

DISPERSAL OF YELLOW-LEGGED GULLS
LARUS MICHAHELLIS RINGED IN ALGERIA:
A PRELIMINARY ANALYSIS

DISPERSIÓN DE GAVIOTAS PATIAMARILLAS *LARUS MICHAHELLIS*
ANILLADAS EN ARGELIA: UN ANÁLISIS PRELIMINAR

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SUMMARY.—Ringing of yellow-legged gulls *Larus michahellis michahellis* begun in Algeria in 2009, the first scheme of its kind in North Africa. Ringing of chicks was initiated at Skikda and extended a year later to four other colonies located along the Algerian coast. Preliminary analysis of observations of ringed yellow-legged gulls from Algerian colonies indicates that juveniles dispersed in a north-westerly direction to the Balearic Sea and the Bay of Biscay, and westwards to the Alborán Sea and the Iberian Atlantic coast from Cádiz Bay to Galicia. Preliminary results suggested two distinct routes: gulls from the eastern Algerian colonies moved N/NW to eastern Spain and overland to the Bay of Biscay, a pattern of dispersal previously reported for birds from Spanish and French western Mediterranean colonies. Juveniles from western colonies seemed to move N/NW to the Alborán Sea and Cádiz Bay. In Spain, to where most dispersal occurred, the data suggests that Algerian gulls summered at coastal areas before returning to North Africa in late autumn and winter.

RESUMEN.—En 2009 iniciamos un programa de anillamiento de la gaviota patiamarilla *Larus michahellis michahellis*, el primer esquema de este tipo en el norte de África. El anillamiento de pollos comenzó en Skikda y se extendió un año más tarde a otras cuatro colonias a lo largo de la costa argelina. El análisis preliminar de las gaviotas anilladas en las colonias argelinas indica que los juveniles se dispersaron en dirección noroeste hacia el mar Balear y golfo de Vizcaya, y en dirección oeste hacia el mar de Alborán y la costa Atlántica oriental desde el golfo de Cádiz a las costas gallegas. Los resultados preliminares sugieren dos rutas diferentes: las gaviotas de las colonias del este de Argelia se desplazaron en dirección N/NO hacia el este de España y sobre tierra firme hacia el golfo de Vizcaya. Los juveniles de las colonias occidentales argelinas parecieron desplazarse N/NO hacia el mar de Alborán y el golfo de Cádiz. Los datos sugieren que en España, hacia donde tiene lugar la mayoría de la dispersión, las gaviotas ocupan áreas costeras utilizadas como refugios estivales antes de regresar al norte de África al final del otoño y en invierno.

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INTRODUCTION

The study of dispersal, the movement of individuals between populations, is of central importance in understanding the spatial distribution and genetic structure of populations (Greenwood and Harvey, 1982; Johnson and Gaines, 1990). The yellow-legged gull *Larus michahellis* is well known for its high disper-

sal capabilities (Isenmann, 1973). Yet, despite this dispersal propensity, molecular data indicate that some yellow-legged populations are genetically distinct, suggesting reduced gene flow between populations from the Atlantic coast and the Mediterranean Basin that is congruent with the wide variation of phenotypic and life history traits exhibited by the species (Pons *et al.*, 2004). The



FIG. 1.—Locations of the ringing colonies and of resighted individuals from each. Numbers are totals of ringed gulls observed. C, S, J, B and R represent Chetaïbi, Skikda, Jijel, Béjaïa and Rachgoun, respectively. Each bird is included only once, at the maximum distance travelled.

[Mapa de las colonias donde se realizaron los anillamientos con distribución de registros de pollos anillados. Los números indican el número de registros de gaviotas anilladas y las letras C, S, J, B y R la localización de las colonias Chetaïbi, Skikda, Jijel, Béjaïa y Rachgoun, respectivamente. Cada ave (distancia máxima recorrida) sólo se incluye una vez.]

yellow-legged gull was initially split into two subspecies: *Larus m. atlantis*, confined to the Macaronesian Archipelagoes, and *L. m. michahellis*. Subsequently, the latter taxon was further split into *L. m. lusitanicus*, which occupies the Atlantic Iberian coast, and *L. m. michahellis*, which breeds in the Mediterranean basin (Liebers *et al.*, 2001; Galarza *et al.*, 2008). The northern Mediterranean population is known to move between its colonies and the Atlantic coasts of France and Iberia (Isenmann, 1973; Yésou, 1985; Carrera *et al.*, 1993; Munilla, 1997; Martínez-Abraín *et al.*, 2002) but not much is known of the pattern of movements of yellow-legged gulls from North Africa. Studies of the movements of juvenile and immature yellow-legged gulls may shed light into the strategies adopted by the North African population in response to marked temporal and spatial and environmental changes induced by global changes. This work, part of a larger study aimed at monitoring the status and population dynamics of Algerian waterbirds (Samraoui and Samraoui, 2008; Samraoui *et al.*, 2011), describes the movements of immature yellow-legged gulls from the Algerian coast, focusing on the geographical distribution of resightings and the phenology of dispersal.

