Status of Woolly-necked Storks in Kerala, south-western India

R. ROSHNATH¹ and P. GREESHMA²

¹Department of Zoology, Central University of Kerala, Periya 671316, Kerala, India
²Wildlife Department, Kerala Forest Research Institute, Peechi 680653, Thrissur, Kerala, India
*Corresponding author; e.mail: roshnath.r@gmail.com

Abstract Woolly-necked Stork is a large wading bird found in wetlands and reservoirs in Kerala. Using bird checklists uploaded on eBird, we analysed the distribution, seasonality, flocking propensity, breeding and trend of reporting of Woolly-necked Storks by bird-watchers in Kerala. We found no long-term variation in the annual rates of reporting in checklists between 2000 and 2020. Reports of Woolly-necked Storks were largely of solitary birds, with reports of flocks of more than five individuals being infrequent. Although widespread in the state during winter, Woolly-necked Storks are found concentrated in central Kerala during the summer months. Only 16 nesting sites were identified, most of which were in central Kerala, and included both trees and man-made structures such as cell-phone towers. From our analyses of checklists, we infer that Woolly-necked Storks in Kerala have a small resident population with indications of seasonal movements.

Keywords Breeding, distribution, Kerala, seasonality, Woolly-necked Storks, Kerala.

Introduction

Woolly-necked Stork Ciconia episcopus is a large wading bird that inhabits various wetland habitats including natural wetlands, manmade reservoirs, paddy fields, and other cultivated fields in Kerala (Sashikumar et al. 2011). Among the three subspecies recognised, Ciconia episcopus episcopus (Boddart 1783) is the subspecies found in Kerala and throughout India (del Hoyo et al. 2020; Gill et al. 2020). Together with Ciconia episcopus neglecta (Java and south Sumatra), the Asian population is accorded species status by BirdLife International as ‘Asian Woollyneck’ and its threat status is assessed as Vulnerable (BirdLife International 2020).

Historical records of the species in Kerala date back to before the 1920s from the Bharathapuzha river basin in central Kerala which was then a known hotspot for these birds. K K Neelakantan, also known as Induchoodan on his book “Keralathille Pakshikal”, mentioned sighting records of these birds during the 1930s by Salim Ali (Sashikumar et al. 2011). During 1938-1960, Induchoodan himself sighted up to nine birds (at least one each time) when he was travelling by train via Bharathapuzha. He also mentioned sighting of a flock of 14 birds in Periyar during the summer, which was the highest count then. Thus, the bird was referred as “uncommon” in Kerala (Induchoodan 2004). Later, with more records available from within the state, the bird was referred as winter visitor in Kerala with 180 birds recorded in 1999 at Cheruvallor in Thrissur district (Sashikumar et al. 2011).

There is no systematic long-term monitoring of Woolly-necked Storks in Kerala, and we have no information on its general habits, potential seasonal variations in distribution, and nesting ecology. In other locations in India and Nepal, Woolly-necked Stork densities, flock sizes and habitat use varied by location and by season potentially due to

Article history
Received: 08 September 2020,
Received in revised form: 10 September 2020,
Accepted: 10 September 2020,
Published online: 07 October 2020

© 2020 The Authors. SIS Conservation. Published by: IUCN Stork, Ibis and Spoonbill Specialist Group
changing landscape conditions brought about by cropping patterns and climatic variations (Sundar 2006, Kittur and Sundar 2020). Using citizen data uploaded on the online platform eBird (eBird.org), we undertake the first analyses of distribution, seasonality, flocking propensity, breeding and trends in rates of reporting of Woolly-necked Storks by bird-watchers in Kerala. We specifically hypothesized that: (1) reporting trends of the species over time has increased (2) flock sizes would vary by month in response to changing seasons; and (3) the species’ distribution across Kerala would vary by season also in response to changing seasons.

There is very little information on the breeding ecology of the species, though it is known to use both trees and man-made structures such as cell phone towers to nest on (Hasan and Ghimire 2020). Using available reports on the portal eBird, we summarised nest locations of Woolly-necked Storks in Kerala.

Study area

Kerala state lies in the South Western coastal region of India between latitudes 8° 17’ and 12° 47’ North and longitudes 74° 52’ and 77° 24’ East. Kerala harbours a total of 44 rivers and a continuous chain of lagoons or backwaters along the coast that give rise to a number of wetlands. Kerala has 1,60,590 ha of wetlands which include shallow ponds, reservoirs, low lying coastal lands, brackish water creeks, lagoons, estuaries, mangroves, swamps, lakes, marshes, saline-tolerant paddy farming fields and floodplains (Chitra et al. 2020). But because many of these wetlands co-exist in a single site, wetlands are simply classified as lagoons, low lying cultivation, estuaries, beaches, inland reservoirs and mid elevation paddy fields (Nameer et al. 2015). The total wetland area in Kerala is dominated by natural or manmade inland wetlands (73 %) while 25 % consists of natural coastal wetlands, and a small amount (2 %) are small wetlands not more than 2.25 ha. Kerala wetlands are also important stop over site for migratory birds and come under the Central Asian – Indian Flyway (Chitra et al. 2020).

