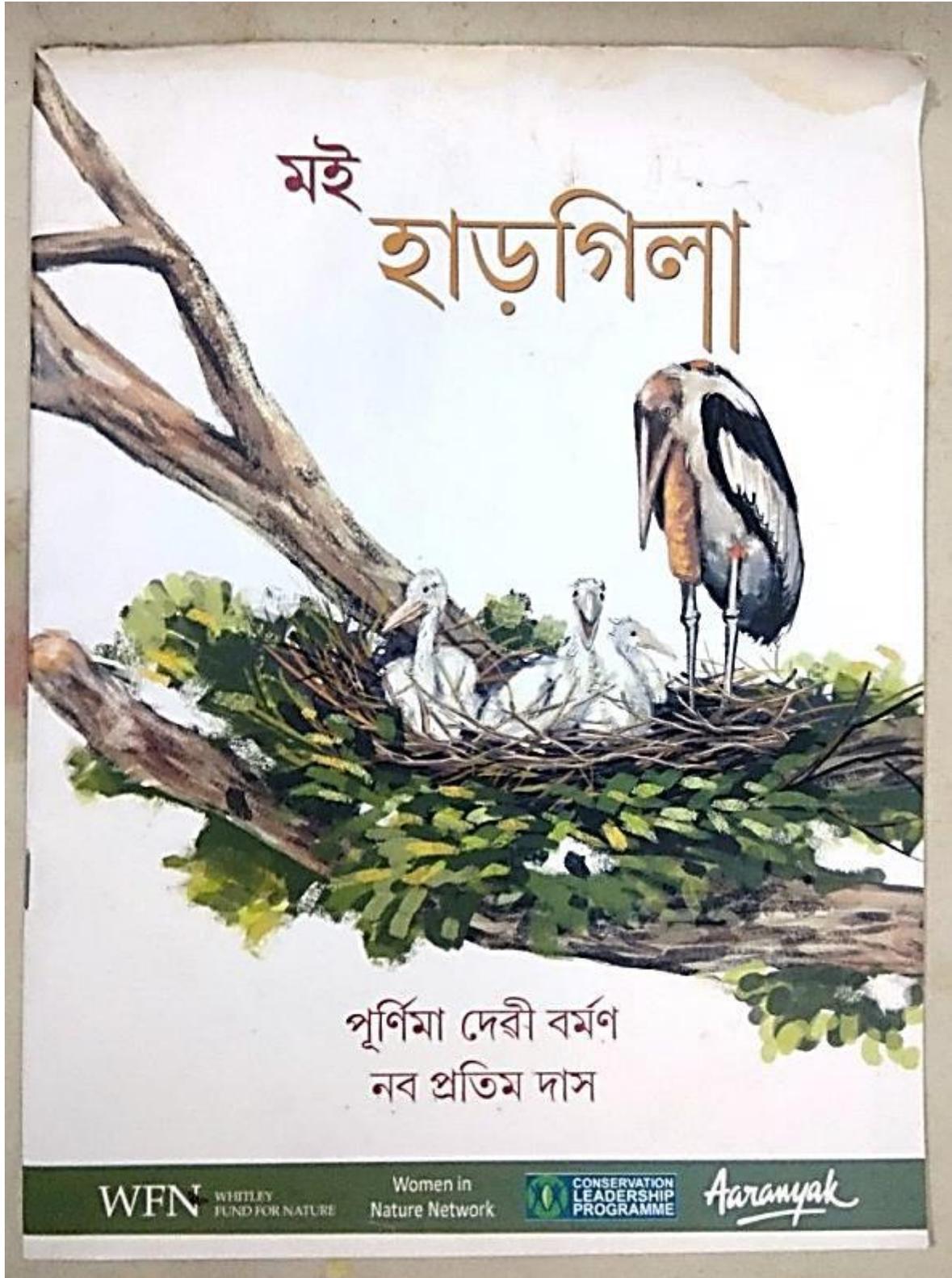
*Purnima Devi Barman is a conservationist, biologist, and activist from Assam. Read this piece to find out how she single-handedly led a movement to save the globally endangered Greater Adjutant stork from extinction.*

**How villagers learnt to love an ugly bird to save it from extinction**

You know a bird has a PR problem when a nineteenth century ornithologist refers to it as 'a prodigy of ugliness.'

This is the Greater Adjutant stork, an imposing bird which stands at a stunning five feet and has an eight-foot wingspan.

