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Activity Budgeting of Lesser Adjutant Stork (*Leptoptilos javanicus*) in Nagaon District of Assam

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Abstract Diurnal activity budgeting of Lesser Adjutant stork (*Leptoptilos javanicus*) was quantified in the Nagaon district of Assam from August 2023 to April 2024. A total of 192 hours were spent recording their activity budget and the behaviour of adults and juveniles. The behavioural activity pattern was observed and recorded through the Focal Sampling and Scan Sampling methods. Different activities were recorded: preening, resting, feeding, movement, wing-leg stretching, head up-down, aggression, and alert. The results showed that preening (42%) and movement (17%) were the most observed behaviour in the study period. The behavioural activities showed significant differences in different time blocks in a day. It was observed that preening and body movement helped the chicks and parents survive predators and parasites. It has been found that the study area has many nesting colonies near human settlements, agricultural fields and highways. By observing their activity budgets, we came to know that the activities of Lesser Adjutant stork depend upon the season, the surrounding environment and the habitats where it lives. So, in order to conserve the species, their habitat should be conserved.

Keywords *Leptoptilos javanicus*, Activity Budgets, Nagaon District, Behavioural Pattern, Focal Animal Sampling, Scan Sampling

1. Introduction

The Lesser Adjutant stork (*Leptoptilos javanicus*) is a large wading bird belonging to the order Ciconiiformes, suborder Ciconiae, family Ciconiidae, with a bare head and neck without a pendant pouch, length of 87–93 cm, weigh up to 8.9 kg [1]. Females typically lay three to four chalky white eggs during a season. Both parents show parental care as they build and attend to the nest, incubate the eggs, and feed the young ones. [2]. These birds are generally solitary, endangered in several countries, and threatened throughout their range from India and Sri Lanka through Southeast Asia and Indonesia [3]. The bird has a distribution range across South and South-East Asia. In India, it is relatively widespread in the South and East. In Nepal and India mostly, the number of matured individuals has been estimated to be between 2000 and 5000 [4]. The species is considered vulnerable according to the IUCN Red List of Threatened Species in 2016. There is a gradual decline in the global population of birds due to habitat loss, human interference, and hunting [1]. However, some nesting records have been found in different parts of India, including Bihar, Jharkhand, Odisha, Tamil Nadu,

Karnataka, West Bengal and Assam [5][6]. Assam has the maximum reports of breeding [7]. The stork is mainly a water-dependent bird that feeds on fish, crabs, frogs, reptiles, large invertebrates, rodents, and small mammals.

The amount of energy and time a bird devotes to its activities throughout the day influences its survival and fitness in nature. Animals' activity and time budgeting are directly associated with animal metabolism [8]. Time budgeting quantitatively describes how animals utilize their time for various activities like feeding, maintenance, roosting, and breeding activities [9]. The time spent by a bird on its daily activity is highly dependent on its type of habitat and the type of food it consumes [10]. Since the bird is found in wetlands, pools in forests, rice paddies, and sometimes in agricultural fields and grasslands, time budgeting will give a brief insight into understanding the activity pattern in different habitats and habitat utilization patterns.

Several studies have been reported on the activity budgets of different storks, including the Oriental White stork [11], the Asian Open-billed stork, and the foraging behaviour of the Greater Adjutant stork, but hardly attempted to study the activity budgets and overall ecology of the Lesser Adjutant stork (Near Threatened) in Central Assam, India. The Nagaon district has a good number of nesting colonies that are close to human settlements and are vulnerable to a variety of anthropogenic causes. This is an area that needs to be investigated. Keeping this in mind, the primary goal of the current research is to estimate the activity budgets of the Lesser Adjutant stork in the Nagaon district of Assam.

