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BREEDING RANGE EXPANSION OF THE BLACK-WINGED KITE (*ELANUS CAERULEUS*): EVIDENCE FROM THE KING ABDULAZIZ ROYAL RESERVE, SAUDI ARABIA

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Abstract. Between January and May 2025, fieldwork conducted in the King Abdulaziz Royal Reserve, supplemented by data from the Global Biodiversity Information Facility (GBIF), revealed new insights into the distribution and breeding behaviour of the Black-winged Kite (*Elanus caeruleus*) in Saudi Arabia. Observations confirmed the presence of both juvenile and adult individuals across seasons and led to the discovery of an active nest containing three eggs in a *Ziziphus* tree, providing concrete evidence of local breeding. The species was primarily observed in habitats in Al-Rawdah characterized by dense *Ziziphus* stands and surrounding open areas that support rodent populations its primary prey. National occurrence data (n = 220) highlighted seasonal trends, with peaks in March and October, suggesting a partially migratory cycle that combines local reproduction with irruptive dispersal. These findings confirm a significant expansion of the species nesting range, facilitated by habitat availability, increased prey abundance linked to land-use changes, and the establishment of protected areas. The study underscores the importance of continuous monitoring, adaptive habitat management, and the integration of new breeding sites into conservation frameworks to support the sustainable expansion of the species in the region.

INTRODUCTION

Birds are among the most conspicuous organisms in any environment, and their diversity is widely regarded as a key bioindicator of ecosystem health (Mekonen 2017; Soliman et al. 2022). Therefore, conserving bird species supports the continuity of ecosystem dynamics, ultimately benefiting all life forms, including humans (Karakaş 2023). Among birds, raptors occupy the highest trophic levels in the avian food chain. Many species undertake annual migrations through the Mesopotamian marshes in southern Iraq to reach their wintering grounds in Arabian Peninsula and Africa, while others persist as breeding residents (Al-Sheikhly and Al-Azawi 2019). Beyond their ecological role as apex predators, raptors provide essential ecosystem services by functioning as natural biocontrol agents, effectively regulating agricultural pests and reducing rodent populations across diverse taxonomic groups and regions (Muñoz-Pedreros et al. 2010; Ivo et al. 2017; Yonas and Leirs 2019; Paz Luna et al. 2020; Zagorski and Swihart 2020).

The Kingdom of Saudi Arabia is a hotspot for avian diversity, with 499 confirmed bird species, including 401 migratory and resident species, 87 vagrants, and 11 invasive species that have established wild populations (Boland et al. 2020). Among the many raptors inhabiting the region, the Black-winged Kite (*Elanus caeruleus*) is a particularly notable species.

The Black-winged Kite is a small diurnal raptor with white and grey plumage and characteristic black shoulder patches. It commonly inhabits open grasslands, savannahs, semi-desert regions, and agricultural landscapes with scattered trees across Africa, Asia, and southern Europe (Bed'Hom et al. 2003; Svensson et al. 2009; Forsman 2016). Its distribution extends throughout the Afrotropical and Indomalayan regions, with marginal occurrences in the Western Palearctic and northern

Australasia (Ferguson-Lees and Christie 2001). Three subspecies are recognized, of which *E. c. caeruleus* and *E. c. vociferus* occur in the Western Palearctic and are distinguishable by underwing coloration (del Hoyo and Collar 2014; Forsman 2016).

The Black-winged Kite is a nomadic and irruptive species capable of dispersing over hundreds of kilometres between natal areas and breeding sites, facilitating rapid colonization of new habitats (Mendelsohn 1983; Scott 1994; Negro et al. 2006; Rivera et al. 2022). Its breeding distribution spans southwest Europe, the Middle East, most of Africa, and southern Asia, with population densities ranging from sparse to locally abundant depending on habitat quality (Del Hoyo et al. 1992; Balbontín et al. 2008). Historically considered a vagrant in the Middle East, including Saudi Arabia, Türkiye, Oman, and the UAE until the 1990s (Porter et al. 1996), the species is now established as a resident breeder across many suitable habitats in the region (Porter and Aspinall 2010; Jarayseh et al. 2023).

