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Short communication

The endemic Cyprus Wheatear (*Oenanthe cypriaca*) adapts readily to artificial nest sites

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ABSTRACT

Widespread urbanization leads to environmental changes and affects avian populations. We provided artificial nest sites in the form of plastic tubes placed in earth embankments and compared the breeding parameters to those in natural nest sites of the endemic Cyprus Wheatear (*Oenanthe cypriaca*). We hypothesized that the loss of semi-natural habitats, in which Cyprus Wheatear have coevolved with agriculturists, could be offset by the provision of alternative nest sites. We found that breeding parameters like clutch size (4.7; 95% CL: 4.6–4.9), the number of nestlings (4.0; 3.7–4.3), fledglings (3.5; 3.2–3.9) and overall breeding success (82.2%; 73.7–89.0) did not differ between natural and artificial nest sites. Average occupancy of artificial nest sites was only 6.1% (5.4–6.7) but at present, the Cyprus Wheatear population appears to be resilient with high reproductive output and survival. The study showed that the endemic Cyprus Wheatear readily adapts to alternative, artificial nest sites, and their reproductive output is similar to individuals nesting in natural sites. Considering novel approaches to sustain future populations of endemic species are crucial in the face of a fast-changing world.

1. Introduction

It is widely accepted that expanding human development leads to a transformation of natural habitats and loss of diversity of breeding bird communities (Devictor et al., 2007; Aronson et al., 2014; Seress and Liker, 2015; Morelli et al., 2016). Some species adapt to these changes while others may irrevocably reduce their ranges and populations (e.g., Trojan et al., 1982; Jokimäki et al., 2016). Even species considered to be extremely abundant globally may dramatically reduce their numbers, like the House Sparrow (*Passer domesticus*) in Europe (Hole et al., 2002; Summers-Smith, 2003). Hence, in a rapidly changing world, it is critical to better understand even those species considered to be abundant to conserve them for future generations (cf. Ehrlich et al., 1995; Dawson et al., 2011).

To pre-empt future loss of populations, it is important to understand foraging and habitat requirements (cf. Randler, 2010; Randler et al., 2010), as well as reproductive behaviour and fecundity (e.g., Xenophontos and Cresswell, 2016a). Island endemics are known to be more susceptible to human encroachment and ecological pressures (e.g., Brown and Kordic-Brown, 1977). Hence, we focused on a relatively little-studied, but still viable population of the endemic Cyprus Wheatear (*Oenanthe cypriaca*). Cyprus is an example of a place wherein urbanization is not only encroaching on surrounding habitats but also infringing on cultural heritage sites (e.g., Agapiou et al., 2015).

In a preliminary study, we observed that the Cyprus Wheatear breeds readily in the proximity of human habitation in the traditional villages where houses are built of stone, and have crevices in them, providing this species and other hole nesters with breeding habitat (also see Randler et al., 2010). However, modern architectural techniques related to the construction and renovation of buildings are known to result in a reduction of cavities (see Hagan, 2001; Surya, 2016). Hence, we predict that the increase of modern building and renovation techniques, and extended urbanized areas, could negatively impact the Cyprus Wheatear (Hansen et al., 2005). In this study, we tested the effectiveness of providing artificial nest sites in the form of plastic tubes placed in the field by comparing basic breeding parameters of these sites to natural nest places. We reasoned that if this cavity nesting species can adapt to artificial nest sites in the proximity of humans, continued modernization of Cyprus will be less likely to affect their long-term persistence.

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2. Methods

The island of Cyprus, located in the south-eastern Mediterranean, is considered a tourist hot-spot, which has led to extensive development over the past three decades (Sharpley, 2003). Kammas (1993) noted the unprecedented pressure of these changes on the natural environment, while others found that tourism and modernization have led to pollution, loss of flora and fauna, and loss of agricultural land (Apostilides, 1995; Akis et al., 1996).

Our study area in Cyprus covered the central and southern parts of the island, from sea level to 1200 m a.s.l. It is dominated by open, xeric habitats and includes Mediterranean grasslands, shrublands, forests and garrigue, with intermixed agricultural fields, orchards, and villages. Summers are hot and dry, and winters relatively cool and wet. The mean annual temperature is 18 °C and the average annual precipitation is > 400 mm (Iezikel et al., 2016). This habitat differs significantly from that of Xenophontos and Cresswell (2016a,b) in that their study was conducted at higher altitudes of 1800 m a.s.l. within the Troodos National Forest Park (TNFP).

This study of the Cyprus Wheatear, an island endemic that migrates to sub-Saharan Africa in winter (Xenophontos and Cresswell, 2016a,b), was conducted during two breeding seasons (March–July) in 2011–2012. We established 7 transects measuring a total of 46.3 km and between 09:00–15:00 h searched an area of 50 m on both sides for nests. Transects were visited every 2–3 days in early spring (late-March–mid-April), and every 4–5 days when territories occupied (mid-April to late-June). In addition to searching for natural nests (Fig. 1a), in January and February 2011, in the transect area, we placed 200 artificial nest sites (plastic tubes 35 cm long and 10 cm in diameter; Fig. 1b). Of these 180 were operational in the 2012 breeding season. The tubes were placed in roadside banks or in agricultural terraces, such that entrance holes were equidistant from the top and the ground and protruded ca. 6 cm. We placed small stones at the entrance of the tube to imitate natural *Oenanthe* spp. nests (cf., Moreno et al., 1994; Yosef and Afik, 1999). Reproduction data, from egg laying to fledging, were collected at 4–5 day intervals. Nests were inspected only when parents were absent. Owing to the structure of the natural nests or the artificial tubes, we were able to easily identify the nest contents and status. We obtained data for 107 nests, 84 natural (51 – 2011, 33 – 2012) and 23 artificial (12 – 2011, 11 – 2012).

