Zoology and Ecology, 2019, Volumen 29, Issue 1
Print ISSN: 2165-8005
Online ISSN: 2165-8013
https://doi.org/10.35513/21658005.2019.1.10

BREEDING OF THE GULL-BILLED TERN IN THE SAHARA AND AN UPDATE ON ITS DISTRIBUTION IN ALGERIA

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Article history
Received: 2 July 2018;
accepted: 3 January 2019

Keywords:
Algeria; breeding; El Goléa; Gull-billed Tern; predation; Sahara; water birds

Abstract. The breeding distribution of the Gull-billed Tern *Gelochelidon nilotica* in Algeria is poorly known as the species is mainly associated with highly unstable habitats. We conducted a survey of the distribution of the species across all major Algerian wetlands and monitored a breeding colony at El Goléa during 2009. The species is usually described as a passage migrant in the Sahara, but its status may have to be reconsidered following our discovery of a small colony nesting on an islet in Sebkhet El Maleh, El Goléa. The colony consisted of 25 birds which built nine nests and foraged exclusively in and around the salt lake. Laying of eggs began in mid-April, in synchrony with high temperatures and strong evaporation. Clutches varied between 1 and 3 eggs but none was successful. The gradual drop in water level and subsequent drying of the Sebkha coincided with the first hatchings, exposing the first hatchlings to mammalian predation arising from the intrusion of jackals *Canis aureus*, which entirely destroyed the colony.

INTRODUCTION

Due to its cosmopolitan distribution, the Gull-billed Tern *Gelochelidon nilotica* has a LC (least concern) global status (BirdLife International 2017) (Figure 1). However, despite relative stability of the Western Mediterranean colonies, the species exhibits a pronounced decline in the Western Palaearctic which, combined with the disappearance of some European colonies (Møller 1975; Sanchez et al. 2004), is a source of legitimate concern.

Figure 1. A flying adult of Gull-billed Tern at El Goléa.

The Gull-billed Tern's wintering areas are located in tropical Africa, but the species breeds regularly in the northern regions of the Western Palaearctic (Cramp 1985). Its diet is varied and is composed mainly of insects, crustaceans, fish, amphibians, some reptiles, small mammals and, sometimes, eggs (Costa 1986; Bogliani et al. 1990; Sanchez, Muñoz del Viejo, and De La Cruz1991; Biber 1993; Dies, Marín, and Pérez 2005; Radi et al. 2011; Aourir, Radi, and Znari 2013). This diet plasticity facilitates the species' establishment in various wetlands. Indeed, the Gull-billed Tern occupies temporary areas (salt lakes, salines, halophilic steppes) or unstable (islets in reservoirs) habitats particularly vulnerable to anthropogenic impact (Møller 1975; Reichholf 1989). Climate fluctuations and habitat degradation, particularly its feeding sites, are at the source of the marked decline of the Gull-billed Tern in Europe and Africa (Møller 1982; Biber 1993; Sanchez et al. 2004).

In Algeria, the Gull-billed Tern was recorded by Heim de Balsac and Mayaud (1962) as a common breeder in the 19th century on Lake Fetzara and on two other lakes around Constantine. In the 20th century, the species was recorded breeding on Lake Boughzoul (François 1975; Jacob and Jacob 1980) and several attempts were noted across the country (Ledant et al. 1981; Isenmann and Moali 2000).

Figure 2. Two views of the salt lake of El Goléa (a, b).

MATERIALS AND METHODS

The salt lake of El Goléa, Sebkhet El Maleh (Figure 2a, b), is located near the transition area between the Northern Algerian Sahara and the Central Sahara (30°28'09 N, 2°55'32 E). It extends over an area of 1800 ha and borders the north-east of the great Western Erg limit (Figure 3). The study area is characterized by an arid Saharan climate with mild winters, sparse rainfall not exceeding 47.3 mm, and an annual average temperature of 22.5°C. The prevailing south-westerly winds are generally loaded with sand.