In recent decades, the Black-winged Kite has shown a marked range expansion in southern Iran (Vosoghi et al. 2012) and south-eastern Anatolia in Turkey (Karakaş 2012; Karakaş and Biricik 2017), possibly linked to increasing populations in neighbouring Iraq and Iran. Similar patterns of colonization have been recorded across Western and Central Europe, driven by its dispersal capacity and opportunistic breeding behaviour (Del Hoyo et al. 1992; Kirwan et al. 2003). This expansion is often associated with seasonal rodent population booms, which constitute over 95% of its diet, underlining the species' dependence on prey availability for successful dispersal and breeding (Mendelsohn and Jaksic 1989; Scott 1994; Kemp et al. 2020).

Globally, *Elanus caeruleus* is classified as Least Concern by the IUCN due to its wide geographic distribution and increasing population trend. The global population is estimated at 2,600–5,700 mature individuals, with a median of approximately 3,800, and is considered stable (BirdLife International 2021). In Saudi Arabia, the species is regarded as a very rare resident breeder and occasional visitor, with a few breeding pairs reported in the southern Tihama and the foothills of the western highlands, where annual breeding is likely to and may indicate an early stage of population expansion and regional stabilization (Ghamdi et al. 2020). However, no previous studies have documented breeding activity in either the northern or eastern regions of the Kingdom. In this study, we report a breeding record in eastern Saudi Arabia at the King Abdulaziz Royal Reserve (KARR) and provide an updated assessment of the species' distribution range.

DATA ANALYSIS

Study area

The King Abdulaziz Royal Reserve (KARR), designated in 2018 and listed on the IUCN Green List in 2025, is located approximately 70 km north of Riyadh and spans 28,345 km² across the Riyadh and Eastern Provinces. The reserve experiences an arid hot desert climate characterised by extremely hot and dry summers (June–September) and mild wetter winters (November–April), which are occasionally interrupted by intense rainfall events (Almazroui et al. 2012). The mean annual precipitation averages 66 mm (Climate Data 2025), with temperatures ranging from 6.7 °C in winter to 42.8 °C in summer, and occasionally exceeding 50 °C (Weather Spark 2025). According to the Köppen–Geiger classification, the region is categorized as hot desert (World Bank 2024).

Data analysis

To assess the presence and nesting sites of the Black-winged Kite within the King Abdulaziz Royal Reserve, occurrence data were collected between 20 January and 26 May 2025 using the progressive frequency sampling (*Echantillonnage Fréquentiel Progressif* "EFP") method, which is a point-sampling technique (see details in Blondel (1975), Bendjoudi et al. (2013), and Chedad et al. (2021)). The occurrence records obtained in this study and supplemented with additional data from GBIF (www.gbif.org) were used to map and update the current distribution range of the species. Notably, the global distribution range of this species does not fully include Saudi Arabia (BirdLife International 2021).

All spatial analyses and mapping of *Elanus caeruleus* occurrences were conducted using R version 4.5.0 (R Core Team 2024). Occurrence data were compiled from field surveys (January–May 2025) and the Global Biodiversity Information Facility (GBIF 2025). The datasets were processed and cleaned using the *dplyr* and *Coordinate Cleaner* packages, then converted into spatial objects with sf. The geographic boundaries of Saudi Arabia were obtained through *rnaturalearth* and used to extract only occurrences within national borders via spatial intersection.

Field-recorded coordinates from the eastern region and known breeding sites in Tihama were integrated with the GBIF dataset to update the national distribution range. Mapping was performed using *ggplot2* and *ggspatial*, incorporating scale bars and north arrows for cartographic accuracy. KML reserve boundaries were overlaid to assess spatial overlap with protected areas. All scripts are fully reproducible, enabling future updates as new occurrence records become available.

RESULTS AND DISCUSSION

The study was conducted from 20 January to 26 May 2025, covering the entire territory of the reserve over two study seasons and integrating occurrence data from the Global Biodiversity Information Facility (GBIF 2025) to update the national distribution of the species in Saudi Arabia.

During winter, six individuals were recorded, including two juveniles observed on 22 January 2025 across four distinct sites. In spring, five individuals were reported from three localities. All observations were made in the Al-Rawdah areas, which are characterized by a high density of *Ziziphus* trees surrounded by open land. These areas often remain flooded for several days, especially in late autumn, and were used by the species for perching, nesting, and foraging (Figure 1A). The species was frequently observed hunting from perches and feeding primarily on rodents and gerbils (Figure 1B). A single active nest containing three eggs was discovered on 14 May 2025. Firmly placed at the top of a *Ziziphus* tree at a height of 2.9 m, the nest was mainly constructed from *Ziziphus* branches mixed with a few spontaneous plants, with an outer diameter of approximately 42 cm and a cup depth of around 8 cm (Figure 1C, D). The use of twigs and a soft lining is consistent with previous descriptions of the species' nests in the region (Cramp and Simmons 1980; Abed and Salim 2018; del Hoyo et al. 1994). The clutch size of three eggs also falls within the range reported for the Black-winged Kite in the Middle East (Jarayseh et al. 2023) and is close to that reported for Türkiye (Karakaş and Biricik 2017).

