

Second record of reproduction of *Canis aureus* in Central Bohemia, Czech Republic (Carnivora: Canidae)

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Abstract. The permanent breeding range of the golden jackal (*Canis aureus*) in Europe was restricted to the Black Sea coast and Balkans in the 1960s. From the 1980s, a rapid and steady increase of the species occurrence has been documented throughout Europe. The observations of single individuals prevail, the proofs of breeding family groups are much more scarce. Here we present the second evidence of golden jackal breeding in Central Bohemia (Czech Republic) which took place near Dlouhá Lhota, about 50 km south of Prague, in 2022. Photographic evidence of adults and two cubs was made with the help of camera traps.

Key words. Mesopredator, breeding, golden jackal, Central Europe.

INTRODUCTION

The golden jackal (*Canis aureus* Linnaeus, 1758) is one of the most expanding mammals in Europe. Its spreading started during the second half of the 20th century (KRYŠTUFEK & TVRTKOVIĆ 1990) and originated from two core areas – the Black Sea coast (Bulgaria) and the western Balkans (Croatia). The golden jackal is resident in most of south-eastern Europe, from Bosnia and Herzegovina to Russia (KRYŠTUFEK et al. 1997, SZABÓ et al. 2009, RUTKOWSKI et al. 2015, TROUWBORST et al. 2015, TRBOJEVIĆ et al. 2018, SPASSOV & ACOSTA-PANKOV 2019).

The first confirmed occurrence of golden jackals in Slovenia dates back to 1952 (BRELIH 1955) and two territorial families were recorded near Bevke, central Slovenia, in 2009 (KROFEL 2009). The golden jackals also spread to Italy, where they were recorded during the 1980s, with reproducing families confirmed in South Tyrol in 2009 (LAPINI & PERCO 1988, LAPINI et al. 2009). Since that time, the number of jackal sightings throughout Europe has increased rapidly, however the number of documented breeding events outside the core contiguous breeding range is still relatively scarce. It is largely due to the fact that it is often difficult to identify the species and to distinguish between migratory and resident individuals (KOWALCZYK et al. 2020).

The golden jackal has been recorded as far as in northern Norway (SØRENSEN & LINDSØ 2021). The species was for the first time recorded in Estonia in 2011, in Latvia in 2013 and in Lithuania in 2015 (PAULAUSKAS et al. 2018). The migrating individuals have already reached western Europe and the species appeared in Denmark in 2015 (TILLMANN 2020), the first record

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in the Netherlands was made in 2016 (VAN DER GRIFT 2016). Jackals have been observed also in Switzerland (TROUWBORST et al. 2015) and France (POTOČNIK et al. 2022).

The golden jackal has been found in all countries neighbouring the Czech Republic. The occurrence of the species in Slovakia increased steadily from 1989, when the first record was confirmed (besides an old doubtful record from the 1940s). Altogether 418 records of the jackal were gathered until 2016; it was recorded throughout Slovakia, with the centre of occurrence in the southern lowlands (GUIMARÃES et al. 2019), and the number of jackals was estimated at 444 individuals in 2019 (URBAN et al. 2020). However, no clear evidence of reproduction in Slovakia is available until now (GUIMARÃES et al. 2021).

The first record of the species from Austria came from 1987 (HOI-LEITNER & KRAUS 1989) and the reproduction of the golden jackal was confirmed in the eastern part of the country near Lake Neusiedl in 2007 (HERZIG-STRASCHIL 2008). The second proof of golden jackal reproduction was obtained in 2016 (HATLAUF & HACKLÄNDER 2016). At least four jackal family groups were confirmed in Styria and Burgenland, based on the bioacoustics stimulation monitoring (HATLAUF et al. 2021, 2022).

The first three records of golden jackals in Poland were made in 2015. One individual was a young male roadkill found in the north-eastern part of the country, two other records were confirmed by photographs made in eastern Poland (KOWALCZYK et al. 2015). In 2015 and 2017, the reproduction of jackal was proved near Kwidzin in the northern part of the country. Recently, fifteen localities of jackal are known throughout the country (KOWALCZYK et al. 2020).

The situation of the species in Germany is similar to the pattern of other Central European countries. The jackal was first recorded in 1996 in Brandenburg (ARNOLD et al. 2012). Altogether, 25 observations were made until 2020 (TILLMANN 2020), the permanent occurrence of the golden



Fig. 1. An adult golden jackal photographed by Richard PĀPST near Dlouhá Lhota, Central Bohemia, Czech Republic on 18 July 2022.

jackal is confined to three regions: Ravensburg area (Baden-Württemberg), Vogelsberg area (Hesse) and in the Heinrich National Park (Thuringia; BÖCKER et al. 2020). More recently, a juvenile was documented by a camera trap in the Schwarzwald-Baar District (Baden-Württemberg) in 2021, providing the first evidence of reproduction in Germany. In June 2022, two adult golden jackals accompanied by cubs were observed in the same area. Additionally, jackal reproduction was reported from Lower-Saxony in September 2022 (BÖCKER et al. 2022).

