

Breeding biology of the chaffinch *Fringilla coelebs africana* in the El Kala National Park (North East Algeria)

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Abstract

Breeding biology of the chaffinch *Fringilla coelebs africana* in the El Kala National Park (North East Algeria). This work focused on monitoring the reproductive phenology of the Chaffinch *Fringilla coelebs africana* for two successive seasons (2016 and 2017) in the mountains of the El Kala National Park (North East Algeria). We searched for nests in the tree stratum or by direct observation of breeding pairs carrying building materials from mid–March to the end of June and found a total of 34 nests that were measured without affecting the breeding process. The results show that nests were built at an average height of 6.3 m from the ground. The laying period was 46 days (Early April to mid–May) and the average laying date was May 2. The mean of clutch size is 3.2 eggs per brood. All the previous traits are similar to those recorded in Europe. The mean hatching success rate was 43.1% and the average breeding success rate was 36.3%. These two values are relatively low compared to those found in European populations.

Key words: *Fringilla coelebs africana*, El Kala National Park, North–east Algeria, Reproductive phenology, Reproductive success

Resumen

Biología reproductiva del pinzón *Fringilla coelebs africana* en el Parque Nacional de El Kala (Noreste de Argelia). Este trabajo se centró en el seguimiento de la fenología reproductiva del pinzón *Fringilla coelebs africana* durante dos temporadas consecutivas (2016 y 2017) en las montañas del Parque Nacional de El Kala (noreste de Argelia). Se buscaron nidos en el estrato arbóreo o por observación directa de parejas reproductoras que llevaban materiales de construcción desde mediados de marzo hasta finales de junio y se encontró un total de 34 nidos que fueron medidos sin afectar al proceso de reproducción. Los resultados muestran que los nidos se construyen a una altura media de 6,3 m del suelo. El período de puesta es de 46 días (de principios de abril a mediados de mayo) y la fecha media de puesta es el 2 de mayo. El tamaño medio de la puesta es de 3,2 huevos por nidada. Todos los rasgos anteriores son similares a los registrados en Europa. La tasa media de éxito de eclosión es del 43,1% y la tasa media de éxito reproductor del 36,3%. Estos dos valores son relativamente bajos en comparación con los de las poblaciones europeas.

Palabras clave: *Fringilla coelebs africana*, Parque Nacional de El Kala, Noreste de Argelia, Fenología de la reproducción, Éxito reproductivo

Resum

Biologia reproductiva del pinsà Fringilla coelebs africana al Parc Nacional d'El Kala (nord-est d'Algèria). Aquest treball es va centrar en el seguiment de la fenologia reproductiva del pinsà *Fringilla coelebs africana* durant dues temporades consecutives (2016 i 2017) a les muntanyes del Parc Nacional d'El Kala (nord-est d'Algèria). Es van buscar nius a l'estrat arboreu o per observació directa de parelles reproductores que portaven materials de construcció des de mitjan març fins a la fi de juny i es van trobar un total de 34 nius que van ser mesurats sense afectar el procés de reproducció. Els resultats mostren que els nius es construeixen a una altura mitjana de 6,3 m de terra. El període de posta és de 46 dies (des del començament d'abril a mitjan maig) i la data mitjana de la posta és el 2 de maig. La grandària mitjana de la posta és de 3,2 ous per niuada. Tots els trets anteriors són similars als registrats a Europa. La taxa mitjana d'èxit d'eclosió és del 43,1 % i la taxa mitjana d'èxit reproductor del 36,3%. Aquests dos valors són relativament baixos en comparació amb els de les poblacions europees.

Paraules clau: *Fringilla coelebs africana*, Parc Nacional d'El Kala, Nord-est d'Algèria, Fenologia de la reproducció, Éxit reproductiu

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Introduction

The family Fringillidae has 31 species in the Western Palearctic (Beaman and Madge, 1998). They are small or relatively small granivorous birds with short, strong beaks and generally undulating flight and sexual dimorphism (Cramp and Perrins, 1994; Beaman and Madge, 1998). Among these species is the chaffinch *Fringilla coelebs africana*, which nests in North Africa. It is a passerine, granivorous in winter and insectivore during the breeding season (Cramp and Perrins, 1994). The chaffinch breeds throughout the Palearctic (Cramp and Perrins, 1994). It occupies a variety of habitats but prefers wooded areas (forests, parks, hedges and gardens) (Newton, 1967; Cramp and Perrins, 1994; Macleod and al., 2014). This species, like other Fringillidae, nests either in 'loose colonies' or solitary, but it is not territorial (Newton, 1967).

