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Distribution, habitats and abundance of the herb field mouse (*Apodemus uralensis*) in Lithuania

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Abstract: Lithuania is situated in the north-western corner of the large distributional range of the herb field mouse, *Apodemus uralensis*. *Apodemus uralensis* is distributed mainly in the north-western part of Lithuania, where the majority of specimens were captured in the ecotones of mixed forests and open habitats (natural meadows, cornfields and fallow fields) and in open habitats bordering forests or situated close to them. *Apodemus uralensis* is rare in Lithuania: the average relative abundance was only 2.2 ind. per 100 trap-days and it accounted for up to 8.5% of all small mammals trapped. Avoidance of forest habitats and preference of ecotonic habitats, as well as the comparatively low abundance, are the main peculiarities of *A. uralensis* in the north-western corner of the range.

Key words: *Apodemus microps*; *Sylvaemus uralensis*; distributional range; ecotones

Introduction

Although the name herb field mouse *Apodemus uralensis* (Pallas, 1811) is used in many globally recognised sources (e.g., Wilson & Reeder 2005; Kryštufek et al. 2008), several other scientific and common names are also widely used for the species. *Apodemus microps* was a name previously used in Central Europe and *Sylvaemus uralensis* is frequently used in current Russian publications. Pygmy field mouse and Ural field mouse are alternative common names for the species, with pygmy wood mouse also applied in some scientific publications.

Apodemus uralensis has been the subject of many taxonomic, genetic, morphometric and parasitological studies (e.g., Vashchenok & Tret'yakov 2005; de Mendonça & Benedek 2012; Čanády et al. 2014; Kolcheva 2015; Vlasov et al. 2015). Additionally, populations of *A. uralensis* have frequently been used as models for investigations into the influence of radioactive contamination on the territory of the East Ural radioactive trace (e.g., Vasil'eva et al. 2003; Grigorkina et al. 2008; Modorov & Pozolotina 2011; Bol'shakov et al. 2012). The distribution of *A. uralensis* on the peripheries of its range have also attracted the attention of researchers (Juškaitis 2003; Kryštufek & Vohralík 2007; Cichocki et al. 2011; Shar et al. 2015). However, in spite of its wide geographical distribution, most data relating to the biology of *A. uralensis* come from central Europe (e.g., Holišová et al. 1962; Steiner 1978; Stanko 1993; Stanko & Miklisová 1995; Heroldová et al. 2007; Heroldová & Tkadlec 2011; Baláž et al. 2012), whilst such data from other parts of the range are scanty (e.g., Tolkachev 2016).

Apodemus uralensis has a very large distributional range which stretches from Central and Eastern Europe through Russia and Central Asia to north-western China (Fig. 1; Kryštufek et al. 2008). Within this range, *A. uralensis* contains two divergent phylogenetic lineages, which may represent two distinct species (*uralensis* s. str. and *kastschenkoi*) separated by the Irtysh River (Pavlinov & Lissovsky 2012). In Europe, there is a large gap between the north-western part of the range (Latvia, north-western Lithuania and north-eastern Belarus) and the south-western part of the range (southern Poland, southern Ukraine, the Czech Republic, Slovakia, Hungary and Romania).

Lithuania is situated in the north-western corner of the species range (Fig. 1). *Apodemus uralensis* was identified as a new mammal species for Lithuania as recently as 1999, with many sites of this species subsequently discovered in north-western Lithuania during 1999–2000 (Juškaitis & Baranauskas 2001; Juškaitis et al. 2001; Mačiulis 2002; Juškaitis 2003). During extensive studies of small mammals in the northern part of Lithuania during 2004–2010, new data on the distribution, habitats and ecology of *A. uralensis* were collected (Balčiauskas & Gudaitė 2006; Alejūnas & Stirkė 2010; Balčiauskas & Alejūnas 2011).

The aim of the present paper is to summarize the data on the distribution, habitats and abundance of *A. uralensis* in Lithuania, and to compare these characteristics with the rest of the species range.