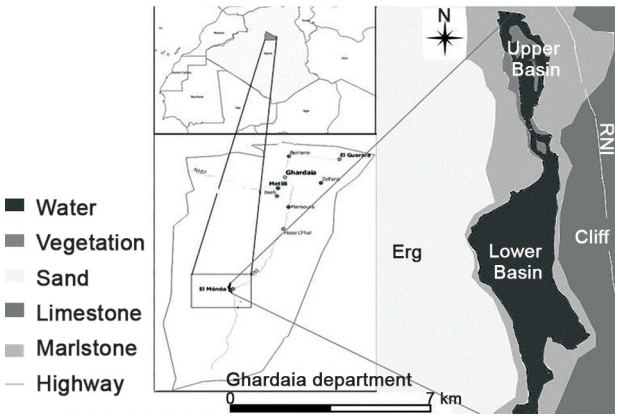

Figure 3. Location map of the study area: Sebkhet El Maleh, El Goléa.

The study wetland is divided into two parts: a northern upper area characterized by an abundance of vegetation and fresh to brackish water, and a southern lower and hypersaline area almost devoid of vegetation with the exception of a few *Tamarix* on scattered islets. The monitoring of the breeding of the Gull-billed Tern was conducted every three days. Measurements of the eggs' size were carried out using Vernier callipers (± 0.1 mm) and a portable scale (± 0.1 g). The distances between nearest nests and nest-to-water were performed using a measuring tape.

RESULTS

Our study spanned a period of nine years (2002–2010) and included surveys of one hundred Algerian wetlands (Samraoui and Samraoui 2008; Samraoui et al. 2011). We found the Gull-billed Tern breeding at four sites (Lake Fetzara, Guelif, Tinsilt, and El Goléa) (Figures 4–6). In addition to recent breeding sites, we also re-

corded the species aestivating at several other sites in the coastal zone (Salines, Mekhada, Oubeira, Oum El Ghellez) and the Hauts Plateaux (Ezzemoul, Jemot, Tazougart II, Timerganine, Lake Boughzoul, and Dayet El Ferd) (Figure 7).

In 2009, the Gull-billed Tern nested in the southern part of the lake of El Goléa together with several species of birds breeding in the same lake (Greater Flamingo *Phenicopterus roseus*) (Bouzid et al. 2009), Black-winged Stilt *Himantopus himantopus*, Avocet *Recurvirostra avosetta*, *Kentish* Plover *Charadrius alexandrinus*) or in the northern part of the lake and its surroundings (Coot *Fulica atra*, Ruddy Shelduck *Tadorna ferruginea*, Ferruginous Duck *Aythya nyroca*, and Marbled Teal *Marmaronetta angustirostris*). In 2005, in an islet of Guelif, a salt lake located in the eastern Hauts Plateaux, the species also nested in the company of Black-winged Stilt, Avocet, *Kentish* Plover, and an important colony of Slender-billed Gull *Larus genei* (Baaloudj et al. 2018).

Figure 4. Nest of Gull-billed Tern at Guelif (Haut Plateaux) with a decapitated head of an adult (a). Hatching eggs and chicks at the same colony (b, c).

At El Goléa, we noted nine nests of the Gull-billed Tern located on an islet in the southern part of the lake, holding an overall total of 19 eggs. Nests were shallow scrapes and crevices at ground level adorned with *Tamaris* leaves and some feathers (Figure 6a, b). The average inter-nest distance was 1.64 ± 0.62 m (N = 7) while the average nest-edge to water was 9.4 ± 2.7 m (N = 7). The average nearest nest distance was particularly small and it differed significantly from cited values (Borodulina in Møller 1981) (one sample *t*-test: $t = 6.9$, df = 6, $p = 0.0004$).

Laying began during April coinciding with the beginning of the hot season prompting drying of a large part of the salt lake. The clutch size was variable, ranging from one to three eggs (Figure 2 c), with an average value of 2.11 ± 0.93 (N = 9). Egg length and width were 47.43 ± 2.19 mm and 34.66 ± 1.06 mm, respectively. The weight of individual eggs varied between 20.3 and 32.2 g (Table 1). The egg size at the El Goléa colony was clearly lower than that described from Europe (Cramp 1985), particularly the length and the weight: one sample *t*-test: $t = -5.5$, df = 18, $p = 3e\text{-}05$ (weight); $t = -3.1$, df = 18, $p < 0.006$ (length); $t = -1.4$, df = 18, $p = 0.18$ (width). The first hatchings were observed during the first half of May, but, unfortunately, the partial drying out of the lake led to incursion of the Golden Jackal *Canis aureus* and the subsequent depredation of the colony of Gull-billed

Figure 5. Gull-billed Terns on the nesting site at El Goléa.