MATERIAL AND METHODS

Ringling of yellow-legged gull chicks started in 2009 at Srigina, Skikda (36° 56.254' N, 6° 53.184' E) and was extended during the following two years to other colonies across the Algerian coast: Kef Amor, Chetaïbi (37° 5.070' N, 7° 19.870' E), Aouana, Jijel (36° 47.110' N, 5° 36.466' E), Ile de Pisan, Béjaïa (36° 49.524' N, 4° 59.835' E) and Rachgoun, Aïn Temouchent (35° 19.301' N, 1° 28.808' W) (fig. 1). Each chick over 20 days old was ringed with a unique engraved PVC band allowing it to be individually recognised. The rings had a white (Srigina) or red (other

colonies) background with the following specific code: AX|XX where X is an alphanumeric character.

Resighting data on gulls observed alive outside their colonies were compiled from 19 July 2009 to 27 August 2011. Records were collected mainly by students and an international network of birdwatchers coordinated by EURING. The number of resightings represents the number of individual birds observed once or more after fledging. Resighting of rings in Algeria was carried out at a refuse tip near the town of Skikda which was visited weekly between October 2010 and February 2011. Only records of live birds were considered in our analysis in order to avoid possible biases, such as the drifting of corpses by currents. However, only one dead ringed bird was recorded outside the natal colonies. Allowance for some bias needs to be taken into account in drawing conclusions from the data as the apparent lack of records from some regions (e. g., the whole coast of North Africa) may be due to shortage of observers instead of gulls.

RESULTS

In total, 728 yellow-legged gull chicks were ringed during 2009-2011. Twenty-seven months after the start of the ringling programme, the total number of resightings of Algerian gulls amounted to 293 corresponding to 131 individuals (18% of the rings fitted). Most observations were made in Algeria and Spain (table 2) with a few from France and Portugal. The mean number of resightings for each recorded ring was 2.3 ± 1.6 (N = 104 rings) and 1.7 ± 1.1 (N = 33 rings) in Algeria and Europe, respectively. The number of resighted birds ranged from 3.1% (Béjaïa and Rachgoun) to 80.2% (Skikda), where most ringling and resighting effort occurred (table 1). When this bias in ring monitoring is corrected by

TABLE 1

Annual ringing totals, total numbers of resightings and resighting data for each Algerian colony. The overall percentage is based on resightings of individuals anywhere, whereas the European percentage is based on individuals recorded in Europe.

[*Año de anillamiento y números tanto de pollos de gaviota patiamarilla anillados como del total de registros de avistamientos, así como número de individuos reavistados, para cada colonia argelina. El porcentaje total está basado en avistamientos de anillas individuales registrados en cualquier sitio, mientras que el porcentaje europeo está basado en el registro de anillas individuales en Europa.*]

Year	Chetaïbi	Skikda	Jijel	Béjaïa	Rachgoun	Total
2009	0	101	0	0	0	101
2010	70	194	84	49	51	448
2011	0	76	62	41	0	179
Total	70	371	146	90	51	728
Percent	9.6	51	20.1	12.4	7	100
N° sightings	15	257	12	4	5	293
N° gulls sighted	8	105	10	4	4	131
Overall perc.	6.1	80.2	7.6	3.1	3.1	100
European perc.	8.8	50	20.6	8.8	11.8	100

TABLE 2

Total resightings of Algerian yellow-legged gulls in different countries and the numbers of individuals involved. Eight birds were seen both in Algeria and Europe. Two Italian-ringed birds recorded once in Algeria are excluded.

[*Número total de reavistamientos de gaviotas patiamarillas argelinas en diferentes países y número de individuos implicados. Ocho aves se controlaron tanto en Argelia como en Europa. No se incluyen dos aves italianas registradas una vez en Argelia.*]

	Algeria	France	Spain	Portugal	Total
Resightings	238	4	50	1	293
Individual birds	104	3	31	1	139 (131)

considering just the European records, the percentage of records varied from 8.8% (Béjaïa and Chetaïbi) to 50% (Skikda), reflecting the ringing effort closely ($\chi^2 = 15$, $df = 12$, $p = 0.2$).