Our project work has been included in class curriculum



A book on local language was published



**Greater adjutant festival**



**Greater adjutant festival**





**Greeted by Hon Chief Minister of Assam**



**Release of our project documentary by Honourable Chief Minister of Assam**



Photo: AnupamNath

**Student's activities (drawing competition)**



Photo: AnupamNath

**Classroom learning on Greater adjutant conservation**



**Livelihood Training and capacity building training for woman on World Women's Day**



**Nesting colony women produced handloom products as alternative livelihood options**



Photo: VijoyBedi

**Activities for Students..**



Photo: VijoyBedi

**Activities for Students**



**The team leader in a workshop with school children.  
PC:Gerryt Vyn**



**Hargila army women with Hargila headdress PC. Smita  
Sharma**



**A very active Hargila army proudly showing Hargila henna in a wedding. PC: Carla Rhodes**



**A group of students from Assam Engineering college during internship in the project were conducting workshop with school children**



**Hargila motif in Assamese traditional dress *mekhela sadors* launched for sales by Hargila army**



**The team leaders taking a theory and a practical class on Wildlife conservation and management to 50 Forest guards in batches**



**The bird in feeding in the garbage dump. PC: Gerryt Vyn**



**The Hargila birds and the babies in a sunny day PC: Gerryt Vyn**

## Appendix III:

List of important news published about the project work:

1. <https://news.mongabay.com/2016/12/from-loathed-to-loved-villagers-rally-to-save-greater-adjutant-stork/>
2. <https://news.mongabay.com/2016/12/from-loathed-to-loved-villagers-rally-to-save-greater-adjutant-stork/>
3. <https://yourstory.com/2016/04/purnima-devi-burman/>  
<https://news.mongabay.com/2016/12/from-loathed-to-loved-villagers-rally-to-save-greater-adjutant-stork/>
4. <https://www.indiatimes.com/news/india/here-s-the-woman-who-made-assam-greener-and-ensured-a-safe-future-for-the-greater-adjutant-stork-266175.html>
5. <https://www.thehindu.com/sci-tech/energy-and-environment/purnima-barman-works-with-communities-to-protect-a-scruffy-endangered-stork-in-assam/article22325079.ece>
6. <https://nenow.in/environment/assam-environmentalist-purnima-devi-barman-donates-award-money-buy-yarn-village-weavers.html>
7. [https://www.youtube.com/watch?v=-eWlp\\_eCWBE](https://www.youtube.com/watch?v=-eWlp_eCWBE)
8. <https://www.youtube.com/watch?v=zqxhExViNIc>
9. <https://www.guwahatiplus.com/daily-news/assam-s-purnima-devi-barman-achieves-nari-shakti-puraskar-from-president>
10. <https://baliparafoundation.com/en/blog/case-study-purnima-devi-barman-assam>
11. <https://economictimes.indiatimes.com/news/politics-and-nation/environmentalist-purnima-devi-barman-wins-green-oscar/articleshow/58766163.cms>
12. <https://www.thehindu.com/society/in-assam-adjutant-storks-get-a-baby-shower/article29846302.ece>
13. <https://nenow.in/north-east-news/assam-greater-adjutant-stork-breeds-first-time-assisted-breeding-platform.html>
14. <https://www.birdlife.org/worldwide/news/adjutant-army-all-female-campaign-endangered-stork>
15. <https://www.livemint.com/Leisure/D36cmXEpZdXX9zdeVSK5WL/Stork-the-oncereviled-scorpion-bird-now-the-pride-of-Ass.html>
16. <https://www.csmonitor.com/World/Asia-South-Central/2020/0224/Saving-India-s-storks-How-smelly-pests-became-a-point-of-pride>
17. <https://www.nationalgeographic.com/news/2016/08/storks-science-india-animals-rare/>
18. <https://round.glass/sustain/people/greater-adjutant-purnima-barman/>
19. <https://www.time8.in/assam-police-rescues-greater-adjutant-stork-in-kamrup/>
20. <https://www.aa.com.tr/en/culture-and-art/in-india-s-assam-villagers-work-to-protect-rare-stork/557587>

## Appendix IV:

### Paper published:

## International Journal of Zoology Studies

International Journal of Zoology Studies

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www.zoologyjournals.com

Volume 2; Issue 6; November 2017; Page No. 272-281

**Behavioural ethogram of the endangered greater Adjutant Stork**

*Leptoptilosdubius*(Gmelin)

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<http://www.zoologyjournals.com/download/225/2-6-74-326.pdf>

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