Table 1. Egg dimensions of Gull-billed Tern recorded in this and other studies.

	Weight (g)	Length (mm)	Width (mm)	N
This study	27.5 ± 3.6 (20.3–32.2)	47.4 ± 2.2 (42.8–51.6)	34.7 ± 1.1 (32.4–36.1)	19
Cramp (1985)	32.0	49.0 (45.0–66.0)	35.0 (32.0–40.0)	200
Ataei et al. (2014)	30.0 ± 3.1 (17.0–48.0)	47.8 ± 2.8 (36.9–58.3)	34.5 ± 2.7 (29.7–36.6)	138
Radi et al. (2004)	NA	48.3 ± 1.96 (42.8–58.8)	33.9 ± 1.03 (31.0–36.8)	190

Figure 6. Nests of Gull-billed Tern at El Goléa containing one egg (a) and two eggs (b), respectively.

Tern. The same incursion also led to the desertion of the adjacent colony of Greater Flamingo (Bouzid et al. 2009).

DISCUSSION

Nowadays, the Gull-billed Tern breeds in the coastal zone (Lake Fetzara), the Highlands (Guelif and Tinsilt), and Sahara (El Goléa). Without evidence of nesting, it aestivates at many other sites like Lake Boughzoul where it has bred successfully in the past (François 1975; Jacob and Jacob 1980). The vast majority of breeding or aestivation sites are brackish (Lake Fetzara) or hypersaline (all other sites) lakes, which highlights the importance of the conservation of such highly vulnerable wetlands in North Africa (Béchet and Samraoui 2010).

Elsewhere in the Maghreb, the species is also recorded as a breeding species in Libya (Isenmann et al. 2016; Chokri et al. 2010), Tunisia (Isenmann et al. 2005), Morocco (Thévenot, Vernon, and Bergier 2003; Radi et al. 2004; Aourir, Radi, and Znari 2013) and Mauritania (Isenmann et al. 2010).

The laying date begins relatively early at El Goléa, in the first half of April, while laying in Europe varies from the end of April to the beginning of July (Møller 1981; Cramp 1985). In Tunisia and Morocco, the onset of

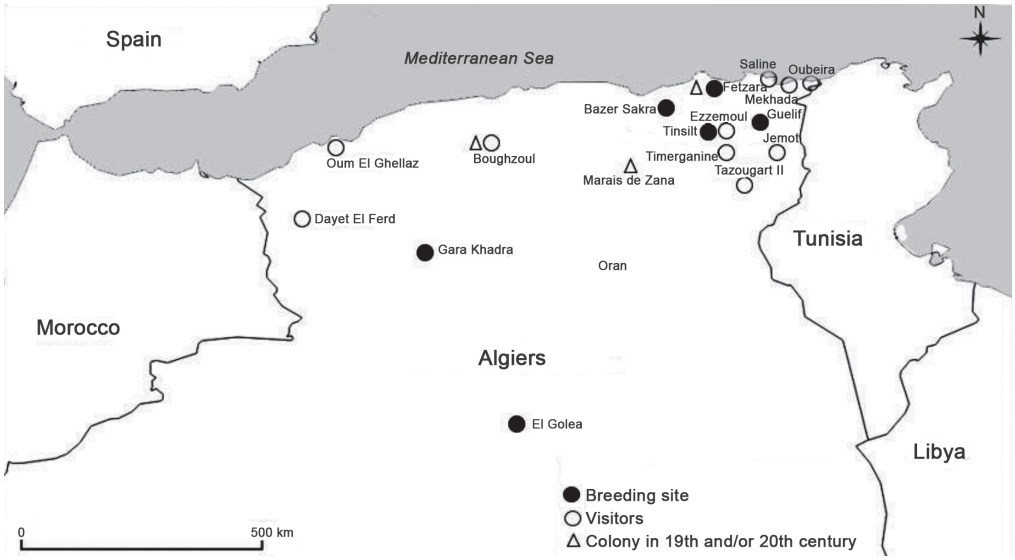

Figure 7. Distribution map of breeding and non-breeding sites of Gull-billed Tern in Algeria.