In the Czech Republic, the first occurrence of the golden jackal was confirmed in southern Moravia in 2006 based on a reportedly roadkill (in fact a shot individual) found at Podolí, southern Moravia (KOUBEK & ČERVENÝ 2007). Other two individuals were also found killed on roads, the first one in southern Moravia between Klobouky u Brna and Morkůvky in 2010 (FOREJTEK et al. 2011) and the other in a vicinity of Vranovice in Central Bohemia in 2011 (KADLEC 2012). Furthermore, a female was shot in northern Moravia near Hukovice by a hunter who confused a golden jackal for a fox (HUDEČEK & JAKUBEC 2014). The permanent occurrence of a presumably one jackal individual was documented from a former military training area near Milovice between 2015 and 2016 (PYŠKOVÁ et al. 2016), and the reproduction of jackal was first documented from the Czech Republic in 2017 from the same area (JIRKŮ et al. 2018). In our paper, we present an evidence of permanent occurrence and reproduction of the golden jackal in the southern part of Central Bohemia.

THE RECORD

The evidence of the golden jackal breeding is based on photographs from five camera traps Cuddeback C1 with white flash and three other camera traps, OXE Gepard II, Ancheer, and Ltl. Acorn 5310 MC. The traps were installed near Dlouhá Lhota, Příbram district, Central Bohemia, ca. 50 km south of Prague (49.72598°N, 14.11936°E). The landscape is flat or gently undulating and lies at a medium altitude of 400–452 m a. s. l. The average annual air temperature in the area is 8 °C (TOLASZ et al. 2007).

The first camera trap was installed on 10 July 2022. The camera traps were checked and data downloaded from SD cards in 3–4 week intervals. The photographs used in this paper were collected between 10 July and 21 December 2022. Three to seven camera traps were used simultaneously in the field, four traps most often; the traps were set to take photographs in series, the video mode was not used. The cameras were set up on an area ca. 21 hectares in size. Additionally, two authors (RP, MM) also took photographs of an adult individual during two morning field monitoring sessions (Fig. 1).

There is an intensively used agricultural land around the village of Dlouhá Lhota, which is interspersed with smaller mixed coniferous-deciduous forests with the prevalence of the Norway spruce (*Picea abies*), Scots pine (*Pinus sylvestris*), and English oak (*Quercus robur*). Fields are in some places separated by hedgerows which consist mainly of the goat willow (*Salix caprea*), black elder (*Sambucus nigra*) and Eurasian aspen (*Populus tremula*). There are a few small watercourses and several small ponds in the broader area. Corn, wheat, barley, and rapeseed were grown predominantly in the area. The alfalfa (*Medicago sativa*) and red clover (*Trifolium pratense*) were grown on several fields (the approximate area of 149 hectares in 2021, measured as a polygon on www.mapy.cz). A high abundance of the common vole (*Microtus arvalis*) was observed on these fields in 2021 and 2022. Most of these fields were ploughed and new crops planted during the summer of 2022. All registered records of the golden jackal were assessed and categorised according to HATLAUF & BÖCKER (2022). Only C1 data were taken into account



Fig. 2. Two juvenile golden jackals photographed by a camera trap near Dlouhá Lhota, Central Bohemia, Czech Republic on 15 September 2022.

for the purpose of this paper (camera trap photos). The particular events were separated from each other if there was a time delay longer than 1 minute between different pictures or series of pictures. It was possible to identify the golden jackal in 95 photographs during the period of camera trap monitoring, which corresponded to 55 C1 events. No more than two cubs were recorded simultaneously during three events (Fig. 2), these individuals were determined as juveniles especially by their overall body size, muzzle length and head shape (Fig. 3).

The highest number of photos with jackals were taken in July (30) and September (23), lower activity was observed in October (18) and December (13), with the fewest records in November (7) and August (4). Most of the events (37) were collected during the first half of the day (midnight–noon), which comprised 67% of all observations. The jackals were most frequently documented at 7:00–8:00 a.m., which corresponds to 20% of all sightings (11 C1 events).

