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Article:
Pârâu, LG, Kingma, SA, Weigl, SE et al. (3 more authors) (2017) Dynamics in numbers of group-roosting individuals in relation to pair-sleeping occurrence and onset of egg-laying in European Bee-eaters Merops apiaster. Journal of Ornithology, 158 (4). pp. 1119-1122. ISSN 0021-8375

https://doi.org/10.1007/s10336-017-1468-1

Dynamics in numbers of group-roosting individuals in relation to pair-sleeping occurrence and onset of egg-laying in European Bee-eaters Merops apiaster

Running title: Group-roosting and pair-sleeping in bee-eaters

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Abstract

Sleeping in the nest at the beginning of the breeding season is common for birds nesting in cavities. Here, we report evidence that European Bee-eaters Merops apiaster sleep in pairs in the nesting burrow. In 3.2 % of the nest checks we found two individuals sleeping together. This behaviour ceased once hatching started. A decrease in the number of birds at a communal roost coincided with the incidences of pair-sleeping and initiation of egg-laying. Thus, checking the burrows of European Bee-eaters at beginning of the breeding season increases the chance of observing pair-sleeping.

Keywords: roost, sleeping behaviour, burrow, pair, European Bee-eater, Merops apiaster

Introduction

European Bee-eaters Merops apiaster (Aves, Coraciiformes) are migratory birds that breed in colonies in Northern temperate regions (Cramp 1985). They return between late April and early May from tropical Africa (Glutz von Blotzheim and Bauer 1980). Bee-eaters dig deep horizontal burrows in sites such as loess walls and sand pits in which they lay eggs and rear the brood (Fry 1984). After arriving at the breeding grounds, it is common for individuals in a population to flock in the evening and roost together, often at the same roosting site. Before egg-laying, the pair occasionally sleep together in the nesting burrow (Glutz von Blotzheim and Bauer 1980; Fry 1984). After egg-laying initiation, one of the partners, most often the female, will remain in the burrow during the night, to incubate the clutch (Glutz von Blotzheim and Bauer 1980, this study).

Here, we examine if counts of individuals at roosts can be used to predict the population-wide timing of egg laying, as numbers will go down once individuals start to sleep in burrows. This may be especially obvious if pairs roost together in the burrow, as the number of individuals at the roost is therefore expected to decrease. This phenomenon, if not taken into account, could potentially bias the numbers of breeding birds estimated through roost counts. Little information exists so far on the frequency and timing of pair-sleeping in European Bee-eaters and their consequences for roost size fluctuations. In this paper, we report pair-sleeping behaviour of European Bee-eaters and we interpret its importance for estimating breeding initiation by analyzing roost counts.

Methods

We carried out our observations on Susak Island, Croatia (44°30'28"N, 14°18'13"E) from May 10th until August 7th, 2014 (see Bi et al. 2016). The study site, a natural island (3.8 km^2), is the largest sandy island in the area. It is dominated by a high plateau (approximately 70 m altitude) surrounded by vertical sand and loess walls, which provide suitable breeding places for the bee-eaters. From this elevated plateau we observed that all bee-eaters sleep in the same roost. At the roosting site we counted incoming birds every evening between 8 and 9 PM, except for evenings with unfavourable weather conditions. To confirm that birds spent the night at the roost, we also observed the emerging flock on four days at dawn. We recorded the roost group size at dawn on two other occasions, when counts could not be made on the previous evening. Breeding birds were confirmed by observing bird behaviour (defending the burrow, entering with food) or checking the burrow contents with an endoscope (see Checking burrows section).

Checking burrows

The island had a total of 470 burrows (unoccupied, old, new, unusable, etc.), excavated in loess walls or sand pits. With an endoscopic camera (Ridgid micro-CA100, USA) we investigated 86 burrows that could be safely reached, of which 25 were occupied by bee-eaters. These burrows were checked every second day, to minimize disturbance. We checked burrows during three periods: (1) "morning" between 5 AM until 9 AM, (2) "day" between 9 AM and 6 PM and (3) "evening" between 6 PM until 10 PM. In the period between the first egg (May 29th) and the last egg laid (June 30th) we monitored 14 active burrows (186 checks, mean 13 checks per burrow). We made a total of 111 checks during the daytime (mean 7.9 checks per burrow), 39 during the

morning (2.8) and 36 during the evening (2.6). All burrows were checked during all three periods.