Table 2. Distance to nearest nest and minimum nest-water edge distance of Gull billed Tern recorded in this and other studies.

	Nearest-neighbour nest (m)	Nest-water edge (m)	N
This study	1.6 ± 0.6 (0.9–2.7)	9.4 ± 2.7 (6.0–12.0)	7
Møller (1981)	22.4 ± 14.3 (2.0–92.0)	NA	37
Radi et al. (2004): C1	4.03 (1.00–10.0)	NA	40
Radi et al. (2004): C2	2.95 (0.90–8.0)	NA	38

laying is also late: the end of April and the beginning of May, respectively (Radi et al. 2004; Chokri et al. 2010). The effect of latitude/temperature cannot account for this delay and it is noteworthy that Møller (1981) indicates that small colonies begin laying significantly later than large colonies. Another peculiarity of small-sized colonies is that they show a reduced nearest neighbour nest distance (Møller 1981).

Contrary to clutch sizes recorded in Europe (Cramp 1985; Sanchez and Fasola 2002), laying of 4–6 eggs was not noted in the Maghreb (Radi et al. 2004; Chokri et al. 2010; present study). The mean clutch size of the El Goléa colony (2.1) is lower than that measured in Tunisia (2.2–2.6) (Chokri et al. 2010), in Morocco (2.4) (Radi et al. 2004) or in Europe (2.4–3.0) (Cramp 1985). However, Møller (1981) reported a marked variability of clutch size (1.2–3.0) in Denmark, at the northern limit of the species' range. The same author also reported that the average clutch size is positively correlated to the size of the colony.

The breeding success of the Gull-billed Tern in the Maghreb seems to display large fluctuations. Contrary to Morocco where the success rate is substantial (74.7%), the Tunisian colonies had low success rates (0.14–0.25 chicks/pair) due to excessive disturbance and predation (Chokri et al. 2010). If disturbance is relatively low at El Goléa, heat waves are relatively frequent from the mid-April, provoking high evaporation rates and considerably lowering the water level of the lake. These heat surges prompt more frequent irrigation of riparian agricultural plots and drastically curtail the water inflow to the lake.

Because the Gull-billed Tern is intimately associated with unstable habitats, their eggs and broods are vulnerable to the rapid fluctuations of water levels which may either rise and flood the islets or decrease and allow intrusion of mammalian predators (Biber 1993; Sanchez et al. 2004). The instability of the breeding habitats of the Gull-billed Tern is a major constraint which probably limits its population.

In contrast, trophic resources seem amply sufficient: Lake El Goléa, and in particular its lower part, presents a very high concentration of salt estimated at 290 g/l of NaCl (Hacène et al. 2004), which favours the development and proliferation of halophilic organisms represented mainly by the Fairy Shrimp *Artemia salina*. In addition, locusts and beetles abound in the riparian zone (Samraoui, Chakri, and Samraoui 2006; Bouzid et al. 2009). This abundant food also includes rodents and reptiles, found mainly in the dunes around the lake.

The colonies of water birds nesting in the Algerian salt lakes are subject to relatively frequent attacks by numerous predators (mammals and birds) (Bouzid et al. 2009; Samraoui et al. 2010). Some ground predators like jackals or stray dogs can invade a colony when a drought allows connectivity between the islets and the bank of the lake (Sanchez and Rodríguez 1994). Although it is difficult in the short-term to control the populations of natural predators, it is relatively easier and more urgent to regulate the hydrological changes (reservoirs, uncontrolled irrigation, etc.) which influence the water level of salt lakes and limit the populations of stray dogs in the neighbourhood of breeding colonies.

ACKNOWLEDGEMENTS

We thank two reviewers for their constructive comments that improved the manuscript.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

FUNDING

This work was supported by the Algerian Ministère de l'Enseignement Supérieur et de la Recherche Scientifique (MESRS).

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