The photographs from the camera traps confirmed the presence of other mammalian species that shared the same habitat with golden jackals: the wild boar (*Sus scrofa*) – juvenile/adult, roe deer (*Capreolus capreolus*) – adult, red deer (*Cervus elaphus*) – adult, European fallow deer (*Dama dama*) – juvenile/adult, white-tailed deer (*Odocoileus virginianus*) – juvenile/adult,

European hare (*Lepus europaeus*), stone marten (*Martes martes*), pine marten (*Martes foina*), red fox (*Vulpes vulpes*), European badger (*Meles meles*), brown rat (*Rattus norvegicus*), and the domestic cat. Wolves and stray dogs were not recorded in the area.

DISCUSSION

The spreading of the golden jackal from its core distribution areas to western and northern Europe has been rapid in recent decades. Several factors related to its natural dispersal were reported, such as the global warming (ARNOLD et al. 2012, PYŠKOVÁ et al. 2016), the absence of wolves in the territory (KRYŠTUFEK & TVRTKOVIĆ 1990, KROFEL et al. 2017), deforestation, the development of road networks, the availability of food near human settlements, and activities in agriculture (SPASSOV & ACOSTA-PANKOV 2019).

The golden jackal is now present in the whole Central Europe, its reproduction has been already confirmed in three countries neighbouring the Czech Republic – Germany, Poland, Austria, but not in Slovakia. It can be assumed that breeding of golden jackals in Slovakia is also very likely, as the species is estimated to be much more abundant there (URBAN et al. 2020) than in the Czech Republic. For example, the data from Poland indicate that the jackal expansion took



Fig. 3. A juvenile golden jackal photographed by a camera trap near Dlouhá Lhota, Central Bohemia, Czech Republic on 20 September 2022.

place before the first records of its breeding were confirmed in 2015 (RUTKOWSKI et al. 2015). As a secretive animal with twilight and nocturnal activity, it is likely to escape attention. It is very probable that its permanent occurrence and thus the evidence of breeding of the species is underestimated in many other areas, due to the hidden life of jackals, the unfamiliarity of the species, and its possible confusion with the red fox (HUDEČEK & JAKUBEC 2014).

The golden jackals prefer cultivated agricultural areas and wetlands at lower elevations. They utilise heterogeneous habitats with adequate cover for hiding and breeding, such as shrub-herbaceous vegetation. Their presence is positively influenced by short snow cover duration. However, as an opportunistic omnivorous mesocarnivore it is able to utilise a wide variety of habitats (ŠÁLEK et al. 2014, HOFFMANN et al. 2018). SPASSOV & ACOSTA-PANKOV (2019) demonstrated the most positive golden jackal call responses were collected within 1 km from a water source in an intensively used agricultural landscape, with sparse forests. The golden jackals have also been confirmed more frequently at lower altitudes up to 500 m a. s. l. The negative effect of the proximity to settlements has not been confirmed but the jackals tend to occur in areas close to settlements with lower numbers of inhabitants (200–1000; SPASSOV & ACOSTA-PANKOV 2019).

Concerning such data, the area where the species was found to reproduce in Central Bohemia fits very well the description of the preferred habitat and its requirements given in the above literature. Agricultural practice in the area was mainly focused on crop production – cultivation of corn, rape, barley, and wheat. In several places, fields of larger surface (ca. 150 ha in total) have been sown with alfalfa and red clover. The forage crops from these fields were used to feed cows in several nearby cowsheds, they remained in the same fields for several (typically 3–4) years.

From the autumn 2021 until spring 2022, high densities of common vole burrows were observed in the largest alfalfa fields. Between 23 November 2021 and 24 February 2022, thirteen wintering short-eared owls (*Asio flammeus*) were ringed in the area, which was by far the highest number during the past 14 winters. About 15–20 wintering hen harriers (*Circus cyaneus*) were recorded in the fields there during the same period; it was also the highest number of individuals recorded in the area during the monitoring between 2010 and 2022. These findings indicate that the high supply of easily available prey (common vole), which is an important component of the golden jackal diet (MARKOV & LANSZKI 2012, LANGE et al. 2021), may have contributed significantly to the permanent presence of jackals in the area and finally resulted in successful reproduction. However, there is another undocumented sighting of an adult jackal with four cubs in the same area from 2020. The head of the local hunting association reported observation of jackals in a field during the rapeseed harvest (M. VOPIČKA, pers. comm.). Considering our record from 2022, the presence of the golden jackals in 2020 and their reproduction might be considered highly probable.

Further research is needed to gain a better knowledge on the distribution and co-existence of jackals not only in the Czech Republic and to monitor the development of a newly established and highly overlooked population in areas outside the permanent breeding range. Last but not least, it is also necessary to raise hunters' awareness of the ecology and ethology of the species.

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