Results

We counted a maximum of 80 bee-eaters at the roost site. From May 25th onwards the roost size decreased and we recorded days with less than ten birds at the roost (Fig. 1). Towards the beginning of the hatching period (June 25th), roost size increased again, but it did not reach the initial high values. The low numbers recorded between 14th – 20th May (including 3 days with no count) might be explained by the strong winds (pers. obs.). The results for our breeding pair count agree with the initial roost size: we counted a total of 42 breeding pairs distributed across the island.

We observed pair-sleeping (Fig. 2) in four burrows (28% of monitored burrows); in two of the burrows we recorded pair-sleeping twice. We detected pair-sleeping on six occasions in these four burrows (10% of total checks), but we only found one bird inside on 43 occasions in these four burrows (69%) and 13 times these four burrows were empty (21%). We detected the pair-sleeping events in the morning at 05:55, 06:15 and 08:20 AM, and in the evening at 8:00, 8:10 and 8:30 PM.

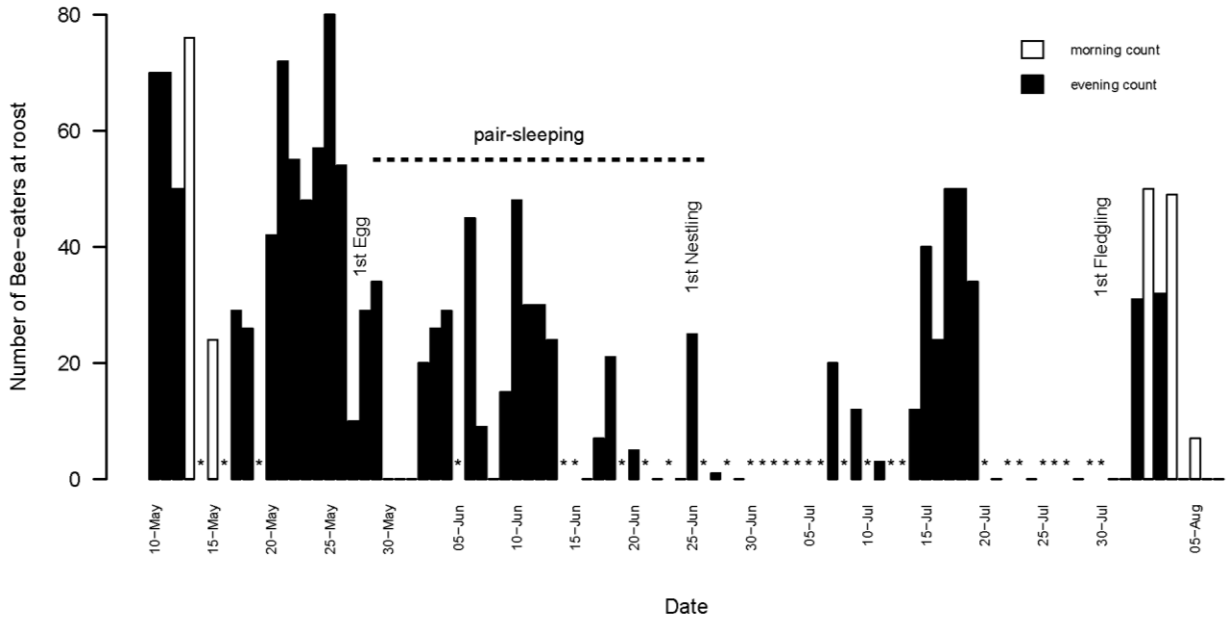

Figure 1. Number of European Bee-eaters counted at the roost on Susak Island, from May 10th until August 7th, 2014. "*" marks the days when no counts were conducted.

Figure 2: Endoscope picture showing pair-sleeping of European Bee-eaters - May 31st 2014, 8:10 PM, Susak Island.

