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Migration flyway of the Mediterranean breeding Lesser Crested Tern *Thalasseus bengalensis emigratus*

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The Lesser Crested Tern *Thalasseus bengalensis emigratus* breeding population in the Mediterranean is found exclusively in Libya, on the two coastal islands of Gara and Elba and one wetland on the mainland coast at Benghazi. In order to improve knowledge of the species migration to wintering quarters in West Africa, a ringing programme was conducted from 2006–2008 and 2009–2012. From a total of 1 354 nestlings ringed using metal and/or colour rings, 64 were recovered along their flyway and in their wintering range, representing 6.9% of birds ringed with both colour and metal rings. This provided the opportunity to collect information on post-natal movements (staging and wintering ranges), breeding philopatry and recruitment, in addition to a preliminary estimate of their migration journey duration. This paper indicates sighting and recovery distributions in space and time, highlighting the important areas for the species during its journey between breeding and wintering sites. The findings indicate that several areas where ringed terns stop-over during pre- and post-breeding migration journeys are not protected, causing an additional threat to their survival, as some wintering areas are also not protected. Conservation of this highly localised and threatened population needs not only to address protection at breeding sites but also at migratory stop-overs and wintering strongholds.

Voies migratoires de la Sterne voyageuse *Thalasseus bengalensis emigratus*, espèce se reproduisant en Méditerranée

La population nicheuse de la Sterne voyageuse (*Thalasseus bengalensis emigratus*) en Méditerranée se trouve exclusivement en Libye, sur les îles côtières de Gara et Elba ainsi que dans une unique zone humide de ses côtes, à Benghazi. Afin d'améliorer notre connaissance de la migration de cette espèce vers leurs territoires hivernaux en Afrique de l'ouest un programme de baguage a été mis en place de 2006 à 2012. A partir d'un total de 1354 couvées baguées à l'aide de bagues métalliques et/ou colorées, 64 ont été retrouvées le long de leur voie migratoire ou sur leur aire d'hivernage, soit 6,9 % des oiseaux tous types de baguage confondus. Ceci a fourni l'opportunité de collecter des données sur leurs déplacements post-nataux (haltes migratoires et aires d'hivernage), leurs philopatrie et recrutement reproductifs, et d'obtenir une estimation préliminaire de la durée de leur voyage migratoire. Cet article spécifie la répartition dans le temps et l'espace des observations et des récupérations, mettant en évidence les zones importantes pour l'espèce lors de son voyage entre ses sites de reproduction et d'hivernage. Les résultats montrent que de nombreuses zones d'escale pré- et post-natales des Sternes baguées ne sont pas protégées. Certaines zones d'hivernage étant elles-mêmes non protégées, ce facteur constitue une menace additionnelle à leur survie. La conservation de cette population particulièrement localisée et menacée ne réclame pas seulement une protection des sites de reproduction mais également celle des escales migratoires et des sanctuaires d'hivernage.

Keywords: breeding, Lesser Crested Tern, Libya, migration, ringing, West Africa

Introduction

Mark and recapture techniques, with accurately recorded information within a ringing scheme, are a relatively common and low-cost method to understand population movement and dispersal ecology (Spina 1999). Bird

ringing has provided valuable information, not only through ring sightings of live birds and recoveries from dead ones, but also by determining the migration routes and patterns of several species (Wernham et al. 2002). Bird ringing can

also contribute to the monitoring of the population dynamics of a species (Balmer et al. 2008). It provides measures of survival, productivity and dispersal (Baillie 2001; Viana et al. 2013) and is a useful tool for behavioural studies (see review by Sharp 2009). Ringing is also a support tool for conservation actions and adaptive management (Nichols et al. 2007). The probability of encountering recoveries decreases when wintering areas are distant from breeding grounds (Shiomi et al. 2015), therefore long-term ringing campaigns and intensive ring monitoring at targeted areas are central to successful migration studies in such cases.

