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Short communication

The occurrence of Pannonian root vole (*Microtus oeconomus mehelyi*) in small mammals' communities in Danubian Plain

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Abstract

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Two orographic units, Podunajská rovina (Danubian Plain) and Hronská pahorkatina Highlands represent the border of Pannonian root vole's central European population distribution area, where it colonises wet habitats. Communities of small mammals, especially the occurrence of Root vole, were investigated during the period 1981–2015 along the rivers Danube, Váh, Nitra, Žitava and Ipeľ. We investigated 146 sites and the occurrence of Root vole was confirmed in 39 localities (177 ind.), where it occurred together with other 18 small mammal species (1610 ind.). Root vole, Bank vole and the Common shrew were eudominant species in these communities. The character of recent Root vole population in these areas is not well studied. The isolation of habitats, recent knowledge about dynamics of its demography or possibilities and abilities for migration, indicate a prospect of metapopulation structure of this population. The answers to these questions will provide fundamental consequences for modifying or changing the conservation management strategy of this species.

Keywords

community, habitats, rodents, Slovakia, small mammals

Introduction

One of the rare and endangered species of the mammal fauna in Slovakia is the Pannonian root vole, *Microtus oeconomus mehelyi*. This glacial relict subspecies occurs only in the southern part of Slovakia on the Pannonian Lowland (Danubian Plain). Besides Slovakia, this rare subspecies occurs locally in Northern Austria and in some isolated localities in Hungary (Miklós et al., 2014). In Slovakia, *M. oeconomus mehelyi* inhabits habitats created by the activity of rivers, such as meander, blind stream branch and secondarily, river-basins (side streams – bifurcations), which are currently isolated in agricultural areas and in different phases of succession

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of semi-natural vegetation. The distribution of Pannonian root vole in the territory of Slovakia is characterised by the change of the landscape and its natural conditions in the postglacial age. The population was negatively influenced by the change of post-neolitic land use activity which formed agricultural steppe and reduced the suitable natural and semi-natural habitats for species. The currently proceeding fragmentation process of species distribution is caused by reduction and loss of habitats. Decline in food offer have negative effects on the survival of local populations. The agricultural landscape of the southern part of Slovakia has undergone significant changes over the past 150–200 years, especially since the 1950s. These are for example, interventions in the hydrological mode of landscape, land consolidation, functional changes of particular landscape units, spreading of alien species, mechanisation and application of chemistry. These changes and processes had a negative impact on the biodiversity of agricultural landscapes and numerous species have become rare or completely extinct. However, new approach in evaluation of the structure and functions of agricultural landscape may help to solve these problems (Izakovičová et al., 2008).

The results of the mapping of the occurrence and the distribution of the Pannonian root vole before 2010 have been presented in a number of studies. The first indication of the presence of this species from the studied region is stated by Binder and Štollmann (1975). Other information from the territory among the rivers Váh, Nitra, Žitava, Hron, Ipeľ are stated by Ambros (2010a, b, 2011, 2013), Ambros et al.(1999a, b, 2001, 2003, 2005), Baláž et al. (2003), Bridišová et al. (2006), Gubányi et al. (2009), Jančová et al. (2008), Krištofík and Stollmann (2012). The eastern boundary of the species distribution in Slovakia is currently defined by the locality Parížske močiare – swamps near the village Gbelce (Ambros et al., 1999b, 2005; Ambros and Baláž, 2002).

In this short communication, we summarize new, as yet unpublished data on the occurrence of Pannonian root vole in Slovakia. Based on knowledge of metapopulation ecology, we present different perspective on the function of the recent population of Pannonian root vole in the investigated part of its range of distribution, so we can provide the proper management and long-term conservation of the Slovakian population or subpopulation of this subspecies. We complete and specify information about the position of this species in small mammals' communities.

Material and methods

The study area represents the eastern part of the distribution range of Pannonian root vole in Slovakia. It consists of basins of five rivers that flow down in the direction north–south from the slopes of the Western Carpathians to the Danube: Váh, Nitra, Žitava, Hron, and Ipeľ. The studied area is delimited by the flow of river Váh from the west and by the flow of the Danube from the south. The eastern border of the studied area is formed by the river Ipeľ. The northern boundary goes in the direction east–west on the level city Nové Zámky. In the past, extensive flood-protection interventions were realised in the river channel of these rivers, which changed the direction and hydrodynamics of their flows. It had an impact on the hydrological regime in the land and, consequently, to natural conditions. In parallel with these activities, continued the construction of the system of channel network with the function of irrigation as well as the aridification of agrocenoses of surrounding area. The natural dynamic processes of the flows, their subsequent modification, water channel system and the gradual change in the functions of grasslands (meadows) in favour of agricultural cultures created the conditions for the emergence of habitats which represent preferred habitats for the Pannonian root vole. The identification of localities, where the Pannonian root vole occurs, was carried out in the defined sampling area during 1981, 1990, 1999–2006 and 2010–2015. Small mammals were trapped with snap traps arranged in line transect (50 pcs) with a two-day exposition in the field.

