Short communication

Breeding parameters of the trumpeter finch at the periphery of its range: A case study with mainland expanding and island populations

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ABSTRACT

Studies on breeding parameters in peripheral populations have been centred on species with stable or regressive ranges. However, the studies on peripheral expanding populations are few, probably due to the scarcity of suitable models. On the other hand, islands are a sort of peripheral populations with their own rules. By using an arid-land passerine, the Trumpeter Finch, we compare the clutch size between two peripheral populations, one in expansion located in south-eastern Iberian Peninsula, another located in Fuerteventura, Canary Islands, with the clutch size of their presumably source population, Northwest Africa. We did not find differences in clutch size between continental peripheral population nor island one compared with North African one. We also present other breeding parameters including incubation period, hatching rate, nestling period, fledgling rate and productivity in both peripheral populations.

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1. Introduction

Peripheral populations are usually characterised by inhabiting suboptimal areas and, consequently, by presenting poorer breeding outputs than those populations settled at the centre of the distribution range (Fargallo, 2004; Sanz, 1997, 1998; Slagsvold, 1981). However, the definition of peripheral population is somehow complex as many features of local populations can only be understood with reference to a regional scale (Gaston, 1996). For example, the dynamic of a certain peripheral population and, hence, its classification, can depend on its history. As species ranges are not constant, it is possible to identify several stages of peripheral populations on the basis of their current trend: stable, regressive or expansive.

Monitoring populations in different stages is basic to our understanding of the mechanisms involved in range size variation (Gaston, 1996). Most of studies carried out on peripheral populations share the idea that these populations have reduced breeding output compared with core populations (reviewed in

Hoffmann and Blows, 1994; see also Brewer and Gaston, 2003; Díaz et al., 2007; Fargallo, 2004; García and Arroyo, 2001; Sanz, 1997, 1998). Several reasons have been argued to explain such poorer breeding outputs in peripheral populations. In birds, for instance, peripheral localities are assumed to have lower availability of resources, leading to smaller clutch sizes (Fargallo, 2004; Sanz, 1997, 1998; Slagsvold, 1981). However, most of these studies have been carried out on well established or regressive peripheral populations. On the contrary, to our knowledge, little attention has been paid to the study of the breeding biology of peripheral populations that could be involved in expansive processes. In this particular stage, it is expectable a high production of individuals to fuel the ongoing expansion (Sánchez-Lafuente et al., 2001; Soutullo et al., 2006).

Islands hold particular types of peripheral populations. Several aspects of the life histories of island dwellers differ from their mainland counterparts (reviewed in Blondel, 2000; Whittaker, 1998). For breeding, there is a general trend to reduced clutch size in insular populations (reviewed in Blondel, 2000; Martin, 1992; see also Förschler and Kalko, 2006; García-del-Rey et al., 2007; Rodríguez and Rodríguez, 2007). Reduced predation, higher adult survival and higher population density typical of islands are expected to reduce clutch size (Blondel, 2000; Whittaker, 1998).

The Trumpeter Finch (*Bucanetes githagineus*, Lichtenstein, 1823) is a good model for studying breeding parameters in different peripheral populations. This is a fringillid found across warm arid

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Table 1
Comparison of Trumpeter Finch breeding parameters in Tabernas (mainland expanding population in south-eastern Iberian Peninsula), La Oliva (Canary Islands) and two African areas (mainland stable population). African raw data are from Heim de Balsac and Mayaud (1962) and Etchécopar and Hüe (1964). Data are expressed as mean ± SE number of eggs (clutch size), percentage of viable eggs (hatching rate), number of days (incubation and nestling periods) and number of chicks (fledgling rate and productivity). Samples sizes are shown in brackets.

Population	Clutch size	Incubation period	Hatching rate	Nestling period	Fledgling rate	Productivity	Data source
Tabernas	5.0 ± 0.2 (15)	12.5 ± 0.2 (14)	89.3 ± 4.8 (9)	12.8 ± 0.5 (10)	3.5 ± 0.5 (11)	1.1 ± 0.3 (39)	Barrientos et al. (2007), this study
La Oliva	4.9 ± 0.1 (40)	12.3 ± 0.2 (22)	91.9 ± 2.4 (27)	13.5 ± 0.2 (22)	4.2 ± 0.2 (24)	1.9 ± 0.3 (47)	This study
NW Africa (Morocco, Algeria, Tunisia)	5.1 ± 0.1 (106)						Heim de Balsac and Mayaud (1962)
N Africa (Tunisia)	4.9 ± 0.1 (20)						Etchécopar and Hüe (1964)

