

Range expansion of the golden jackal (*Canis aureus*) into Poland: first records

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Abstract The range of the golden jackal (*Canis aureus*) in Europe has been expanding in recent decades. We describe the first three records of golden jackal from Poland and attribute them to the natural range expansion of the species. A young male jackal was found dead on a road in western Poland, close to the German border, on 13th April 2015. Morphological examination and genetic analysis confirmed the species identification. This individual had the same mitochondrial DNA haplotype as a comparative individual from the wild population in southern Ukraine. The two other observations of jackals, confirmed from photographs, were reported in May and June 2015 from the Biebrza river valley and the Polesie region, both in eastern Poland. The records suggest a natural expansion of the species into Poland, probably from different source populations, and indicate the urgent need to determine the status of the golden jackal in this part of Europe.

Keywords Species identification · Species distribution · Non-native species · mtDNA D-loop

Introduction

The golden jackal (*Canis aureus*) is a medium-sized carnivore that is widespread in southern Eurasia and northern Africa (Sillero-Zubiri et al. 2004). After a decline in the 1960s, mainly due to human persecution, the species survived in Bulgaria due

to its protected status. Thanks to protection and reduced persecution in other countries, it recovered and not only recolonized its previous range but also expanded into new areas (Arnold et al. 2012, Trouwborst et al. 2015). The other factors behind the survival and expansion of the species are its plasticity (Šálek et al. 2014) and warming of the climate, which creates favourable conditions for golden jackal in central Europe. Until now, the species has not been recorded in Poland, although in recent decades it has been identified in neighbouring countries: in southern Brandenburg in Germany in the 1990s (Arnold et al. 2012); two jackals were shot in northern Moravia in the Czech Republic, 6 km from Polish border, in January 2015 (www.nto.pl); a jackal was observed in the eastern Brest region of Belarus, 100 km from the Polish border, in January 2012 (goldenjackalround.blogspot.com). In this paper, we describe the first evidence for the presence of the golden jackal in Poland, based on morphological and genetic identification of a dead individual, together with two photographically documented observations.

Methods

Morphological identification

A necropsy and morphological investigation was carried out on a male canid that was found dead on a road in north-western Poland. The species was identified on the basis of coat coloration, body measurements and the presence of typical features such as connate pads on the medial digits of the forelimbs (Fig. 1). The age of the animal was estimated on the basis of incisor tooth wear (Raichev 2011) and the width of the canine tooth canal (Goszczyński 1989). More extensive investigation was not possible due to skull damage and deterioration of the carcass.

Other individuals from Poland were identified through photographs, on the basis of the features such as coat

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Fig. 1 Characteristic connate pads on the medial digits of the forelimbs (shown by the arrow) of the investigated jackal from western Poland. Photo by Tomasz Kamiński

coloration, body size and proportions and the tail length. There were at least a couple of photographs per record.

Genetic analysis

We performed genetic analysis to confirm the morphological identification. Two samples were analysed: one obtained from the dead individual found in north-western Poland and another (as a reference sample for the golden jackal) from an individual collected in southern Ukraine (Odessa Oblast, Velyka Mykhailivka Region; N 47.083333, E 30.000000).

Total genomic DNA was extracted from tissue samples using the Qiagen DNeasy Tissue Kit according to the manufacturer's protocol. A 640 base-pair (b.p.) fragment of the mitochondrial (mtDNA) D-loop was amplified using forward primer VVDL1 5'-TCCCCAAGACTCAAGGAAGA-3' (Aubry et al. 2009) and reverse primer RF16076 5'-TGTCCTGAAACCATTGACTGA-3' (J. Mullins and J.M. Wójcik, unpubl.). Amplification and sequencing were carried out according to Wójcik et al. (2010). Nucleotide sequences were determined using an ABI PRISM 3130xl Genetic Analyzer (Applied Biosystems). BIOEDIT 7.0.9 (Hall 1999) and BLAST (<http://blast.ncbi.nlm.nih.gov>) were used to compare sequences obtained by us with sequences downloaded from GenBank. The two mtDNA D-loop sequences that were amplified in this study were deposited in GenBank (accession nos: KT268318 and KT268319).

Results

On 13th April 2015, a male canid was found dead beside the road no. 122, between the villages of Krajnik Dolny and Ognica in north-western Poland (N 53.06158, E 14.36186) (Figs. 2 and 3).

