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SPECIAL SECTION EDITORIAL

Woolly-necked Stork - a species ignored

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Introduction

Storks, Ibises and Spoonbills (SIS) are most diverse in Africa and Asia, but SIS species in these two continents are also among the least studied. The IUCN SIS Specialist Group is determined to change this situation working with colleagues who are intrigued by these species. This issue of *SIS Conservation* takes another small step towards this goal of improving understanding of poorly studied species. The Special Section focuses on one of the least studied waterbird species in the world, the Woolly-necked Stork. In this Editorial I provide an overview of the species' ecology and conservation status, describe in brief the contributions to the Special Section, and contrast some of the published information with information available online. This editorial and the Special Section is biased towards the population found in south and south-east Asia, though information from Africa is included where pertinent. I also bias the editorial to few aspects of the species' ecology, and a full literature review will be provided elsewhere.

A prologue to this editorial is that the taxonomy of Woolly-necked Storks remains unresolved with authorities either recognising one species with three subspecies (Gill *et al*. 2020), or separating the African and Asian Woolly-necks into two separate species, *Ciconia microscelis* and *C. episcopus* respectively (del Hoyo *et al*. 2019). The split into two species is based on geographical separation alone and requires additional genetic analyses to confirm the proposed split. In this issue of *SIS Conservation*, authors were not asked to follow any one taxonomy and the Special Section reflects the diversity of current opinions.

Background to the Special Section

In the recent past a few observations on Woolly-necked Storks (WNS) attracted my attention to this species. The first was a field visit in November 2015 to Haryana state in India to observe a WNS nest that a colleague had discovered on a fig *Ficus religiosa* tree amid crop fields. We got exceedingly lucky in reaching the nest just in time to watch the juveniles fledge. To our astonishment, six juveniles fledged from the single nest. The juveniles continued begging on the ground and sported a prominent white forehead (Figure 1). Such a large number of fledgelings from one nest of a single-nesting stork species was unprecedented. This WNS pair in Haryana had fledged two chicks more than the previous record of four chicks in a nest documented in southern Africa (Scott 1975) and India (Vyas and Tomar 2006), and had a larger clutch size than was known for the species (3-5 eggs; Hancock *et al*. 1992). In addition, the white forehead helps to identify newly fledged WNS, and is an unreported colouration.

The second observation was the discovery of WNS above 3,500 m in China and Nepal (Han *et al*. 2011; Ghale and Karmacharya 2018). This too was unprecedented, and the observation in China (Figure 2) also constituted a major range extension of WNS. Both observations coming within a few years of each other were suggestive of a species expanding its altitudinal and geographic range. With several SIS species struggling to survive and

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Figure 1. Six newly fledged Woolly-necked Stork juveniles (right) in a farmland area of Haryana, India. Fledgelings are soliciting attention from the adult bird (left) and sported distinct white colouring on the forehead that is not seen in older birds. Photograph by K. S. Gopi Sundar, November 2020.

requiring expensive conservation interventions, news of a species expanding on its own was significant.

Finally, the third detail that attracted my attention was the proposal in 2014 to elevate the conservation status of the Asian WNS from "Near-threatened" to "Vulnerable" following the proposed split of the WNS into two species (BirdLife International 2014). This proposal was made on an online forum where experts from south and south-east Asia provided their thoughts. Several experts from south Asia provided field observations that did not support a change in status. Published literature from south Asia supported these observations. Two experts from south-east Asia made passionate calls to elevate the conservation status suggesting that the species was imperilled by conversion of forests to agriculture and hunting in south-east Asian countries. They suggested that these habitat changes exposed the species to increased hunting and that the species may not be able to survive in agricultural areas. Using the inputs on this forum, BirdLife International elevated the Asian WNS from "Least Concern" to "Vulnerable" (BirdLife International 2014).

These three disparate but somewhat connected aspects converged in my mind towards a couple of realizations. The first was that it was entirely likely that other ornithologists and researchers had field observations on WNS that could help build a more complete picture of the species' ecology and conservation requirements. The second was that conservation status of several SIS species (see also Gula 2020), and most certainly the WNS, may be biased by anecdotal information from a small part of its distribution range.

