

# Local variation in egg size of Citril Finches *Carduelis citrinella* in the Catalan Pre-Pyrenees

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Egg-size variation in Citril Finches *Carduelis citrinella* was studied at the Port del Comte in the Catalan Pre-Pyrenees. The study was carried out in one area in which habitat quality was high and another in which it was low. Although sample sizes were rather small, some evidence was obtained for larger eggs with slightly higher volumes at the high-quality site. These data are in accordance with the results of previous studies, in which considerable differences between these two localities have been found in survival rate, body condition, moult speed, diet selection, and breeding success. The data give some indication that habitat quality, and therefore female quality, also affect egg size in these local, short-distance subpopulations.

Key words: Citril Finch, *Carduelis citrinella*, egg size, local variation, Catalan Pre-Pyrenees

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Egg volume in birds is known to have a high degree of heritability (Lessels *et al.* 1989, Potti 1993, Blomqvist *et al.* 1997). However, it is also related to environmental conditions due to energetic and nutritional constraints (Potti 1993, Amundsen 1995, Smith & Bruun 1998, Zanette *et al.* 2000, Hargitai *et al.* 2005). Female birds are known to influence offspring quality by early maternal investments, such as deposition of nutrients in their eggs (Mousseau & Fox 1998, Reynolds *et al.* 2003, de Neve *et al.* 2004, Hargitai *et al.* 2005). Experienced females are able to deposit more nutrients in their eggs due to better foraging abilities (Birkhead & Nettleship 1982, Williams 1994, Styrsky *et al.* 1999, Nager *et al.* 2000, Bize *et al.* 2002, Michel *et al.* 2003). This may also have considerable effects on nestling growth, hatching success and survival. Many studies have shown a direct relationship between egg size and offspring fitness (Amundsen & Stokland 1990, Bolton 1991, Bollinger 1994, Williams 1994, Blomqvist *et al.* 1997, Styrsky *et al.* 1998, Aparicio 1999, Christians 2002).

Notable differences have been found in several studies between two Citril Finch *Carduelis citrinella* subpopulations located only 5 km apart at the Port del Comte in the Catalan Pre-Pyrenees, Spain (Senar *et al.* 2002, Borràs *et al.* 2003, Borràs *et al.* 2004). Bofia faces south and is generally drier and sunnier than Vansa; the latter faces north and is moister and cooler, and has a higher abundance of the food and of the nesting plant, the Mountain Pine *Pinus mugo uncinata* (Borràs & Junyent 1993, Borràs *et al.* 2004). The birds at the high-quality locality (Vansa) show higher survival rates, body condition, moult speed, and variations in diet selection, as compared with the birds at the low-quality locality (Bofia). In a study on variation in the breeding success of the two subpopulation, Citril Finches of the high-quality area enjoyed higher breeding success than those of the low-quality area, and furthermore clutch size was larger at Vansa (Förschler *et al.* 2005).

At these same sites, I measured the egg parameters of the Citril Finches between the mid-

dle of April and the end of May 2002. In total, I collected data from 25 eggs of 12 distinct individuals, from separate nesting sites. For my study, I used only synchronously breeding pairs (Förschler *et al.* 2006) to avoid pseudo-replication and to guarantee comparability. Altogether, 11 eggs of 5 females were measured from the low-quality area (Bofia) between 28<sup>th</sup> April and 27<sup>th</sup> May, with low reproductive success; and 14 eggs of 7 females from high-quality area (Vansa, Prat de Botons) between 18<sup>th</sup> April and 26<sup>th</sup> May, with high reproductive success (Förschler *et al.* 2005). Egg length and width were measured with a caliper (to the nearest 0.1 mm); egg volume was estimated from Hoyt's formula (volume = length × breadth<sup>2</sup> × 0.51). For analyses, mean values of egg length, egg width and egg volume per clutch were used.