The observation of juveniles accompanied by adults in mid-January together with the discovery of an active nest in mid-May indicate that this species breeds locally and is likely capable of producing more than one clutch per year, like in some other countries (see Ferrero et al. 2003). In the Western Palearctic, the breeding season usually lasts from March to August, whereas in India and Africa it often begins after the monsoon, with the possibility of two broods when food is abundant (Ferguson-Lees and Christie 2001). This flexibility is further supported by records from the Iberian Peninsula, showing that, unlike most raptors, the species can reproduce at almost any time of the year and raise two broods (Ferrero et al. 2003; Negro et al. 2006). Its breeding range extends from south-western Europe and parts of the Middle East to most of Africa and South Asia (del Hoyo et al. 1994).

Figure 1. Black-winged Kite (*Elanus caeruleus*) in King Abdulaziz Royal Reserve, Saudi Arabia. A: General view of a nesting site in Al-Rawdah; B: Feeding behaviour; C: Three eggs in the nest; D: At the nest during incubation.

According to GBIF (2025), a total of 220 validated observations of Black-winged Kites in Saudi Arabia were analysed. Statistical tests revealed no significant differences in their monthly distribution (Kruskal-Wallis, $\chi^2 = 11$, $p = 0.4433$), although a clear seasonal pattern emerges. Activity remains moderate from January to May (8–23 observations), with a pre-nuptial peak in March (23 observations) that likely reflects movements associated with breeding. A marked decline in June, followed by the absence of records in July, may indicate a post-breeding phase or a temporary withdrawal due to extreme summer conditions. From August onwards, observations rise sharply peaking in October (53 observations), which is consistent with post-nuptial movements along the main flyways of the Arabian Peninsula. Elevated numbers in November and December (21–32 observations) suggest the presence of overwintering individuals or prolonged stopovers, indicating a partially migratory cycle that combines local breeding with broader seasonal dispersal (Figure 2).

The species' ecology as a nomadic and irruptive raptor capable of dispersing over long distances between natal and breeding areas facilitates the colonisation of new habitats (Negro et al. 2006). This trait has underpinned the rapid expansion of Black-winged Kite populations in Europe and the Middle East in recent decades, with newly established populations driving increased vagrancy into adjacent regions (Ławicki and Perlman 2017). Historically considered a vagrant in the Middle East, the species' status shifted after the first confirmed breeding record in Iraq in 1998, which was followed by a sharp population increase (Karakaş and Biricik 2017; Abed and Salim 2018). In Saudi Arabia, only a few historical records were reported before 1984 (Jennings 2010), whereas more frequent observations between 2012 and 2015 across the northern, central and eastern regions indicate a transition towards regular occurrence.

This ongoing range expansion is closely linked to land-use change and increased rodent availability associated with agricultural development. As rodent abundance directly affects both population density and breeding success (Mañosa et al. 2005; Balbontín et al. 2008; Karakaş 2012), agricultural landscapes have provided favourable conditions for the species. Similar dynamics have been observed in Spain, where the Black-winged Kite benefitted from the spread of dehesa systems structurally resembling African savannahs (Balbontín et al. 2008). Its strong dietary dependence on rodents often exceeding 95 % of prey items (Mendelsohn and Jaksic 1989) also explains the correlation between its movements, rainfall patterns and rodent population booms (Naoroji 2006; Llorente-Llurba et al. 2019; Kemp et al. 2020).