Species accounts and WNS ecology

As with all poorly studied species, generalized accounts based on anecdotal reporting and ad hoc field observations formed the majority of literature driving understanding of WNS ecology and conservation requirements. Early accounts of the species derived from field observations during surveys of relatively small geographical areas described it as using a variety of habitats including lowland swamps and rice paddies up to elevations of 1,400 m and 3,000 m (Britton 1980; White and Bruce 1986). In a prominent generalized species account that considered the species' full distribution range, WNS began being described as a solitary forest-nesting stork species (Luthin 1987). Subsequent species accounts highlighted anecdotal information from south-east Asia and provided early suggestions that deforestation and hunting were primary threats to the potentially imperilled WNS. These suggestions were repeated in subsequent generalised accounts, including in the seminal SIS book by Hancock *et al*. (1992). Based on their personal observations, the authors described the WNS in India as difficult to observe due to its habit of sharing the same habitat as the tiger (Hancock *et al*. 1992: 83-84). The authors noted the ability of WNS to nest in or near human

Figure 2. Adult Woolly-necked Stork at 3,500 m altitude at Napa Lake, China. Photograph by Peng Jian-sheng.

habitation but did not discuss these observations further beyond a parenthetical mention. Some later species accounts included agricultural areas as habitats used by WNS, but the source of this information was not clear (Elliott 1992). These species accounts continued to state that primary threats to WNS were habitat loss and hunting.

Other literature with analysed field observations, primarily from south Asia and southern Africa, took a different trajectory in describing WNS status and ecology. Multi-year counts along a protected riverine reserve showed WNS populations to be stable in multiple locations (Sharma and Singh 2018). Higher resolution observations showed WNS to habitually use unprotected wetlands situated in agricultural landscapes (Pande *et al*. 2007). Analyses also showed relatively large numbers of WNS to be resident in human-modified landscapes using a variety of man-made features such as gardens, cell-phone towers, residential back yards, irrigation canals, village trees, crop fields and fallow fields in Asia and Africa (Sundar 2006; Choudhary *et al*. 2013; Vaghela *et al*. 2015; Greeshma *et al*. 2018; Thabethe and Downs 2018). In KwaZulu Natal, several observations have been made on WNS at land fills with dozens of storks gathering at sites where livestock offal was dumped (J. Gula pers. comm.; Thabethe and Downs 2018). In south-east Asia, research continued to be focussed largely inside protected reserves, and camera-trapping studies confirmed the value of seasonal shallow water holes inside forest preserves for WNS (Pin *et al*. 2020).

Both generalized accounts and literature published using primary observations provided similar information regarding some aspects of the species' biology. For example, both suggested that WNS in Africa nested singly but often congregated suggestive of seasonal movements. Both sources also described the WNS in Asia as being a solitary nesting stork usually found in small groups of < 4 with larger flocks being rare and seasonal.

Depending on the source of information, descriptions of the ecology and conservation requirements of WNS varied in key aspects. The conservation implications of this variation were not trivial. Generalized accounts continued to stress that the species was imperilled by habitat loss and hunting especially in Asia. This continued repetition alongside the proposed split of WNS into two species likely biased status assessments. However, primary literature from south Asia showed the species using a variety of human-dominated landscapes including agricultural areas in relatively large numbers. This was similar to the habits of the WNS in Africa. Thanks in part to an absence of ecological work on the species, the population estimate for the Asian WNS is a "best guess" at 25,000 (Wetlands International 2020).

Special Section on WNS

I started reaching out to colleagues, researchers and students in 2019 to consider delving into their notebooks looking for unpublished information on WNS. By early 2020, enough people had

responded for me to be sure that a Special Section on the species could be developed in *SIS Conservation*. Luis Santiago Cano was enthusiastic as ever about the idea and I started working with potential authors to develop manuscripts. At the time of finalising Issue 2, we have completed reviewing, editing, and proofing nine articles that form the Special Section on WNS. There are additional manuscripts in different stages of completion that could not meet the deadline for Issue 2 but will hopefully be included in subsequent issues.

