

Short Communication

Temporal Occurrence of European Bee-Eater *Merops apiaster* and its Impact on Foraging Behavior and Queen Survival of Native Honeybee *Apis mellifera jemenitica* in Asir Region of Saudi Arabia

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ABSTRACT

Merops apiaster, a migrating bee-eating bird, wreaks havoc on their path and pasture in Saudi Arabia. It is widely found throughout the Kingdom during migration and in peak periods in April (spring) and September to mid-October (fall). It may breed from time to time in the east and northeast of the Kingdom, where pairs spend the summer. The present study investigated how honeybee *Apis mellifera* foraged in the presence and absence of the European bee-eater (*M. apiaster*). The data was gathered in the year 2020 during the migratory occurrence season of *M. apiaster* in Abha, Asir region of Saudi Arabia. The findings revealed that the number of forager bees collecting ground pollen from plates placed at various distances (10, 25, and 50 meters) from the hive entrances was affected by the presence of bee-eating birds. Three virgin sister queens were lost out of ten during the presence of European bee-eaters, while no queens were lost during the absence.

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Authors' Contribution

ZA and HAG designed the project and completed the field data collection. KAK analyzed the data. ZA, HAG and KAK wrote the final manuscript.

Key words

Predatory birds, *Merops apiaster*, *Apis mellifera*, Queen losses, Foraging activity

Aristotle classified *Merops*, along with other birds like swallows and woodpeckers as the natural enemies of bees. This perception has endured from ancient times to the present among beekeepers, who view bee-eaters as a significant threat to beekeeping. Among the predatory birds, the European bee-eater (*Merops apiaster* L.) is a widely distributed species, threatening bees throughout the Arabian Peninsula by destroying foraging bees at nearby apiaries. It is a diurnal migratory birds species that spend part of the year in flyway regions, raiding and devour both

foraging workers bee and queens during nuptial (mating) flights at nearby apiaries, and reported that a single bird can devour more than 100 bees per day (Al-Chzawi *et al.*, 2009; Ali and Taha, 2012; Floris *et al.*, 2020; Glaiim, 2014; Moreno-Opo *et al.*, 2018; Yakobson and Rosenthal, 1990).

The Asir region in southwestern Saudi Arabia lies between Africa and Arabian Peninsula, serves as a crucial refuelling and stopover site for numerous migratory birds (Newton and Newton, 1996; Boland *et al.*, 2020). Among these migratory species is the European bee-eater (EBE), which undertakes its annual migrations during the spring and autumn seasons (Boland *et al.*, 2020). More than 500 million birds from Europe and Asia are believed to undertake migration through the Middle East annually (Yosef *et al.*, 2006). Consequently, many birds choose the Asir region as a stopover, either to replenish their energy reserves during the spring for resting or for refuelling to cross the Red Sea zone (Stagg, 1994; Moneim, 1992). During the annual stopovers in both spring and autumn,

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EBE poses a severe threat to honeybee colonies of native bee *Apis mellifera jemenetica*. It single-handedly contributes to significant losses in the beekeeping industry in the Asir region of southwestern Saudi Arabia (Ali, 2012; Ahmad, 2023; MEWA, 2019). There have been occasional scientific reports of this species presence, largely in local languages (Ali and Taha, 2012; Glaiim, 2014; MEWA, 2019). This study describes the seasonal occurrence of bird around apiaries and their effects on the foraging activities of honeybee colonies. Additional aspects of bird behaviour in terms of queen loss are also investigated.

Materials and methods

The Asir region, situated in the southwest region of Saudi Arabia, and covers an area of 81,000 km² and is positioned between latitudes 17°25' and 19°50' in the north and longitudes 50°00' and 41°50' east. The Asir region comprises mountains, plains, and valleys of the Arabian highlands running parallel to the Red Sea. Its climate varies significantly based on topography, slope, aspect, and seasons (NCWCD and JICA, 2007). The present study was conducted at the Centre of Honeybee Research and Products (CHRP) at Lasan Campus, King Khalid University, Abha, specifically on an apiary with 50 colonies of the native bee *Apis mellifera jemenetica* Rutner. To record and observe the occurrence and interactional behaviour patterns of bees and EBE a permanent observer was assigned at the station of CHRP, King Khalid University, Abha, Saudi Arabia.

This experiment employed 10 virgin queens in ten honeybee mating nuclei, consisting of four frames, two brood frames, and two honey/pollen combs. All the nuclei were separately given to newly emerged sister virgin queens for mating. These nuclei were inspected to ensure that no old queen cells remained and that the virgin (new) queens could fly and breed. To feed the nuclei constantly, sugar syrup (1:1) was provided at a distance of 10 meters. Every day, nuclei were examined for signs of mating and the presence of eggs in the comb. The number of mated and lost queens was recorded for each nuc.