Discussion

Communal roosts

Concerning roost site dynamics, the decrease in roost numbers during egg laying phase that we observed, is comparable to the one described by Cougill and Marsden (2004) who observed a decline in numbers of Red-tailed Amazons Amazona brasiliensis at the beginning of the breeding season. The size of the bee-eater roost on Susak declined from May 25th, and did not reach the initial high numbers again later in the season, even after the fledgling period. During our study, we did not observe males roosting in the vicinity of their nesting burrow, or any bee-eater activity during the night (see also Inglisa and Galeotti 1993). As diurnal wild birds generally sleep 6-7 hours per night (Campbell and Tobler 1984; Amlaner and Ball 1994), we believe the strong decrease in roost size can be explained by a higher frequency of pair-sleeping during that period. We therefore advocate that, at least for isolated European Bee-eater populations, roost counts can be used to determine the onset of egg-laying.

Pair-sleeping occurrence

To our knowledge, this is the first detailed note on adult European Bee-eaters pair-sleeping in the nesting cavity. In the period when we observed two birds sleeping in the burrow, we recorded neither helpers nor other birds at the nest, indicating that the two birds sleeping together were a pair. In the literature, there is evidence for Rufous-fronted Thornbirds Phacellodomus rufifrons (two to several) occupying the same nest during the night (Skutch 1996) and Purple Martins

Progne subis occasionally display pair-sleeping (Brown 1980). Moreover, pairs of Barn Swallows Hirundo rustica often roost together in the nest (Liviu G. Pârâu and Simon E. Weigl pers. obs.) and pairs of Sand Martins Riparia riparia occasionally sleep in the burrow (Zoltán D. Szabó, pers. com.). In addition to our study, we also incorporated unpublished data from 1988 (2^{nd} to 8^{th} of June) collected at a European Bee-eater colony with 85 nests in the Camargue, southern France (see Lessells 1990; Lessells et al. 1994). In this population, pair-sleeping was observed in 5.9% of cases (versus 3.2% on Susak), but always after 9 PM. Previous comprehensive research on European Bee-eaters (Avery et al. 1984; Inglisa and Galeotti 1993; Václav 2000; Pittocopitis 2007) does not mention pair-sleeping, illustrating that this behaviour might be irregular or overlooked.

One factor that may limit the frequency of pair-sleeping is the enhanced risk of predation in the burrow. We witnessed a Western Whip Snake Hierophis viridiflavus predating one of the bee-eater burrows on Susak. In the Camargue colony in 1987 (one year before the included data were collected), a Least Weasel Mustela nivalis killed 15 breeding bee-eaters in their burrows. We suggest that predation inside the burrow – a common phenomenon in our study areas – might explain why bee-eaters do not always sleep together in the burrow. Finally, since the period in which birds sleep together in burrows is just before or during egg-laying, we cannot exclude that pair-sleeping also functions as a mate guarding mechanism.

Despite having potentially important consequences, little is known about pair-sleeping. This lack of information might have three causes: (i) few species display pair-sleeping behaviour, (ii) the current field research methodology (like the time of checking cavities) is insufficient to detect pair-sleeping or (iii) it is simply not reported in the literature. To conclude, we believe that

performing nest inspections at appropriate times of day will improve our knowledge about the range of species that display pair-sleeping behaviour.

Acknowledgements

We would like to thank Maja Keleraba, Alen Hosic, Harv Stanic Staalman, Kat Bebbington and Sarah Vanes for their help on Susak Island. The study was supported by a grant from the Nicolaas Mulerius Foundation to HLD. SAK was funded by a VENI fellowship (863.13.017) awarded by the Netherlands Organisation for Scientific Research (NWO) and a grant from the Ecology fund (UPS/297/ECO/1414J) awarded by Royal Netherlands Academy of Arts and Sciences (KNAW). JS was funded by the Volkswagen Foundation. Fieldwork in Croatia was approved by the Croatian Institute for Ornithology and the Croatian Ministry of Environmental and Nature Protection. We thank two anonymous referees for comments on the original manuscript.

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