The nesting area of the North African subspecies of chaffinch covers eastern Morocco to the west of Tunisia (Etchecopar and Hùe, 1964; Svensson, 2015) and northeastern Libya



Fig. 1. Location of study stations in El Kala National Park.

Fig. 1. Ubicación de las estaciones de estudio en el Parque Nacional El Kala.

(Svensson, 2015). According to Heim De Balsac (1926), this subspecies in Algeria is settled from the sea to the forested areas of the Saharan Atlas.

This work aimed to characterize the breeding parameters of North African subspecies of the Chaffinch *Fringilla coelebs aricana*. Specifically, we aimed to determine nest characteristics, laying date, clutch size, egg characteristics, incubation time, hatching success and reproductive success in a Mediterranean coastal area of north–eastern Algeria. We compared the values found in this locality with others reported for other areas within the large geographic distribution of the species

Material and methods

Study site

The study was carried out in north–eastern Algeria, in a cork oak *Quercus suber* forest at an altitude of 30 m, (36° 53' N; 08° 30' E) (fig. 1). The climate is Mediterranean with a hot and dry season between May and November. It is humid and rainy the rest of the year. Rainfall reaches 1000 mm per year (Benyacoub and Chabi, 2000).

The study site corresponds to three stations, two of which (Stations 1 and 2) are located in the Brabtia area and the third is located in the cork oak forest, upstream from the northern shore of Lake Oubeira. The most recent fires at the first two stations occurred in 2000, while a fire at the site of the third station occurred in 2008. The study stations have a mixed habitat, consisting of a monospecific tree stratum (fig. 2), composed mainly of *Quercus suber*, with an average height of 7 m. The undergrowth is mainly composed of *Phillyrea augustifolia*, *Pistacia lentiscus*, *Mirtus communis*, *Rubus ulmifolius*, *Calycotome villosa*, *Crataegus monogyna* and *Erica arborea*, with a height between 0.5 m and 2 m.



Fig. 2. Matorral dominated by *Quercus suber* (Original picture, K. Ramdani).

Fig. 2. Matorral con arbres (*Quercus suber*). (Foto original, K. Ramdani).

The herbaceous stratum is relatively rare because of the density of the undergrowth. It is composed of *Asphodelus microcarpus*, *Chamaerops humilis* and *Urginea maritima*.

Methodology

Sampling consisted of a systematic search for nests in vegetation (tree stratum) and by observing breeding pairs carrying building materials (Drachmann et al., 1997, 2002; Kouidri et al., 2012; Macleod et al., 2014). A good proportion were also found accidentally, while team members were walking near nests, causing the females to fly off (Kouidri et al., 2012, 2016; Bensouilah et al., 2014, 2016; Brahmia et al., 2015; Kafi et al., 2015; Zeraoula et al., 2015). Once the nests were identified, we monitored and recorded breeding parameters such as laying date, clutch size, incubation time, hatching, flight, and breeding success. The biometric parameters of the nests (height above the ground, internal and external diameter, height and depth of the cutting and its weight) were measured just after the young fledged. Egg measurements were also taken, namely the length and width of the eggs, measured using the caliper with an accuracy of 0.01 mm and the egg mass, using an electronic scale with an accuracy of 0.1 g. The egg volume was calculated according to the formula developed by Hoyt (1979):

$$V = 0.51 * L * B^2$$

Nesting monitoring parameters were recorded twice a week to avoid disturbance to breeding pairs. Statistical analysis (descriptive statistics; one-way analysis of variance) to compare the different parameters between two breeding seasons and the correlation coefficient to analyze the links between the different parameters) was carried out using Statistix software, version 8.

Table 1. Construction support and nest height of the chaffinch *Fringilla coelebs africana* in El Kala National Park.

Tabla 1. Construcción del soporte y altura del nido del pinzón arbóreo *Fringilla coelebs africana* en el Parque Nacional El Kala.