2. Methodology

The current study was conducted from August 2023 to April 2024, including the stork's breeding (August to January), 2023 and post-breeding season (February to April), 2024. Scan Sampling method for recording multiple individuals' behaviour simultaneously and the Focal Animal Sampling method for observing a single stork at a time for collecting data on behavioural patterns and activity budgets were used [12]. Diurnal activities were recorded and shot by a Nikon Coolpix P900 camera, 10×50 Zenith binoculars and location was tracked by Garmin eTrex 10 GPS device. For observing behavioural patterns, videos and images were captured. Each study day was divided into three time periods viz. morning (08:00 - 10:00 AM), afternoon (12:00-2:00 PM), and evening (03:00-05:00 PM). A bird was randomly selected from the nesting colonies or foraging ground closest to the eye distance. Its behaviour was observed continuously for 10 minutes and noted down with a 5-minute break. A total of 81 no storks including 43 juveniles were observed within the nesting colonies in 4 different locations.

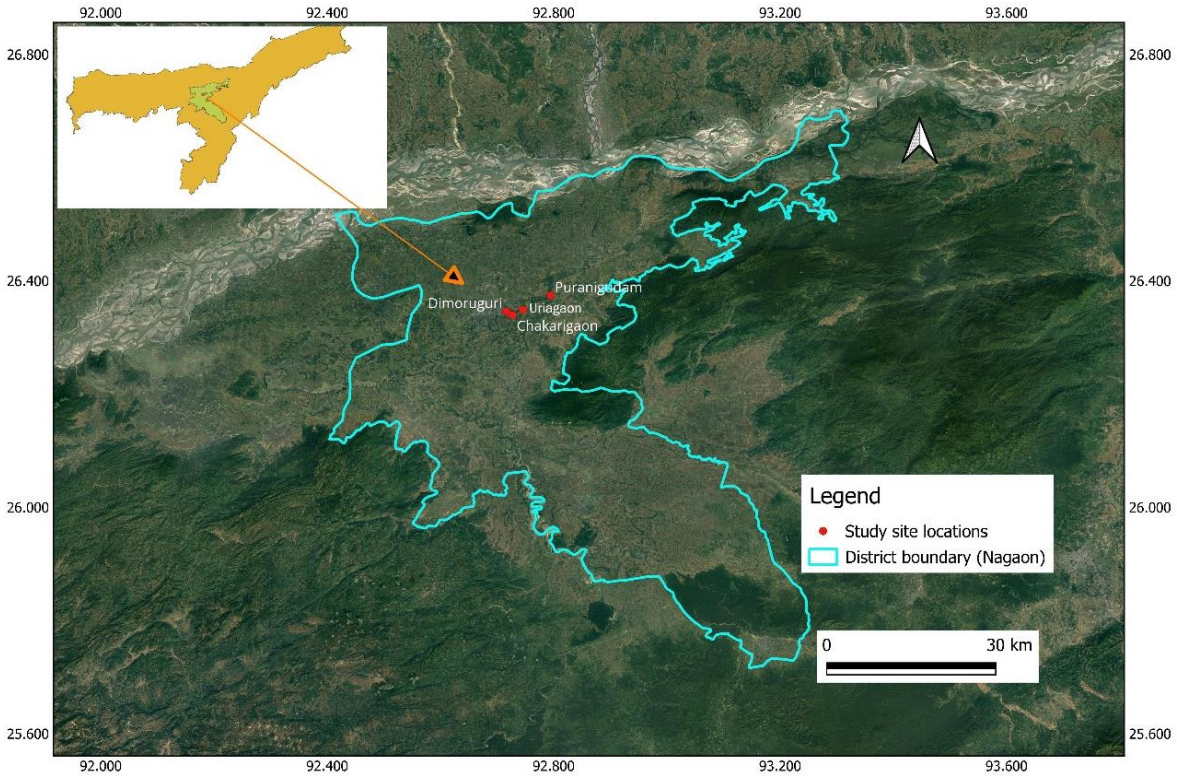

Figure 1. Map showing the study area

2.1. Location of the Study

The study was conducted in 4 specific locations i.e. Dimaruguri, Uriagaon, Chakarigaon, and Puranigudam of Nagaon district of Assam, located on the South bank of the Brahmaputra River which lies between 25°45" and 26 °North latitudes and 91°50" and 93°20" East longitudes (Figure 1). The Kalong River is the major river that divides the town into two halves Haibargaon and Nagaon. The average rainfall is about 1750 mm. The district includes several beels, marshy lands and swamps, which are the old abandoned channels of Kalong and Kopili rivers that support various flora and fauna and many migratory bird species. The study area includes the bank of River Kalong across the town with all human habitation and the NH-37 in Uriagaon, Nagaon, which contains the nesting trees of the Lesser adjutant stork, paddy fields near the highways.

2.2. Data Analysis

For the statistical analysis, the Standard deviation was calculated in MS Excel. Student t-test was conducted assuming unequal variances between different activities like resting, preening, feeding, alert, movement, wing-leg stretching, aggression, head up-down in different time slots of morning, afternoon and evening respectively. P-values between two tails were considered to conclude the significance of the results.

3. Results

