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Short communication

An assessment of the possible recent establishment of *Hyalomma rufipes* in Hungary

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ABSTRACT

The aim of this study was to assess the viability of an opportunistic population of *Hyalomma rufipes*, as evidence of reproduction had been documented in the southern part of Central Europe, specifically Hungary, in 2022. To assess the current situation, tick collections targeting various mammalian species were organized with the assistance of local veterinarians between September 2022 and May 2024. Over the study period, 1502 ticks were collected; however, none belonged to the *Hyalomma* genus. *Dermacentor reticulatus* dominated in our sample population ($n = 963$), followed by *Ixodes ricinus* ($n = 436$). Other species found in the area were: *Haemaphysalis concinna* ($n = 45$), *Dermacentor marginatus* ($n = 38$), *Ixodes hexagonus* ($n = 13$), *Alloceraea inermis* ($n = 6$), and *Rhipicephalus sanguineus* s.s. ($n = 1$). Two *Hyalomma marginatum* males were received from veterinarians between 2022 and 2024, although these were collected far from our study area. Our results suggests that the *H. rufipes* population recorded in 2022 did not persist.

1. Introduction

Hyalomma marginatum ticks are emerging and becoming established in parts of Europe where they were previously considered absent. This range expansion is probably driven, at least in part, by climate change, which creates favorable environmental conditions for their survival and reproduction. (Fernández-Ruiz and Estrada-Peña, 2021; Vial et al., 2016). However, despite the sporadic appearance of *Hyalomma rufipes* in Europe, until recently this tick species has only been known to have viable populations in Africa (Hoffman et al., 2021). At the same time, it was also suspected that small, local and transient populations could have emerged elsewhere (Hoogstraal, 1956; Pomerantsev, 1959). The overwintering of *H. rufipes* has also been suspected, including Central Europe (Rudolf et al., 2021). The sporadic appearance of *Hyalomma* ticks in Hungary has been known for centuries (Karpelles, 1893). The first documented occurrence of *H. rufipes* in Hungary was in 2011, when two individual males were found feeding on two cattle on different dates (Hornok and Horváth, 2012). A citizen science-based sample collection, aiming mainly at *Hyalomma* species has been conducted in Hungary since 2021 (Földvári et al., 2022). In 2022, a reproducing population of *H. rufipes* was found in Hungary (Keve et al., 2023). Six nymphs and a single unengorged larva were found on Bearded Reedlings (*Panurus biarmicus*), a resident bird species. These ticks were collected on June 26th, 2022, which falls within the breeding period of most migratory bird species in Hungary. Based on the above information, it was strongly suspected that these ticks originated from a local population and their genetic similarity reflected a founder effect (Keve et al., 2023). The aim of this study was to explore and discuss the suspicion of the permanency of this local *H. rufipes* population.

2. Materials and methods

To facilitate sample collection aimed at detecting *Hyalomma* spp., every registered veterinarian in the study area (Somogy, Vas, Veszprém, and Zala Counties; see: Fig. 1) was contacted. Some veterinarians were invited individually and were informed about the correct sample collection protocol in detail (Supplementary Information 1). Others (all veterinarians who had an active license in the region) were alerted through the assistance of the local branch of the Hungarian Chamber of Veterinary Doctors at the beginning of 2023 and sent a shortened version of the sample collection protocol (Supplementary information 2) along with an explanation of the aim of the study. Those veterinarians

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who responded positively were informed further about proper methods for sample collection and, when necessary, given detailed information on the field-identification of *Hyalomma* ticks (Supplementary information 1). They were expected to collect every tick they find, with a focus on those they identified as *Hyalomma* sp.

Targeted tick collections were organized in parallel, primarily focusing on large animals (cattle, buffalo, and horses), which are known hosts of adult *H. rufipes* (Estrada-Peña et al., 2017). These collections were conducted between September 2022 and May 2024 at Kápolnapuszta, Zalakaros, Keszthely and Zákány (Fig. 1). In Fig. 1, only successful collections are shown. Sampling mostly took place alongside other veterinary activities, making collections sporadic. Ticks were preserved in ethanol and identified individually using morphological methods (Estrada-Peña et al., 2017). Additionally, molecular identification was performed on six specimens (four *Ixodes hexagonus* nymphs, one *Dermacentor marginatus* nymph, and one *Rhipicephalus sanguineus* s.s. male), targeting the *cox1* gene (Folmer et al., 1994) and the 16S rRNA gene (Black and Piesman, 1994). These were conducted due to uncertainties in morphological identification (for example, in cases involving severely damaged or unrecognizable specimens, or to enhance the accuracy of identification for some species, e.g., *Rhipicephalus sanguineus* sensu stricto)

In this article, the species name *Alloceraea inermis* is used instead of *Haemaphysalis inermis*, in accordance with the taxonomic revision proposed by Kelava et al. (2024)