The majority of the resightings (50) outside Algeria were from the Iberian Peninsula. French records were from the south-west of the country, close to the Atlantic shores, with the exception of two records involving

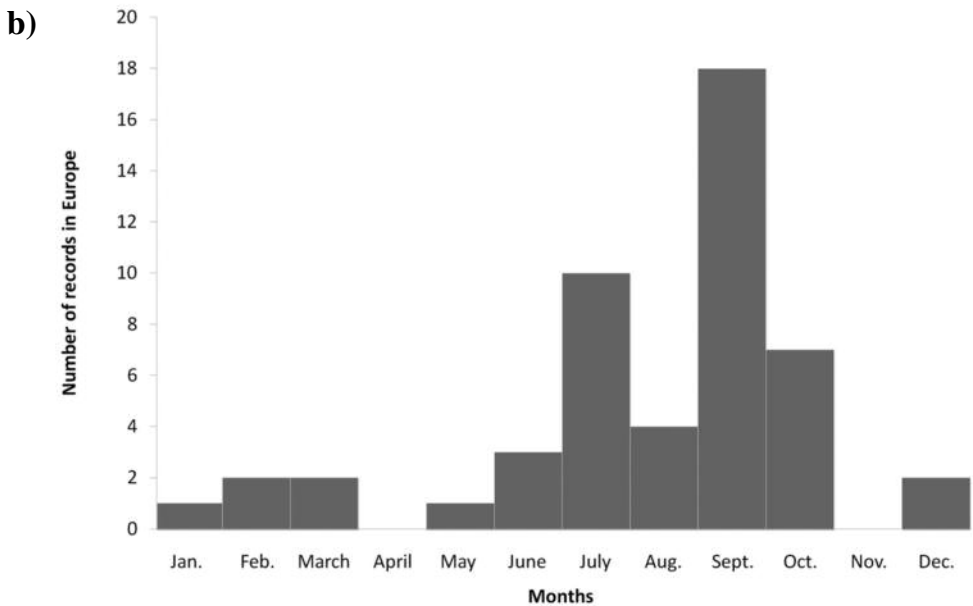
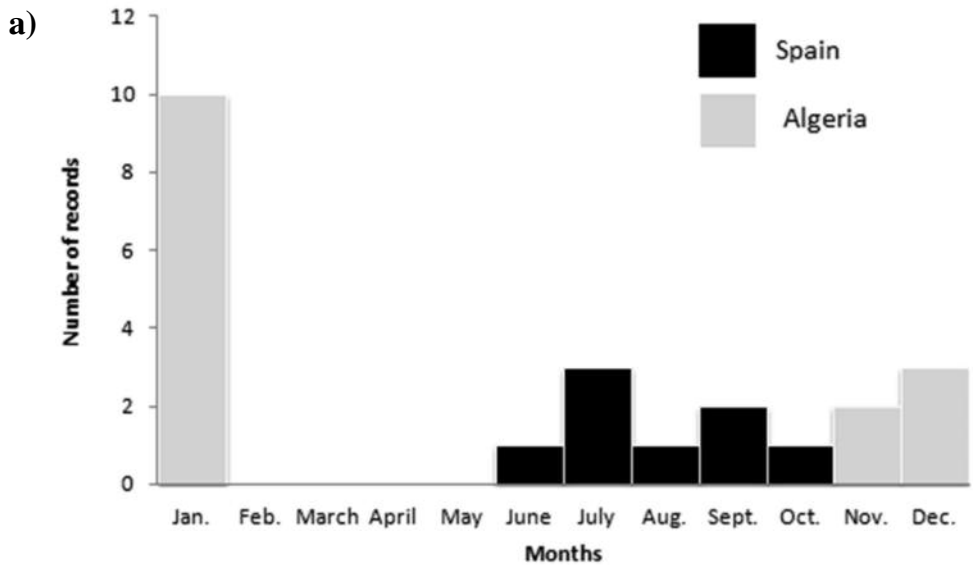


FIG. 2.—a) Dates and sighting locations of seven yellow-legged gulls sighted in Spain and resighted in Algeria (19 July 2009-18 July 2011). b) Monthly distribution of records of ringed Algerian yellow-legged gulls in Europe.

[a) Fecha y localidad de los registros de siete gaviotas patiamarillas avistadas en España y vueltas a observar en Argelia (19 de julio de 2009-18 de julio de 2011). b) Cambios mensuales de registros en Europa de gaviotas patiamarillas anilladas en Argelia.]

the same bird which was last spotted 300 km from Paris. Records from the Iberian Peninsula were spread across a wide area ranging from the Mediterranean and the Atlantic coasts to inland sites (fig. 1). Most, however, were concentrated on the Balearic Sea on the coasts of Valencia and Catalonia and there were very few inland. Sightings outside Algeria were recorded throughout the year but they showed a marked increase between July and October and peaked in September (fig. 2a).