The papers

The articles for the Special Section are diverse, including a collection of unpublished field sightings (Tiwary 2020), a couple of sightings of nesting in previously unreported locations (Hasan and Ghimire 2020; Mehta 2020), an analysis of secondary data available on the online portal eBird (Roshnath and Greeshma 2020), analyses of a combination of field data and volunteer observations from various sources (Gula *et al*. 2020; Mandal *et al*. 2020), and analyses of information collected from systematic field surveys (Katuwal *et al*. 2020; Kittur and Sundar 2020; Win *et al*. 2020). Such a combination of papers with such disparate sources of information has its challenges in terms of how results should be interpreted and whether findings can be easily compared. Notwithstanding these relatively minor challenges, the papers comprise the largest yet source of ecological information on WNS. This helps to propel the species from being one of the least studied storks to one whose habits are much better understood.

Tiwary (2020) used opportunistic field observations made while on other research to build a small and useful understanding of WNS using agricultural fields and unprotected wetlands in northern India. Tiwary (2020) also describes a potentially novel foraging behaviour that speaks of the behavioural plasticity that WNS appear capable of. Hasan and Ghimire (2020) describe nesting of WNS on cell phone towers in Bangladesh – a country where the species was suspected to be extinct as a breeding species. This behaviour of using human-made structures for nesting by WNS was once thought to be novel but seems to be widespread suggesting that some constructions potentially benefit the species. Mehta (2020) provides observations of failed nests of WNS in Udaipur city in India which suggest that WNS may be starting to nest in cities. This is exciting news since WNS have never been observed nesting inside cities in south Asia. The phenomenon of WNS using artificial structures close to human habitation to nest suggests that the species is not persecuted in these areas while also underscoring the species' ability to use unprotected human-dominated areas.

Secondary data from online portals where volunteers upload observations can often be of great use to develop preliminary understanding of birds such as the poorly studied WNS. Roshnath and Greeshma (2020) pull together thousands of observations from Kerala state to piece together an understanding of WNS ecology. Significantly, they show that frequency of sightings of WNS has remained stable between 2000 and 2019, that breeding records are restricted to few areas in the state, and that numbers of WNS appear to reduce across the state during summer. Similarly, Mandal *et al*. (2020) assemble sightings for the north-eastern state of Assam and combine their own observations to build a picture of the species' ecology. Their analyses show WNS in Assam to be seasonal visitors primarily during the winter, with no confirmed record of breeding. This is unusual for WNS that shows seasonal movements in summer in other locations in south Asia. Both these papers also caution readers about the challenges that freely available data posed, but effectively use available information to set up interesting hypotheses that will require standardised field studies to confirm.

Gula *et al*. (2020) similarly used thousands of records of WNS from across Africa and Asia. They obtained observations on WNS from various published and online sources, and were able to include more recent field records that authors of papers in the Special Section provided. Gula *et al*. (2020) provide a comprehensive predictive modelling of WNS distribution across their entire distribution range. Their results show the storks' distribution is affected by slightly different

variables in Africa and Asia pointing to varying environmental conditions and potentially also how storks interact with humans in each location. They suggest that differences could also be due to African researchers usually avoiding agricultural areas where WNS are being increasingly sighted. Modelling also confirmed that the species is very widespread in south Asia and Africa, but with a restricted and declining distribution in south-east Asia.

While papers relying on secondary information have developed substantial understanding of WNS ecology and conservation requirements, it was very exciting to receive manuscripts that analysed primary field data. The three papers with field data are additionally exciting in using systematic repeatable field methods, covering relatively substantial swathes of geographical areas, and undertaking repeated visits to sampling sites across seasons and years. Katuwal *et al.* (2020) use a novel data set from transects laid across lowland Nepal to show that WNS are perhaps uncommon on these floodplains. Kittur and Sundar (2020) use a multi-year multi-location data set to show that WNS are widely distributed across agricultural areas in lowland Nepal and northern India. They also provide preliminary population estimates suggesting that WNS population size has previously been severely underestimated. They also underscore the complexity of monitoring WNS and the ecological plasticity that this species appears to display potentially in response to seasonal landscape-level changes that different agricultural landscapes experience. Finally Win *et al*. (2020) have analysed a unique data set, perhaps the first such data from Myanmar, that allows an assessment of WNS abundance and habitat use inside and outside protected areas. Using data collected systematically from several locations and seasonally over multiple years, they showed that WNS were more abundant outside protected areas in Myanmar, and that WNS liberally used unprotected wetlands and agriculture fields.

