

Evidence of southwestern distribution of the golden jackal in Prince Mohammed bin Salman Royal Reserve, Saudi Arabia

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Abstract. Eid E, Smithson J. 2024. Evidence of southwestern distribution of the golden jackal in Prince Mohammed bin Salman Royal Reserve, Saudi Arabia. *Biodiversitas* 25: 1676-1681. The golden jackal, *Canis aureus* Linnaeus 1758, is listed as a species of globally Least Concern status by the IUCN; however, throughout the Arabian Peninsula, it is classified as Near Threatened due to the lack of information on its population and threats. Despite being a widespread species, the information on the golden jackal distribution in Saudi Arabia is derived from limited historical records that have restricted its presence to the Hofuf area, around Al Asfah and Al Jawf in the Northeast, and very recent records in the agricultural areas in Tabuk governorate. In addition, photographic evidence of a juvenile individual was recorded in 2017 around the Jubail area. Here, we report the first confirmed Western distribution extension for Saudi Arabia, located in Prince Mohammed bin Salman Royal Reserve, and the most southwestern distribution worldwide. The jackal was recorded twice, suggesting a passing individual or a resident population, requiring further investigation and research. The presence of suitable ecosystems, habitats, and prey composition supports this. This record is important for Saudi Arabia and the Reserve as it guides the conservation efforts and highlights the importance of systematic surveys to understand the existing population, state, and threats.

Keywords: *Canis aureus*, distribution, golden jackal, PMBSRR, Saudi Arabia

INTRODUCTION

Golden jackal *Canis aureus* Linnaeus 1758 is a medium-sized canid species classified as a Least Concern, according to the International Union for the Conservation of Nature (IUCN) red lists, with a growing global population (Hoffmann et al. 2018). In the Arabian Peninsula, the golden jackal was also classified as the Least Concern based on the regional assessment of mammals due to its widespread distribution and presumed stable population of over 1,000 mature individuals (Mallon et al. 2023). The European Union legally protects this species since it is listed in Annex V but not the Convention on International Trade of Endangered Species of Fauna and Flora (CITES) (Rutkowski et al. 2015; Trouwborst et al. 2015). The coat color of golden jackals in Arabia tends to be lighter than *Canis aureus* subsp. *syriacus* Hemprich and Ehrenberg 1833 that survives in the Levant area (Harrison and Bates 1991). However, jackals exhibit a range of colors from pale creamy yellow to dark tawny, with a blend of black-brown and white hairs on their backs (Eid et al. 2020).

The documented distribution of this species spans Asia and Europe (Krofel et al. 2022). However, Koepfli et al. (2015) reported its absence from Africa, indicating that the species identified in this continent is *Canis anthus* F.Cuvier 1820, a perspective supported by Hoffmann et al. (2018). The golden jackal is extending its range in Europe, reoccupying areas where it was previously present but disappeared and entering countries where it was not previously recorded (Trouwborst et al. 2015; Krofel et al. 2017). An expansion in the range of distribution of golden

jackals has occurred since the 19th century, starting in Southeastern Europe and growing subsequently Northwards and Westwards into Europe during the 20th century (Trouwborst et al. 2015; Klärner 2017; Krofel et al. 2017; Kowalczyk et al. 2020). Rutkowski et al. (2015) stated that it should not be considered an alien invasive species because of its long-range natural dispersal. A severe decline in its population has occurred in the Balkan region in Europe, where it nearly became extinct in many areas during the 1960s due to habitat loss and poisoning (Fabbri et al. 2014; Rutkowski et al. 2015). This species is a vagrant in Switzerland, Poland, and Germany (Trouwborst et al. 2015). In their comprehensive revision, Spassov and Acosta-Pankov (2019) delved into the historical presence of the golden jackal in Europe, from the Pleistocene era to its modern-day expansion. They highlighted various factors that restrict its distribution, such as deep snow, severe frosts, extensive forested areas, rugged terrain, the presence of wolves, habitat destruction, including scrublands and reeds, and direct threats like poisoned bait. Ivanov et al. 2016 confirmed the recolonization of the golden jackal population in the former Yugoslav Republic of Macedonia. Khan et al. (2024) provided information on its presence eastwards through Iran, Central Asia, and the entire Indian subcontinent East and South to Sri Lanka, Myanmar, and parts of Indochina. Recently, new records of the golden jackal have been confirmed from Finland based on genetic and morphological data (Viranta et al. 2024) and from the Trans-Himalayan region of Ladakh in India, representing the highest elevation ever recorded for golden jackals worldwide (Khan et al. 2024).

