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Use of blackbird nests as a resource by garden dormice (*Eliomys quercinus*)

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Abstract

Since 1996, the population of garden dormice in an orange grove of Eastern Spain has increased. Here, dormice prey on blackbird (*Turdus merula*) eggs and chicks, and eventually occupy their nests to use them as food stores or reproductive nests. This work examined the effect of dormice predation on blackbird reproductive success and the subsequent use of available blackbird nests. We monitored all the blackbird nests built in the study area during the breeding season in 2008. We used the Mayfield Nest Success Estimator to assess the daily nest use rate by dormice and their daily predation rate. Our results suggest that blackbirds respond to the dormice predation rate as they build a larger number of nests. The monthly dormice occupancy rate depends on nest availability. Dormice prefer to occupy nests that have not been used for breeding purposes.

Keywords: interaction, seasonal, occupancy, predation, Gliridae

1. Introduction

Nest predation is the primary agent of avian nest mortality and exerts a strong selection on avian behaviour and life-history strategies. Rodents are known to be an important cause of brood losses of passerine birds. Furthermore, the bird nest structure can become an important resource for many rodent species like garden dormice (*Eliomys quercinus*). Dormice can interact with different bird species because they prey on eggs and nestlings (Koppmann-Rumpf et al. 2003, Juškaitis 2006, Adamík & Král 2008), and compete for similar resources (Sarà et al. 2005, Juškaitis 2006). Throughout their distributional range, garden dormice have been identified as a bird predator (Palacios 1975, Airapetyants 1983, Gatter & Shütt 1999, Henze & Gepp 2004, Gil-Delgado et al. 2009), but their impact on bird species can be greater because garden dormice also use abandoned or recently built nests in which they breed (Palacios 1974, 1975) or store food (Hernández 1994).

We examined the effect of dormice predation on blackbird reproductive success and the use of available blackbird nests.

2. Study area and methods

This study was conducted in an orange plantation of 8 ha located in Sagunto (Valencia, East Spain; 39º 42’ N, 0º 15’ W, 30 m a.s.l.). This study area is a fragment included in an homogeneous plot of 16.92 ha described elsewhere (Gil-Delgado et al. 2002, 2010) whose breeding bird community has been monitored since 1975.

Sampling was conducted using the Nest Searching Method (Val Nolan 1963, Sutherland 1996). Nests were searched for from early March to August, and trees were inspected every 10–12 days (Gil-Delgado & Escarré 1977, Gil-Delgado & Lacort 1996, Gil-Delgado et al. 2005). When nests were found, they were classified into six different categories: i) successful nests: fledged blackbird nestlings, ii) nests preyed on by dormice: predation signs such as egg shell pieces or dead chicks appearing in nests, iii) nests preyed on by other predators: signs belonging to other predators appearing in nests, but also indeterminate predators, iv) abandoned nests visited by dormice: despite the absence of predation evidence, recognisable dormouse faeces were found or nests were modified by dormice, v) unused nests: nests that were never used by blackbirds or other animals, and vi) abandoned nests visited by other predators: nests were never preyed on, but recognisable faeces of different or indeterminate predators were found or nests were modified by other predators.

Common predators in the study area were identified by either direct observation or the presence of remains and faeces (Gil-Delgado & Escarré 1977, Gil-Delgado et al. 2009). Nests were not removed after the first observation, irrespective of the category they belonged to. Used nests without eggs or nestlings were checked every 7 days for a period of 30 days. Non-used nests were eliminated 30 days after the first observation. Occupied nests were checked every 3 days for 30 days.

2.1. Daily nest use and daily predation rates

Mayfield's Nest Success Estimator (Mayfield 1975) was performed to calculate the daily use rate of blackbird nests by garden dormice (NUDR), as well as the daily blackbird predation rate (NPDR).

In order to describe the seasonal trends we adjusted the least-squares quadratic equations to the data on available blackbird nests and nests used by dormice. The relationship between nests used by dormice and available unused nest were determined with Pearson's correlation test. We also analysed nest type preference using the chi-square test. Statistical analyses were done with the SPSS/PC + statistical package, v. 17.0 (SPSS Inc., Chicago, IL, USA).

3. Results

We found a total of 232 blackbird nests belonging to 32 pairs (7.25 nests per pair). However, 42 (22.1%) of these nests had already been occupied by dormice and other animals, so they were excluded from the analysis.

3.1. Different nest use

The remaining nests (n = 190) were used by blackbirds, dormice and other species. In 7 nests (3.7%), blackbird nestlings fledged successfully. Table 1 summarises the different forms of nest use.

3.2. Seasonal occupancy variation

The number of available blackbird nests increased from March to May, after which nest availability decreased ($Y_{available\ nest} = -18.4X^2_{month} + 114X_{month} - 61.4$, $R^2 = 0.96$, $p = 0.044$) (Fig. 1). The same pattern was noted in nest occupation by dormice, although quadratic equation was not significant ($Y_{occupied\ nest} = -10.64X^2_{month} + 63.56X_{month} - 42.2$, $R^2 = 0.95$, $p = 0.056$). Further, the used nests by dormice and the unused nests that remained available were correlated significantly ($r = 0.91$, $p < 0.032$).