In Saudi Arabia, the seasonal patterns likely result from a combination of local breeding in the southern Tihama

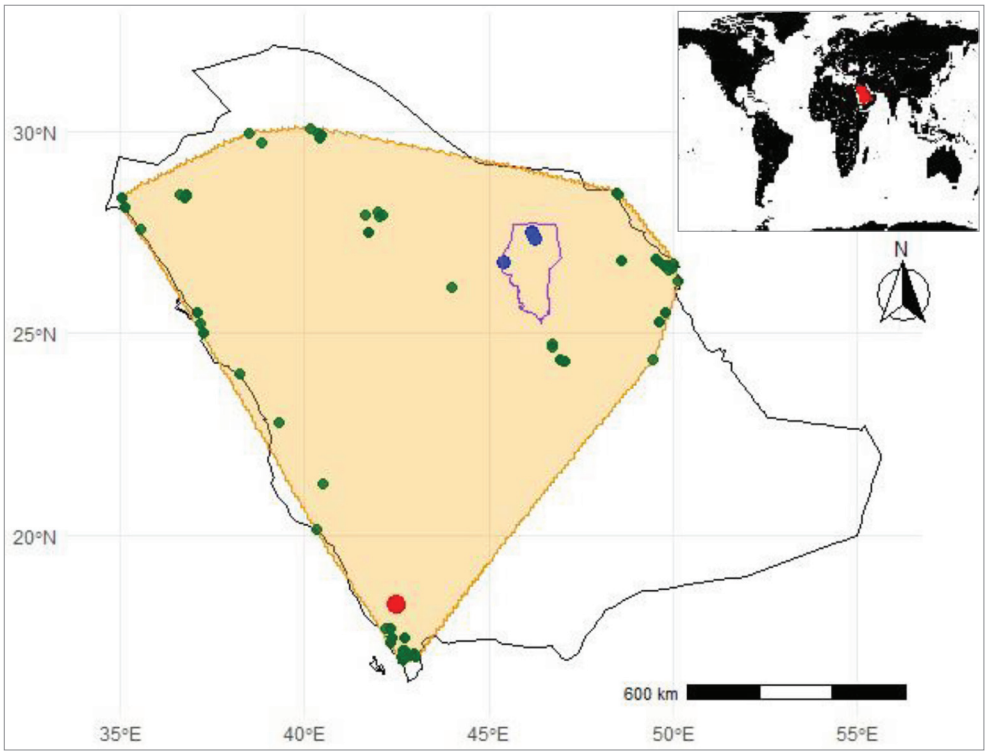

Figure 2. Map showing the previous and updated distributions of the Black-winged Kite (*Elanus caeruleus*) in Saudi Arabia. The red circle indicates the nesting site according to Ghamdi et al. (2020); blue circles represent confirmed occurrences from the current study (breeding); purple polygons correspond to the boundaries of King Abdulaziz Royal Reserve; green points indicate observation records obtained from GBIF (2025); the orange polygon represents the updated distribution range of the species in Saudi Arabia.

region (Ghamdi et al. 2020) and nomadic influxes from neighbouring areas. This dynamic mirrors the species' broader distribution spanning south-western Europe, the Middle East, most of Africa and South Asia (del Hoyo et al. 1994). Its adaptability to open and anthropogenic habitats, high reproductive potential, and capacity for long-distance dispersal underpin the continued spread of the Black-winged Kite across the Western Palearctic (Parejo et al. 2001; Porter and Aspinall 2010; Ławicki and Perlman 2017).

Despite its harsh climatic conditions, the KARR serves a vital ecological function in the central Arabian landscape. Its complex topography – comprising sandy plains, rocky outcrops, ephemeral wadis, and artificial dams – creates a diversity of microhabitats that support a wide range of species, including migratory and vagrant birds. The combination of environmental gradients and seasonal fluctuations underscores the area's importance as a key stopover and wintering site for numerous Palearctic migrants, as well as a potential refuge for vagrant species in transit across the Arabian Peninsula (Al-Asmari et al. 2025; Al-Qahtani et al. 2025).

Available data indicate a marked expansion in the range of this species within Saudi Arabia, with new nesting sites identified in the eastern part of the country, whereas its distribution was previously confined to limited areas in the south. This shift is partly linked to the conservation and biodiversity management strategies implemented by the Kingdom, including the establishment of several protected areas such as the King Abdulaziz Reserve, which have indirectly increased rodent abundance and provided a stable food source for raptors, thereby facilitating their year-round presence and nesting expansion. To ensure the sustainable persistence of this trend, continuous monitoring of Black-winged Kites, especially in newly colonized areas, is essential alongside targeted studies on the interplay between rodent availability, land-use changes, and population dynamics. Furthermore, adaptive habitat management and the integration of new breeding sites into conservation networks are key measures to support the long-term expansion of the species in the region.

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Conflict of interests

The co-authors report no conflicts of interest.

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Data availability

The data used to support the findings of this study are included within the article.

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