The distribution extends Southwards into Turkey, Syria, Jordan, Iraq, and the Arabian Peninsula (Eid et al. 2020). It was reported from Qatar in the 1950s (Hellyer 2009), and it does not occur in Kuwait (Mallon et al. 2023). Eid et al. (2020) confirmed the species' presence across various locales in Jordan and subsequently categorized it as Least Concern based on its extensive distribution and population growth. Gasperetti et al. (1985) reported the species in Yemen, according to accounts from 1895. Still, Mallon et al. (2023) remarked that these reports are unconfirmed and likely to be erroneous or refer to released or imported animals. Despite an unreliable report on capturing a golden jackal along the Abu Dhabi-Saudi Arabia border (Gross 1987), no confirmed records have been obtained from the UAE to date (Hellyer 2009). It is a common species in the West Bank and recorded in Gaza in Palestine (Abd Rabou 2021).

Few records for the golden jackal presence from Saudi Arabia have confirmed a scarce and patchy distribution. A single record from Laija, 18 km South of Al Jouf (Dowmat Al Jandal; approx. 100 km South of Reserve) in Northern Saudi Arabia, dating from the early 1980s, is thought to be of an animal that drifted from populations further North (Mallon et al. 2023). However, Seddon et al. 1997 did not record the jackal in the Harrat al-Harrah Protected Area in Northern Saudi Arabia, close to Jordanian Iraqi borders. Hellyer (2009) considered the golden jackal restricted to a small range in the Eastern parts of the Hofuf area and around Al Asfah in Saudi Arabia. A photo of a juvenile golden jackal around the Jubail Area was obtained in 2017, which overlooks the Arabian Gulf close to Hafuf (P. Roberts pers. comm. 2017). A recent study published by Al Atawi et al. 2023 confirmed the golden jackal from camera traps fixed near Qa' Sharorah pools near Tabuk and in Abo Ali Island in Al Jubail Marine Wildlife Sanctuary.

Several factors threaten the population and habitat of golden jackals, including diseases like mange and ectoparasites (Yousuf et al. 2014). The ongoing competition between human activities and predator presence also influences their survival (Eid et al. 2020). Additionally, the coexistence of other predators and alterations in habitat due to human activities contribute to the challenges faced by these jackals (Mallon et al. 2023). The human-wildlife conflict escalates as golden jackals are often viewed as a threat to livestock, leading to reactive killings and poisoning through predator control programs implemented in certain regions (Khan et al. 2024). Hybridization poses another concern, as documented cases of hybridization with domestic dogs have been reported in Croatia (Fabbri et al. 2014) and Hungary (Ninausz et al. 2023). Stefanović et al. (2024) examined the golden jackal's historical and current range expansion patterns, emphasizing migration routes from Asia to southeastern Europe and subsequent natural spread into central and northern Europe, originating from genetically diverse southern source populations. Their findings indicated no decrease in genetic diversity, possibly due to complex migration paths and genetic merging with domestic dog populations. However, a long-term monitoring program of golden jackal populations in northwestern Jordan has

shown no interactions between jackals and dogs despite their coexistence in the same ecological niche area (Ehab Eid, Personal Communication).

PMBSRR has faced numerous threats, resulting in habitat degradation and species loss, particularly attributed to poaching, overgrazing, poisoning, and unsustainable land use practices within the Reserve. Consequently, the Reserve has set ambitious restoration goals to tackle immediate challenges and promote a mutually beneficial coexistence between wildlife and communities. The primary objective is to enhance ecosystem resilience, safeguard biodiversity, and ensure the long-term sustainability of PMBSRR's natural and cultural resources.

This article presents evidence of the golden jackal's expanded distribution range in the Arabian Peninsula, resulting from comprehensive research efforts undertaken within the Reserve.

MATERIALS AND METHODS

Study area

Prince Mohammed bin Salman Royal Reserve is located in the Northwest of the Kingdom of Saudi Arabia and includes an area of approximately 24,500 km² (ELARD 2022). The Reserve is characterized by a hyper-arid climatic condition, with less than 100 mm annual rainfall. Ambient mean temperatures were between 23°C and 34°C throughout the summer, while winter temperatures ranged from 16 to 28°C. Despite the harsh environment, the Reserve sits within an ecoregion transition zone, as highlighted by the presence of eight Bioregions, namely the Northern Red Sea, Shorelines, sandy coastal plains, Madyan Hills and Mountains, Hejaz Hills and Mountains, Hisma Plateau, Northern Volcanic Outcrops, and Northern Sandstone Plain and Plateau. In addition, the Reserve contains 15 ecosystems which are the (i) Mountain Slope, (ii) Sand Plains, (iii) the Northern Red Sea, (iv) Gravel Plains, (v) Rocky Outcrop and Coastal Hills, (vi) Cliff and Gully; (vii) Plateau (Harrat); (viii) Wadi & Colluvial Fans; (ix) Sand Dunes; (x) Mangrove; (xii) Inland Sabkha; (xiii) Coastal Sabkha; (xiv) Coastal Shore Complex; and (xv) Agriculture and Urban & Other Infrastructure (Figure 1).