I found small differences in egg size between high- and low-quality areas (Table 1). Eggs from the high-quality area (Vansa, Prat de Botons) were significantly longer (U-test: T=19.0; P=0.030) and had almost significantly higher volumes (t-test: t=-1.95; df=10; p=0.068) than those from the low-quality area (Bofia) (see also Table 1). No significance was found for egg width. Although sample size was rather low, my data provide some evidence for an expected egg-size variation in Citril Finches due to environmental conditions, which would be in context to a couple of variations found previously in these subpopulations (Senar *et al.* 2002, Borrás *et al.* 2003, 2004, Förschler *et al.* 2005, Förschler *et al.* 2006). As shown in other studies, habitat

conditions may affect egg size strongly (Potti 1993, Amundsen 1995, Smith & Bruun 1998, Zanette *et al.* 2000, Hargitai *et al.* 2005). However, female quality may also play a role for the observed size variation. This assumption is supported by observational data of a higher portion of inexperienced females breeding in the low-quality area, Bofia (Förschler *et al.* 2006). Further studies need to increase sample size to build stronger support for the observed differences in egg size between Bofia and Vansa, and to address the relative contributions of environmental conditions and female quality.

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### Resum

#### Variació entre localitats en la mida de l'ou de la Llucareta *Carduelis citrinella* al Prepireneu català

Es va estudiar la variació de la mida de l'ou en la Llucareta en dues àrees d'alta i baixa qualitat d'hàbitat

**Table 1.** Egg size in high- and low-quality areas of the Port del Comte in the Catalan Pre-Pyrenees in spring 2002. Comparison of mean values (mean egg length, egg width and egg volume in 7 clutches at Vansa/Prat de Botons and 5 clutches in Bofia) by means of a t-test (parametrically distributed data) and a U-test (non-parametrically distributed data).

*Mida de l'ou en dues localitats d'alta i baixa qualitat d'hàbitat de la serra del Port del Comte al Prepireneu català durant la primavera de 2002. Comparació dels valors mitjans (longitud mitjana de l'ou, alçada i volum de l'ou en 7 postes de la Vansa/Prat de Botons respecte 5 postes de la Bòfia) mitjançant un t-test (dades de distribució paramètrica) i un U-test (dades de distribució no paramètrica).*

	High-quality area Vansa / Prat de Botons (n=7)	Low-quality area Bofia (n=5)	Test	Total (n=12)
Egg length (mm) <i>Longitud de l'ou</i>	16.6±0.9 SD	15.7±0.3 SD	U-test; T=19.0; P=0.030	16.2±0.9 SD
Egg width (mm) <i>Amplada de l'ou</i>	12.5±0.3 SD	12.2±0.4 SD	t-test; t=-1.50; df=10; P=0.16	12.3±0.4 SD
Egg volume (mm <sup>3</sup> ) <i>Volum de l'ou</i>	1330.0±48.3 SD	1183.7±57.2 SD	t-test; t=-1.95; df=10; P=0.068	1269.0±143.2 SD

tat al Port del Comte, al Prepirineu català. Tot i que la mida de la mostra va ser força baixa, es van obtenir evidències d'ous més grans amb volums més grans al lloc d'alta qualitat. Aquestes dades es corresponen amb els resultats d'estudis previs en els quals es va trobar considerable variació entre aquestes dues localitats pel que fa a supervivència, condició física, velocitat de la muda, selecció de dieta i èxit reproductor. Aquestes dades suggereixen que la qualitat d'hàbitat i la qualitat de les femelles també afecten la mida de l'ou en aquestes subpoblacions properes.

## Resumen

### Variación entre localidades en el tamaño del huevo del Verderón Serrano *Carduelis citrinella* en el Prepirineo catalán

Se estudió la variación del tamaño del huevo del Verderón Serrano en dos áreas de alta y baja calidad de hábitat en la sierra del Port del Comte, en el Prepirineo catalán. A pesar de que el tamaño de la muestra fue bajo, se obtuvieron evidencias de huevos mayores con un volumen también mayor en la zona de alta calidad de hábitat. Estos datos se corresponden con los resultados de estudios previos en los cuales se encontró una considerable variación entre estas dos localidades en lo que se refiere a supervivencia, condición física, velocidad de la muda, selección de dieta y éxito reproductor. Estos resultados sugieren que la calidad del hábitat y la calidad de las hembras también afectan al tamaño del huevo en estas subpoblaciones próximas.

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