A total of 192 hours were spent in recording activity budget studies of adults and immature respectively. An ethogram is prepared as a set of behavioural classes that are used to describe a species' behavioural pattern (Table 1). During the present study, several behavioural categories resting, preening, feeding, alert, aggression, movement, sun basking, wing-leg stretching, and head up-down were identified (As shown in Figure 2). The behavioural activity patterns were significantly different throughout the nine-month study period (Fig 3). Preening (42%), movement (17%) and wing-leg stretching (16%) were the most remarkable activities that were recorded in the study period (Figure 2). The parts of the body that stork preen are the breast, and the back of the body. Preening was seen to be the highest in evening hours (188.16 ± 129.94), while it was the lowest in morning hours (123.83 ± 115.14); resting was the highest in evening time (36.16 ± 16.42) and the lowest in morning (8.83 ± 6.91) (Table 2). A few of the storks were seen resting on nearby trees from the nesting trees. The storks were seen to be highly active in the morning time of the day. Aggression was the highest in the morning time (100.33 ± 51.24) when birds chased each other around the nest and the lowest (6.83 ± 12.0) in the afternoon time (Table 2). The bird shows aggression towards intruders and walks or flies near the intruders, causing it to leave the tree or move to nearby trees. This behaviour shows similarities with Greater Adjutant stork [13]. Head up-down movement was only seen in the morning hours, stretching of wing-leg peaked in the morning (96.5 ± 60.28) and the lowest (41.66 ± 29.46) in the afternoon (Table 2). The stork was seen to hold their wings wide open continuously for 3-4 minutes to shade the nest during sunny days, and this behaviour is called Sun basking (Figure 2). Preening was nearly similar in the afternoon and evening (Table 2). Feeding peaked in the afternoon period (72.16 ± 57.88) and was the lowest in the morning (29.33 ± 18.83) (Table 2). The storks held their body in an upright position with their neck straight looking at a wide range distance, and this shows alert behaviour and is maximum in the evening (62.33 ± 46.90) and the lowest (22.33 ± 23.20) in the morning times (Table 2). Movement was the lowest in the evening hours (51.66 ± 40.28), while it peaked in the afternoon period (89.33 ± 112.98) (Table 2) as the matured individuals were seen in foraging ground with continuous walking and flying (Figure 3). Flying off to the nearby trees from nesting trees was also mostly seen in the afternoon period.

Statistical analysis shows that the proportion of time spent by Lesser Adjutant stork throughout different time blocks of the day in resting, aggression, and head up-down was significantly different ($p < 0.05$) in morning, afternoon and evening, while there was no difference ($p > 0.05$) in other activities such as preening, alert, feeding, wing-leg stretching, and movement among different time blocks of the day.