3. Results

In total, 1502 ticks were collected from ten different host species (cattle, horse, buffalo, deer, goat, pig, wild boar, dog, cat, and human) in the study area between September 2022 and May 2024 (Fig. 1). No *Hyalomma* spp. ticks were found among the ticks collected. The most abundant species was *Dermacentor reticulatus* (n = 963), followed by *I. ricinus* (n = 436). *Haemaphysalis concinna* (n = *45*), *D. marginatus* (n = *38*), *I. hexagonus* (n = 13), *A. inermis* (n = 6), and *R. sanguineus* s.s. (n = 1) were also found. The submitting veterinarians collected individuals of all listed tick species, whereas during the individual tick collections, only *I. ricinus* and *D. reticulatus* were found. These results are summarized in Table 1.

Two *H. marginatum* males were collected by veterinarians far from the study region between 2022 and 2024. One of them was collected from a horse (*Equus caballus*) in Felsőpakony (47.34°N; 19.23°E) and another from an alpaca (*Vicugna pacos*) in Tata (47.65°N; 18.32°E) (Fig. 1).

4. Discussion

Local, isolated populations of *H. rufipes* are already established along the Mediterranean coasts of Africa, and are suspected to form populations in Europe in the future as a result of climate change (Hoffman et al., 2021). It is also suspected that *H. rufipes* imported by birds are able to form small, local populations in Russia (Hoogstraal, 1956;

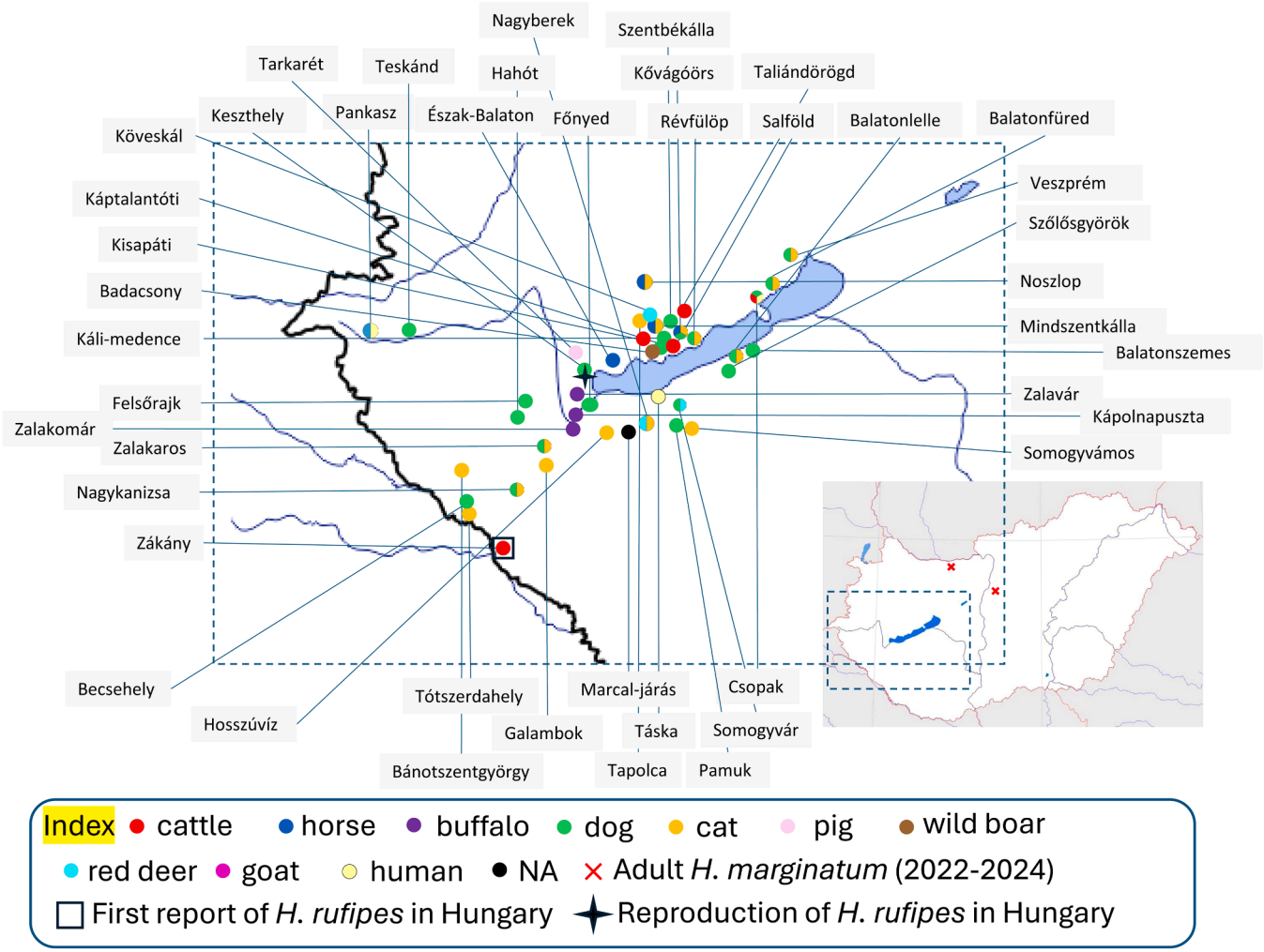

Fig. 1. The map of the sample collections and the study area.