While avian biogeographical data for most North African countries are available, Libya in particular remains one of the least covered countries in terms of bird studies (Bundy 1976; Smart et al. 2006; Etayeb and Essghaier 2007; EGA-RAC/SPA-WCT 2012). The Lesser Crested Tern *Thalasseus bengalensis emigratus* has the smallest population size compared with the other two subspecies, *T.b. bengalensis* (Red Sea and East Africa) and *T.b. torresi* (Persian Gulf to South-east Asia and Australia). It is an endemic exclusive summer breeder to Libya and winters in West Africa (Hamza et al. 2012; Hamza 2014). This localised small-sized population was classified as Endangered under the Mediterranean Action Plan on Seabirds (UNEP-MAP-RAC/SPA 2003). The action plan calls for studies on ecology and movements of this subspecies being of high conservation relevance.

The ringing of young birds at the breeding sites has been conducted during 2006–2008 (Azafzaf et al. 2006; Hamza et al. 2007) followed by a second campaign in 2009–2012 (Hamza 2014). The present study aims to (1) improve our understanding of post-natal dispersal using ring sightings and field observations, (2) investigate initial recruitment age at breeding colonies and (3) identify the important staging and wintering sites based on sightings in North and West Africa.

Methods

Study sites

Two coastal islands of Gara and Elba and one wetland on the Benghazi coast are the main breeding sites for this tern population (Figure 1). Gara island is on the eastern side of the Gulf of Sirte at 30°48' N, 19°54' E, approximately 12 km off the coast near Ajdabiyah, and has a total area of 4.5 ha and is 7 m above sea level. Elba island is a small, low-lying island situated in the Gulf of Bumbah, 32°14' N, 23°17' E (20 ha; Meininger et al. 1994). The third breeding site is located inshore at the northern section of Sebket Jeliana, Benghazi (a 30 ha permanently flooded salt-marsh), on the islet of Jeliana (32°05' N, 20°03' E; 35 m²).

Metal rings were donated by BirdLife Malta and colour rings were provided by the Italian Institute for Environmental Protection and Research (ISPRA). Chicks were herded into a corral set up with a soft plastic mesh about 1 m high, and at least 15 m away from the colony site. Only chicks of 10 d and older were ringed, as their tarsi are then almost similar in size to those of the adult bird, permitting ringing without causing injury (Figure 2). Ringing was conducted either during the early hours of the morning or in the late afternoon, to avoid heat stress on both the

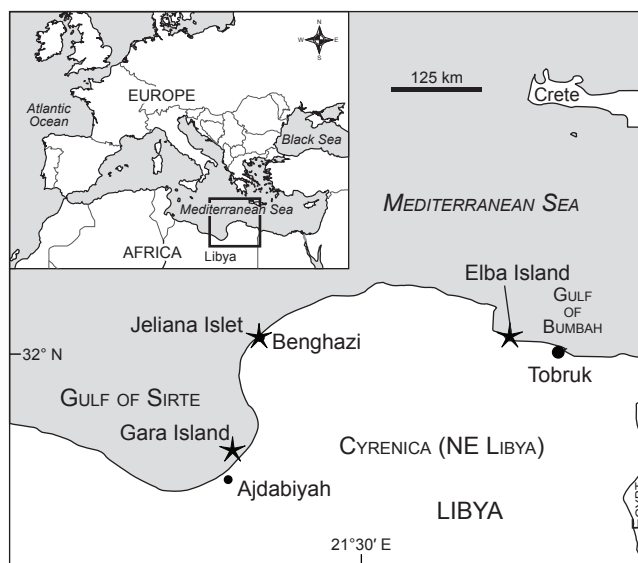


Figure 1: Map of the breeding sites of Lesser Crested Tern *Thalasseus bengalensis emigratus* in Libya

chicks and incubated clutches; in addition, the overall stay at the colony was kept to a minimum to avoid disturbance, following the published protocol (RAC/SPA-UNEP-MAP 2014). Both colour and metal rings had the following dimensions: inner diameter 5.5 mm, length 15 mm; colour rings (white, black or blue) were engraved with 2–3 digits (numbers and 15 alphabet letters, e.g. AA or A01). All data on ringing were uploaded regularly to the European colour ringing database (<http://www.cr-birding.org/node/1042>). No ringing was conducted at Jeliana in 2010 due to colony failure caused by water inundation and predation of all eggs/chicks by stray dogs roaming in the area. It was not possible to visit the breeding sites in 2011 due to security concerns related to the 2011 Libyan uprising, and it was not possible to visit Gara island in 2012, again for security concerns (Table 1).