Material and methods

Data on the distribution, habitats and abundance of *A. uralensis* were collected during studies of small mammals in northern and north-western Lithuania in 1996–2014 (Juškaitis & Baranauskas 2001; Juškaitis et al. 2001 and references therein; Mačiulis 2002; Balčiauskas & Gudaitė 2006; Alejūnas & Stirkė 2010; Balčiauskas & Alejūnas 2011;

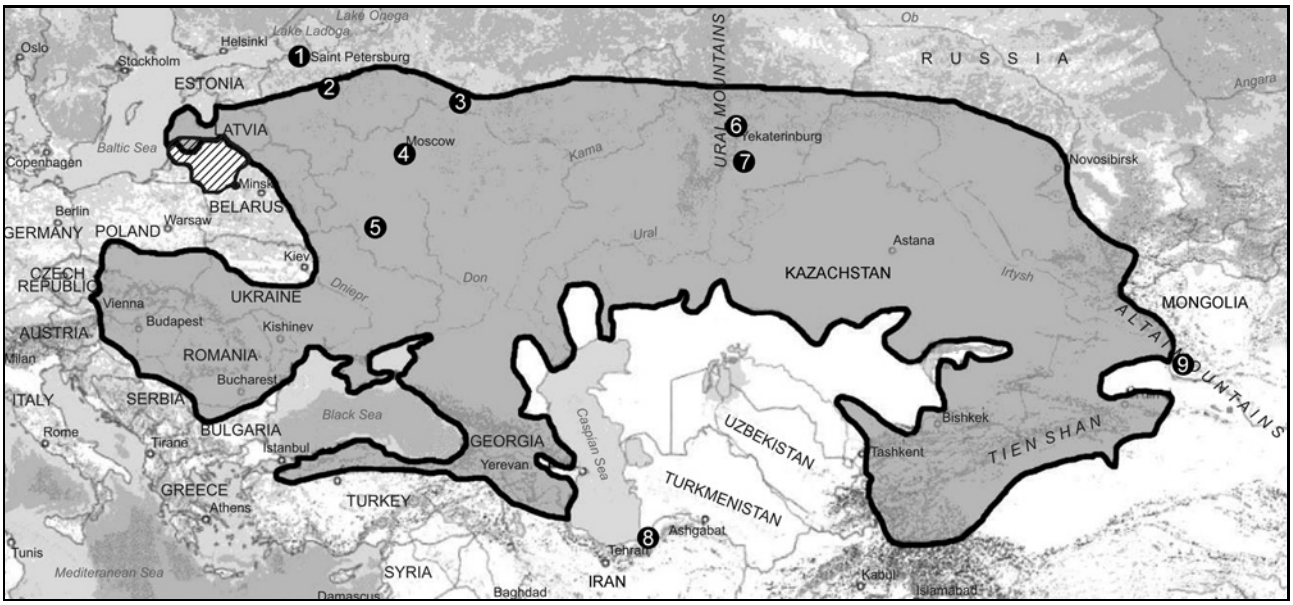

Fig. 1. The distributional range of *Apodemus uralensis* (based on Kryštufek et al. 2008). Lithuania is designated in diagonal line pattern. Sites indicated by numbers: 1 – Saint Petersburg city; 2 – Novgorod region; 3 – Yaroslavl city; 4 – Moscow city; 5 – Central Chernozem nature reserve (Kursk region); 6 – Yekaterinburg city; 7 – Chelyabinsk city; 8 – north-east Iran; 9 – western Mongolia.

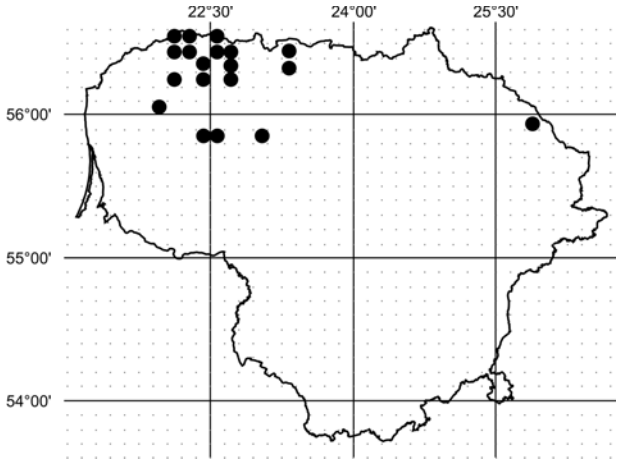

Fig. 2. Distribution of *Apodemus uralensis* in Lithuania. Sites are pooled and mapped on 10 × 10 km squares of the national grid "Lithuania-94".