Table 1. Behavioural Ethogram of Lesser Adjutant stork (*Leptoptilos javanicus),* showing names and descriptions of the different behaviours observed during the study period [28]

Sl. no	Behavioural categories	Description
1.	Alert	The Lesser Adjutant stork keeps their head straight looking at a distance sensing the movement or arrival of an intruder near the nesting tree.
2.	Aggression	Within the nesting colonies, the bird used to peck the other one with its beak, as a result, the other one flew away from its nest and sat on the nearby trees.
3.	Resting	While resting, the bird sits on its nest without much movement.
4.	Preening	The stork bends its head downward and preen its breast region and lower belly with its beak.
5.	Feeding	The stork continuously probes and pecks at the foraging ground while feeding, and it also perches on the nest itself and pecks insects off the branches nearby.
6.	Head Up-Ending	The juveniles continuously move their head in an up-down motion when parents bring food to nests.
7.	Movement	The storks keep moving from one branch to the other in their nesting tree.
8.	Wing-Leg Stretching	Wings and legs are stretched for 2-3 minutes.
9.	Other behaviour	Other behaviours include copulation, incubation, feeding chicks, nest building, and caring for their young ones.

Head Up-down

Feeding of Juveniles

Feeding

Movement

Aggression

Alert

Preening

Resting

Sun Basking Bill Clattering

Figure 2. Different behavioural patterns of Lesser Adjutant stork observed at the study site

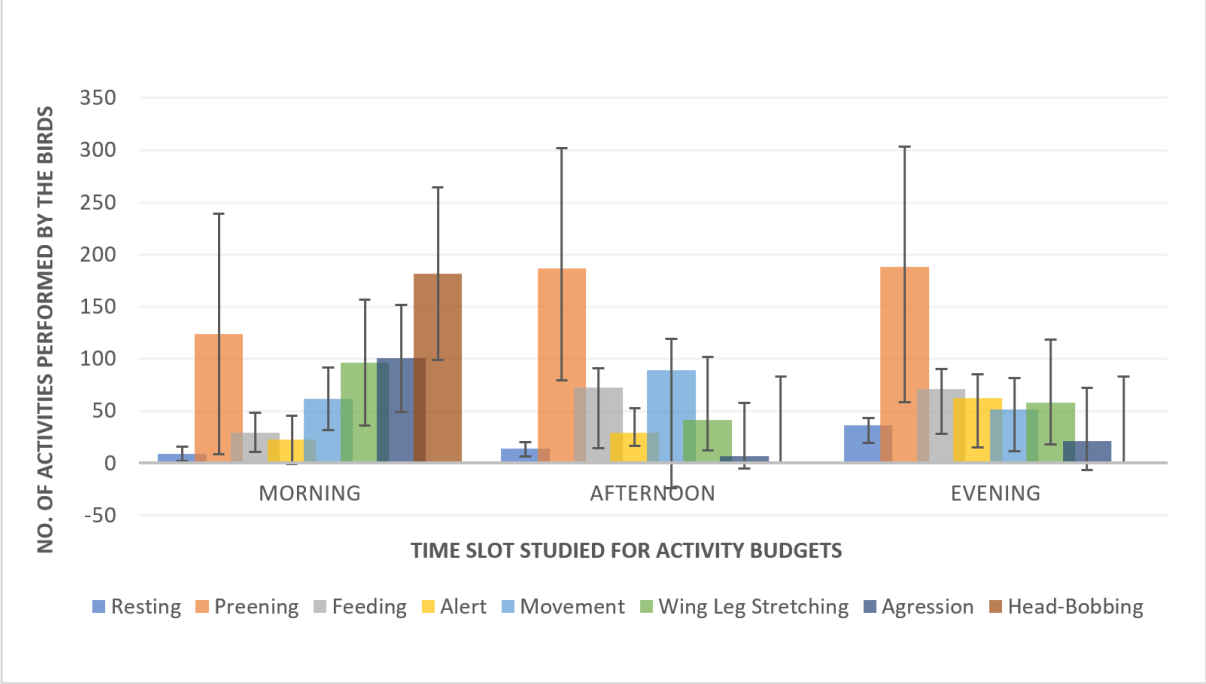

Figure 3. Number of activities performed by Lesser Adjutant stork in different time blocks of the day during the study period