During the fledging period (mid-August to early September), field visits were made to coastal wetlands, rocks/islets and islands located to the west and the east of the breeding sites to monitor the migration pattern in terms of bird numbers and flock structure at some of the staging sites within Libya. Ringed tern observations in staging and wintering areas were provided by birdwatchers to a central database located at ISPRA-Italy.

Results

Ringing totals and recoveries

A total of 1 352 young terns were ringed at their colonies between the 2006 and 2012 breeding seasons. Most of the ringing effort occurred at Gara island (72.85%), being the largest colony with a population size of more than 2 000 breeding pairs, whereas 19.9% and 7.25% of rings were used at the Jeliana and Elba colonies, respectively (Table 1). Ringed birds represented 20–60% of the crèche size present in each season at both Gara and Jeliana colonies, while at Elba all young birds were ringed. A total of 64 ringed terns



Figure 2: (a) Lesser Crested Tern *Thalasseus bengalensis* at Gara island, Libya. (b) Adult in breeding plumage with one week nestling. (c) Nestlings gathered in a collar for ringing operation

Table 1: Numbers of ringed Lesser Crested Terns at breeding sites in Libya from 2006 to 2012

Breeding site	Ringing season						Total	%
	First ringing phase			Second ringing phase				
	2006	2007	2008	2009	2010	2012		
Gara	61*	425*	204	48	247	0	985	72.85
Jeliana	0	0	66	4	0	199	269	19.9
Elba	9*	25	18	25	8	13	98	7.25
Total	70	450	288	77	255	212	1 352	100

* Birds were ringed only with metal rings

have been reobserved/recovered (Table 2) representing 4.73% of total ringed birds with metal and colour rings ($n = 1\ 352$) and 7.47% of the colour-ringed Lesser Crested Terns ($n = 857$) in the present study (Table 2).

Post-natal movements (staging areas)

The present study confirmed that fledging occurs during late July for Jeliana and during late August to early September at Elba and Gara. Juveniles continue to depend on their parents for feeding during their first months. Nine recoveries were juveniles accompanying their parents, six from Gara and three from the Jeliana colony. For example, one bird ringed at Gara in 2008 has been sighted in Ceuta, Spain after one month and 27 d of its ringing date. An additional two chicks from Gara were resighted at Almadraba beach, Spain within 47 d and 58 d after being ringed in Libya. They roost on small islets and in estuaries and coastal wetlands

Table 2: Total recoveries of Lesser Crested Tern by country

Country	Recoveries		Comments
	Number	%	
Libya	21	32.8	11 new recruits at breeding sites
Guinea-Bissau	14	21.9	Wintering area
Gambia	10	15.6	Wintering area
Spain	9	14.1	Staging area
Senegal	5	7.80	Wintering area
Morocco	3	4.70	Staging area
Guinea	1	1.60	Wintering area
Sierra Leone	1	1.60	Wintering area
Total	64	100	

during migration to and from wintering areas in West Africa between Senegal, Gambia, Guinea-Bissau and Sierra Leone. One bird was reported by a fisherman in Tripoli harbour 144 d since its ringing date on 4 August at Gara island (Figure 3).

The first part of the migration was monitored at several sites along the Libyan coastline. For example, a small group of 3–5 birds was seen in late August 2009 for two days at Al-Ghbeba beach, west of Sirte. An additional 18 birds were seen earlier on 15 August 2009 roosting with Little Terns *Sterna albifrons* and feeding their young on small rocky islets off the coast of Sabratah town (80 km west of Tripoli). The post-natal dispersal is unsynchronised, with some birds leaving the breeding sites much earlier than others.