Kerala is one of the most densely populated states in the country (859 persons per km2; Census of India 2011), with 93% growth in urbanisation between the year 2001 and 2011 (Pradhan 2013). Kerala is renowned for land reforms which eases conversion of natural areas to farmland and other human uses (Roy 2016), which in turn threatens existing wetlands.

Methods

eBird is a global platform where bird-watchers upload bird checklists from individual events of bird-watching. This information is potentially useful to understand various aspects of bird ecology and habitats including distribution, habitat use and trends in the reporting rate of a particular species in the checklists. To understand trends in reporting rates, we used the ‘rel-Jun2020’ version of the eBird Basic Dataset (EBD) for India that contained data submitted up to 31 May 2020 and extracted all checklists from Kerala. We did not use count data to estimate abundance since methods of counting vary between the observers who upload checklists. Instead, we used the frequency of reporting of Woolly-necked Storks in checklists for our analyses. This reporting frequency of a species is a crude representation of its detectability (function of its biology, habitat structure, and observer ability) alongside its actual presence. We do not assume this index of reporting frequency to be proportional with the population size of a species (SoIB 2020). We also do not correct for observer ability, spatial and temporal variation in bird-watching effort of individuals, and group sizes of bird-watchers that were associated with each individual checklist. All of these aspects can affect observability and therefore reporting rates of
species. After excluding duplicate checklists (when a checklist is shared with multiple eBird users), each unique checklist was treated as an independent sampling unit assumed to have a binomial error distribution. Detection/non detection (whether or not the species was observed in a checklist) information for the species was modelled as a function of list length (a measure of effort), season and year using Generalized Linear Mixed Effects Models (Walker and Taylor 2017). This modelling was used to obtain standardised frequency of reporting annually along with SE estimates. The year 2000 was taken as a cut off since checklists before this period were relatively fewer. The percentage change in standardized frequency of reporting in 2018 when compared to pre-2000 levels constitutes our index of long-term trend in reporting frequency (SoIB 2020).

Additionally, sighting data of Woolly-necked Stork available on eBird (from the year 1973-2020; 6,984 individual observations) for Kerala state was downloaded. We examined the flock sizes reported in each observation assuming that bird-watchers reported storks from a single flock when more than one bird was reported, and also that they always reported full flock sizes. With a monthly average of $582 \pm 687$ SD checklist, the number of checklists varied considerably across the months (Jan to Dec; 2355, 1209, 748, 422, 224, 81, 69, 90, 105, 179, 383, and 1119). We assessed monthly flock sizes and used the non-parametric Kruskal-Wallis test to ascertain if flock sizes differed by month, but do not control for bird-watching effort in this analysis. We used box-plots to visually assess the monthly flock size information.

We then assessed if Woolly-necked Stork distribution in Kerala varied across two seasons: summer (April to September) and winter (October to March). We used a subset of the sighting data from January 2014 to May 2020 for this because eBird usage increased from 2014 in Kerala providing substantial information for both seasons. We studied the average ratio of checklists in summer and winter months in the state and concluded that the birding effort did not vary between summer ($0.43 \pm 0.06$ SD) and winter ($0.57 \pm 0.06$ SD) months. We obtained 5,711 observations of Woolly-necked Storks in winter and 962 observations in summer from eBird, and used these to map the distribution of the species in each of the two season.

Nesting sites were identified from published literature (Sashikumar et al. 2011; Greeshma et al. 2018) and from eBird data. Confirmed breeding behaviour such as nest building and occupied nests either with eggs or young ones were considered as nesting sites and each location was mapped separately. We additionally supplemented this information by personally communicating with bird-watchers and other professional colleagues in Kerala. Age of nests were unknown in almost all cases. For sites where multi-year monitoring was available, we provide year of first recording when the nest was observed first. From these sites, where current information was available, we provide information on whether or not nesting was still being observed. The nesting month provided refers to when the observation was made and not to when the nest was initiated. To understand the precise nesting period, we tried to get further information on nesting stage of that respective month from the observer wherever possible.

