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RESEARCH ARTICLE

Observations on distribution and feeding behavior of Woolly-necked Stork *Ciconia episcopus* during 2012-20 from north India

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Abstract Woolly-necked Stork *Ciconia episcopus* is a tropical species which has its distribution range in south Asia and south-east Asia with a stronghold of its population in India, Sri Lanka, Nepal, Myanmar, Thailand, and Indonesia. It inhabits a wide range of habitat from wetlands, rivers, ponds, tanks, mudflats, and agricultural fields. Despite its population having a strong presence in India, little is known about their habitat preferences, nesting, and foraging behavior. This paper reports observations about the habitat use and observation of a previously unknown foraging habit of the species in northern India. Wetlands (58.3 % of sightings) and agricultural fields (37.5 % of sightings) were found to be the most occupied habitats with an average flock size of 1.87 ± 0.25. This study also reports an unusual feeding behavior among Woolly-necked Stork which may be a true scavenging behavior or an opportunistic feeding of insects from an animal carcass. Woolly-necked Storks appear to be relatively plastic in their ability to use both wetlands and agricultural fields and being able to scavenge when the opportunity was available. Detailed studies on habitat use and foraging requirements of the species are missing and are required to assist with developing a better ecological understanding of the species.

Keywords Woolly-necked Stork, flock size, habitat use, north India, scavenging.

Introduction

Woolly-necked Stork *Ciconia episcopus* is a glossy-black stork with a fluffy white neck and white under tail coverts. It is distributed in south Asia and south-east Asia with a large part of its population in India, Sri Lanka, Nepal, Myanmar, Thailand, and Indonesia (BirdLife International 2017). It inhabits a wide range of habitat from wetlands, rivers, ponds, tanks, mudflats, and agricultural fields. Despite its population having a stronghold in India, robust ecological knowledge about their habitat preferences and key vital functions like nesting and foraging is largely missing (Jangtarwan *et al*. 2019; Kularatne and Udagedara 2017). Studies from around the world have mostly focused on the breeding of the species and provide basic information about their nesting period, mating display, nesting substrate, and clutch size. They are solitary nesters (Vaghela *et al*. 2015) and prefer tall trees located in any natural landscape for placing their platform nests. However, there are existing records of their nesting on trees in villages (Choudhary *et al*. 2013; Kularatne and Udagedara 2017) and unique substrate like mobile towers in urban areas (Vaghela *et al*. 2015). Even in the domain of breeding ecology, information on vital rates like nest survival for the species is not available.

Woolly-necked Stork is predominantly carnivorous with a wide range of dietary preferences including frogs, reptiles, molluscs and large insects (Ali and Ripley 1978; del Hoyo *et al*. 1992). They also occasionally forage for fishes in dried up water

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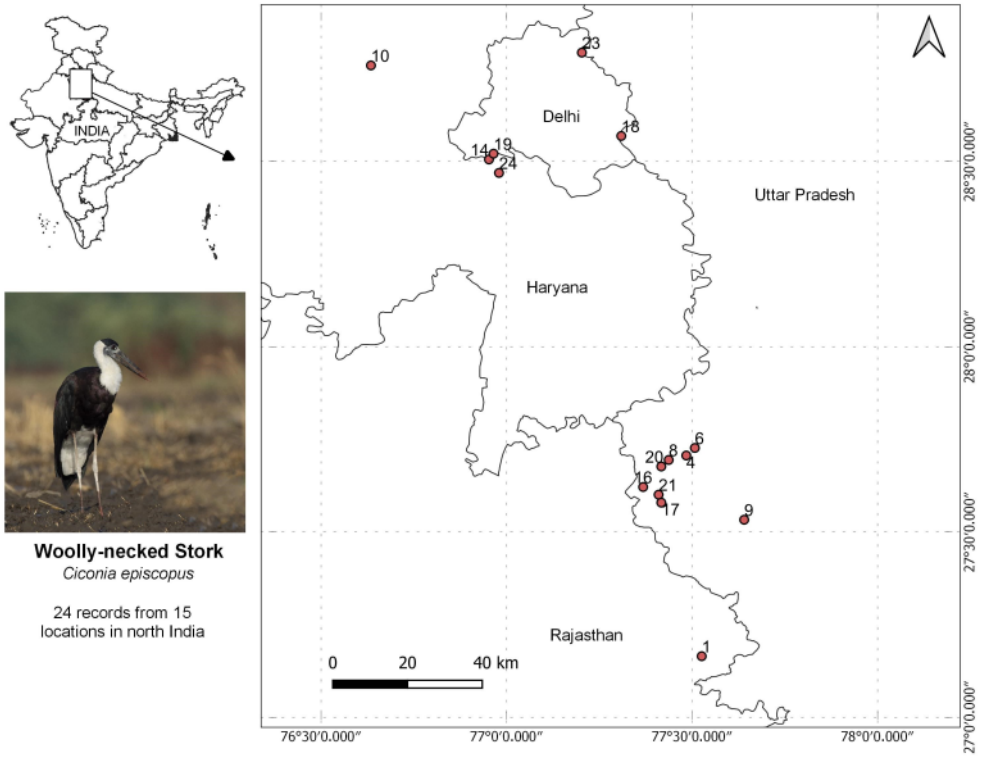