regions from the Middle East to the Canary Islands (Cramp and Perrins, 1994). In the 1970s the species began to expand northwards occupying areas of south-eastern Spain (Carrillo et al., 2007). It was recorded as breeding in the Tabernas Desert (Almería province) for the first time in 1971 (García, 1972). Since then, and for the last 25 years, its breeding range has spread up to 250 km north (Carrillo et al., 2007), Tabernas being the main reproductive nucleus in the Iberian Peninsula (Manrique et al., 2003). South-eastern Spain is therefore currently the northern limit of its distribution range (Carrillo et al., 2007). However, the species was present in the Canary Islands for over 7000 years (Castillo et al., 2001). Birds from the Iberian Peninsula are genetically similar to those from Africa, its expansion source, and both differ from those settled in the Canary Islands (Barrientos et al., 2009a).

This study compares clutch size of three populations of Trumpeter Finch, two of which are considered peripheral. One is a peripheral population recently established and still expanding (Tabernas, south-eastern Iberian Peninsula) (Carrillo et al., 2007) whereas the other is long established in an island (La Oliva, Fuerteventura, Canary Islands) (Castillo et al., 2001). The third population is considered the presumed source (Barrientos et al., 2009a). If Tabernas acts as a typical peripheral population, then clutch size should be lower than the other source population due to the expected poorer habitat quality at the periphery (Slagsvold, 1981). Alternatively, if Tabernas acts as a source of the expanding process, clutch size should be similar or even higher when compared with the main source population. However, clutch size in the island population should be lower than that on the mainland due to the effects of the island syndrome (Blondel, 2000). Finally, we also compare incubation period, hatching rate, nestling period, fledgling rate and productivity between both peripheral populations.

2. Methods

Breeding biology of the Trumpeter Finch was monitored from February to August in 2004 and 2005 in Tabernas Desert (37° 02′ N, 02° 30′ W), Almería province, south-eastern Spain. This is a 12-km² area placed at 260 m a.s.l. where Trumpeter Finch reproduction was recorded for the first time in the Iberian Peninsula in 1971 (García, 1972).

From January to April 2005, breeding was studied in La Oliva (28° 35′ N, 13° 58′ W), Fuerteventura Island, Canary Islands in a 18-km² area placed at 220 m a.s.l. Data on clutch sizes from North African populations were taken from Heim de Balsac and Mayaud (1962) and Etchécopar and Hüe (1964). In our field study, nests were located by following parents with a telescope from exposed observation points that enabled wide areas to be scanned or just by chance while walking. We devoted similar time to search for nests in both study areas as well as in both years. The time employed was 8–10 h per day during 5–6 days per week and it was similar along all the breeding season. During incubation, parental activity in the nests was observed by telescope every 3–5 days and the number of

visits (2–5) was limited to minimize both disturbance to breeding pairs and possible increase in predation risk due to human visits. Research visits did not affect nest predation (Barrientos et al., 2009b). When no parental activity was recorded during incubation, the nest was approached to verify its status. The clutch was considered complete when there was no increase in clutch size between consecutive visits.

The incubation period was calculated only in those nests observed from laying to hatching. Although partial incubation can occur before the clutch is complete (R. Barrientos, personal observation), we defined incubation period the number of days passed since the last egg was laid to the first egg hatched. After 7 days of incubation, nests were visited daily to ascertain the exact hatching date. Hatching rate was the percentage of eggs hatched in relation to the total number present in each nest. Nests were observed daily after 7 days of hatching to record the fledging date and the number of fledglings. The nestling period was calculated from hatching of the first nestling to nest departure of the first one. Nests for which either the incubation period or the nestling period was not completely monitored were not included in the analyses; thus sample sizes for the different breeding parameters may differ (Table 1). A nest was considered successful if at least one chick fledged or if the chicks were out of the nest and developed to the stage of flying. The fledgling rate was calculated as the mean number of fledglings per nest in those nests in which at least one chick fledged. Productivity was calculated as the number of fledglings per pair monitored including pairs with nest failure.

We used ANOVA planned comparisons (as implemented in Statistica 7.0 package, StatSoft) to test for differences in clutch size between the two North African datasets (averaged) and datasets from Tabernas and La Oliva. We could not obtain a complete record from all the nests, as some were found with ongoing breeding, were predated or abandoned. Thus, we have breeding data from 22, 17 and 47 nests, respectively (Table 1). We used ANOVA or Mann–Whitney *U*-tests when appropriate to analyze the differences for the rest of breeding parameters between Tabernas and La Oliva.

