IUCN SSC Stork, Ibis and Spoonbill Specialist Group

International Glossy Ibis Network

IUCN SSC Species Survival Commission

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**

ISBN 978-2-491451-01-1

IUCN SSC Stork, Ibis and Spoonbill Specialist Group

SIS CONSERVATION 1 (2019) 39–42

SPECIAL ISSUE: GLOSSY IBIS ECOLOGY & CONSERVATION

Ecology and Conservation of Glossy Ibis in Algeria: Synthesis and Perspectives

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ARTICLE INFO

Article history:
Received 02 October 2018
Received in revised form 03 October 2018
Accepted 03 October 2018

KEYWORDS

Glossy Ibis, conservation, ecology, North Africa, population dynamics, waterbirds, wetlands.

ABSTRACT

A review of ongoing projects focusing on the Glossy Ibis Plegadis falcinellus and carried out by the *Laboratoire de Conservation des Zones Humides* since 2002 is presented. A brief description of these projects (population counts, breeding ecology, foraging behaviour, niche partitioning, diet, dispersal, morphometric sexing, parasitology and conservation) and constraints hindering these efforts are provided and discussed. These projects have benefitted from a fruitful collaboration with Doñana Biological Station and it is expected that the recently created International Glossy Ibis Network may facilitate further collaboration that will ultimately help the conservation of the species across its breeding range.

Introduction

After an eclipse which lasted over a century, the Glossy Ibis *Plegadis falcinellus* has staged a remarkable return to Algeria (Belhadj et al. 2007; Boucheker et al. 2009), the rest of North Africa (Amezian et al. 2012; Nefla et al. 2012) and Western Europe (Brichetti 1986; Grussu 1987; Figuerola et al. 2004; Kayser et al. 2006) as a breeding species. The species is now mainly located in northeastern Algeria: The El Kala wetlands complex and environs in Eastern Numidia (Samraoui and Samraoui 2008) and Lake Fetzara and the Guerbes-Senhadja wetlands complex in Western Numidia (Samraoui and de Bélair 1997).

The Algerian population, like its counterparts across southern Europe (Santoro et al. 2010, 2013, 2016) is undergoing a rapid growth and is expanding. However, the reasons why the Glossy Ibis disappeared in the last century from its former haunts in the Western Mediterranean are still unclear although anthropogenic pressures involving loss of habitats and persecution are likely candidates (Santoro et al. 2010; Samraoui et al. 2011).

There is also no indication how it managed to stage a spectacular come-back. The unexpected return of the species offers a stimulating but formidable challenge to ornithologists to uncover the ecological determinants behind such a population upswing. At the turn of the 21st century and in the early stages of the recolonization process, the Laboratoire de Recherche des Zones Humides, University of Annaba, now known as the Laboratoire de Conservation des Zones Humides, University of Guelma, set up a long-term research project to investigate the population dynamics of the species. As early as 2008, the project benefitted from a close and fruitful collaboration with the laboratory of Dr. Jordi

Figuerola (Doñana Biological Station, Spain).

Study Area

Northeastern Algeria houses a large spectrum of wetlands (freshwater lakes, ponds, brackish marshes, lagoons and temporary pools) that owe their origin to a combination of climatological and lithological factors. The climate is humid to sub-humid whereas the landscape is made up of low-relief plains contrasting with numerous hills and mountains.
The El Kala National Park (PNEK) includes two freshwater lakes, Lake Tonga and Lake Oubeira, and a lagoon, Lake Mellah, which are all protected by the Ramsar Convention (Samraoui and Samraoui 2008). Further west, but still in Eastern Numidia, lay the vast Mekhada Marsh (15,000 ha). More wetlands are present in Western Numidia which houses Lake Fetzara, another vast brackish marsh, and the Guerbes-Senhadja wetlands complex (Samraoui and de Bélair 1997).

Figure 1. Location of the ringing stations of Glossy Ibis in Numidia (black circles), northeast Algeria (2008-2017)

Results: Ongoing projects

A brief description of current projects is provided as preliminary results of our research on the Glossy Ibis, highlighting progress but also constraints:

1. Population counts: Despite the difficulties (lack of manpower and resources to monitor such a vast region) we attempted to monitor population growth by means of winter and breeding pair counts. Although the species can also be found at El Goléa, in the Sahara, we only carry out regular surveys in Numidia, northeastern Algeria (Figure 1). For logistic reasons, surveys at El Goléa are irregularly undertaken. Preliminary analyses indicate a rapid population growth of the Glossy Ibis in northeastern Algeria.