Camera-trapping

A long-term camera trapping program was initiated at PMBSRR in 2021. As part of this program, 36 cameras (Browning HD Trophy Cam) have been deployed in the Northern and Southern parts of the Bida area from 2 December 2022 to understand the species diversity and distribution. So far, a total of 9,684 camera-trapping nights have been performed. Cameras were fixed to stones or trees at different locations, and no bait was used to minimize biased records. Cameras were placed throughout daylight hours and checked every month. All collected data were checked and stored in an Excel sheet with information such as the species recorded, date, and time.

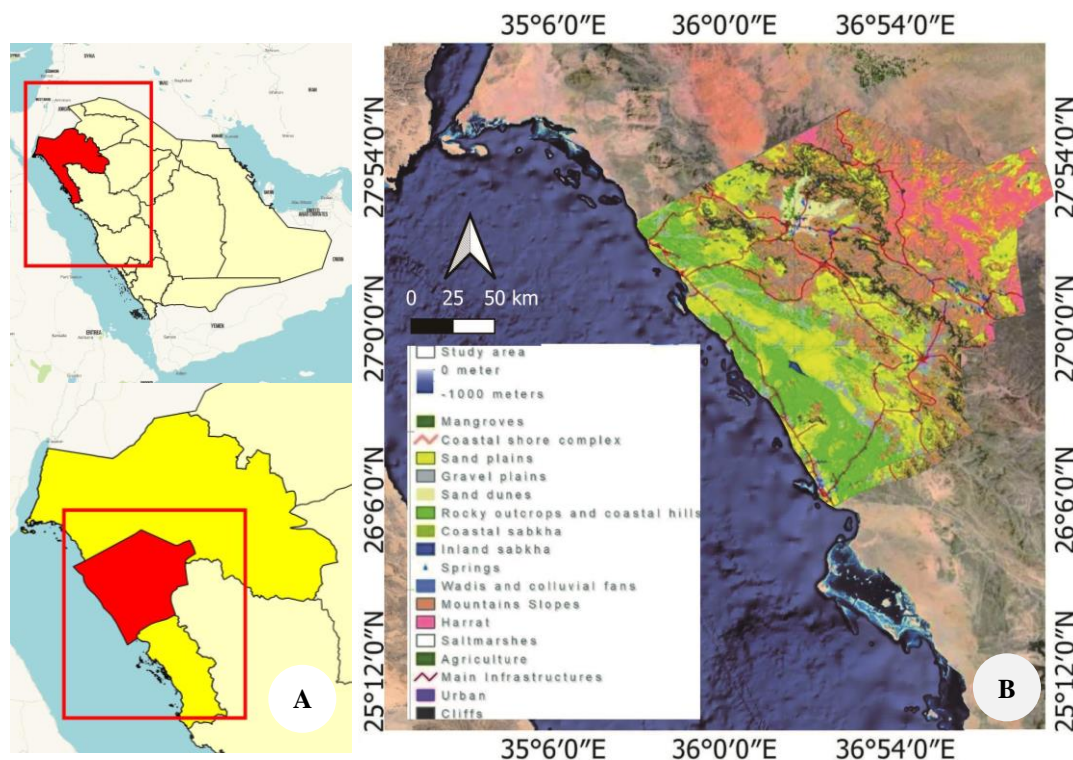


Figure 1. A. Map of the study area Prince Mohammed bin Salman Royal Reserve, Tabuk Region, Saudi Arabia; B. Ecosystems in PMBSRR (Source: ELARD 2022)

RESULTS AND DISCUSSION

Results

The camera-trap station was positioned in Bida, within the Al-Wajh Governorate, part of the Hisma plateau of the Arabian Shield, and features elevations ranging from 600 to 1,850 meters above sea level (masl). The region exhibits a rocky outcrop composed of a sandstone plateau, representing a medium-altitude block of late Cambrian and Ordovician sandstones in the northwestern part of Saudi Arabia. The second station was located in the granite plains and mountainous area within the Al-Wajh Governorate in the Tabuk region of Saudi Arabia, forming part of the Hijaz hills and mountains characterized by granite, metamorphic rock formations, and sedimentary rocks such as sandstone and limestone. Elevations in this area reach heights of approximately 800 masl.