P. Alejūnas, unpublished). Small mammals were trapped with snap-traps, using standard 25-trap lines (traps 5 m apart, baited by bread crust with sunflower oil) and 2 or 3 days exposition. The total trapping effort was 27,825 trap-days (one trap-day equals a trap left in place for 24 hours), and the total number of small mammals trapped was 5,125. A total of 113 specimens of *A. uralensis* were trapped during these studies. Dimensions of the body and features of the skull were used for the identification of the species (Pucek 1981; Mezhzherin & Zagorodnyouk 1989; Balčiauskienė et al. 2004). The relative abundance of the rodents was expressed as a number of individuals caught per 100 trap-days from the first day of trapping. The proportion of specimens of *A. uralensis* among all small mammals trapped in a particular area or habitat was used as another index of its relative abundance.

Results and discussion

Distribution

The absolute majority of sites of *A. uralensis* are concentrated in the north-western part of Lithuania (Fig. 2). They are scattered across almost the entire area of the Mažeikiai administrative district and in some protected areas: the Kamanos strict nature reserve, the Žagarė, Kurtuvėnai and Varniai regional parks and the Žemaitija national park. In the north-eastern part of Lithuania, *A. uralensis* was found at a single site only, situated in the Zarasai district.

It was previously supposed that *A. uralensis* could be quite widespread in northern Lithuania (Juškaitis et al. 2000; Juškaitis 2003), as the species is widespread across neighbouring Latvia, including the southern part of this country (Mitchell-Jones et al. 1999). However, only a few new *A. uralensis* sites were discovered during extensive studies of small mammals carried out by Alejūnas & Stirkė (2010) in ten administrative districts of northern Lithuania, as well as during other small mammal studies in this part of the country (Balčiauskas & Gudaitė 2006; Balčiauskas & Alejūnas 2011; Jasiulionis et al. 2011; Čepukienė & Jasiulionis 2012). From this we can conclude that the established sites for *A. uralensis* do reflect the actual distribution of this species in northern Lithuania, albeit that some new sites could be expected in the very north-western corner and western parts of Lithuania where studies of small mammals have not been carried as yet.

Thus, *A. uralensis* is absent in the major part of Lithuania and some other adjacent large areas in Belarus, Ukraine and Poland (Kryštufek et al. 2008; Cichocki et al. 2011). It remains unclear why there is a large gap in the distributional range of *A. uralensis* in Europe (see Fig. 1). It should be noted that the distri-

Table 1. Main habitats in which *Apodemus uralensis* were trapped in Lithuania during 1996–2014.

Habitat characteristics	Number of sites, *n* (%)	Number of individuals trapped, *n* (%)
Mixed and coniferous forests, regenerating clear-cuts	7 (17.5)	11 (12.0)
Ecotones of forests and open habitats (meadows, cornfields, fallow fields)	15 (37.5)	36 (39.1)
Open habitats bordering forests	13 (32.5)	35 (38.0)
Open habitats situated at a distance of more than 0.5 km from forest	3 (7.5)	4 (4.4)
Transitional swamps and raised bogs	2 (5.0)	6 (6.5)
Total	40 (100)	92 (100)

butional range of *A. uralensis* presented in the IUCN Red List (Kryštufek et al. 2008) should be corrected as many new sites for this species have been recorded in the peripheries of its range recently (Fig. 1), e.g., in western Poland (Cichocki et al. 2011), St. Petersburg city in Russia (Medvedev & Tretyakov 2014), western Mongolia (Shar et al. 2015) and north-east Iran (Ghorbani et al. 2014).

Habitats

In Lithuania, the majority of specimens of *A. uralensis* (77%) were caught in ecotones of mixed forests and open habitats (meadows, cornfields, fallow fields), as well as in open habitats bordering forests (Table 1). Shores of water bodies overgrown with trees and bordering open habitats are attributed to this category as well. In the open habitats, *A. uralensis* were most often trapped in natural unmowed meadows, usually overgrown with sparse shrubs. Some specimens were trapped in mixed and Norway spruce dominated forests, but typically not far from the forest edge, in regenerating clear-cuts or near reclamation canals. In the Kamanos strict nature reserve, *A. uralensis* also occurred in transitional swamps and raised bogs.