Year	Vegetation		Nest height (m)
	<i>Quercus suber</i>	<i>Olea europaea</i>	n; mean \pm SD (min–max)
2016	09 (90%)	01 (10%)	n = 10; 05.20 \pm 01.11 (3.5–7)
2017	14 (58.30%)	10 (41.70%)	n = 24; 06.73 \pm 01.58 (4–9)
Mean	23 (67.60%)	11 (32.40%)	n = 34; 06.28 \pm 01.60 (3.5–9)
One–way ANOVA			$F_{1,32} = 7.70$; $p = 0.009$; HS**

Results

Nest characteristics

Thirty–four nests were identified during the two study seasons. The nests were mainly installed on two plant species: 67.6% of the nests on *Quercus suber* and 32.4% on *Olea europaea*. They were built at an average height of 6.28 m above the ground, between 3.5 and 9 m (table 1). The difference in average nest height between the two seasons was significant ($F_{1,32} = 7.70$; $p = 0.009$; HS**) (table 1). The nests were installed higher in the second season (2017).

The average external and internal diameters of the nests were 8.87 cm and 6.01 cm respectively. The average height and depth of the cups was 5.94 cm and 5.52 cm respectively. The average thickness of the cup was 1.86 cm and its average mass was 14.70 g (table 2).

For nest building, the chaffinch used lichens, predominantly *Xaurotharia parietina*. Fresh mosses such as *Funaria hygrometrica*, and strands, hairs and feathers were also used (fig. 3).

Table 2. Characteristics of the nests of *Fringilla coelebs africana* in El Kala National Park.

Tabla 2. Características de los nidos del pinzón arbóreo *Fringilla coelebs africana* en el Parque Nacional El Kala.

Characteristics	n; mean \pm SD (min–max)
Weight (g)	16; 14.70 \pm 8.40 (7.10–30.20)
Cup height (cm)	16; 5.94 \pm 0.52 (5.05–6.46)
Internal diameter (cm)	16; 6.01 \pm 1.13 (4.58–7.55)
External diameter (cm)	16; 8.87 \pm 1.57 (6.41–10.45)
Cup thickness (cm)	16; 1.86 \pm 0.34 (1.47–2.42)
Depth (cm)	16; 5.52 \pm 1.18 (4.47–7.21)



Fig. 3. A, chaffinch nest and egg; B, chaffinch chicks. (Original picture, K. Ramdani).

Fig. 3. A, nido y huevos del pinzón arbóreo; b, pollos del pinzón arbóreo. (Foto original, K. Ramdani).

Date and period of laying

The laying period lasted 7 weeks: from the second week of April (12 April) to the end of May (27 May), a laying period of 46 days, with a high frequency during the first 4 weeks of breeding (12 April–09 May; fig. 4). The average laying date was May 2 (31.52 ± 11.39). There were no significant differences between the two years regarding the average laying dates ($F_{1,32} = 0.81$; $p = 0.375$; NS).

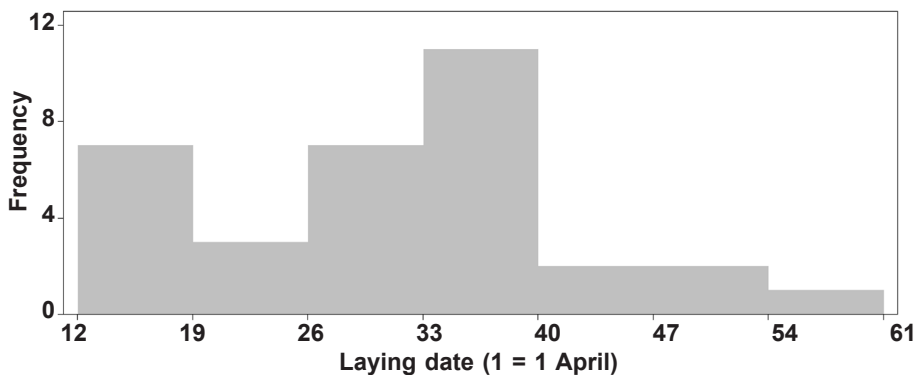


Fig. 4. Egg laying chronology of the chaffinch (2016–2017) in El Kala National Park.

Fig. 4. Cronología de la puesta de huevos del pinzón arbóreo (2016–2017) en el Parque Nacional El Kala.