Emerging methodological considerations

Transect based monitoring of WNS has been carried out in several locations across south and south-east Asia. Some studies have used transects of varying lengths placed either systematically across entire landscapes (e.g. Sundar and Kittur 2012; Katuwal *et al*. 2020) or in areas having different protection status (Win *et al*. 2020). These studies visited transects multiple times for a relatively large number of transect runs providing a noticeable propensity to variation in WNS sightings. Katuwal *et al*. (2020) used 0.5 km transects across lowland Nepal and recorded WNS in 1.4% of 985 transect runs. Sundar and Kittur (2012) used 1 km transects across the Gangetic floodplains of Uttar Pradesh and recorded WNS in 12% of 360 transect runs. Win *et al*. (2020) used 1.5 km transects inside protected areas and 2 km transects outside protected areas. WNS were seen in 25% of 342 transect runs inside protected areas, and in 61% of 648 transect runs outside protected areas. Each of these studies were carried out on landscapes that varied enormously in land use but were in areas where human attitudes to wildlife was more tolerant relative to places like south-east Asia where hunting appears to be widespread. Many different factors could explain the variation in the proportion of transect runs with WNS sightings. However, it is somewhat compelling to note that the WNS sightings were the least in the study with the smallest transects and vice-versa. Intermediate values were obtained in the study with intermediate transect length. These preliminary observations suggest that studies focusing on WNS across relatively large landscapes will require transects of at least 1.5 km in length to obtain adequate information.

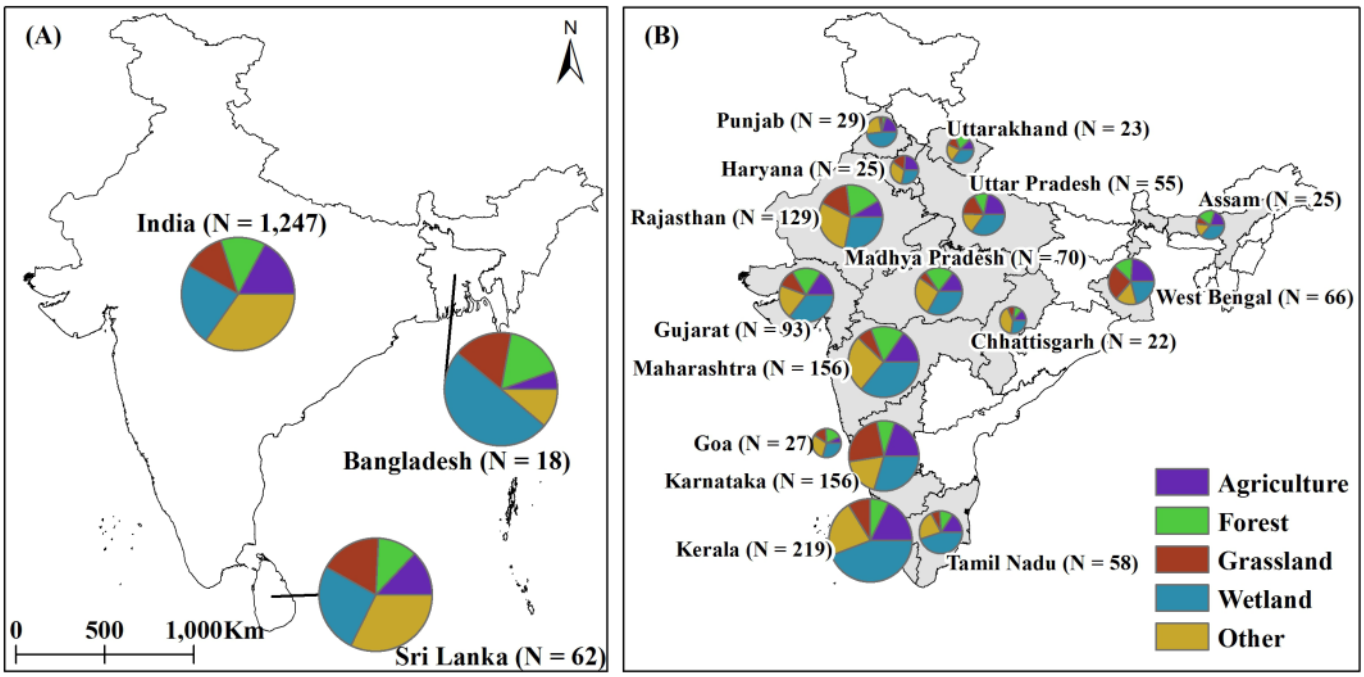
An additional aspect that the new papers bring out is the widespread and significant use of non-wetland habitats by WNS. Past long-term monitoring data on WNS were counts of storks from wetlands as part of the mid-winter waterfowl census that have been useful to develop "guesstimates" of population sizes (Wetlands International 2020). These censuses focus entirely on wetlands and these counts would therefore be inadequate to understand population sizes of the WNS. Other SIS species that have previously been assessed using wetland surveys but are inadequately represented in such counts due to their habit of largely using farmland habitats, include the Black-necked Stork *Ephippiorhynchus asiaticus* (Sundar 2005), the Painted Stork