3. Results

We found 25 nests in Tabernas in 2004, 24 in 2005 and 55 nests in La Oliva in 2005. Nests were built both in cracks in cliffs (55% of the nests from Tabernas and 9% of those from La Oliva) and on the ground. From North Africa, we obtained clutch size data from 126 clutches from Morocco, Algeria and Tunisia. Data from the two years in Tabernas were pooled because there were no differences in any of the breeding parameters (Mann–Whitney *U*-tests, $p > 0.05$; see also Barrientos et al., 2007).

There were no differences in clutch size between Tabernas and North Africa (Planned comparison, $n_{Tabernas} = 15$, $n_{North\ Africa} = 126$, $F_{1,177} = 0.0$, $p = 0.96$) nor between La Oliva and North Africa (Planned comparison, $n_{La\ Oliva} = 40$, $n_{North\ Africa} = 126$, $F_{1,177} = 1.4$, $p = 0.23$). There were no differences between Tabernas and La Oliva

in the duration of the incubation period ($n_{Tabernas} = 14$, $n_{La\ Oliva} = 22$, $F_{1,34} = 0.4$, $p = 0.53$), hatching rate ($n_{Tabernas} = 9$, $n_{La\ Oliva} = 27$, $F_{1,34} = 0.3$, $p = 0.59$) nor fledgling rate ($Z_{adj} = 1.5$, $n_{Tabernas} = 11$, $n_{La\ Oliva} = 24$, $p = 0.15$). The duration of the nestling period was shorter in Tabernas than in La Oliva ($Z_{adj} = 2.2$, $n_{Tabernas} = 10$, $n_{La\ Oliva} = 22$, $p = 0.03$) and productivity was marginally higher in the latter ($Z_{adj} = 1.8$, $n_{Tabernas} = 39$, $n_{La\ Oliva} = 47$, $p = 0.07$).

4. Discussion

Stable continental peripheral populations are usually associated with marginal habitats and, therefore, breeding parameters such as clutch size are expected to be lower compared with core populations. This can be due to worse breeding conditions (Fargallo, 2004; Sanz, 1997, 1998; Slagsvold, 1981) and/or to poorer parental quality (Møller, 1995) in these marginal populations. This framework can vary in expanding populations, as quarters recently established need high fledgling productivity to consolidate the expansion.

In our study, we did not find differences in clutch size between Tabernas and North Africa, what mirrors the results obtained by Khoury et al. (2009) with Desert Finches (*Rhodospiza obsoleta*) and Linnets (*Carduelis cannabina*) in new habitats from Jordan. Other studies found an effect of recent colonization on clutch size reduction as shown by Bachir et al. (2008) with an expanding population of Cattle Egret (*Bubulcus ibis*) in Algeria. Due to the inexperience of first breeders, likely to be young birds, clutch size is low at the beginning and progressively increases after colonization (Bachir et al., 2008). In the particular case of the Trumpeter Finch in the Iberian Peninsula, the establishment of new breeding areas seems to be advanced by juvenile concentrations (Barrientos et al., 2009a), which could suggest that these new breeding quarters are dominated by young breeders. However, data from the Tabernas population do not show differences in clutch size between two consecutive years (Barrientos et al., 2007). Finally, the recent colonization and the continuous arrival of birds from Africa (Barrientos et al., 2009a) could swamp shifts in clutch size between source and expanding population. However, some authors have found differences in clutch size in relation to climatic conditions or nest predation (e.g. Kleindorfer, 2007). In the case of Trumpeter Finch, weather affects breeding season length, but not breeding parameters (Barrientos et al., 2007). Unfortunately, we have no data on nest predation in North Africa to test the latter hypothesis.

Factors such climatic conditions, nest predation or food resources could also influence clutch size for the La Oliva birds. The lack of differences compared with North Africa is striking, as several studies have found that island birds have reduced clutch sizes compared with their mainland relatives (reviewed in Blondel, 2000; Whittaker, 1998), even more when some works show differences between Canary and North African Trumpeter Finches in several aspects of their life history (Barrientos et al., 2009a; Cramp and Perrins, 1994). Specific research in this topic would be useful in the future in order to elucidate which of the potential factors have an influence in this and other breeding parameters.

Differences in the length of the nestling period can be caused by differences in food availability, climate or predation. Barrientos et al. (2009b) found higher predation pressure in Tabernas, which could influence the nest period length, though we cannot rule out influences of other habitat traits.

Acknowledgments

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