Data from the Žagarė regional park show clearly that *A. uralensis* avoid forest habitats. Out of 21 *A. uralensis* specimens trapped in this area in 2008–2010, only a single specimen was trapped in the forest near a reclamation canal, while 20 specimens were trapped in the ecotones of mixed forest and meadows (0.17% and 2.75% of all small mammals caught in 2,586 trap-days and 3,153 trap-days in respective habitats; chi-square = 13.78, df = 1, $P = 0.0002$). According to data from the Mažeikiai district, *A. uralensis* was comparatively abundant at the edges of some cornfields (see sub-chapter Abundance). However, the occurrence of *A. uralensis* in cornfields in Lithuania may be underestimated due to the low trapping effort in such habitats.

Across its range, *A. uralensis* is an eurytopic species inhabiting a variety of different habitats including forests and open habitats as well as anthropogenic ones (Steiner 1978; Spitzenberger & Bauer 2001; Kryštufek et al. 2008). In many parts of the range, e.g., in western Mongolia, north-east Iran, Turkey (Anatolia), southern Ural and the Novgorod region of Russia, *A. uralensis* has been trapped mainly in forest habitats, including floodplain forests along rivers (Vashchenok & Tretyakov 2005; Kryštufek & Vohralík 2007, 2009; Bol'shakov et al. 2013; Ghorbani et al. 2014; Shar et al. 2015).

Apodemus uralensis is a common and even dominant species in forest habitats and parks located within the territories of the cities of Yaroslavl, Yekaterinburg and St. Petersburg in Russia (Tikhonova et al. 2012; Chernousova 2013; Chernousova et al. 2014; Medvedev & Tretyakov 2014) and collective gardens within and outside large cities (e.g., Chelyabinsk, Yaroslavl, Moscow) are another anthropogenic habitat favoured by *A. uralensis* (Nurtdinova & Pyastolova 2004; Tikhonova et al. 2010). *Apodemus uralensis* was one of the dominant small mammal species in the core of the city of Nitra in Slovakia (Klimant et al. 2015), while small numbers of *A. uralensis* were also trapped in public parks and greeneries within the city of Vienna (Mitter et al. 2015).

In the Czech Republic and Slovakia, *A. uralensis* is one of dominant rodent species in agricultural landscapes, especially in crop fields, such as cereal, maize, sugar beet and other crops. In forests, wind breaks and fallow lands however, *A. uralensis* is rare (Holišová et al. 1962; Stanko & Miklisová 1995; Heroldová et al. 2004, 2005, 2007). Meanwhile in the Central Chernozem nature reserve (Kursk Region, Russia), *A. uralensis* was among the dominant species both in oak forest and in protected steppe habitat (Vlasov 1996; E. Vlasov, unpublished).

Thus, in the major part of the range, *A. uralensis* occurs mainly in natural and anthropogenic forest habitats, where it can be among the dominant species in the small mammal communities. However, *A. uralensis* is not confined to forest habitats in the less forested western part of the range, especially in Central Europe. In the north-western corner of its range, the habitat preferences of *A. uralensis* appear rather specific: it avoids forests and is predominantly an "ecotonic" species. It should be noted that *A. uralensis* has also been trapped in ecotones in the Ural region (Grigorkina et al. 2008; Modorov & Pozolotina 2011) and in Romania (de Mendonça & Bendek 2012).

Abundance

In north-western Lithuania (Mažeikiai district), the average relative abundance of *A. uralensis* was low – 2.2 ind. per 100 trap-days. In the ecotones of forests and open habitats, the relative abundance was 4–8 ind. per 100 trap-days in most cases. The highest abundances

Table 2. Proportions of *Apodemus uralensis* in small mammal communities in sites with the highest numbers of the target species trapped in north-western Lithuania.