Table 2. Overall time spent by Lesser Adjutant stork in performing various activities in different time blocks of the day (in approximate hours) during the study period from August 2023 to April 2024 in Nagaon district of Assam

Activities	**Morning** (Minutes)	**Afternoon** (Minutes)	**Evening** (Minutes)	**Overall Time spent** (In hours)
Resting	8.83 ±6.91	13.66 ±6.97	36.16 ±16.42	1 hr
Preening	123.83 ±115.14	186.83 ±107.35	188.16 ±129.94	8 hrs
Feeding	29.33 ±18.83	72.16 ±57.88	71.16 ±42.87	3 hrs
Alert	22.33 ±23.20	29.16 ±12.30	62.33 ±46.90	2 hrs
Movement	61.83 ±29.83	89.33 ±112.98	51.66 ±40.28	3 hrs
Wing-Leg Stretching	96.5 ±60.28	41.66 ±29.46	58.33 ±40.63	3 hrs
Aggression	100.33 ±51.24	6.83 ±12.0	21.33 ±28.10	2 hrs
Head Up- down	181.83 ±82.84	0	0	3 hrs

4. Discussion

The major activities that were seen in Lesser Adjutant storks include preening and movement, whereas these activities were also seen to be dominant in other species like Oriental White stroke [11], Caribbean Flamingos [14], Lesser Flamingos [15]. Feeding of storks was mainly in day time, and the adults were seen in foraging fields, for example mud-flats, and paddy fields, preying on fishes, crabs, crustaceans and locusts, while the juveniles rested in the nests and feeding on the food particles left on the nests by the parents. Aggressive behaviour was mostly seen in the nest and this might be due to the breeding season of the Stork. The adult and juveniles both show aggression which shows quite similarities with Greater Flamingo where no significant difference was recorded for time spent in aggression between adult and immature [16]. Wing and leg stretching was mostly seen in the morning period, and this might be due to extended periods of resting or sleeping. Two types of stretching were recorded, one with the leg and wing on one side stretched, while the other is a wide opening of both the wings for a few seconds standing on the nest, which shows similar behaviour with Greater Adjutant stork [13] and Greater Flamingo [16]. Morning time shows the lowest in resting as the storks were recorded to be highly active at this period. However, resting is to be seen more (35%) in other storks like Asian Open Billed Stork [17], and in other birds like Large Whistling teal, resting was seen to be (36.1%) [18]. The bird stays in a sitting posture for most of the time in the evening. Few were seen resting in a standing position in the nest without any movement. Movement of the Lesser Adjutant stork is recorded to be (17.46%), which is roughly similar to the movement shown by Black Headed ibis (14.23%) and Red Naped ibis (18.01%) [19]. The Oriental White stork, however, moves at a rate of (13.46%) [11]. 9.8% of the time, the Lesser Adjutant stork exhibited alert behaviour, however, other storks like Red Naped Ibis and Black Headed Ibis showed (2.63%) and (4.62%) respectively [19]. Other birds like Greater Flamingo showed only (3.3%) alertness [16].

Preening is a type of behaviour studied in many types of bird species including endangered species like Oriental White stork [11] and in captivity like budgerigars [20][21][22], domestic canaries *Serinus canaria* [23], with only a few studies in the wild: swallows *Hirundo rustica* [24], terns Sterna spp. [25]. Varghese [26] studied in Marottichal and Bhoothathankettu forests self-maintenance activities of Malabar Trogon.