Table 1
Results of the sample collection aiming to find *Hyalomma* ticks between September 2022 and May 2024. This table contains all ticks collected by the veterinarians and during individual sample collections.

	I. ricinus	*I. hexagonus*	*D. reticulatus*	*D. marginatus*	*H. concinna*	*A. inermis*	*R. sanguineus* s.s.	Total
Dog (*Canis lupus familiaris*)	2 N; 85 F; 13 M	2 N; 4 F	22 F; 9 M	2 M	1 L; 4 N; 4 F; 1 M	0	0	149
Domestic cat (*Felis silvestris catus*)	1 N; 32 F; 3 M	5 N; 2 F	1 F; 1 M	1 N	1 L	0	1 M	48
Horse (*Equus caballus*)	1 L; 31 F; 8 M	0	3 N; 169 F, 118 M	1 F	1 N; 1 F; 2 M	6 F	0	341
Water buffalo (*Bubalus bubalis*)	4 F	0	17 F; 15 M	0	0	0	0	36
Red deer (*Cervus elaphus*)	45 F; 7 M	0	0	0	5 N; 4F; 12 M	0	0	73
Wild boar (*Sus scrofa*)	0	0	1 M; 1 F	0	0	0	0	2
Cattle (*Bos taurus*)	21 F; 4 M	0	456 F; 124 M	33 F; 1 M	0	0	0	639
Goat (*Capra hircus*)	70 N; 84 F; 19 M	0	5 F; 2 M	0	8 N	0	0	188
Pig (*Sus scrofa domesticus*)	1	0	4 F; 5 M	0	1 F	0	0	11
Human (*Homo sapiens*)	1 L; 1 N	0	2 F	0	0	0	0	4
NA	3 F	0	7 F, 1 M	0	0	0	0	11
Total:	436	13	963	38	45	6	1	1502

Abbreviations: *I = Ixodes; D = Dermacentor; H = Haemaphysalis; A = Alloceraea; R = Rhipicephalus*; L = larva; N = nymph, F = female, M = male, NA = no data.

Pomerantsev, 1959). Moreover, the fact that several *H. rufipes* nymphs and an unengorged larva with the same genetic background were found on resident birds in the same location in the middle of summer, provided strong evidence for local reproduction (Keve et al., 2023). The persistence of this population, however, needed to be assessed. The study primarily targeted grazing ungulates, as *Hyalomma rufipes* primarily prefers desert, semi-desert, and arid habitats (Estrada-Peña et al., 2017). In Hungary, grazing livestock are typically kept in such dry, open habitats, which, according to our hypothesis, would increase the likelihood of detecting this tick species on these animals. Also, most of the adult *H. rufipes* ticks were found on horses or on cattle in Europe so far (Grandi et al., 2020; Hornok and Horváth, 2012; Hubálek et al., 2020). This explains the large abundance of *D. reticulatus* compared to *I. ricinus* in our samples, as open environments are less favorable to the latter species compared to *D. reticulatus* (Estrada-Peña et al., 2017). In addition, *D. reticulatus* is a relatively large tick species, and its legs sometimes display a striped pattern, which may have misled some of the submitting veterinarians. As a result of these efforts, 1502 ticks were collected from nine different animal species. No *Hyalomma* ticks were collected in the study region, however two *H. marginatum* males were collected by veterinarians, although relatively far from the study region. These sites lie ~166.5 and ~132.5 km in a straight-line distance from the location of confirmed reproduction of *H. rufipes* in Fenékpuszta (Fig. 1).

These results suggest that the population found in 2022 was not able to survive to the next tick season although this cannot be completely ruled out, given the nature of our sample collection, since the absence of *H. rufipes* detections in the area does not necessarily indicate the true absence of the species. However, the reproduction that had evidently occurred may be the first step towards the species' later establishment in the era of climate change.

CRediT authorship contribution statement

Gergő Keve: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Tekla Varga:** Writing – review & editing, Validation, Investigation, Data curation. **Márton Hoitsy:** Investigation, Writing – review & editing. **Kata Wermer:** Investigation, Writing – review & editing. **Sándor Hornok:** Visualization, Validation, Supervision, Resources, Project administration, Conceptualization.

Declaration of competing interest

The authors declare no competing interests.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ttbdis.2025.102544.

Data availability

No data was used for the research described in the article.

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