Breeding ecology

In Numidia, the Glossy Ibis breeds in mixed heron colonies together with Purple Heron *Ardea purpurea*, Grey Heron *Ardea cinerea*, Western Cattle Egret *Ardea ibis*, Little Egret *Egretta garzetta*, Squacco Heron *Ardeola ralloides*, and Black-crowned Night Heron *Nycticorax nycticorax*. The reproductive ecology of the Glossy Ibis was studied between 2002 and 2012 (Boucheker *et al.* 2009). Egg-laying occurs from mid-April to the end of June. Mean clutch size for three combined years (2004, 2005 and 2007) was 3.7 ± 0.7 eggs (N = 49) (Boucheker *et al.* 2009). The study of the reproductive ecology of the Glossy Ibis was discontinued after it was found that breeding pairs exhibit extreme shyness (similar to Purple Heron *Ardea purpurea*) towards human intrusion. In a mixed heron breeding colony where competition for nest material is high, Glossy Ibis are the last to return to their nests, spending considerable time flying over the colony well after pairs of other species have resumed their incubation. Although the species appears to be extremely sensitive to human disturbance, it manages to breed in peri-urban sites like Chatt and Boussedra.

3. Foraging behaviour: A comparative study of the foraging behaviour of herons and ibis was undertaken in parallel with a study of their diet.
4. Niche partitioning: An investigation of nest-site selection and resource partitioning between Glossy Ibis and herons was carried out suggesting a high degree of overlap. However, the resource utilization suggests a pattern of resource segregation by coexisting nesting herons and ibis based on the timing of reproduction, nest height, prey types, prey size and foraging microhabitats (Samraoui *et al.* 2012; in prep.).
5. Diet: A study of the chicks' diet was carried out in the years 2004, 2005 and 2007. The analysis indicated that the diet was dominated by vertebrates (the frog *Rana saharica*) and invertebrates (dragonfly larvae, water beetles, and freshwater snails).

6. Dispersal: Starting in 2008, a ringing program was initiated with rings provided by the Doñana Biological Station. This program, still ongoing, has been running uninterrupted over the last ten years (2008-2017) and a total of 1027 chicks have been ringed (Table 1). A monitoring program of ringed birds has been active throughout this period providing data that shed light on dispersal of native and foreign birds.

Table 1. Number of Darvic rings fitted to Glossy Ibis chicks between 2008 and 2017 in northeastern Algeria

Year/Sites	Chatt	Dakhla	Fetzara	Tonga	Boussedra	Estah	Total
2008	41	0	26	4	0	0	71
2009	0	58	0	0	0	0	58
2010	96	0	156	0	0	0	252
2011	0	55	0	0	0	0	55
2012	0	103	9	0	0	0	112
2013	74	0	0	0	0	0	74
2014	0	61	0	0	0	0	61
2015	0	66	42	0	0	0	108
2016	9	0	0	0	115	29	153
2017	83	0	0	0	0	0	83
Total	303	343	233	4	115	29	1027

7. Morphometric sexing: We have relied on molecular techniques carried out at the Doñana Biological Station to sex ringed chicks. However, these methods are time-consuming and costly (Childress *et al.* 2005). Two Discriminant Function Analyses (DFA) were developed for Glossy Ibis chicks born in Doñana (Figuerola *et al.* 2006) indicating substantial predictive value for tarsus length (or tarsus width) and, to a lesser extent, wing length. However, the validity of these two functions outside of Spain has not yet been verified. We have initiated a project to (1) identify which morphometric covariates help to predict the sex of Glossy Ibis chicks, (2) ascertain whether there is geographical variation in the morphology of Glossy Ibis, and (3) evaluate different classification methods that best achieve the first two objectives.

8. Parasitology: In order to explore the impact of parasites on population dynamics and survival, we investigated the taxonomical diversity and spatial distribution of ectoparasites of Glossy Ibis chicks. The following chewing lice (*Phthiraptera: Amblycera, Ischnocera*) were recorded: *Plegadiphilus plegadis, Colpocephalum leptopygos, Ardeicola rhaphidius* and *Ibidoecus bisignatus*. In addition, one tick, *Ixodes ricinus* was also recorded (Touati *et al.* 2015).

9. Conservation: Although the species is formally protected, its future is far from secure as its habitats are under severe anthropogenic pressures. An unexpected side-effect of the ringing program was the discovery that the Glossy Ibis is a victim of illegal hunting. Many rings were recovered from poachers and one of the rings was even handed out with an incrusted shotgun pellet. The identification of current pressures as well as a good understanding of the species' ecological requirements and population dynamics at the metapopulation level will undoubtedly help to develop efficient management tools.

Conclusions

This was a concise review of ongoing and published research being carried out at the *Laboratoire de Conservation des Zones Humides*, University of Guelma in collaboration with the Doñana Biological Station. Conservation has much to gain from the study of a species that had exhibited a dramatic reversal in its population growth. However, the species still faces increasing anthropogenic pressures over much of its North African range where its habitats are shrinking. It is expected that global warming will exacerbate this looming threat as drought becomes more frequent. The species has shown fast responses to past environmental changes (Santoro *et al.* 2016) and it may prove a fitting biological model to monitor how species may respond to current global changes. Another constraint is the lack of funding that limits severely both the quality and the range of research that can be carried out. This is where a vigorous International and well-established Glossy Ibis Network can mitigate such drawbacks and offers new avenues of fruitful collaboration.

Acknowledgements

We thank the Algerian Ministère de l'Enseignement Supérieur et de la Recherche Scientifique (M.E.S.R.S.) for material support.

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