For determining foraging activity, freshly powdered bee-pollen were dispersed on plastic plates, each one measuring a quarter of an inch in diameter (20 cm in diameter and 1 cm depth). There were three groups of five plates each, for a total of fifteen plates. The plates in each group were positioned in a row on the apiary's east side (behind the beehive entrances), with a 5-meter spacing between each plate in each group in each row. The first group was placed 10 meters from the apiary, the second 25 meters, and the third 50 meters away. Throughout the experiment, ground bee pollen was continuously supplied, and the number of honeybee workers who accumulated

ground bee pollens on their body hair and legs was counted on the plates for 5 min thrice a day (7-8, 11-12 and 5-6 pm). This approach of three times observation in a day was continuously followed throughout the four weeks of September 2020, when bee-eaters were present in the apiaries, as well as during their absence from the apiary on the last week of October and the next three weeks of November 2020.

The data were calculated as mean and standard error using the SPSS (version 20). All statistical analyses were performed using XLSTAT software.

Results and discussion

Temporal occurrence: The brightly colored bird *M. apiaster* is known as 'wirwar' and 'lagu' in Saudi Arabia. It is considered one of the serious pests attacking honeybee colonies in Saudi Arabia during Spring and Autumn (Ahmad, 2023). On their way back from the southern regions towards the north of the globe, they arrived in the south of the Kingdom as part of their seasonal journey and usually stay for about forty days or less during autumn while a month or less in spring (Moneim, 1992).

EBE is a frequently observed migrant during both passages, with a notable abundance in spring, reaching its peak in late April. The later occurrence hints that the populations traversing Asir likely originate from the eastern and northern regions of the species Eurasian range, where breeding is known to occur 2–3 weeks later than in the southwest (Boland, 2020; Yosef, 2006).

Usually, they come in flocks but sometime notice solitary standing on nearby perch scanning for prey at apiaries. Their continuous chirping in the sky gives the impression that their purpose is to announce the changing seasons in Saudi Arabia. Their temporal appearance in Asir region of Saudi Arabia is very specific during spring season (Ali and Taha, 2012; Omran *et al.*, 2018). EBE spring migrants returning from their wintering grounds in Africa to the Palearctic region had their stopover in the Asir region. This observation period spanned from the 1st of September to the 20th of October in the fall season (Ahmad, 2023). Similar observations were also documented in the present investigation and by some beekeepers in the Asir region (Fig. 3). EBE poses a significant challenge, appearing in almost 100% of the apiaries in the Asir region, as it prepares for its onward voyage to African continent by traversing the Red Sea channel.

The results of this study revealed that EBE had a detrimental impact on virgin queen mating. No virgin queens were harmed during mating flights since EBE wasn't present in the apiary; nevertheless, three queens perished on mating flights when bee-eaters were present in the apiary.

Foraging activity: In the absence of EBE within 10 m

of the hive entrances, the number of bee workers collecting ground pollen from the plates was 161.57 ± 26.98 worker/plate (7-8 am); 136.43 ± 25.03 worker/plate (11-12 am) and 59.27 ± 20.08 worker/plate (4-5 pm). However, when a bee eater was present, the number of bee foraging workers gathered ground pollen from the apiary was 38.07 ± 31.99 worker/plate (7-8 am); 38.21 ± 26.90 worker/plate (11-12 am) and 12.14 ± 13.08 worker/plate (4-5 pm), respectively. Similarly, at the same distance 25 m during the absence of EBE the number of bee workers gathered ground pollen from the plates was 129.62 ± 19.30 worker/plate (7-8 am); 121.07 ± 28.02 worker/plate (11-12 am) and 38.14 ± 19.94 worker/plate (4-5 pm). However, during the presence of EBE the number of bee workers gathered ground pollen from the plates in the apiary was 30.50 ± 31.27 worker/plate (7-8 am); 28.85 ± 26.32 worker/plate (11-12 am) and 8.07 ± 9.47 worker/plate (4-5 pm), respectively. Also, at the same distance 50 m during the absence of EBE the number of bee workers gathered ground pollen from the plates was 100.71 ± 27.86 worker/plate (7-8 am); 91.64 ± 17.26 worker/plate (11-12 am) and 22.71 ± 16.14 worker/plate (4-5 pm). However, during the presence of EBE the number of bee foraging workers gathered ground pollen from the plates in the apiary was 21.07 ± 25.24 worker/plate (7-8 am); 21.50 ± 20.89 worker/plate (11-12 am) and 3.50 ± 5.15 worker/plate (4-5 pm), respectively (Fig. 1).