It was found that preening and movement were the highest during the study period. The breeding season starts in August when the storks spend most of their time in nests. Incubation starts from mid-August to September and fledglings were seen in September. Both the parents were involved in nurturing the young ones and, therefore spent maximum time in their nests. This was the time when nestlings were mostly prone to attack by predators and parasites. The parents show vigilance through body movements and chasing of intruders from the nests. Preening is also seen in both parents most, for ridding of ectoparasites, which is helpful in maintaining their body and keeping their family safe [27]

From our observations, the preening and movement behaviour were seen to be highest in the study period. Birds spend most of their time in preening and movement to protect their young ones from parasites and predators leading to a healthier family. This indirectly promotes the survival of the parents and young ones and fitness in the environment.

5. Conclusions

In the present study, activities show significant variations in different time blocks of the day. The amount of time spent by the stork in preening, alert, feeding, wing-leg stretching and movement behaviour shows no differences in three-time blocks of the day, while resting, aggression, and head up-down were significantly different throughout the day. This indicates that the Lesser Adjutant stork has good flexibility in maintaining their behaviour. From this study, it was found that preening and movement were mostly observed throughout the breeding period. Both these behaviours were helpful in protecting the chicks and parents from parasites and predators and in maintaining a healthy family. These threatened species are observed throughout the year in the Nagaon district of Assam, establishing this area for the conservation of wetland-dependent bird species along with associated flora and fauna.

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Conflict of Interest

All authors agree to this paper's publication and do not have any conflict of interest with any party or commercial identity. They have no involvement that might raise questions of bias in this reported work or its conclusions, implications, or opinions.

REFERENCE

[1] Subaraj R., & Lok A.F.S.L., "Status of Lesser Adjutant Stork (Leptoptilos javanicus) in Singapore," Nature in Singapore, Vol. 2, pp. 107-113, 2002. https://r.search.yahoo.com/_ylt=Awrx.qbbdIpnLwIAP3W7HAx.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1738336731/RO=10/RU=https%3a%2f%2flkcnhm.nus.edu.sg%2fapp%2fuploads%2f2017%2f06%2f2009nis107-113.pdf/RK=2/RS=RixybUgcSmtnf_WfwMMK2EVgWNI-

[2] Pokorny Y., Samaroo L., Sheppard C., Mahood S., Hook N., Raphael B., & Oehler D. A., "The Lesser Adjutant Stork Leptoptilos javanicus, its Husbandry and Conservation at the Wildlife Conservation Society," Avicultural Magazine, Vol. 122, No. 3, pp. 70-92, 2016. https://r.search.yahoo.com/_ylt=AwrPpTqfdYpnDgIAHye7HAx.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1738336928/RO=10/RU=https%3a%2f%2fwww.researchgate.net%2fpublication%2f316972842_The_Lesser_Adjutant_Stork_Leptoptilos_javanicus_its_Husbandry_and_Conservation_at_the_Wildlife_Conservation_Society/RK=2/RS=ZRFtmuDiiCKnvigWWwhl4bjrKZE-

[3] Saikia P. K., Saikia M.K., Bhattacharjee P.C., Coulter M.C., & Sharma D.K., "Conservation of Adjutant Storks (Ciconidae: *Leptoptilos dubius* and *L. javanicus*) in South and Southeast Asia", in 'Animal Diversity, Natural History and Conservation', 1st ed, DPH, pp. 189-211.2011. https://r.search.yahoo.com/_ylt=AwrKGQcFd4pnIAIAD_q7HAx.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1738337285/RO=10/RU=https%3a%2f%2fwww.researchgate.net%2fpublication%2f312057038_CONSERVATION_OF_ADJUTANT_STORKSCiconidae_Leptoptilos_dubius_and_L_javanicusIN_SOUTH_AND_SOUTHEAST_ASIA/RK=2/RS=OwG1A4RbHA_20uIBEvZ2mzuLlxc-

