





## SIS Conservation

Publication of the IUCN SSC Stork, Ibis and Spoonbill Specialist Group

**ISSUE 1, 2019** 

SPECIAL ISSUE: GLOSSY IBIS ECOLOGY & CONSERVATION



Editors-in-chief: K.S. Gopi Sundar and Luis Santiago Cano Alonso

**Guest Editor for Special Issue: Simone Santoro** 



#### SPECIAL ISSUE: GLOSSY IBIS ECOLOGY & CONSERVATION



## Glossy Ibis Distribution and Abundance in an Indian Agricultural Landscape: Seasonal and Annual Variations

### K. S. Gopi SUNDAR<sup>1, 2</sup>, Swati KITTUR<sup>2</sup>

<sup>1</sup>IUCN SSC Stork, Ibis and Spoonbill Specialist Group, C/o International Crane Foundation, E-11376, Shady Lane Road, Baraboo, Wisconsin 53913, USA.

<sup>2</sup>Cranes and Wetlands Programme, Nature Conservation Foundation, 1311, "Amritha", 12th A Main, Opposite Kodava Samaj, Vijayanagar 1st Stage, Mysuru 570017, Karnataka, India.

#### ARTICLE INFO

# Article history: Received 02 October 2018 Received in revised form 30 October 2018 Accepted 05 November 2018

#### KEYWORDS

Glossy Ibis, India, Agriculture, variations

#### ABSTRACT

Glossy Ibis is assumed to be a non-breeding, winter migrant in India but its habits in the region are poorly documented. Their ability to use agricultural landscapes is known, but how they would use such landscapes with seasonal crops is not clearly understood. We carried out year-round observations of Glossy Ibis in Anand and Kheda districts of Gujarat between November 2015 and June 2017. Glossy Ibises were resident year-round, with the least counts during the monsoon. Glossy Ibises showed strong scale-dependent use of the landscape preferring areas with at least intermediate amounts of wetlands (50-100 ha), and preferentially using areas with the most wetlands (>200 ha) in summers. Additional effort to survey similar agricultural areas is needed to develop a more complete understanding of Glossy Ibis status in south Asia.

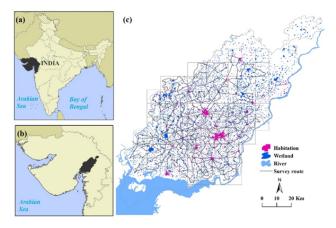
#### Introduction

We carried out the study in the adjoining districts of Anand and Kheda in Gujarat state in western India (Figure 1a, b). Agriculture was the primary land use in the two districts with a minimum of three crops grown in fields annually. A range of wetland types persisted including coastal wetlands in the south, seasonal marshes, and perennial artificial reservoirs that aided farming. Wetlands were used extensively by people throughout the year for grazing livestock, fishing, extracting water for irrigation, and provided a range of natural resources (personal observations). The landscape had a high human footprint with a large number of villages, towns and cities interspersed with agricultural areas and wetlands (see Figure 1c). Crops were seasonal with dominant crops being wheat and mustard during the winter

(November - February), mixed dry crops such as vegetables and cereals during the summer (March -June) and rice and corn during the rainy or monsoon season (July – October). The landscape was therefore wettest during the monsoon, intermediate during the winter, and driest during the summer. However, irrigation canals and reservoirs provided considerable hydrological complexity. We digitized all wetlands located on Government of India 1:50,000 topographic sheets published in 2011 and overlaid the entire area with 5'x5' grids that measured ~10x10 km<sup>2</sup>. We trained a local resident as our field associate to survey the two districts using the extensive road network. The survey route (see Figure 1c) was covered once in each of three seasons between November 2015 and June 2017 for five consecutive seasons.

<sup>\*</sup>Corresponding author; e.mail: gopi.sundar@gmail.com

Figure 1. Glossy Ibis survey location in the western Indian state of Gujarat (a,b). The focal districts of Anand and Kheda (c) are shown with all human habitations and wetlands digitized from topographic sheets, and the survey route taken each season to study ibis. Grids are ~10x10 km in size