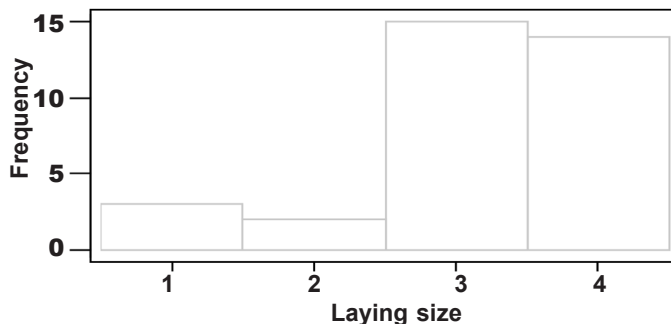


Fig. 5. Clutch size of the chaffinch (2016–2017) in El Kala National Park.

Fig. 5. Tamaño de la puesta del pinzón arbóreo (2016–2017) en el Parque Nacional El Kala.

Clutch size

The average clutch size was 3.18 ± 0.90 eggs per brood. No significant differences were observed in the average egg laying size between the two seasons ($F_{1,32} = 0.53$; $p = 0.471$; NS). The most frequent spawnings were those of 3 and 4 eggs per nest, representing 44.1% (15 nests) and 41.2% (14 nests) respectively (fig. 5).

We did not record a significant relationship between egg laying date and egg laying size ($r = -0.148$; $p = 0.402$; NS), and the number of eggs laid did not decrease during the breeding season.

Egg characteristics

The average egg mass was 2.16 ± 0.27 g, varying between 1.7 and 2.70 g. There was significant difference between the average egg mass in the two seasons ($F_{1,106} = 6.83$; $p = 0.010$), this being higher in 2016. The average length of the eggs was 19.74 ± 1.06 mm, varying between 17.8 and 23 mm. There was no significant difference between the average egg length between the two seasons ($F_{1,106} = 1$; $p = 0.319$; NS). The average egg width was 14.76 ± 0.51 mm, ranging between 13.79 and 16.35 mm. There as no significant difference between the average egg width between the two seasons ($F_{1,106} = 1.14$; $p = 0.289$; NS). The average volume of eggs was 2.20 ± 0.21 cm³, ranging between 1.74 and 2.85 cm³. The average egg volume showed no significant difference between the two seasons ($F_{1,106} = 1.78$; $p = 0.185$; NS) (table 3).

Incubation time

The average incubation period was 13.65 ± 0.81 days, ranging between 12 and 15 days. The two seasons showed no significant difference regarding the average incubation time ($F_{1,18} = 1.25$; $p = 0.278$; NS) (table 4).

Date of hatching

The average hatching date was May 11 (41.25 ± 12.05), ranging from April 21 to June 09. There was no significant difference between the two seasons regarding the average hatching date ($F_{1,18} = 1.34$; $p = 0.263$; NS) (table 5).

Table 3. Traits of the chaffinch eggs (n; mean \pm SD (min–max)) in El Kala National Park.

Tabla 3. Características de los huevos (n; media \pm DE (min–max)) del pinzón arbóreo en el Parque Nacional El Kala.

Egg characteristics				
Year	Weight (g)	Length (mm)	Width (mm)	Volume (cm ³)
2016	30; 2.27 \pm 0.29 (1.8–2.7)	30; 19.90 \pm 1.11 (18.07–21.83)	30; 14.85 \pm 0.58 (14.02–16.35)	30; 2.24 \pm 0.24 (1.85–2.85)
2017	78; 2.12 \pm 0.25 (1.7–2.7)	78; 19.67 \pm 1.05 (17.8–23)	78; 14.73 \pm 0.48 (13.79–16.35)	78; 2.18 \pm 0.20 (1.74–2.85)
Mean	108; 2.16 \pm 0.27 (1.7–2.7)	108; 19.74 \pm 1.06 (17.8–23)	108; 14.76 \pm 0.51 (13.79–16.35)	108; 2.20 \pm 0.21 (1.74–2.85)
One-way ANOVA	$F_{1,106} = 6.83$; $p = 0.010$	$F_{1,106} = 1$; $p = 0.319$; NS	$F_{1,106} = 1,14$; $p = 0,289$; NS	$F_{1,106} = 1,78$; $p = 0.185$; NS

Table 4. Variation in incubation time (n; mean \pm SD (min–max)) between the two seasons in El Kala National Park.

Tabla 4. Variación del tiempo de incubación (n; media \pm DE (min–max)) entre los dos periodos de estudio en el Parque Nacional El Kala.