[4] Data Zone - Birdlife International 2023.https://datazone.birdlife.org/home

[5] Rahmani A. R., "Threatened Birds of India- Their conservation requirements" Indian Bird Conservation Network, Bombay Natural History Society (BNHS), Royal Society for the Protection of Birds, BirdLife International & Oxford University Press, pp. 358-363, 2012. ISBN 0-19-8085974. https://r.search.yahoo.com/_ylt=AwrPpTr_eIpn9wEACiu7HAx.;_ylu=Y29sbwNzZzMEcG9zAzIEdnRpZAMEc2VjA3Ny/RV=2/RE=1738337791/RO=10/RU=https%3a%2f%2fbooks.google.com%2fbooks%2fabout%2fThreatened_Birds_of_India.html%3fid%3dTktcLgEACAAJ/RK=2/RS=ITQQ2Cx6T9HOmM755D_H50lGSl4-

[6] Dwivedi M. D., Raziuddin M., Mishra A., "Population Expansion of Vulnerable Stork Species Lesser Adjutant (*Leptoptilos Javanicus*, Horsfield,1821) In Jharkhand, India," International Journal of Creative Research Thoughts, Vol. 11, No. 5, pp. 944-954, 2023 https://r.search.yahoo.com/_ylt=AwrKAAaeiopnVgIAHye7HAx.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1738342303/RO=10/RU=https%3a%2f%2fijcrt.org%2fpapers%2fIJCRT23A5201.pdf/RK=2/RS=ojEASa75jekcmWAQ7gJMUJAKGP4-

[7] Baruah M., & Sharma P., "The birds of Nameri National Park, Assam, India," Forktail, Vol 21, pp. 15-26, 2005. https://r.search.yahoo.com/_ylt=AwrKCZxPi4pn7QEAv7O7HAx.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1738342479/RO=10/RU=https%3a%2f%2fwww.researchgate.net%2fpublication%2f242778719_The_birds_of_Nameri_National_Park_Assam_India/RK=2/RS=cKCg9z8iZqfCozn8FGfJP6vSVOI-

[8] Halle S., & Stenaeth N. C., "Activity patterns in small mammals: An ecological approach," Springer Verlag, New York, Vol. 141, 2000. DOI: 10.1007/978-3-642-18264-8

[9] Baldassarre G. A., & Bolen E.G., "Waterfowl Ecology and Management," The Journal of Wildlife Management, Vol. 71, No. 1, pp. 295-296, 1994. DOI: 10.2193.2006-532

[10] Paulus S. L., "Time-Activity Budgets of Mottled Ducks in Louisiana in Winter," The Journal of Wildlife Management, Vol. 52, No. 4, pp. 711-718, 1988. DOI: 10.2307/3800935

[11] Shao M., Guo H., Cui P., & Hu B., "Preliminary Study on Time Budget and Foraging Strategy of Wintering Oriental White Stork at Poyang Lake, Jiangxi Province, China," Pakistan Journal of Zoology, Vol.47, No. 1, pp. 71-78, 2015.

[12] Altmann J., "Observational Study of Behaviour: Sampling Method," Behaviour, Vol. 39, No 3/4, pp. 227-267, 1974. DOI: 10.1163/156853974X00534

[13] Barman P. D., & Sharma D. K., "Behavioural ethogram of the endangered greater Adjutant Stork *Leptoptilos dubius* (Gmelin)," International Journal of Zoology Studies, Vol. 2, No. 6, pp. 272-281, 2017

[14] Espino-Barros, R. and Baldassarre, G. A., "Numbers, migration chronology, and activity patterns of nonbreeding Caribbean Flamingos in Yucatan, Mexico," The Condor, Vol. 91, No. 3, pp. 592-597,1989. DOI: 10.2307/1368109

[15] Rameshchandra V. V., "Studies on lesser flamingo phoeniconaias minor with special reference to ecology threats and conservation management," Environment Science, Biology, 2014.