3.3. Differences in nest use by garden dormice and other predators

Blackbirds used 121 nests for breeding whilst 69 nests were unused. Dormice visited 79 out of these 121 used nests and 30 out of 69 unused nests. So, used nests were significantly more visited than unused nests. ($\chi^2_1 = 8.55$; $p < 0.01$). Furthermore, our results showed that unused nests (n = 69) were not visited significantly more often by dormice (n = 30) than other predators (n = 9) ($\chi^2_1 = 0.111$; $p < 0.01$; n = 81). Finally, we observed that both used (n = 15) and unused (n = 17) blackbird nests showed signs of secondary use by dormice. Dormice preferred to occupy unused nests in respect to nests used by blackbirds and preyed previously by dormice ($\chi^2_1 = 14.88$; $p < 0.001$).

3.4. Daily nest use rate and daily predation rate

Garden dormice were responsible for 63 % of the visits to blackbird nests. Another important visitor was the black rat (*Rattus rattus*). The daily nest use rates were 0.032 and 0.009 nests visited per day by dormice and by black rats, respectively.

A total of 121 out of 190 nests were predated by dormice (63.7 %). The daily predation rate of nests by dormice was 0.1591 nests per day. Thus, more than 99 % of nests failed.

Tab. 1 Number and percentage of blackbird nests and their various uses by different species. BSN: blackbird successful nests, GD: nests used by garden dormice, B + GD: nests used by blackbirds and garden dormice, B + O: nests used by blackbirds and other species. MS: nests used by more than two species, NU: nests not used.

	BSN	GD	B + GD	B + O	MS	NU	TOTAL
No.	7	30	79	35	9	30	190
%	3.68	15.79	41.58	18.42	4.74	15.79	100

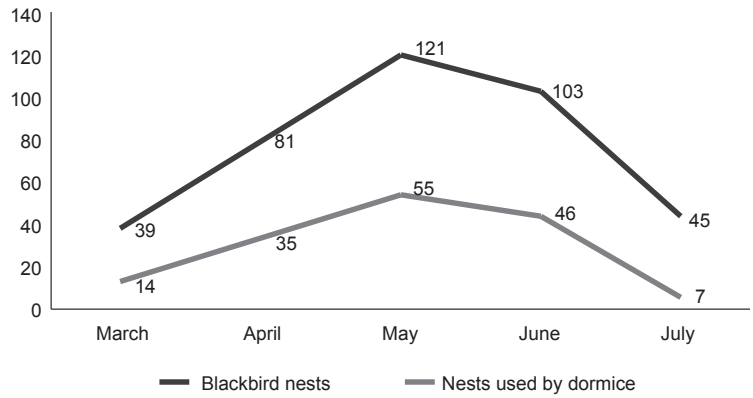

Fig. 1 Number of available blackbird nests (new built nest + available nests of the previous month) and number of nests occupied by dormice during the blackbird breeding season.

4. Discussion

In the orange groves of Eastern Spain, more than half of blackbird nests were preyed upon or occupied by dormice. This means that dormice have no difficulties in finding blackbird

nests in spite of the concealment that orange trees offer to blackbirds. This result agrees with other studies which suggested that some carnivorous dormice, such as garden dormice, forest dormice (*Dryomys nitedula*) or edible dormice (*Glis glis*), can prey on birds because they systematically inspect nest boxes (Gatter & Shütt 1999) and tree cavities when looking for food (Adamík & Král 2008).

Nests are considered a resource for dormice (Adamík & Král 2008). Hence, variation in the number of nests occupied by dormice according to changes in nest availability is expected. However, although dormice occupied blackbird nests in parallel with the increasing number of nests available from March to April, the lower number of nests available from May to July did not correspond to a larger proportion of nests occupied by dormice. This pattern can be explained by the drop in nest-searching activity, which could occur when most dormice have already occupied nests.

Our data on seasonal nest use indicate that nest sites such as tree cavities, nest-boxes and bird nests, are an important resource for dormice. They could take advantage of already-built nests to save energy by using existing nests as the basis for their own. This nest interference has led blackbirds to abandon nest used by dormice or other predators and to start building another new nest. This anti-predatory response has been reported for different bird species that avoid the nest-boxes used by dormice (Juškaitis 1995, 2006). Before the first evidence of colonisation of orange groves by dormice in 1999, blackbirds built approximately 2–3 nests per breeding pair (Gil-Delgado & Lacort 1996). In 2008, each blackbird pair built an average of 7 nests, which is likely to have been a response to predatory pressure.

We also found that dormice used robbed blackbird nests for different purposes, depending on the previous use by blackbirds. Dormice prefer blackbird nests that have not been used to those previously employed for breeding purposes. We suggest different reasons for this behaviour. Dormice and other predators may be attracted by the presence of egg or corpse remains, so dormice may prefer empty nests to prevent other competitors or predators from visiting. Moreover, used nests may still contain a significant amount of parasites, which could infect young dormice.

Some factors may prove important to determine the level of the dormice-birds interaction in different ecosystems (Juškaitis 2006, Koppmann-Rumpf et al. 2003, Adamík & Král 2008). These main factors are dormice abundance, activity time or bird species diversity. In our case, we conclude that the strong interaction between garden dormice and blackbirds is caused by two basic factors; firstly, the dormice population has increased considerably since the first colonisation steps in orange groves. On the other hand, dormice are active all year round given the complete absence of hibernation in orange groves in East Spain (Gil-Delgado et al. 2006) so the blackbird breeding season fully overlaps with the active period of this rodent.

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