**Results**

The long-term trend analysis using rates of reporting on eBird.org showed no significant change in the reporting frequency of Woolly-necked Storks (Figure 1). Most reports were of solitary birds (30% of all observations) or in small...
groups of not more than 5 individuals (49% observations). Only less than one percentage (0.74%) of all observations reported large flock of more than 30 individuals mostly during December to February months. There was no significant difference ($p = 0.07$) in their flock sizes sighted during different months across the state (Figure 2). Woolly-necked Storks were much more widespread during winter relative to summer when they were concentrated in central Kerala with very few observations from northern and southern Kerala (Figure 3).

A total of 16 nesting sites were identified (Figure 4). Most of these were from central Kerala except for one site in Periyar Tiger Reserve in Idukki district. Woolly-necked Storks were reported nesting on various nesting trees such as *Ficus religiosa* ($N = 3$), *Mangifera indica* ($N = 3$), *Alstonia scholaris* ($N = 2$), and also on cell-phone towers ($N = 4$). One nest was observed in March but this was historical data from 1954 (Table 1). Apart from the four nesting locations, all the sites had nests active over multiple years. Nests reported since 2002 were seen between September and December, with storks seen incubating one nest as late as November (Table 1).

**Discussion**

The trend of reporting of Woolly-necked Storks from 2000 to 2020 was similar year-to-year in Kerala. We were able to use only available checklist data on eBird and therefore are unable to conclusively state anything regarding the abundance or population of Woolly-necked Storks in Kerala. Formal monitoring across Kerala using robust field methods are needed to derive current populations, and long-term monitoring is needed to understand if the species’ population fluctuates in the state.

Reports suggest that Woolly-necked Storks were solitary, and mostly remain in small groups throughout the year, but flocks of more than 50 birds were sometimes seen in winter in wetlands of central Kerala including inland reservoirs (Nameer *et al*. 2015). Only 0.74% of the observations reported flocks more than 30 birds. This habit of largely being seen in small flocks with extraordinary large flocks being rare is similar to information available from other locations in Nepal and India (Sundar 2006, Kittur and Sundar 2020).

During summer months, most reports of the species were from central Kerala which hosts the Kole wetlands and the Bharathapuzha River. In winter months, bird-watchers reported this species from many more locations across the state. This suggests that the species displays strong seasonal variation in distribution at the level of the state. Such a large variation in distribution with season has not been observed during seasonal, long-term
monitoring efforts in northern India and in lowland Nepal (Sundar 2006, Kittur and Sundar 2020). It is not immediately clear why Woolly-necked Storks show a much smaller distribution in summers, but we suspect that the shrinking of wetlands and other water bodies may force this species to existing sources of water on the landscape. Existing accounts refer to Woolly-necked Storks as an “uncommon” species (Induchoodan 2004) and as a “widespread winter visitor” in Kerala (Sashikumar et al. 2011). Our analyses of bird-watcher’s reports suggests that while Woolly-necked Storks are a resident species in Kerala, it is possible that the number of birds reduces during the hot summer months. A more careful evaluation of distribution and numbers of Woolly-necked Storks using year-long field data is needed to understand if the species varies in distribution during the breeding season as well. If the distribution during the breeding season is also smaller than the observed distribution in the winter, it can be suggested that Kerala experiences inward movement of Woolly-necked Storks during the winter.

Woolly-necked Storks are solitary breeders nesting singly on trees (Ali and Ripley 1987), cliffs (Rahmani and Singh 1996) and on cell-phone towers (Choudhary et al. 2013; Vaghela et al. 2015; Greeshma et al. 2018; Hasan and Ghimire 2020). In this study, we found Woolly-necked Storks using large trees such as Ficus religiosa, Mangifera indica, and Alstonia scholaris for nesting in Kerala. In Paralikkadu, Thrissur, a pair was found nesting on a Jackfruit tree (Artocarpus heterophyllus). After the tree was cut, the storks nested again on a nearby cell-phone tower (pers. obs.). We also obtained reports of four nests on cell-phone towers. Storks may view man-made structure like cell-phone towers as safer nesting sites compared to trees owing to the reduced accessibility of such nests to certain predators (Tryjanowski et al. 2009, Bialas et al. 2020).

Breeding season of Woolly-necked Storks in India has been reported during the rainy season in the months July to September in the south, but the species is reported to nest between December and March in the north (Ali and Ripley 1978). But, we found Woolly-necked Storks to breed largely during the post-monsoon season in Kerala. This pattern is similar to observations in Pune, which is slightly to the north of Kerala (Vaghela et al. 2015).