[16] Kumar A., & Rana S., "Behavioural Patterns and Activity Budgeting of Greater Flamingo, *Phoenicopterus roseus* in Najafgarh Jheel Bird Sanctuary (Drain), Haryana, India." Asian Journal of Conservation Biology, Vol. 10, No. 2, pp. 258–265, 2021. DOI: 10.53562/ajcb.68919

[17] Anam J., Ahmed M., Saikia M. K., & Saikia P.K., "Food and Feeding Behaviour of Openbilled Stork (*Anastomus oscitans*) In Assam, India," Journal of Global Biosciences, Vol 5, No. 6, pp. 4188-4196, 2016.

[18] Das J., Deka H., & Saikia P. K., "Diurnal activity budgeting of Large Whistling Teal *Dendrocygna bicolor* (Vieillot, 1816) (Anseriformes: Anatidae) in Deepor Beel wetlands, Assam, India," Journal of Threatened Taxa, Vol. 3, No. 12, pp. 2263–2267, 2011. DOI: 10.11609/jott.o2682.2263-7

[19] Soni A., & Rana S., "Behavioural aspects and Activity budgeting of Black Headed Ibis, (*Threskiornis melanocephalus*) and Red Naped Ibis, (*Pseudibis papillosa*) in Dighal (Potential IBA site), Jhajjar, Haryana, India," Asian Journal of Conservation Biology, Vol. 12, No. 1, pp. 143-150, 2023. DOI: 10.53562/ajcb.76744

[20] Zampiga E., Hoi H., Pilastro A., "Preening, plumage reflectance and female choice in budgerigars," Ethology, Ecology & Evolution, Vol. 16, No. 4, pp. 339-349, 2004.

DOI: 10.1080/08927014.2004.9522625

[21] Griggio M., & Hoi H., "Is preening behaviour sexually selected? An experimental approach," Ethology, Vol. 112, pp. 1145-1151, 2006. DOI: 10.1111/J.1439-0310.2006.01270.X

[22] Griggio M., Hoi H., & Pilastro A., "Plumage maintenance affects ultraviolet colour and female preference in the budgerigar," Behavioural Process, Vol. 84, No. 3, pp. 739-744, 2010. DOI: 10.1016/j.beproc.2010.05.003

[23] Lenouvel P., Gomez D., Théry M., & Kreutzer M., "Do grooming behaviours affect visual properties of feathers in male domestic canaries, *Serinus canaria*?," Animal Behaviour, Vol. 77, No. 5, pp. 1253-1260, 2009. DOI: 10.1016/j.anbehav.2009.02.007

[24] Moller A.P., "The preening activity of swallows, *Hirundo rustica*, in relation to experimentally manipulated loads of haematophagous mites," Animal Behaviour, Vol. 42, No. 2, pp. 251-260, 1991. DOI: 10.1016/S0003-3472(05)80556-1

[25] Van Iersel J.J.A., & Bol A.A.C., "Preening of two tern species. A study on displacement activities," Behaviour, Vol. 13, No.1/2, pp. 1-87, 1958. DOI: 10.1163/156853958X00037

[26] Varghese A. P., "Ecology and behaviour of malabar trogon,Harpactes fasclatus malabarlcus," Ph.D. thesis, Department of Zoology, Mahatma Gandhi University, 2002. http://hdl.handle.net/10603/6418

[27] Desale A. A., & Singh R. B., "Study of Different Breeding Site Activities of Openbill Stork, Anastomus Oscitans ,in Palghar, Maharashtra," International Journal of Scientific Research in Science and Technology. Vol. 4, No. 3, pp. 08-12, 2018. DOI: 10.32628/IJSRST184302

[28] Hancock J.A., Kushlan J.A. & Kahl M.P., Storks, Ibises and Spoonbills of the world. Academic Press, London. 8 September 1992. DOI: 10.2307/1521566