Results and discussion

The presence of Pannonian root vole was detected in 39 of the 146 investigated sampling plots, in total in 18 sites (Fig. 1, Appendix 1). From 2010 to 2015 we have confirmed the occurrence of other local populations of the root vole in the area between the Váh and channel of Stará Nitra and in the other localities that are remnants of meanders, blind streams or secondary distributaries of nowadays non-existing continuous flow of the river Žitava.

The recent habitats of Pannonian Root Vole represent places that are: (1) units of natural hydrodynamic processes of rivers (2) accessory products of river system modification of Váh, Nitra, Žitava, Hron and Ipeľ rivers or (3) the rest of previous primary grasslands of partially preserved original grasslands (flooded meadows and pastures) situated between rivers. Nowadays the occurrence of Pannonian root vole in underflooding meadows and pastures with ruderal association is considered to be unique, rare and suboptimal for the species (Miklós et al., 2011). The creation and variety of these elements of the river system is closely linked to the dynamics and physical characteristics of the considered Carpathian Rivers' flow before they flow into the Danube. A slowdown in the rate of flow at a given volume of water, morphology and elevation of terrain of this part accelerates the sedimentation of materials.

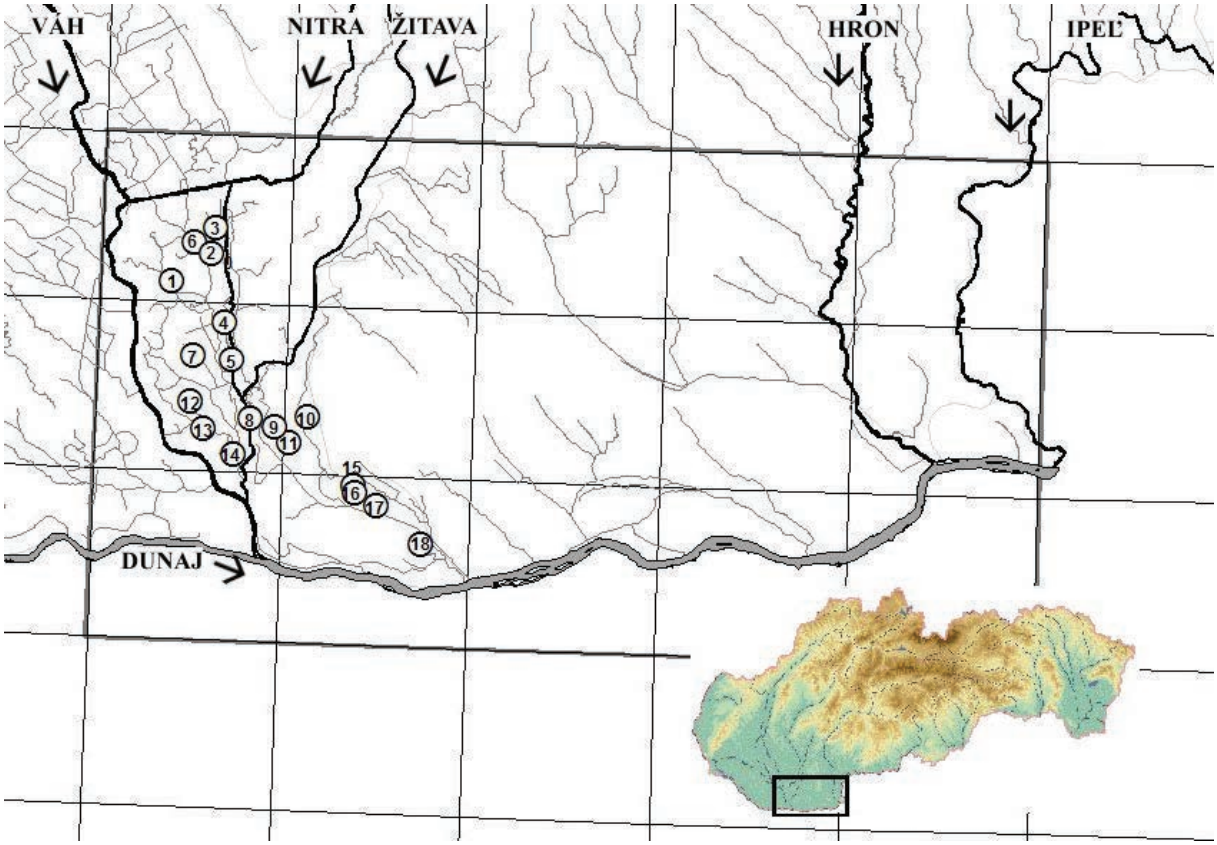

Fig.1. Map of the sites (details see in Appendix 1) with occurrence of the Pannonian root vole in the catchments areas of lower flows of Carpathians rivers (Váh, Nitra, Žitava, Hron, Ipeľ) after 2010.