Several nesting reports of Woolly-necked Storks were from the Bharathapuzha River Basin in central Kerala (Sashikumar et al. 2011, Greeshma et al. 2018). However, the first nesting record for the species in the state is from Periyar Tiger Reserve that is not in central Kerala (Figure 4). Since the first report in 1954, a single pair has continued to nest in a large Ceiba pentandra tree near the boat landing centre in the Tiger Reserve (Induchoodan 2004). In 2018, three active nests were observed in the same site near to the lake (Patrick David pers. comm. 2020). During our study, we did not get any confirmed nesting reports from Edappal, Thiruvilvamala, and Kuttipuram where nests were recorded earlier.
Our analyses provide some initial understanding of the biology and habits of Woolly-necked Storks. However, a much more focused effort is needed to obtain robust metrics of population sizes, and to understand breeding propensity of the species in the state. We suggest that such studies can provide invaluable additional knowledge to understanding how Woolly-necked Storks – one of the least studied stork species in the world – is faring.

Acknowledgments

We thank K.S. Gopi Sundar for inviting this paper for the Special Section of SIS Conservation, for editing and revising multiple previous drafts, and for providing pertinent literature. We thank Ashwin Viswanathan for help with the analysis and writing and Anjana Unni for helping with the data analysis. We thank Arya Vinod, Asfiaq Mohammed, Kavya H Das, Manoj Karingamadathil, Patrick David and all the birders of Kerala for contributing information on Woolly-necked Stork in eBird. We thank Arjun C.P. for providing the maps and Praveen J. for his generous support in structuring the manuscript in present form. We also thank an anonymous reviewer for constructive comments.

References


---

Table 1. Nesting location and present status of Woolly-necked Stork in Kerala.

<table>
<thead>
<tr>
<th>District</th>
<th>Location</th>
<th>Nest found</th>
<th>Month</th>
<th>Nesting stage</th>
<th>Tree/substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idukki</td>
<td>Periyar Tiger Reserve</td>
<td>1954-2019</td>
<td>Mar</td>
<td>-</td>
<td>Ceiba pentandra</td>
</tr>
<tr>
<td>Malappuram</td>
<td>Edapall</td>
<td>2002</td>
<td>Unknown -</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Malappuram</td>
<td>Kuttippuram</td>
<td>2002</td>
<td>Unknown -</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Palakkad</td>
<td>Kottanad</td>
<td>2004-2019</td>
<td>Nov</td>
<td>With chicks</td>
<td>Mangifera indica</td>
</tr>
<tr>
<td>Palakkad</td>
<td>Mannanur</td>
<td>2004-2018</td>
<td>Nov</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Thrisur</td>
<td>Thiruvilvamala</td>
<td>2004</td>
<td>Oct</td>
<td>Nest building</td>
<td>Cell-phone tower</td>
</tr>
<tr>
<td>Thrisur</td>
<td>Paralikkadu</td>
<td>2015-2019</td>
<td>Dec</td>
<td>Nest building</td>
<td>Cell-phone tower</td>
</tr>
<tr>
<td>Palakkad</td>
<td>Manissery</td>
<td>2016</td>
<td>Sept</td>
<td>Nest building</td>
<td>Cell-phone tower</td>
</tr>
<tr>
<td>Thrisur</td>
<td>Punnayurkulan</td>
<td>2017-2017</td>
<td>Nov</td>
<td>Nest building</td>
<td>Ficus religiosa</td>
</tr>
<tr>
<td>Thrisur</td>
<td>Varadiyam</td>
<td>2017-2017</td>
<td>Oct</td>
<td>With chicks</td>
<td>Mangifera indica</td>
</tr>
<tr>
<td>Thrisur</td>
<td>Wadakkanchery</td>
<td>2017-2019</td>
<td>Nov</td>
<td>With chicks</td>
<td>Cell-phone tower</td>
</tr>
<tr>
<td>Thrisur</td>
<td>Cheerkuzhi</td>
<td>2017-2018</td>
<td>Nov</td>
<td>Incubation</td>
<td>Ficus religiosa</td>
</tr>
<tr>
<td>Thrisur</td>
<td>Mulangummathukavu</td>
<td>2018-2019</td>
<td>Oct</td>
<td>With chicks</td>
<td>Cell-phone tower</td>
</tr>
<tr>
<td>Palakkad</td>
<td>Kodumunda</td>
<td>2019-2019</td>
<td>Sept</td>
<td>Nest building</td>
<td>Cell-phone tower</td>
</tr>
<tr>
<td>Thrisur</td>
<td>Thangalur</td>
<td>2019-2019</td>
<td>Sept</td>
<td>Nest building</td>
<td>Cell-phone tower</td>
</tr>
<tr>
<td>Palakkad</td>
<td>Palappuram</td>
<td>2019-2019</td>
<td>Sept</td>
<td>With chicks</td>
<td>Alstonia scholaris</td>
</tr>
</tbody>
</table>
Woolly-necked Stork status in Kerala

Roshnath and Greeshma, 2020