Mycteria leucocephala and the Black-headed Ibis *Threskiornis melanocephalus* (Sundar 2006). A much more careful assessment of the habits of SIS species is needed to identify which species can be reliably monitored using only wetland surveys and which ones require wider coverage.

WNS natural history and information sources

While some papers in the Special Section were developed using either freely available data online, or combined different sources of data, there is not yet an evaluation of the reliability of the different sources of information. Habitat use emerged as an aspect that was relatively easy to document. Findings from few sites within the WNS distribution varied significantly from information in most generalised accounts. I was curious as to whether a similar understanding would be reached if photographs available on the internet were used as a source of data to measure habitat use of WNS. Thanks to volunteers, 2,254 photographs of WNS in south Asia were curated from the internet (eBird, Facebook, iNaturalist, Wiki photographs, individual blogs, and others). Volunteers listed the broad habitat categories (agriculture, forests, wetlands, other) that WNS were using in photographs. WNS habitat use determined from these photographs showed considerable variation in the three south Asian countries for which we obtained at least 15 photographs each (Figure 3A). In addition, WNS habitat use was similar across some Indian states but differed in others (Figure 3B). WNS habitat use assessed using photographs suggested a low use of agricultural areas and a high use of wetlands (Figure 3C). This was contrary to the data obtained by systematic field work across large landscapes in south Asia (Figure 3C).

This variation likely reflects the habits of photographers and bird watchers visiting some areas like wetlands more than they do others. Data obtained from online photographs may therefore reflect people's biases rather than habits of WNS, similar to the bias in historic observations by researchers and conservationists. Any freely available data therefore requires to be used thoughtfully and will likely not be adequate to



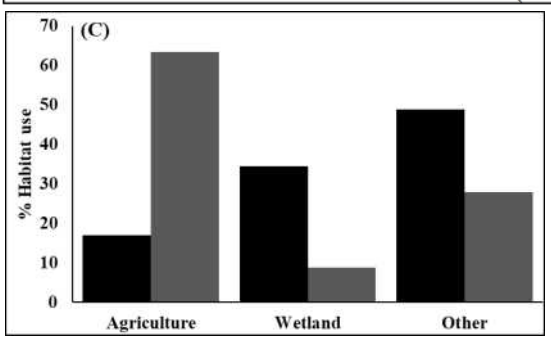


Figure 3. Habitat use by Woolly-necked Storks assessed using freely available photographs online at the level of the country in south Asia (A: only countries that had at least 15 photographs) and states of India (B: only states that had at least 20 photographs). Maps were developed by Swati Kittur using information curated by volunteers listed in the Acknowledgements. Additionally, a comparison of use of two major habitat types by storks as assessed using online photographs (C: black bars) and multi-year field data (from Kittur and Sundar 2020; C: dark-grey bars).

develop an unbiased understanding of the species' natural history and conservation requirements.