Post-natal movements (wintering range)

Within Libya wintering records ranged from three to 15 individuals, reported during the mid-winter waterbird census between 2007 and 2011. The most distant dispersal recorded for a newly fledged Lesser Crested Tern was reported from the Turtle Islands, Sierra Leone, having travelled some 6 700 km within 149 d after being ringed in Libya (average 45 km d⁻¹). Six of the 46 sighted birds were observed in Dakar (2), N'Gor Island in Senegal (2) and two at the Tanji Bird Reserve in Gambia.

Some birds were sighted more than once after being ringed at their natal sites. For instance, an individual was sighted in October 2013 after three years and two months of ringing at Garain Melilla, southern Spain, then again in January 2014 at Catabao Segundo, Guinea-Bissau. The same bird was resighted in October 2014, exactly a year later, showing the same pattern in stopping at the same site each year on the way from breeding to wintering areas.

Another individual was ringed initially in 2007 at Elba island, and was first resighted after almost five years (July 2012) in a different breeding site of Jeliana, Libya, and then was resighted in Massa estuary, Morocco, in April 2013.

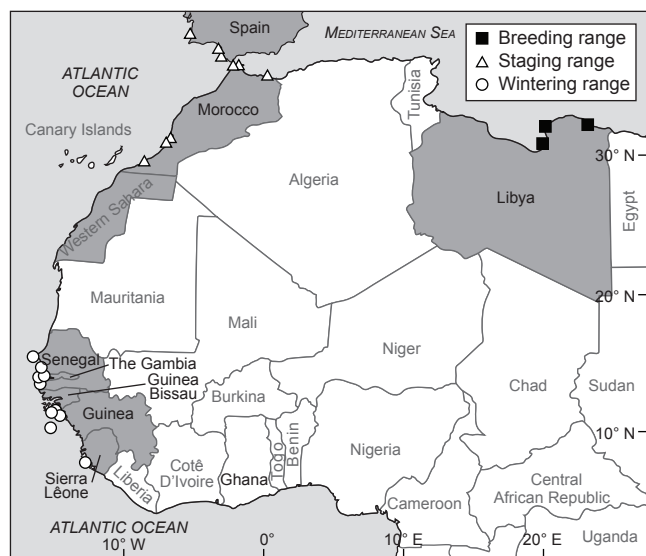


Figure 3: Map of the breeding, staging and wintering ranges for Lesser Crested Tern *Thalasseus bengalensis emigratus*

These records confirm the regular migratory pattern of Lesser Crested Tern along the north-west African coastline between breeding and wintering zones.

Site fidelity and recruitment

During the 2011 season, one ringed Lesser Crested Tern was observed in flight and bred at Elba island where it had been ringed in August 2007. In 2012 three additional ringed terns were observed breeding at Elba. One adult bird had a blue ring (ringed in 2009), whereas the other two birds had white rings (ringed in 2010). These latter two were the youngest birds to return to a breeding site during this study. At Jeliana, 11 ringed adults were breeding in the 2012 season, eight of which were ringed at the same site in August 2008, one was ringed in Jeliana in the 2009 season, and the other two were a ringed bird from Gara island (ringed in August 2008) and a ringed bird from Elba in August 2007; these latter two records clearly demonstrate inter-colony movements of this species.

Discussion

Ring sightings and recoveries of Lesser Crested Terns in the present study showed that several sites along the north and north-west African coast are used as staging sites during the migration to and from the breeding sites. Some juveniles spent their first winter with their parents, at some sites along the north and north-west African coast in what is known as the 'nomadic period' during the first year (Barlow 1998) without wintering in West Africa as do most post-breeding migrant terns. In contrast, West Africa is the final wintering destination for this population, as there are no data available on *T.b. emigratus* dispersal to the eastern Mediterranean basin or the Red Sea, despite some limited observations on the Egyptian Mediterranean coastline (Goodman and Meininger 1989). The latter could have been foraging or non-breeding individuals from the nominate subspecies *T. b. bengalensis* that breeds in the Red Sea.