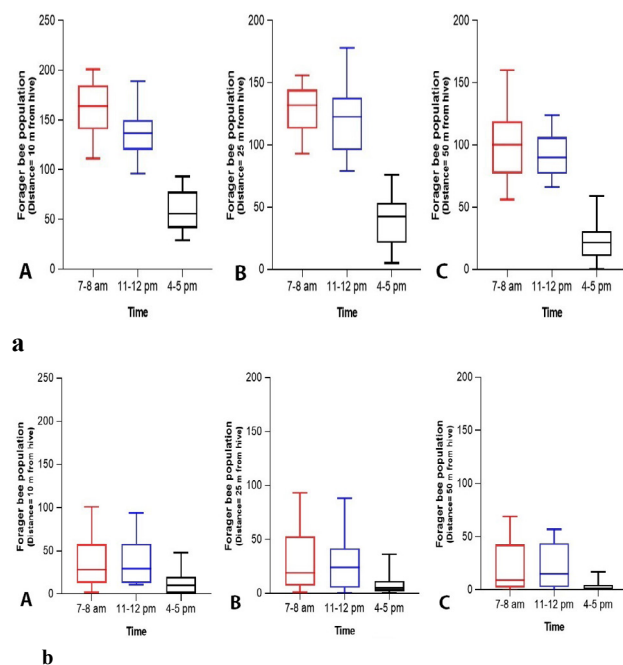


Fig. 1. Mean number of forager bees gathered around bee-pollen placed on (A) 10 m, (B) 25 m, and 50 m distances from the hives entrances at three times/day (7-8 am, 11-12 am, and 4-5 pm) during the presence (a) and absence (b) of bee-eaters around the apiary.

The above data demonstrated that EBE had a moderate to negative impact on the presence of pollen collecting bees at all the distances at 7-8 am as compared to the absence. The significant difference was also found at 11-12 am in the presence/absence of EBE. Meanwhile a similar trend was also observed at the 4-5 pm.

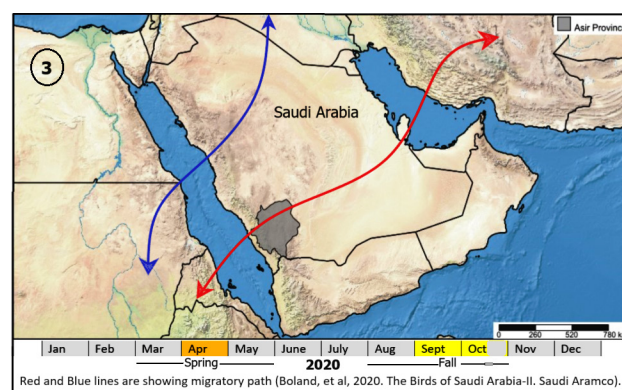


Fig. 1. Red and blue lines are showing migratory path (Boland *et al.*, 2020). The birds of Saudi Arabia-II, Saudi Aramco.

Bee-eaters is considered a major honey bee predator, their effects and damages on bees vary depending on location and season, with several studies revealing significant harm and an adverse effect on bees and beekeeping (Yakobson, and Rosenthal, 1990; El-Sarrag, 1993; Sihag, 1993; Kärcher *et al.*, 2008; Al-Chzawi, *et al.*, 2009; Farinós-Celdrán, *et al.*, 2016; Glaiim, 2014; Omran *et al.*, 2018; Goras *et al.*, 2022). The bee-eaters efficiency was quite high and preys in great numbers on foraging honey bees worker near an apiary during their migratory season and their flocks was continuously spotted near the apiaries (Sihag, 1993). Despite these studies, some reports indicate minor damages caused by various species of bee-eaters to bees and the beekeeping industry (Botha, 1970; Cramp, 1999; Helbig, 1982; Sturtevant, 1949). Further, few workers observed that bee-eaters were not the main impediment to bee foraging, which contradicts the previous findings (Alfallah *et al.*, 2010; Farinós-Celdrán *et al.*, 2016).

Moreover, Fry (1984) presented the view that bee-eaters are beneficial to beekeeping, as their diet includes 15 bee-predatory insects out of every hundred bees. The findings of the present studies revealed that the activities forager was significantly affected by the presence of bee-eating birds in Asir region of Saudi Arabia.

In the Asir region of Saudi Arabia, EBE is found in the apiaries in almost around four weeks in April (spring) and fall in which their occurrence starts from the first

week of September unto almost third week of November (Fig. 1). During their stop-over they causes some serious damages to the local apiaries and these findings are in accordance with those of previous studies (Yakobson and Rosenthal, 1990; El-Sarrag, 1993; Sihag, 1993; Al-Chzawi *et al.*, 2009; Farinós-Celdrán *et al.*, 2016; Glaiim, 2014; Omran *et al.*, 2018; Goras *et al.*, 2022). We conclude that bee-eating birds feeding near apiaries can cause significant honey bee losses, poses a significant threat to foraging worker on their way to foraging nectar (Sihag, 1993; Ali and Taha, 2012). The results of this study regarding the queen loss also reveal that bee-eaters had a detrimental impact on queen mating, with the number of queens mating remaining unchanged when bee-eaters were absent from the apiaries compared to while they were onsite (El-Sarrag, 1993; Sihag, 1993; Ali and Taha, 2012). Because of this, most beekeepers were compelled to postpone queen rearing until after the EBE left from Saudi Arabia. To reduce the damage caused by bee-eating birds, deterrence and prevention techniques must be employed.

DECLARATIONS

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Statement of conflict of interest

The authors have declared no conflict of interest.

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