Two photographs of a golden jackal were captured by camera traps at coordinates (Lat. 27.46593, Lon. 36.71962) and (Lat. 27.04382, Lon. 37.06486) on the 2 March 2023 at 07:12h and on 23 February 2024 at 10:59h, respectively, with an elevation of approximately 1173 m above sea level. The jackals in the images displayed brown ears, dark fur on their backs and sides, whitish-yellow undersides, and a black tip on their tails (Figure 2). The first photograph was taken in the Hisma Plateau area, known for its rugged terrain and sandstone mountains, featuring expansive rocky deserts dotted with wadis and sporadic vegetation, including drought-resistant plants like acacia trees (i.e., *Vachellia* spp.), shrubs (i.e., *Lycium shawii* Roem. & Schult. and *Haloxylon salicornicum* *Haloxylon salicornicum* (Moq.) Bunge ex Boiss.), and desert herbs

(i.e., *Panicum turgidum* Forssk.). The second photograph was captured near a temporary water body in the granite mountains, characterized by rugged granite formations and supporting pockets of vegetation in wadis and on slopes such as acacia trees (i.e. *Vachellia* spp. and *Moringa peregrina* (Forssk.) Fiori). Generally, the areas where golden jackals have been observed are experiencing degradation primarily attributed to extensive overgrazing by camels and livestock, a widespread phenomenon across the entire Reserve. This overgrazing has led to significant impacts on the vegetation cover in these localities.

Discussion

This photographic evidence establishes the presence of golden jackals in the Reserve while expanding known records in Saudi Arabia to the Western location (Figure 3). Further, this photographic record also expands Southwest's global distribution into Saudi Arabia (Figure 3). The expansion of the species' range and the associated findings can be linked to insufficient surveys conducted in the underexplored or remote regions of the Reserve before its establishment, leading to knowledge gaps. The establishment of the PMBSRR has enabled more comprehensive surveys, thereby improving our comprehension of species presence and range distribution. Additionally, adopting technologies such as photo-trapping cameras has demonstrated efficacy in detecting species in difficult-to-survey areas. Al Atawi et al. 2023 stated that the golden jackal should receive high priority for protection in nature reserves in Saudi Arabia, and they have pointed out that the indiscriminate killing of canids in Saudi Arabia contributes to the limited distribution of this species.

PMBSRR can potentially sustain a healthy population of golden jackals due to its extensive area, presence of prey, and the wide variety of habitats suitable for the golden jackal's survival. The golden jackal, an omnivorous species, can survive in a variety of habitats ranging from semi-arid to arid environments to forested areas, agricultural, mangrove, rural, and semi-urban habitats, and it can withstand elevations exceeding 2,000 masl (Al Atawi et al. 2023). The jackal's diet is composed of rodents, hares, birds, and insects (Lanszki et al. 2016; Temu et al. 2016; Temu et al. 2017; Lanszki 2022;) as well as fruits as a secondary food source (Lange et al. 2021). This species depends on the viscera of domestic animals in areas where slaughter waste is improperly discarded (Ćirović et al. 2016). Moreover, this species removed many rodent crop pests and favored plant biodiversity without apex predators (Ćirović et al. 2016). Therefore, designing a survey to understand the jackal population in PMBSRR is necessary in light of several farm areas. There are no estimates for the population densities from Arabia.

The ambitious efforts at the Reserve to conserve, restore, and rewild will undoubtedly encourage the survival of golden jackals among several other predatorial species. However, reducing threats, including hunting, poaching, and poisoning, is key to ensuring the survivability of this species. Alatawi 2023 studied the potential role of large agricultural areas as supplementary habitats for wild carnivores in a desert ecosystem in the Tabuk region in

Saudi Arabia, where he confirmed the presence of the golden jackal utilized in these agricultural areas.