Some important staging sites were identified by the present study: the Strait of Gibraltar (five sightings within 1–2 months after ringing) is a migratory must pass point for this species and many other bird species (Hashmi 2000; Paracuellos and Jerez 2003).

Lesser Crested Terns are generally rare on the Iberian Peninsula. However, a few individuals have been detected around Cadiz, the Doñana National Park, Montijo and La Jara beaches (at the mouth of the Guadalquivir River), Salinas de la Tapa (El Puerto de Santa María) and Odiel marshes (Huelva), associating with Sandwich Tern *Thalasseus andvicensis* and Common Tern *Sterna hirundo* (C Gutiérrez, SEO/BirdLife, pers. comm.). During this study four ringed birds were reported from there.

The present study has also identified areas that still require more monitoring effort, particularly in northern Tunisia and Algeria, during onward and outward migrations (Isenmann et al. 2005). The species is a passage migrant in Morocco (Thévenot et al. 2003) and several sites on the Moroccan side of the Strait of Gibraltar and on the Atlantic coastline are frequent sighting areas during both passages from and to wintering areas in West Africa. In Mauritania the Banc d'Arguin National Park is an important hotspot

(Isenmann et al. 2010). The peninsula of Nouadhibou to the north of the country represents the northern limit of the wintering range. Similarly, Senegal hosts large concentrations of Lesser Crested Terns. Over 825 birds were counted from 3 to 16 October 2005 at N'Gor, with a daily average of 59 birds (Holmström et al. 2005). The Tanji Bird Reserve and Barra Ferry Terminal on the Gambia River are also sites where the species has been frequently reported by several birdwatchers (Skov and Jensen 2002). Senegal and The Gambia are at the centre of the wintering range for the species and more monitoring is essential to understand where the species is concentrated and what conservation measures need to be in place (Schricke et al. 2001).

Guinea-Bissau hosts an important number of wintering Lesser Crested Terns. A total of 400 individuals were counted along the coast and the total number of wintering individuals was estimated at 600–1 000 (Meininger 1988). However, no updated information is available on the species in this country.

More monitoring is necessary to determine the wintering southern distribution of the species. In the Sierra Leone Western Area National Park, several Lesser Crested Terns were recorded in December 2008, associated with other tern species, such as the Royal Tern *Thalasseus maximus* (Valentine 2008). In the present study one ring recovery was from Turtle Islands in Sierra Leone. This site is the southernmost wintering site known (Gatter 1988), and although some isolated observations of small number of wintering individuals are mentioned for Ghana (Grimes 1987) and Nigeria (Meininger 1988), no recent data are available on these two countries.

Eleven out of 15 individuals previously ringed at Jeliana in 2007–2008 had returned to their natal site to breed in 2012. Site fidelity is a common feature in several gull and tern species (see review by McNicholl 1975; Coulson 2001) to increase breeding success (Greenwood and Harvey 1982) and reduce the cost of prospecting for a new breeding site (Naves et al. 2006). Inter-colony movements were observed at Jeliana in 2012, which has been reported in several tern species, e.g. Sooty Terns *Sterna fuscata* in the Seychelles (Feare and Lesperance 2002) and nominate Swift Terns *Thalasseus bergii bergii* (Crawford et al. 2002). The presence of individuals originating from a different site suggests that mate choice was made at either the wintering area or staging site(s) prior to arrival at the Libyan colony site.

The present study also accurately confirmed the breeding and migration phenology of this localised population. Threats to this species and other migratory seabirds/waterbirds on the flyway and in wintering ranges need to be addressed and conservation measures should be taken by different countries of this flyway. In addition, protection of breeding and feeding sites in Libya is also a priority for the maintenance of this limited population that faces the threat of extinction from the Mediterranean if appropriate steps are not taken in time.

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