

SIGNIFICANT DECLINE IN THE NUMBER OF ACTIVE NESTS IN THE COUNTRY'S LARGEST BEE-EATER COLONY OVER A TWO-YEAR PERIOD

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ABSTRACT. We report a significant decline in the number of active breeding burrows at the largest national colony of bee-eaters *Merops apiaster* Linnaeus, 1758, located in the Protected habitat “Glinara” in Belgrade. The number of active burrows decreased from 305 in the 2023 breeding season to 204 in 2025.

Keywords: anthropogenic disturbance, breeding season, *Merops apiaster*.

The European bee-eater (*Merops apiaster*; hereafter “bee-eater”) is a migratory species that breeds across the Palearctic and overwinters in Africa (BASTIAN and BASTIAN, 2024). Bee-eaters nest in burrows that they excavate in substrates such as loess, clay, or sand, typically on vertical cliffs, forming colonies that may range from only a few to several hundred breeding pairs (CRAMP, 1985; BASTIAN and BASTIAN, 2024). Through their burrow-excavation activity, bee-eaters create nesting opportunities for a variety of secondary cavity-nesting bird species (PETRESCU and ADAM, 2001; PURGER, 2001; KOSHELEV *et al.*, 2020, CASAS-CRIVILLÉ and VALERA, 2024; SHUPOVA *et al.*, 2022). In addition, various amphibians, reptiles, and mammals use bee-eater burrows as shelters or breeding sites, which makes this species an important ecosystem engineer (CASAS-CRIVILLÉ and VALERA, 2024).

In general, adult birds tend to return to the same breeding site in subsequent breeding seasons (BASTIAN and BASTIAN, 2024), although the proportion of returning birds may vary. For instance, ring-recovery data revealed that 80% of birds returned to their previous-year colony in Ryazan, Russia (FRY, 1984), whereas around 34% returned in Camargue, France (LESSELLS and KREBS, 1989). Typically, birds that were successful at breeding in the previous year are also more likely to return to the same colony. Nevertheless, if the colony is disturbed, site fidelity may drop, with only 25% of birds returning to their previous-year breeding site (BASTIAN and BASTIAN, 2024). Breeding-site fidelity is less pronounced in first-year birds, of which around 20% return to their natal colony; young males return more often, whereas young females disperse elsewhere (FRY, 1984; BASTIAN and BASTIAN, 2024).

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The bee-eater population in Serbia is estimated at 5,200–8,500 breeding pairs, with an increasing long-term population trend (BIRDLIFE INTERNATIONAL, 2021). The highest number of bee-eaters breeds in Vojvodina, which comprises 60% of the breeding population in the country (PUZOVIĆ *et al.*, 2015). Large bee-eater colonies have been recorded at Titelski Breg, where the total number of breeding pairs in the area is estimated at 400–700, and along the Danube loess bluffs, with an estimated 200–400 breeding pairs (PUZOVIĆ *et al.*, 2009). The largest colony in Serbia, with the highest density of breeding pairs, has been recorded in the Protected habitat “Glinara” in Višnjička Kosa, Belgrade, where around 300 pairs of bee-eaters bred in a mixed colony with swifts *Apus apus* (Linnaeus, 1758) and starlings *Sturnus vulgaris* Linnaeus, 1758 (NOVČIĆ *et al.*, 2024). Here, we report a significant reduction in the number of active breeding burrows at this colony over a short period of two years and discuss possible reasons for such a decline.

The studied colony was situated in a loess bank in Višnjička Kosa, Belgrade, which originated from historical clay excavation. A recent study revealed that 305 breeding burrows were active in 2023, along with over 120 starling nests, and about a dozen swift nests (NOVČIĆ *et al.*, 2024). Since 2024, the 30-hectare area – including the studied bank – has been protected under the Decision on the declaration of the Protected habitat “Glinara”, as a site of local significance (ANONYMOUS, 2024).

We visited the colony once to several times per week from 5 June to 8 August 2025. To evaluate the number of active nests, we used a slightly modified methodology of NOVČIĆ *et al.* (2024), in which we recorded the colony with high-definition digital camcorders in 45–60-minute sessions. Each segment of the colony was recorded once in early July, when birds were actively provisioning their nestlings, and selected burrows were examined with an endoscope camera. The recorded material was reviewed on a computer, and a burrow was classified as active if (1) birds entered the burrow at least twice during a single observation session, or (2) the presence of eggs or nestlings inside the burrow was confirmed. Differences in the numbers of active burrows recorded in 2023 and 2025 were examined using binomial tests of proportions (CRAWLEY, 2013) in R version 4.5.1 (R Core Team, 2025).

For the 2025 breeding season, we recorded 204 active bee-eater nests, which was 33% lower than in the 2023 breeding season (binomial test: $\chi^2 = 303.5$, $df = 1$, $p < 0.0001$). The decline was most pronounced in the south-eastern portion of the colony, where we recorded 128 active nests in 2023 but only 47 in 2025. The westernmost portion of the bank contained similar numbers of active nests in 2023 and 2025 – 86 and 84, respectively.