Year	Incubation time (day)
2016	5; 14 \pm 0.71 (13–15)
2017	15; 13.53 \pm 0.84 (12–15)
Mean	20; 13.65 \pm 0.81 (12–15)
One-way ANOVA	$F_{1,18} = 1.25$; $p = 0.278$; NS

Table 5. Variation in the hatching date (n; mean \pm SD (min–max)) between the two seasons in El Kala National Park.

Tabla 5. Variación de la fecha de eclosión (n; media \pm DE (min–max)) entre los dos periodos de estudio en el Parque Nacional El Kala.

Year	Date of hatching (day)
2016	5; 46.6 \pm 15.08 (3 May–9 June)
2017	15; 36.47 \pm 10.89 (21 April–29 May)
Mean	20; 41.25 \pm 12.05 (21 April–9 June)
One-way ANOVA	$F_{1,18} = 1.34$; $p = 0.263$; NS

Success at hatching

The average hatching success was $43.06 \pm 42.20\%$, ranging between 0 and 100%. There was no significant difference between the two seasons regarding the average hatching success ($F_{1,32} = 1.58$; $p = 0.218$; NS) (table 6).

Young in flight

The average number of young at flight was 1.29 ± 1.59 per clutch, ranging between 0 and 4 per clutch. There was no significant difference between the average number of young in the two seasons ($F_{1,32} = 0.87$; $p = 0.358$; NS) (table 7).

Reproductive success

The average reproductive success rate was $36.27 \pm 44.42\%$, ranging from 0 to 100%. There was no significant difference between the two seasons regarding the average reproductive success ($F_{1,32} = 0.78$; $p = 0.384$; NS) (table 8).

Table 6. Successful hatching (n; mean \pm SD (min–max)) in the reproductive seasons in El Kala National Park.

Tabla 6. Porcentaje de eclosión (n; media \pm DE (min–max)) en los dos periodos de cría en el Parque Nacional El Kala.

Year	Successful hatching (%)
2016	10; 29.10 ± 36.26 (0–100)
2017	24; 48.88 ± 43.83 (0–100)
Mean	34; 43.06 ± 42.20 (0–100)
One–way ANOVA	$F_{1,32} = 1.58$; $p = 0.218$; NS

Table 7. Variation in the number of young at flight per brood (n; mean \pm SD (min–max)) between the two seasons in El Kala National Park.

Tabla 7. Variación en el número de volantones por nido (n; media \pm DE (min–max)) entre los dos periodos de cría en el Parque Nacional El Kala.

Year	Number of young at flight per brood
2016	10; 0.90 ± 1.29 (0–3)
2017	24; 1.46 ± 1.69 (0–4)
Mean	34; 1.29 ± 1.57 (0–4)
One–way ANOVA	$F_{1,32} = 0.87$; $p = 0.358$; NS

Table 8. Variation in the number of young at flight per brood (n; mean \pm SD (min–max)) between the two seasons in El Kala National Park.

Tabla 8. Éxito de la reproducción (n; media \pm DE (min–max)) entre los dos periodos de estudio en el Parque Nacional El Kala.

Year	Reproductive success (%)
2016	10; 25.80 \pm 37.35 (0–100)
2017	24; 40.63 \pm 47.10 (0–100)
Mean	34; 36.27 \pm 44.42 (0–100)
One-way ANOVA	$F_{1,32} = 0.78$; $p = 0.384$; NS

Discussion

The subspecies of chaffinch *Fringilla coelebs africana* builds its nest on branches or several thin twigs (Heim De Balsac, 1926; Etchecopar and Hüe, 1964; Cramp and Perrins, 1994; Ramdani, 2007) in diverse habitats: particularly trees (both conifers and deciduous, and even palm trees), hedges (Macleod et al., 2014), and olive shrubs (Mestari et al., 2013). We observed that the nests were mainly built on two plant species: cork oak and olive trees.

We found that the nest building material in our region was generally similar to that described for Europe (Cramp and Perrins, 1994) and Algeria (Ramdani, 2007).

The nest height recorded in our study was comparable to those mentioned in several previous studies: in Spain (Canary Islands) (5.1 m) (Cramp and Perrins, 1994) and north-eastern Algeria (El Kala National Park) (5.83 m) (Ramdani, 2007), and is relatively high compared to those reported by (Cramp and Perrins, 1994) in the southwest of Germany (4.4 m) and east of Germany (1.8 m–2.5 m) and Poland (3.9 m).