Site	Total No. of small mammals trapped	*A. uralensis* trapped		Number of trap-days	Study period	Reference
		n	%			
Mažeikiai district	520	44	8.5	2075	2000	Juškaitis & Baranauskas (2001)
Kamanos SNR	222	15	6.8	3300	1999–2001	Mačiulis (2002)
Žagarė RP	1256	21	1.7	5929	2008–2010	Balčiauskas & Alejūnas (2011)

of *A. uralensis* were recorded on the edge of barley and oat fields not far from forest (20 ind. per 100 trap-days) and in grass-covered reclamation canal in rye field (16 ind. per 100 trap-days). In the Žagarė regional park, the maximum relative abundance of *A. uralensis* was 4–5 ind. per 100 trap-days in shrubby meadows and ecotones of forest and meadows.

The relative abundance of *A. uralensis* in other parts of the range is indicated only in a few publications. The abundance estimated in Lithuania is most similar to the abundances given in the Novgorod region and Latvia, both also situated on the north-western periphery of the species range. In the Novgorod region, the average relative abundance was low (1.3–6.5 ind. per 100 trap-days) and unstable between years, reaching 12–18 ind. per 100 trap-days in particular sites in the year of maximum abundance (Vashchenok & Tret'yakov 2005). In Latvia, this index reached 1.6 ind. per 100 trap-days in forest and 0.1 ind. per 100 trap-days in grassland at a single study site (Pupila & Bergmanis 2006). In the Central Chernozem nature reserve, the average relative abundance was 0.5 and 1.5 ind. per 100 trap-days in steppe and forest habitats respectively in 1953–1961, but it increased to 2.8 and 5.9 ind. per 100 trap-days in the respective habitats in 1988–1993 (Vlasov 1996).

In southern Moravia, the average autumn or winter peak abundance varied at around 4 to 5 ind. per 100 trap-days in 1958–1960, with a maximum of 11.6 ind. per 100 trap-days in December 1961. The highest relative abundance was 43 ind. per 100 trap-days in a narrow weedy ridge and in a weedy sugar beet field (Holišová et al. 1962).

In Lithuania, *A. uralensis* is also a rare species according to its proportion among all small mammals trapped (Table 2). The highest proportion of *A. uralensis* (8.5%) was recorded in the Mažeikiai district, but in this study the majority of trap lines were set in favourite *A. uralensis* habitats. In most studied areas in Lithuania however, *A. uralensis* accounted for less than 1% of all small mammals trapped.

In other parts of the range, the proportion of *A. uralensis* among all small mammals trapped reached 40–50% in many areas. In the Ural region, *A. uralensis* numerically dominated among small mammal trapped at two study plots (from 40 to 60% in different years; Grigorkina et al. 2008). In collective gardens located within and beyond Chelyabinsk city limits, *A. uralensis* accounted for 52% of small mammals trapped, but only 21% in adjacent habitats (Nurtdinova & Pyastolova 2004). In the steppe habitat of the Central Chernozem nature reserve, the abundance of *A. uralensis* in the small mammal community increased significantly from 4.9% in 1953–1961 to 17.6% in 1988–1993 and to 45.9% in 2012–2014 (Vlasov 1996; E. Vlasov, unpublished). Previously, *A. uralensis* was more abundant in forest habitat of the same reserve (up to 40.3% in 1988–1993). In southern Moravia, *A. uralensis* accounted for 43% of the approximately 2500 small mammals trapped in woodless agricultural habitats (Holišová et al. 1962) and for 32–46% of all small mammals trapped in various crop fields (Heroldová et al. 2007).

Thus, the abundance of *A. uralensis* was found to be much higher in many other parts of the range than in Lithuania. In many cases, *A. uralensis* was dominant or among the dominant species in the small mammal communities in both forests and open habitats. *A. uralensis* may be one of dominant species together with bank vole (*Myodes glareolus* Schreber, 1780) in forest habitats (Vlasov 1996; Bol'shakov et al. 2013; Tolkachev 2016) and together with common vole (*Microtus arvalis* Pallas, 1778) and wood mouse (*Apodemus sylvaticus* L., 1758) in crop fields (Holišová et al. 1962; Heroldová et al. 2007).

According to our review of publications on *A. uralensis* across its range, we can conclude that avoidance of forest habitats and preference of ecotonic habitats, as well as the comparatively low abundance, are the main peculiarities of *A. uralensis* in the north-western corner of the range. The reasons for the presence of the gap in the distribution of *A. uralensis* in the major part of Lithuania, as well as in Belarus, Poland and Ukraine, remain unclear.

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