Subcutaneous ticks: first report in a golden jackal and further proof for the negativity of non-canid carnivores

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Short report

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Abstract

**Background:** Ticks are hematophagous arthropods which normally attach to the surface of the skin of the host for the blood meal. Their aberrant presence in the subcutaneous tissue of few carnivores, predominantly foxes has been reported. However, there are no reports in other carnivores such as mustelids or golden jackals. Our aim was to investigate and broaden the host spectrum for this aberrant localization of ticks.

**Methods:** Between 2015 and 2020, 198 carnivore carcasses from 12 species have been examined by parasitological necropsy. If subcutaneous ticks were found, the nodules were removed, carefully dissected, and stored in ethanol. The identification of the subcutaneous ticks was carried out at the species level.

**Results:** A single subcutaneous tick was found in one sample, a golden jackal and was identified as a female *Ixodes ricinus*. All other carcasses were negative for subcutaneous ticks.

**Conclusion:** The present paper represents the first report of a subcutaneous tick in a golden jackal (*Canis aureus*), extends the host spectrum of this unusual phenomenon and demonstrates to date its presence only in canid carnivores.

Background

Ticks represent a large group of blood-sucking arthropods that are parasitic in a wide range of mammals, birds, and reptiles, and occasionally in amphibians, being also important vectors for various pathogens [1]. All active life stages require a blood meal in order to molt (larva, nymph), to lay eggs (female), or to become ready to mate (males of certain species) [2].

Despite their typical localization on the host, on the surface of the skin, there are several reports of subcutaneous localization of ticks. The vast majority of reports of subcutaneous ticks were in red foxes, with occasional reports in a raccoon dog, one domestic dog, and a human (Table 1). So far, several hypotheses were suggested to explain the presence of ticks in the subcutaneous tissue, but none of them has been confirmed by experimental studies. It is not known if the number of reports and the relatively common occurrence of subcutaneous ticks in red foxes is related to some host preference or to more extensive studies. Hence, understanding the full host spectrum is important to fill in the puzzle of this unusual phenomenon. It is also unclear why most reports are from Eastern and Central Europe or if this geographical bias is related to the fact that foxes are here the most common and studied wild canids. Nevertheless, in the last twenty years, the population of another canid, the golden jackal (*Canis aureus*) has increased significantly [3]. Golden jackals also have an important role as reservoir hosts for parasites [4]. Moreover, it is not clear if other wild carnivores, such as mustelids can harbor subcutaneous ticks, as the lack of published reports can be related to the lack of studies. In this context, the aim of the present paper was to investigate the occurrence of subcutaneous ticks in various species of wild carnivores in a
geographical area where this aberrant localization is known to be prevalent in red foxes, in order to elucidate the role of the host species.

**Materials And Methods**

Between 2015 and 2020, 198 carnivore carcasses from 12 species (57 golden jackals, 6 gray wolves, 19 wild cats, 2 Eurasian lynxes, 76 Eurasian badgers, 20 beech martens, 8 European polecats, 4 European pine martens, 3 Eurasian otters, 1 stoat, 1 European mink, 1 least weasel) (Suppl. material) have been examined by parasitological necropsy. Carcasses originated from road kills or legally hunted animals. The carcasses were stored at -20°C until processing. The age of the animals was estimated based on the state of tooth wear [5] and sexual maturity [6]. The carcasses were subjected to external inspection, body condition appreciated and checked for the presence of ectoparasites then necropsied using a standard method, starting with the removal of the skin. If subcutaneous ticks were found, the nodules were removed, carefully dissected, and stored in ethanol. The identification of the subcutaneous ticks was carried out at the species level under an Olympus® binocular magnifier and was based essentially on the taxonomic criteria according to literature [1].

**Results**

A single subcutaneous tick was found in one sample, a golden jackal collected in Comana Natural Park, Romania (Fig. 1). The nodule was found under the skin in the hind leg of the left internal hip area. The tick was in an advanced stage of decomposition. However, despite the state of tick degradation, the gnathosoma and the scutum were well preserved, and the tick was identified as a female *Ixodes ricinus*. All other carcasses were negative for subcutaneous ticks.

**Discussion**

The mechanism by which ticks get into the subcutaneous tissue is still unexplained. Several tick-related factors such as the species or the sex were incriminated as favoring factors. According to currently available literature, a more common presence under the skin was noted for ticks with a long rostrum (i.e. *Ixodes* spp.) or ticks feeding for longer periods (adults in general and females in particular), which seem to be predisposing factors [7, 8]. Although it is evident that the vast majority of reports of subcutaneous ticks are from red foxes (Table 1), it is not clear if also host-related factors are involved. It is also unclear if the lack of reports from other hosts is related to the absence of subcutaneous ticks or the lack of studies or incomplete necropsies in other hosts. To understand the full host spectrum of this unusual occurrence, negative reports are also useful. However, with the exception of one study in roe deer [9], no other negative reports are known.

**Table 1. Review of reports of ticks in subcutaneous tissues of various hosts**
We report here for the first time the presence of a subcutaneous tick in golden jackals (frequency 1/57; 95% CI 0.04-9.39%) and the absence in 11 other carnivore host species. However, with the exception of few hosts, such as Eurasian badgers, beech martens and wild cats, the number of samples from other carnivore species is too low to draw a stronger conclusion.

What is clear at the moment is that so far, with the exception of one human case, all other reports originate from canids, with high local prevalence in red foxes [7, 8]. The vast majority of these reports refer to ticks of genus *Ixodes* (Table 1) but this may also be related to the more common occurrence of these ticks in red foxes [10, 11].

## Conclusion

The present paper reports a new host for the presence of subcutaneous ticks and confirms the canids as the single group of animals to show this phenomenon indicating a possible role of the host as a risk factor. We highlight the importance of further studies, on other hosts, but also in other geographical region than Europe.
Declarations

Ethics approval and consent to participate
Not applicable

Consent for publication
Not applicable

Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests
The authors declare that they have no competing interest.

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Authors' contributions
NM wrote the manuscript and identified the tick species. GD performed the necropsies and revised the manuscript. CMG and AMI performed necropsies. DTI and GBC collected carnivore samples. ADM and CMG coordinated the study and revised the manuscript. All authors read and approved the final manuscript.

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**Figures**

![Figure 1](image)

**Figure 1**

Ixodes ricinus in the subcutaneous tissue of a golden jackal, Canis aureus, in Romania

**Supplementary Files**

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