The characteristics of the nests (external and internal diameter, height and depth of the cup) in our study were similar to those cited in Poland (Cramp and Perrins, 1994) and in north-east Algeria (El Kala National Park) (Ramdani, 2007) (table 9).

The laying date of the North African subspecies was comparable to that reported in European regions (subspecies: *Fringilla coelebs coelebs*) (Cramp and Perrins, 1994), but the laying period was relatively shorter than that reported for Great Britain (late April to mid-June and mid-March to mid-July; with regional variation), Western Russia (early

Table 9. Measurements (mean) of the chaffinch nests.

Tabla 9. Medidas (media) de los nidos del pinzón arbóreo.

Parameters	Poland	North-East Algeria
Cup heights (cm)	7.1	5.94
Internal diameters (cm)	5.3	6.01
External diameters (cm)	9	8.87
Depths (cm)	4	5.52

Table 10. Measurements (n; mean) of the chaffinch eggs.

Tabla 10. Medidas (n; media) de los huevos del pinzón arbóreo.

	Length (cm)	Width (cm)	Weight (g)
<i>F. c. coelebs</i>	1.93–2.28	1.46–1.55	–
<i>F. c. gengleri</i>	121; 1.99	121; 1.47	21; 2.24
<i>F. c. africana</i>	101; 2.07	101; 1.52	101; 2.61
	56; 1.98	56; 1.48	56; 2.15
<i>F. c. maderensis</i>	40; 2.21	40; 1.55	40; 2.78

May to early July and late May to early July), Germany (early April to mid–July) (Cramp and Perrins, 1994), and the Czech Republic (early April to early July) (Weidinger, 2001) and similar to that reported in Northeast Algeria (early April to mid–May) (Ramdani, 2007). This variation is related to factors such as latitude, altitude and habitat type (Zang, 1982; Berndt et al., 1983; Chabi et al., 1995; Chabi and Isenmann, 1997; Brahmia et al., 2013; Kouidri et al., 2015). Populations living in northern latitudes breed later than those living in the southern regions.

The recorded clutch size of the North African subspecies is similar to that of populations (North African subspecies) in Northwest Africa (3.9 eggs/clutch) (Cramp and Perrins, 1994) and North East Algeria (3.22 eggs/clutch) (Ramdani, 2007) and relatively small compared to European populations (subspecies: *Fringilla coelebs coelebs*): Britain (4.3 eggs/clutch); Finland (4.7 eggs/clutch); France (4 to 5 eggs/clutch); Czechoslovakia and Western Russia (4.64 eggs/clutch) (Newton, 1964; Cramp and Perrins, 1994) and Czech Republic (4.77; 4.34 and 4.80 eggs/clutch) (Weidinger, 2001). The latter can lay up to 7 eggs/clutch (Newton, 1964). This variation is linked to several factors, particularly the quality of the habitat or territory, the availability of trophic resources, and the general quality of the female (physiology, experience, etc.) (Lack, 1954; Newton, 1964; Lambrechts et al., 1997; Chabi, 1998; Christians, 2002).

The characteristics of eggs are comparable to those mentioned in many studies in Europe (Cramp and Perrins, 1994) and North Africa (Heim De Balsac, 1926; Etchecopar and Hùe, 1964; Ramdani, 2007) (table 10).

The incubation period of eggs for the North African subspecies is similar to that of European populations (subspecies: *Fringilla coelebs coelebs*). It varies from 9 to 16 days with an average of 12.6 days (Newton, 1964).

The number of eggs hatched in our study area is significantly lower than that observed by Mestari et al. (2013) in an olive grove in Tlemcen (Western Algeria). However, flight success and reproductive success are low in our region compared to figures reported by (Mestari et al., 2013), but they are relatively close to those reported by (Cramp and Perrins, 1994). The failure rates observed during the breeding period, between egg hatch and young flight, could be the result of several factors, namely, egg infertility, frequent human disturbances at the site (nest vandalism) and predation (*Malpolon monspessulanus*, *Larcerta pater*, *Mus spretus*, *Genetta genetta*).

This study is the first to characterize the breeding activity of the North–African subspecies of the chaffinch, *Fringilla coelebs Africana*. Further work is needed to better understand its dynamics, such as analysis of food availability and composition of the diet of chicks and study of the influence of parasitism on the population and its effect on reproductive success.

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