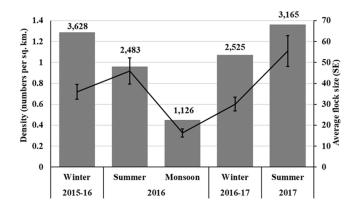


Using a hand-held Global Positioning System, the survey effort and locations of all observed Glossy Ibises *Plegadis falcinellus* were marked. It took 60-75 days to complete each seasonal survey. It is therefore likely that individual Glossy Ibis moved around and were counted multiple times. The counts, therefore, cannot be used to represent population numbers. Wetland numbers and extent (in ha) were extracted grid-wise in the Global Information Systems domain, and showed a strong linear correlation at the grid-level (p < 0.01). We therefore retained only wetland extent for analyses. We were able to use only one set of wetland maps and have assumed that grids with higher wetland extent would remain so in all seasons. We stratified grids into five classes of wetland extent (0-50, 50-100, 100-150, 150-200 and >200 ha). Density was estimated as observed number of Glossy Ibises per km<sup>2</sup> using a transect width of 300 m on either side of the road. Ibis flocks were plotted seasonally on stratified grids, and maps were created for each season showing ibis distribution against wetland presence. Glossy Ibises occurred primarily in flocks and each flock was taken as the unit for analyses. We assessed scaledependence at the landscape level. We plotted bargraphs of proportions of grids with each class of wetland alongside number of flocks that used each wetland strata in a season. If Glossy Ibises used grids randomly proportions of flocks in each stratum would match availability. We used bar graphs to assess if Glossy Ibis used wetland strata similar to their availability, or if they showed scale-dependence by using some strata less or more than what was available.

#### Results

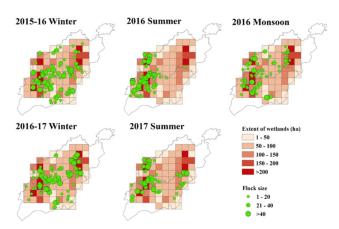
A total of 365 flocks with 12,927 individual Glossy Ibis were enumerated in this study. Glossy Ibis were present on the landscape throughout the year, with the least abundance during the 2016 monsoon season (Figure 2). Average flock sizes also varied seasonally and tracked overall abundance. Flocks of over 50 ibis were not uncommon (15% of all flocks sighted), with flocks of over 100 (9%) and 250 (2%) being rarer. The largest flock had over 1,000 ibis.

Figure 2. Seasonal density (grey bars) and average flock size (± SE; black line) of Glossy Ibis in the agricultural landscape of Anand and Kheda districts, Gujarat India. Numbers above graphs indicate the total number of ibis counted



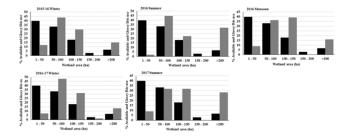
Seasonal abundances varied dramatically with the highest abundance being over three-times the season with the lowest abundance. Seasonal spatial distribution varied greatly with ibis being the most dispersed in winters and most concentrated within the least number of grids in summers each year (Figure 3).

Figure 3. Seasonal variation in Glossy Ibis distribution (green dots) in Anand and Kheda districts, Gujarat, India. Grids are ~10x10 km and show extent of wetlands in hectares. Areas not surveyed are in white



Grids with the smallest wetland extents were used the least by Glossy Ibis (Figure 4). Grids with intermediate levels of wetland extents were used higher than their availability in nearly all seasons in both years, and the grids with the highest wetland extent were used disproportionately more during summers (Figure 4).

Figure 4. Availability (black bars) of grids with different extents of wetlands, and use by Glossy Ibis represented as proportions of flocks seen in each (grey bars) in the agricultural landscape of Anand and Kheda districts, Gujarat, India



#### Discussion

Glossy Ibis were resident throughout the year in Anand and Kheda districts, and used the agricultural landscape extensively. Glossy Ibis nesting has been recorded in Gujarat (Tiwari and Rahmani 1998) and in several locations in south India (Subramanya 2005; Venkatraman 2009; Matheu *et al.* 2018). These observations collectively indicate that Glossy Ibises

are a year-round resident in India. Glossy Ibis numbers increased in winters in a south Indian reserve (Venkatraman 2009) identical to our observations in the agricultural landscape of Gujarat. The dramatic reduction of numbers of ibis in Anand and Kheda districts during the monsoon is indicative of local movements. Glossy Ibis nesting in Gujarat was observed in September and October (Tiwari and Rahmani 1998) suggesting that the movements in Anand and Kheda during the monsoon are linked to breeding. Flock sizes varied greatly, and the majority of flocks were <50 birds. However, the largest flocks in each season ranged from 100-1,000 birds. There are no studies at landscape scales providing abundance estimates and flock sizes along with seasonal variations of both to compare with observations in Anand and Kheda. It is likely that there are several other landscapes in south Asia that are equally or perhaps more important for Glossy Ibis populations, and surveys to cover additional agricultural landscapes are essential.