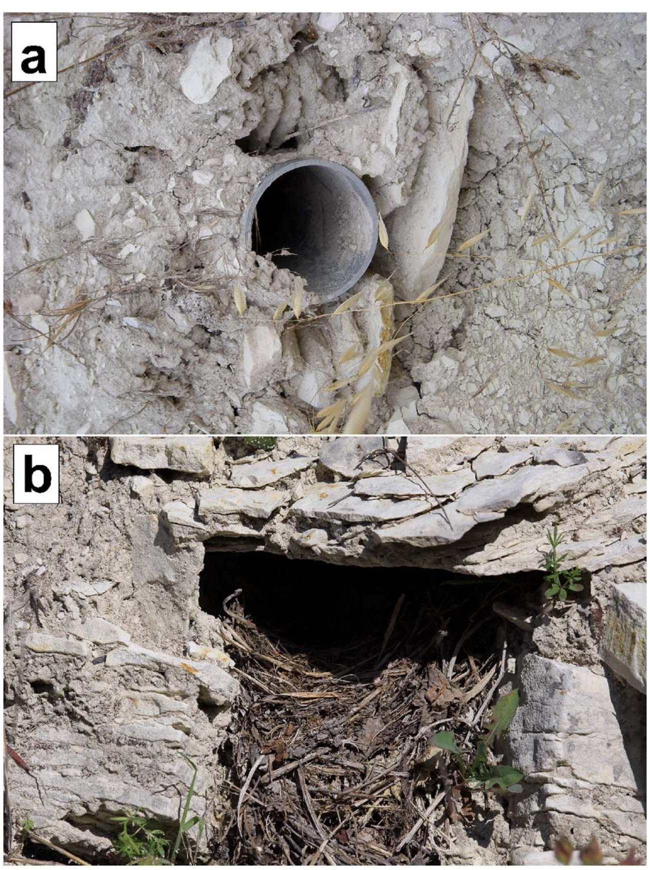

Fig. 1. Photographs of the artificial (a) and natural (b) nest sites of the Cyprus Wheatear in earth embankments.

Only first clutches were analysed. We considered brood initiation as the day on which the first egg was laid in the nest and the data are presented in number of days after 31 March (1st April – 1 day, etc.). Furthermore, only completed clutches with 3 or more eggs were included in the analysis. The number of nestlings was calculated based on the first inspection after hatching. The number of fledglings was defined as the number of nestlings present in the nest during the last visit before fledging, that they were older than 10 days, and that the next inspection did not show any evidence of nest failure. A reproductive attempt was considered successful if at least one young fledged. The breeding success was defined as the proportion of successful nests to all inspected nests and was presented in %.

In order to compare the breeding performance between the "natural" and artificial nest sites, we analysed basic breeding parameters including clutch initiation, clutch size, and the number of nestlings and fledglings. Because these parameters could be influenced by year, our analysis was performed using Factorial ANOVA with the type of nest site and year as factors (Zar, 1999). The Bonferroni corrections were applied to adjust the alpha values for the increased probability of obtaining statistical significance from multiple testing. Not all information was obtained for all nests studied and this resulted in differences in sample size between the different analyses. Mean values are presented with 95% confidence limits (CL).

3. Results

The occupancy rate of the artificial nest sites was 6.0% (CL: 3.1–10.3) in 2011, and 6.1% (CL: 3.1–10.7) in 2012 and did not differ between the years (chi-square = 0.01, df = 1, p = 0.964). Furthermore, the date of clutch initiation, clutch size and number of nestlings and fledglings did not differ between the natural and the artificial nest places (Factorial ANOVA; date: $F_{1,\ 103} = 0.05$, $p = 0.829$; clutch: $F_{1,\ 101} = 0.23$, $p = 0.630$; nestlings: $F_{1,\ 103} = 1.08$, $p = 0.302$; fledglings: $F_{1,\ 103} = 1.78$, $p = 0.185$; Table 1). The overall breeding success also did not differ between the nest site types (chi-square = 0.45, df = 1, p = 0.504; Table 1).

4. Discussion

Artificial nests have been considered for many avian species, particularly when nesting habitat is a population limiting factor (cf. Newton, 1994). This conservation tool is most commonly applied with cavity nesting species such as seabirds (e.g., Bolton et al., 2004), Passerines (e.g., Dawson et al., 2005), Near Passerines (Wang et al., 2009), diurnal and nocturnal raptors (e.g., Sonerud, 1985) and Parrots (Vaughan et al., 2003). However, no previous studies have evaluated the viability of artificial nests for *Oenanthe* species. Hence, the importance of this study is in verifying that a still-common cavity nesting species can adapt to artificial nest sites in a rapidly urbanizing environment.

Our study demonstrates that artificial tubes constitute a valuable compensatory nest for the Cyprus Wheatear. We did not find any differences in the phenology or the basic reproductive parameters between the artificial and natural nest sites. Furthermore, the reproductive output was similar to that documented by Xenophontos and Cresswell (2016b). This is of interest because both studies were conducted simultaneously but in geographically different areas. While our study was closer to the coastal plain and below 1200 m a.s.l., Xenophontos and