Figure 1. A map showing records of Woolly-necked Stork presence at 15 locations in North India. The description of the location marker is in Table 1. Serial number of a location as per their first appearance in the table is used as labels.

holes and streams. Studies have shown that natural wetlands are their preferred foraging sites (Sundar 2006) but they also use agricultural fields, marshes, and flooded pastures. The species is thought to be threatened by fragmentation and loss of habitat which have negatively impacted its population, mainly in south-east Asia where a marked decline is observed over the past few years (BirdLife International 2017). The absence of baseline data on the distribution and ecology of the species and lack of a better understanding of relative threats is a major challenge in devising effective conservation strategies for this species. This note reports observations about the habitat use and one instance of scavenging by Woolly-necked Storks in northern India.

Methods and study area

The observations on Woolly-necked Stork were made mainly in four states of northern India, *viz*. Delhi, Haryana, Uttar Pradesh, and Rajasthan. From Rajasthan, the Keoladeo National Park, Bharatpur was the only site where data was recorded. During several field visits from 2012 to 2020, we conducted extensive surveys in these four states to record sightings of the focal species (Figure 1). Field surveys were conducted for 10 to 14 days, every year between November to March. Counts were made at focal wetlands and all the road routes traversed to reach these wetlands. Observation on habitat use, flock size, flock composition and foraging behavior were recorded. All observations were made in the early morning (0600 to1000 h) using a pair of binoculars.

Results

Woolly-necked Storks were sighted in different habitats with most of the observations in unprotected agricultural wetlands (N = 8), protected wetlands (N = 6), agricultural fields (N = 9), and riverbeds (N = 1) (Table 1). The average flock size of Woolly-necked Stork observed was 1.87 ± 0.25 (range = 1 to 8). Mean flock size for the species was estimated to be 2.33 ± 0.62 in agricultural fields and 1.57 ± 0.17 in wetlands. The largest recorded group was a flock with eight individuals foraging in an agricultural field near Palson village, Uttar Pradesh along with other waterbird species. They were seen foraging alongside other species (45% of sightings) like Painted Stork *Mycteria leucocephala*, Black-headed Ibis *Threskiornis melanocephalus*, Eurasian Spoonbill *Platalea leucorodia*, Cattle Egret *Bubulcus ibis*, Little Egret *Egretta garzetta* and Grey Heron *Ardea cinerea*.

In June 2018, an unusual feeding behavior was observed. A pair of Woolly-necked Stork was seen feeding on a cattle carcass in Keoladeo National Park, Bharatpur, India (Figure 2). They were seen digging their beak into the flesh of the dead animal. They were either feeding on the flesh or were picking up insects or maggots from the

Figure 2. A pair of Woolly-necked Stork feeding on the cattle carcass at Keoladeo National Park, Bharatpur, Rajasthan, India. Photograph by Nawin K. Tiwary.

rotting carcass. Another interesting observation was made in January 2020, when a pair of Woolly-necked Stork was seen foraging for insects in freshly plowed agricultural fields along with a flock of Cattle Egrets (Figure 3). One foraging individual in this pair had a considerably larger or overgrown lower mandible. Despite this deformity in its beak structure, the bird was able to forage normally alongside its conspecific.

Discussion

Sightings of Woolly-necked Stork in north India during the study reflects that both wetland and agricultural fields were used by Woolly-necked Stork, and they were seen largely in small flocks of 2-3 individuals. Most of the observations were from unprotected agricultural wetlands with very few from a protected reserve. These observations are identical to those from another agricultural landscape in south-western Uttar Pradesh where the storks also used irrigation canals, fallow fields and grasslands (Sundar 2006). Unprotected wetlands, which are mostly outside the protected area network, are fast diminishing due to rapid urban expansion and agricultural intensification.

In our study, the mean flock size for Woolly-necked Stork was estimated to be 1.87 ± 0.25, however, in one case the largest recorded flock was of 8 individuals. Woolly-necked Storks are known to exhibit social foraging behavior during non-breeding seasons (Pande *et al*. 2007) and aggregate in large numbers in foraging patches usually

Figure 3. Woolly-necked Stork feeding with a flock of Cattle Egret in a freshly tilled agricultural field. The unusual growth in the lower mandible can be seen in this individual. Photograph by Nawin K. Tiwary.

Table 1: Woolly-necked Stork *Ciconia episcopus* sightings in north India. Sightings are provided in chronological order.