Distribution maps and use of grids with different wetland extents showed clear scale-dependent use of the landscape by Glossy Ibis. They largely used grids with intermediate extents of wetlands (50-100, and 100-150 ha; Figures 3, 4). However, the grids with the highest wetland extents were most important during summers suggesting that agricultural areas with large wetlands are crucial for Glossy Ibis to survive the dry season. The extensive network of canals and the presence of several perennial reservoirs undoubtedly aided retaining the Glossy Ibis throughout the year in Anand and Kheda. It will be important to understand if and how Glossy Ibis persist throughout the year in other agricultural landscapes that have different amounts of artificial structures such as canals and reservoirs.

The importance of landscapes that are cultivated year-round with substantial human presence to sustain relatively high abundances of Glossy Ibis was not previously known. It is likely that wet crops and supporting structures such as canals and reservoirs favour Glossy Ibis, suggesting that this species is likely to do well in other areas where agriculture dominates the landscape. This is similar to the high conservation value that multi-cropped landscapes in several locations in India provide to other ibis species

such as the Black-headed Ibis *Threskiornis melanocephalus* (Sundar 2006; Chaudhary and Koli 2018). Breeding locations and ecology of Glossy Ibis in south Asia is poorly documented. A concerted and robust effort to overcome this lacuna is necessary if a holistic status assessment of Glossy Ibis is to be had for this region.

#### Acknowledgements

We gratefully acknowledge the assistance of Arun Mani Dixit and the panchayat of Pariej village, especially their suggestion to hire Amit Makwana as the field associate for our long-term effort. Amit has been an invaluable asset in our work, and his multiple years of field work is gratefully acknowledged. We thank the International Crane Foundation and the Nature Conservation Foundation for various help and administrative support. A previous draft of the manuscript benefitted greatly from the comments of Simone Santoro.

#### REFERENCES

BirdLife International. 2016. Plegadis falcinellus. The IUCN Red List of Threatened Species 2016: e e.T22697422A86436401. http://dx.doi.org/10.2305/IUCN.UK.2016-

- 3.RLTS.T22697422A86436401.en, accessed 20 October 2017.
- Chaudhury, S. and V. K. Koli. 2018. Population status, habitat preference, and nesting characteristics of black-headed ibis Threskiornis melanocephalus Latham, 1790 in southern Rajasthan, India. *Journal of Asia-Pacific Biodiversity* 11: 223-228.
- Matheu, E., J. del Hoyo, G.M. Kirwan, E.F.J. Garcia and P. Boesman. 2018. Glossy Ibis (Plegadis falcinellus). In: del Hoyo, J., A. Elliott, J. Sargatal, D.A. Christie and E. de Juana (eds.). Handbook of the Birds of the World Alive. Lynx Edicions, Barcelona. (retrieved from https://www.hbw.com/node/52775 on 3 October 2018).
- Subramanya, S. 2005. Heronries of Tamil Nadu. Indian Birds 1(6): 126-140.
- Sundar, K. S. G. 2006. Flock size, density and habitat selection of four large waterbird species in an agricultural landscape in Uttar Pradesh, India: implications for management. *Waterbirds* 29: 365-374.
- Sundar, K. S. G. and S. Kittur. 2012. Methodological, temporal and spatial factors affecting modeled occupancy of resident birds in the perennially cultivated landscape of Uttar Pradesh, India. *Landscape Ecology* 27: 59-72.
- Sundar, K. S. G. and S. Kittur. 2013. Can wetlands maintained for human use also help conserve biodiversity? Landscape-scale patterns of bird use of wetlands in an agricultural landscape in north India. *Biological Conservation* 168: 49-56.
- Tiwari, J. K. and A. R. Rahmani. 1998. Large heronries in Kutch and the nesting of Glossy Ibis Plegadis falcinellus at Luna jheel, Kutch, Gujarat, India. Journal of the Bombay Natural *History Society* 95: 67-70.
- Toral, G. M., R. A. Stillman, S. Santoro and J.Figuerola. 2012. The importance of rice fields for glossy ibis (*Plegadis falcinellus*): Management recommendations derived from an individual-based model. *Biological Conservation* 148: 19-27.
- Venkatraman, C. 2009. Breeding of Glossy Ibis Plegadis falcinellus at Vedanthangal Waterbird Sanctuary, southern India. *Indian Birds* 5(1): 18-19.