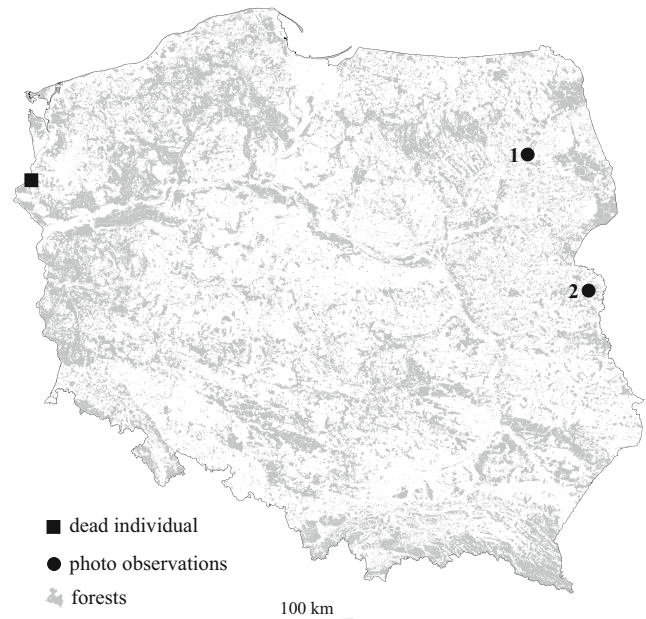


Fig. 2 Locations of golden jackal observations from Poland in April–June 2015. 1—photo record from Biebrza river valley, 2—photo record near Piszczac village

The necropsy showed extensive hematomas and a shattered skull, indicative of a road casualty.

Body measurements were within the range for the species and were as follow: body mass—10.6 kg, head and body length—85.0 cm, tail length—24.5 cm, shoulder height—48.0 cm, hind foot length—16.0 cm, ear length—8.0 cm. The age of the animal was determined as 1 year old. Coat coloration, body measurements (especially length of the tail) (Fig. 3) and the presence of connate pads on the medial digits of the forelimbs (Fig. 1) indicate that the animal was a golden jackal *Canis aureus*.

For genetic identification, we analysed a 640 b.p. fragment of the mtDNA D-loop. A sequence obtained from the dead individual found in north-western Poland was identical with a sequence from a reference sample of the



Fig. 3 Golden jackal carcass found in April 2015 in western Poland. Photo by Tomasz Kamiński



Fig. 4 Golden jackal photo made in May 2015 in Biebrza river valley in north-eastern Poland. Photo by Adam Doliwka

golden jackal collected in southern Ukraine. The sequence was also compared with those available in GenBank and definitely identified by BLAST as a fragment of the mtDNA D-loop of the golden jackal. Genetic analysis has therefore confirmed that the dead male found in north-western Poland was a golden jackal.

Two other observations of jackal, confirmed by photographic documentation, originate from eastern Poland (550 and 620 km from the location of dead jackal). The first photo observation was made on 1st May 2015 near Gugny settlement (N 53.347552, E 22.597319) in the Biebrza river valley of the Podlasie region in north-eastern Poland (Figs. 2 and 4). The second photo observation, from 10th June 2015, comes from Chmielne near Piszczac village (N 51.947980, E 23.395009) in eastern Poland (Figs. 2 and 5). Both photographed individuals had size and coat coloration typical for the golden jackal.



Fig. 5 Incidental photo of golden jackal made in June 2015 near Piszczac village in eastern Poland. Photo by Robert Wakulski

Discussion

The dead jackal found in north-western Poland and the two other well-documented observations from eastern Poland reveal the natural expansion of the golden jackal into Poland, probably from different directions. These records, together with a number of unconfirmed observations of golden jackal from elsewhere in Poland, not only near the country border-line, indicate increasing colonization of Poland by the species. Sex and age of the necropsied individual suggests its migrant status. The question is: has the golden jackal already become established in Poland? The lack of any observations from southern Poland, where jackals have been recorded close to the Polish border in neighbouring countries, and observed expansion from the west and east, suggest that the largely forested Carpathian Mountains may form a barrier to the spread of the species.

A complete homology between the two 640 b.p. fragments of the mtDNA D-loop of the jackal from north-western Poland and one with the same haplotype from the Ukrainian population probably indicates an eastern origin of this individual; however, it requires further investigation.

It is difficult to speculate about potential impacts of golden jackal expansion in Poland.

Competition with native red foxes (*Vulpes vulpes*) and invasive raccoon dogs (*Nyctereutes procyonoides*), which inhabit similar habitats (open areas, wetlands, river valleys) and overlap in their food habits (rodents, carrion), as well as effects on rodents, brown hare and roe deer can probably be expected (Jędrzejewska and Jędrzejewski 1998; Lanszki and Heltai 2002; Kidawa and Kowalczyk 2011; Markov and Lanszki 2012; Penezić and Čirović 2015).

Our findings demonstrate the urgent need to determine the status of the golden jackal in Poland. As there is no evidence on human introduction of jackal to Poland or elsewhere, it cannot be treated as an alien species (Trouwborst et al. 2015). The golden jackal is listed in Habitats Directive Annex V, which covers species of community interest, whose taking in the wild and exploitation may be subject to management measures. However, according to the Directive provisions, they should also be maintained at favourable conservation status. It indicates need of species protection at the present state.

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