Figure 2. Photographed golden jackal in PMBSRR. A. Bida area; B. Granite mountains and plains)

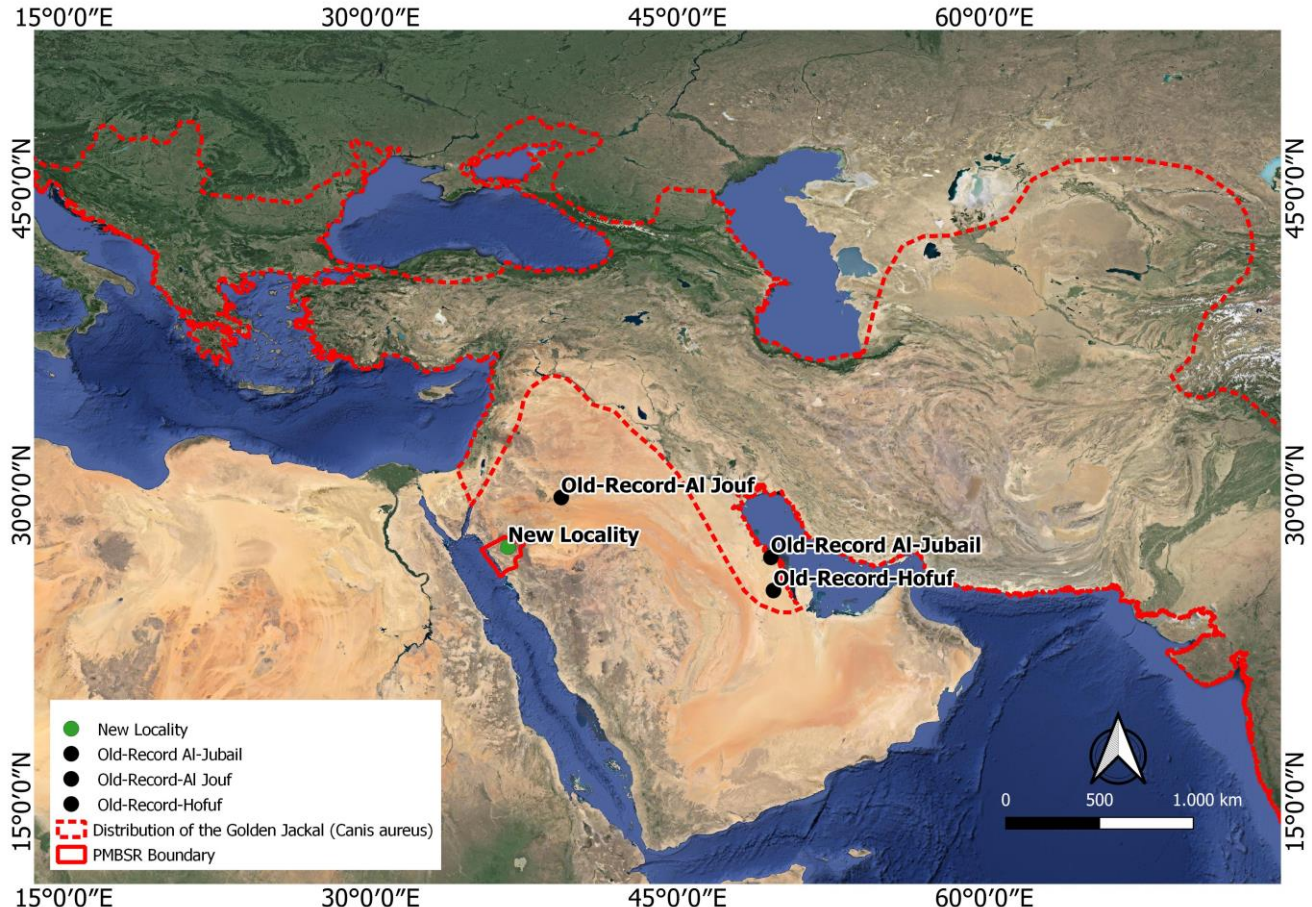


Figure 3. Known records of the Golden Jackal in Saudi Arabia (Map adapted from IUCN red list website)

Globally, the golden jackal is a widespread species, and its population is presumably increasing (Eid et al. 2020). According to Eid et al. (2020), poisoning and persecution might be considered the primary threats to this species, and Eid and Handal (2018) confirmed three killed specimens by hunters based on Facebook photos collected in 2015 in Jordan. Mallon et al. 2023 suggested that the threats in Arabia are still unknown, but the lack of suitable habitats will likely limit range expansion. The research that has been done at PMBSRR so far indicates the presence of several suitable habitats and ecosystems for the survival of the golden jackal. Therefore, it is important to continue monitoring programs at the Reserve to collect more information on the species' habitat preferences and identify the population status.

Recording the golden jackal twice in PMBSRR indicates the possible presence of either a passing individual or a resident population. Nonetheless, it's premature to ascertain the status or size of the golden jackal population. Therefore, thorough investigation and research are essential, given that these records potentially signify a new range distribution that requires detailed exploration. The results also support the global status of the golden jackal, especially since it will increase the extent of occurrence and area of occupancy.

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