WNS as a study species

Papers in the Special Section and other literature point to the suitability of WNS as a model study species, especially to understand how agricultural areas can be retained as multifunctional landscapes for both growing crops and providing SIS species with habitat. Such understanding is critically important to conserve biodiversity in crowded countries such as those in south and south-east Asia where developing new reserves for wildlife is becoming less and less feasible. New papers in this issue of *SIS Conservation* and available literature provide considerable understanding of WNS, but many ecological aspects remain unstudied. Studies to understand its feeding habits, breeding ecology, movements, and seasonal use of habitats in unexplored landscapes. Behaviour of WNS in different conditions are very poorly documented, and recent observations are beginning to showcase how this line of study may yield novel insights into bird behaviour and conservation (Ghimire *et al*. 2020; Ghimire *et al*. in press). Studies are needed across Africa to understand if the species uses areas close to and within human habitation elsewhere in the continent, and whether different pressures such as land use change and hunting regulate where and how many WNS live.

WNS is also a species that can be used to underscore the importance of using evidence to build conservation status assessments. WNS has helped to showcase how generalised species accounts can either add new information or accentuate some aspects of existing information without substantiation. This in turn, when parroted by subsequent generalised accounts, can lead to incomplete and incorrect understanding of the species' habits. Incorrect assumptions regarding a species' habits can lead to unreliable population estimates and eventual assignment to an inappropriate conservation status. This problem appears to be more widespread for SIS species than previously known (see also Gula *et al*. 2019; Gula 2020). While all SIS species have been accorded conservation status, several species like the WNS lacked even basic studies, leading to questionable status assessments. Such species that require basic ecological research need to be explicitly identified so that resources may be acquired to develop studies which in turn can inform evidence-based status assessments.

An additional problem that the WNS is helping highlight is the unequal level of threats that a single species faces in different parts of its distribution range. While the south Asia population of WNS appears to be safe outside inviolate forested reserves, the south-east Asian population, which constitutes a relatively small proportion of the species' distribution range (see Gula *et al*. 2020), appears to require urgent conservation intervention (e.g. Mittermeier *et al*. 2019). The status assessment of the species will, however, be biased by its population and status in the rest of the distribution range. To address this bias - which is certainly not unique to WNS - the IUCN status assessment process needs to develop a mechanism where imperilled populations can be highlighted even for species that are not endangered or threatened.

Epilogue

A discussion to reassess the conservation status of WNS was recently hosted on a new online forum (BirdLife International 2020). New information that was being developed for the Special Section of this issue of *SIS Conservation* was provided on this forum to help build a more complete understanding of WNS. Several papers published in the Special Section were not complete at the time of the discussion and will add to the growing information on the species. The new discussions included observations from Pakistan and Nepal that suggested that the south Asian population was expanding. Experts, however, underscored the serious predicament of the WNS in south-east Asia, as did a recent publication along the Mekong river in Cambodia (Mittermeier *et al*. 2019). One of the concerned experts on the discussion suggested that the WNS numbers being reported across south Asia may be due to roaming individuals that were being recounted in different locations. This suggestion seemed bizarre and experts in south Asia responded on how this was

implausible. To me, it brought home the dire situation in south-east Asia where experts appear unable to conceive that the species may number in the tens of thousands anywhere. Using the information provided to the updated discussion, WNS in Asia is now proposed to be classified as "Near-threatened". This revision is certainly a more realistic reflection of the species' state of being, but the new down listing reduces the number of species that conservationists can use in south-east Asia to stem the ongoing deterioration of forests and wetlands. While new work has added tremendously to knowledge of WNS ecology, they also help bring out how much remains unknown. My hope is that the Special Section attracts additional attention to WNS and that we can together find a way to help secure the species, specially the faltering population in south-east Asia. At the very least, I hope that WNS, and other SIS species, no longer remain ignored.

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