Sl. No.	Location	Coordinates	Flock size	Habitat	Monospecific/ Mixed flock (species composition*)	Date
1.	Keoladeo National park, Rajasthan	27° 9'54.12"N; 77°31'33.92"E	2	Wetland	Mixed (KBD, ES, BHI)	28 November 2012
2.	Keoladeo National park, Rajasthan	27° 9'54.12"N; 77°31'33.92"E	2	Wetland	Monospecific	12 February 2013
3.	Keoladeo National park, Rajasthan	27° 9'54.12"N; 77°31'33.92"E	1	Wetland	Mixed (LE)	06 December 2013
4.	Khanpur, Uttar Pradesh	27°42'41.77"N; 77°29'26.42"E	2	Agricultural field	Monospecific	17 January 2014
5.	Keoladeo National park, Rajasthan	27° 9'54.12"N; 77°31'33.92"E	2	Wetland	Mixed (BHI, LE)	15 September 2015
6.	Chhata, Uttar Pradesh	27°43'37.57"N; 77°30'27.59"E	1	Wetland	Monospecific	09 November 2015
7.	Chhata, Uttar Pradesh	27°43'37.57"N; 77°30'27.59"E	1	Wetland	Monospecific	13 November 2015
8.	Khaira, Uttar Pradesh	27°41'41.88"N; 77°26'14.17"E	2	Wetland	Mixed (PS)	20 December 2015
9.	Mathura, Uttar Pradesh	27°31'59.78"N; 77°38'26.10"E	1	Agricultural field	Monospecific	25 November 2017
10.	Dighal, Haryana	28°45'33.69"N; 76°38'4.24"E	1	Wetland	Mixed (BHI)	14 February 2018
11.	Dighal, Haryana	28°45'33.69"N; 76°38'4.24"E	1	Agricultural field	Monospecific	08 December 2018
12.	Dighal, Haryana	28°45'33.69"N; 76°38'4.24"E	1	Wetland	Mixed (PS)	08 December 2018
13.	Keoladeo National park, Rajasthan	27° 9'54.12"N; 77°31'33.92"E	1	Wetland	Mixed (GH,PS)	16 December 2018
14.	Najafgarh Jheel, Haryana	28°30'19.98"N; 76°57'9.36"E	2	Wetland	Monospecific	05 January 2019
15.	Najafgarh Jheel, Haryana	28°30'19.98"N; 76°57'9.36"E	1	Agricultural field	Mixed (BHI, CE)	05 January 2019
16.	Barsana, Uttar Pradesh	27°37'19.23"N; 77°22'11.28"E	2	Agricultural field	Monospecific	07 February 2019
17.	Palson, Uttar Pradesh	27°34'46.22"N; 77°25'1.64"E	8	Agricultural field	Mixed (PS)	07 February 2019
18.	Okhla Bird Sanctuary, Uttar Pradesh	28°34'8.28"N; 77°18'33.44"E	1	Wetland	Monospecific	08 February 2019
19.	Jhatikra, Haryana	28°31'16.18"N; 76°57'53.77"E	3	Agricultural field	Monospecific	29 March 2019
20.	Ajanoka, Uttar Pradesh	27°40'37.27"N; 77°25'1.50"E	2	Agricultural field	Monospecific	09 December 2019
21.	Seeh, Uttar Pradesh	27°36'3.39"N; 77°24'35.33"E	2	Agricultural field	Monospecific	09 December 2019
22.	Najafgarh Jheel, Haryana	28°30'19.98"N; 76°57'9.36"E	2	Wetland	Mixed (CE)	10 January 2020
23.	Yamuna River, Ibrahimpur, Delhi	28°47'38.24"N; 77°12'10.89"E	2	Riverbed	Monospecific	12 February 2020
24.	Basai Wetland, Haryana	28°28'9.61"N; 76°58'46.80"E	3	Wetland	Mixed (IE, CE)	04 March 2020

*The abbreviations used are as follows – KBD: Knob-billed Duck *Sarkidiornis melanotos*; PS: Painted Stork *Mycteria leucocephala*; GH: Grey Heron *Ardea cinerea*; IE: Intermediate Egret *Ardea intermedia*; LE: Little Egret *Egretta garzetta*; CE: Cattle Egret *Bubulcus ibis*; BHI: Black-headed Ibis *Threskiornis melanocephalus*; ES: Eurasian Spoonbill *Platalea leucorodia*.

located in the vicinity of water bodies. They mostly feed on large insects, frogs, crabs, lizards, and snakes (Ali and Ripley 1978). However, there are no previous records of scavenging behavior in Woolly-necked Storks. The unusual feeding behavior observed by us may be a true scavenging behavior or an opportunistic feeding of insects from the animal carcass. In either case, this remains a unique photo documentation for this species. Detailed studies on habitat use and foraging pattern can be very useful in filling the gaps in the knowledge about this species. Maintaining agricultural landscape with interspersed wetlands can be a key in developing a congenial habitat for the Woolly-necked Storks.

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