Seven birds recorded at Skikda refuse tip were previously observed in Spain, indicating a two-way movement across the Mediterranean. Most birds remained in Spain for three to six months during summer to early autumn (fig. 2b). A large majority of resighted birds on Skikda refuse tip came from the Skikda colony whereas only six birds came from Chetaïbi, three birds from Jijel and one from Béjaïa. No bird from Rachgoun was ever observed. Thus, the number of birds seen at Skikda decreased with distance between the refuse tip and the natal colony.

DISCUSSION

Although this study has been conducted over a short timespan, it provides new insights on the geographical distribution and possible dispersal routes of immature yellow-legged gulls from North African shores.

A yellow-legged gull metapopulation?

Our study indicates exchanges between the Algerian colonies and, more importantly, the data reveal extensive links between North African colonies and European ones, extending from Italy to Portugal. It is not clear whether yellow-legged gulls in the western Mediterranean region comprise a metapopu-

lation (Hanski, 1999; Oro, 2003) as evidence of limited gene flow between different populations seems to argue against this hypothesis (Pons *et al.*, 2004). Yellow-legged gulls *L. m. lusitanius* from the southeastern Bay of Biscay are mainly resident (Munilla, 1997) with most birds dispersing to the west of their natal colonies (Arizaga *et al.*, 2010). In contrast, their Mediterranean counterparts are migratory, especially immature birds that reach the Atlantic coasts of Iberia and France during late summer and autumn (Isenmann, 1973; Carrera *et al.*, 1993; Martínez-Abraín *et al.*, 2002). Some regions of the western Mediterranean and eastern Atlantic are well known for their productivity (Le Mao and Yésou, 1993) and these seem to be acting as an attractive summering refuge for a sizeable proportion of juvenile and immature North African gulls.

Possible dispersal routes

Knowledge of movements of North African populations has so far been lacking. Ringing of eleven chicks in Tunis between 1968 and 1972 showed that they dispersed to Sardinia, the Provence-Languedoc and the Italian coast of the Tyrrhenian Sea (Isenmann, 1973). Although no tracking was carried out in the present study, we can infer some possible dispersal flyways from the resighting records. Juvenile yellow-legged gulls from North African Mediterranean colonies appear to reach the Atlantic via two distinct routes. Birds from eastern colonies follow a similar path to that described for gulls from Spanish and French western Mediterranean colonies which fly overland through eastern and northeastern Spain to the Bay of Biscay (Isenmann, 1973; Nicolau-Guillaumet, 1977; Carrera *et al.*, 1993; Le Mao and Yésou, 1993; Martínez-Abraín *et al.*, 2002). A second route has emerged from our study: juvenile gulls from western colonies reach the Gulf

of Cádiz by flying along the southern coast of Spain through the Strait of Gibraltar or overland across southern Spain. A noteworthy third route is used by Mediterranean yellow-legged gulls that summer at Lake Geneva. These birds, which originate from the Hyères archipelago, Sardinia and the Tuscan Archipelago, use the Rhône Valley to reach Lake Geneva and from there the Belgian and Dutch coasts (Géroutet, 1984). Yellow-legged gulls from the northern Adriatic Sea (Italy, Croatia) take a more easterly fourth route towards the Polish and German Baltic Sea coasts (Klein and Neubauer, 2006). These flyways are probably not entirely separate and a certain degree of overlap may exist. Two Italian yellow-legged gulls originating from Commachio, northern Italy, were noted at the refuse tip near Skikda, providing the only two records of yellow-legged gulls originating outside Algeria.

The short duration of the study has not allowed age-related analyses but previous studies of the yellow-legged gull and the closely-related herring gull *Larus argentatus* have uncovered age-related differences in dispersal (Coulter, 1975; Parsons and Duncan, 1978; Spaans, 1971).

Ring resighting effort

There is a marked difference between our results and those of the previous study of Tunisian ringed birds, which were found on the French and Italian Mediterranean coasts. These differences could be accounted for the small size of the Tunisian sample, the inadequacy of ring monitoring on Mediterranean coasts or the geographical location of the Tunisian ringing site (Tunis). Our preliminary findings suggest that the timing of the marked increase of juvenile gulls from Algeria recorded in Spain is congruent with the peak influx of yellow-legged gulls recorded between July and September in several lo-

calities across Europe (Isenmann, 1973; Yé-sou, 1985; Dean, 2004; Klein and Neubauer, 2006). The summer dispersal of Mediterranean yellow-legged gulls is mainly oriented northwards (Isenmann, 1973; Martínez-Abraín *et al.*, 2002), thus probably accounting for the limited number of foreign-ringed birds recorded so far in Algeria.

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