There are several possible reasons for such a decline in the number of breeding pairs within the colony. First, the colony’s position on the outskirts of a densely populated city makes it vulnerable to various forms of anthropogenic disturbance. A long-term study from Germany revealed that bee-eaters are susceptible to anthropogenic disturbance in areas where the frequency of disturbance is generally low, which is reflected in reduced provisioning of nestlings and lower return rates to previous-year colonies (BASTIAN *et al.*, 2013; BASTIAN and BASTIAN, 2024). We witnessed disturbance events on numerous occasions, including the riding of motorbikes and all-terrain vehicles, particularly in the south-eastern part of the colony, where a low portion of the bank is used for motorcycle jumping. In addition, residents from the surrounding area often deposit solid waste at the colony. For instance, in May 2025, when the birds had already arrived and begun occupying burrows, a resident deposited a full truckload of soil and debris down the bank, covering a substantial portion of it (Fig. 1). Although the studied bank and surrounding area have been protected under the Decision on the declaration of the Protected habitat “Glinara” as a habitat of local significance since 2024 (ANONYMOUS, 2024), the manager of the protected area – the association “Zeleno plavi koridori” – has difficulties implementing protection measures due to insufficient funds it receives from the city government (Fig. 2).



Figure 1. The portion of the colony covered by soil and debris deposited by a local resident (Photo I. Novčić, 2025).

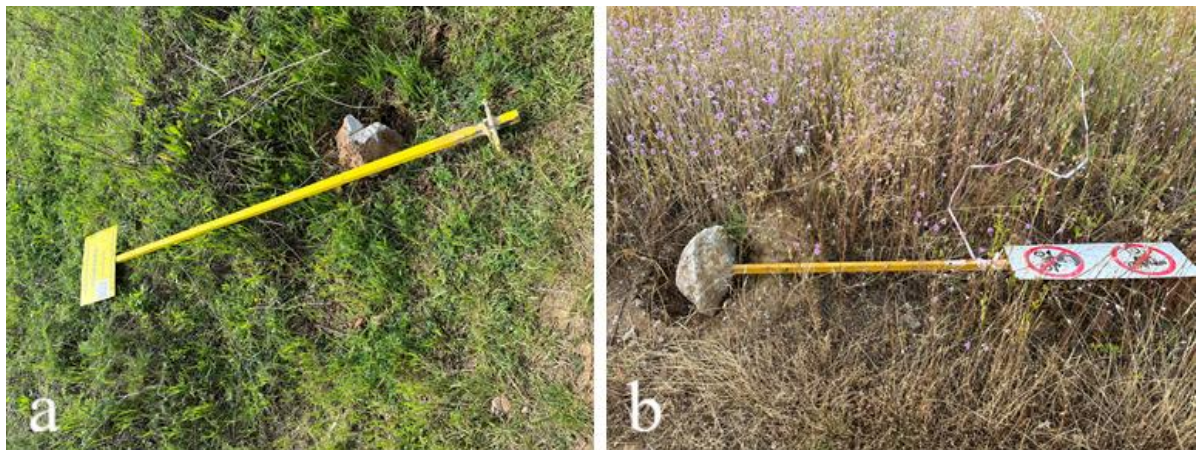


Figure 2. The information boards installed at the Protected habitat “Glinara” by the management authority – the association “Zeleno plavi koridori” – have been destroyed (Photo I. Novčić, 2025).

A second reason why the bee-eater colony may have experienced a significant reduction is extensive predation by the Caspian whipsnake *Dolichophis caspius* (Gmelin, 1789), which can depredate over 30% of bee-eater nests over a very short period (RAKOVIĆ *et al.*, 2024). We observed snakes entering bee-eater burrows throughout the 2024 and 2025 breeding seasons in all portions of the colony. Predation risk may influence birds' choice of breeding sites. For instance, a study in which predation risk was experimentally manipulated by placing snake models near nest boxes used by the little owl *Athene noctua* (Scopoli, 1769), scops owl *Otus scops* (Linnaeus, 1758), and European roller *Coracias garrulus* Linnaeus, 1758, showed that individuals of all three species re-occupied nest boxes without snake models significantly more often (PAREJO and AVILÉS, 2009). Hence, predation by snakes, in combination with human activities at the colony, may have forced birds to move elsewhere.

In addition to direct anthropogenic disturbances and predation at the nesting site, the observed decline in active burrows may also be linked to fluctuations in local food availability. European bee-eaters are highly specialized insectivores that rely predominantly on large flying insects, primarily Hymenoptera (bees and wasps) (BASTIAN and BASTIAN, 2024). As honeybees constitute the predominant prey of bee-eaters at the study colony (POPIĆ *et al.*, 2025), a potential decrease in local bee populations during the 2025 season—whether driven by adverse weather conditions, agricultural pesticide use in the surrounding foraging areas, or natural population cycles—could have reduced the carrying capacity of the habitat. Consequently, reduced prey

availability might have deterred some breeding pairs from settling at the Glinara colony, further exacerbating the decline caused by habitat disturbance.

Finally, the survival of migratory birds may be affected by conditions they encounter along their migratory routes or in their wintering areas (NEWTON, 2004). Insufficient food and increased competition at staging sites may lead to reduced feeding and fueling rates, which can affect subsequent survival and reproduction (NEWTON, 2006). Therefore, bee-eaters may have experienced a population decline before arriving at the study colony.

For a better understanding of the dynamics of the bee-eater colony in Višnjička Kosa and its improved protection, we propose continuous monitoring of the colony in subsequent breeding seasons, focusing on both the number of breeding birds and the presence of snakes. In addition, we propose a bee-eater banding program to determine return rates and breeding-site fidelity for this colony. Finally, we recommend stricter implementation of protection policies and adherence to the penal regulations defined by the Belgrade City Assembly.

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