This is reflected in the relatively fast alternation of the formation and termination of meanders and side arms in this area. After the modification (channel straightening) of the main flows of these Carpathian Rivers, some branches were completely or partially cut off the supply of water, with the subsequent infilling and succession. In addition to aridification, also intensive meliorative modifications occurred, in the form of a dense network of drainage channels. Water management constructions (if they are currently working) on the one hand, drain the wetlands, on the other hand, they are the source of at least the minimum amount of water that keeps and stabilises the habitats suitable for the surviving of the species.

Our results showed that small mammal community in the investigated areas with Pannonian root vole consists of 18 species of small mammals (insectivores and rodents). In the vast majority of samples the eudominant species were Bank vole *Clethrionomys glareolus*, Common shrew *Sorex araneus* and Root vole *Microtus oeconomus*. Dominant constituent of these assemblages were Pygmy field mouse *Apodemus microps*, Wood mouse *Apodemus sylvaticus*, Harvest mouse *Micromys minutus* and Striped field mouse *Apodemus agrarius*. The subdominant species include Common vole *Microtus arvalis*, Yellow-necked mouse *Apodemus flavicollis,* Pygmy shrew *Sorex minutus*, Miller's water shrew *Neomys anomalus*, Common pine vole *Microtus subterraneus,* Eastern house mouse *Mus musculus,* Steppe mouse *Mus spicilegus*, Bi-coloured white-toothed shrew *Crocidura leucodon*, Lesser white-toothed shrew *Crocidura suaveolens*, Water shrew *Neomys fodiens* and Water vole *Arvicola amphibius*.

We assume that in the past (at least at the end of the 18th century) the root vole population expanded in natural conditions among Váh–Nitra–Žitava–Hron–Ipeľ rivers in a spatially continuous way. We can support this assumption with only relatively insufficient information from the comparison and evaluation of historical sources (1st and 2nd Military Mapping Survey of the Habsburg Empire) with our knowledge. Based on our knowledge, the distribution of populations or subpopulations of this species increase in the remaining original wetlands habitats, and it determined by the connectivity between remaining habitats what provides the dispersal of the individuals between the given subpopulations. Some indirect evidence, such as the recent osteological records from owl pellets (Šilhár, 1975; Noga and Obuch, 2003) suggest that the species may still live in an enclosed area in the investigated distribution range. The survival of local populations in the fragmented regions depends on the migration ability of the species

between particular fragments with different topic and trophic propositions and so to maintain the gene pool among the subpopulation (Andrén, 1994). The population of Pannonian root vole in the area between Váh, Nitra, Žitava, and Hron rivers was characterized by the local subpopulations with its own structure and dynamics, which together form a metapopulation structure. In this case, it is necessary to investigate and evaluate the dynamic of the subpopulations and role of connectivity of refugial habitats as well as plan appropriate conservation management based on metapopulation ecology approach.

The typical landscape cover of the studied area with a dense network of linear units (water channels) offers the premise that they also function as random and temporally non-determined migration routes. In the case of fragmented environment, there is a network of these real and presumptive migration corridors in the studied area, formed also by the rest of underflooding meadows, pastures, and meanders at different stages of vegetation succession. Their function as migration corridor is highly variable and unstable and depends on several factors, such as the course of weather in a given season, the technical status of water construction works and implementation of land consolidation. Part of this network of migration routes may be in a latent stage and the "migration gates" can open just after suitable (e.g. climatic) conditions activated, for colonisation of suitable habitats. It happened in 2009, when after an unusual rainy spring season, landscape depressions and unfilled riverbeds of non-existing watercourses were filled with water and in the following years they temporarily created the appropriate topic conditions for migration.

In conclusion, it is necessary to point out some of the facts related to the local root vole population in the current landscape structure in the catchment areas of the studied Carpathian Rivers. Generally, the isolation of small populations leads to their gradual extinction. The partial isolation of some species may be the reason for their successful survival. If the environment is fragmented over a long period, the organisms that colonise it are adapted to the fragmentation of habitats or they are dependent on it (Storch, 2000). The characteristics of the fragmented environment are augmented by the proportion of border structures that causes further changes in biotic as well as abiotic conditions of fragmented patches. This phenomenon, also known as the edge effect, has a dynamic nature depending on the productivity of the ecosystem, landscape, and natural sites of particular region, such as the state of the shrubs and trees, the stage or density of vegetation cover (Paton 1994; Donovan et al., 1997). The successful survival of the populations of Pannonian root vole in the particular region thus depends on the dynamics of the development, quantitative and structural changes and properties of local subpopulation and on the success of the migration of individuals between them.

The protection and conservation of the populations of the Pannonian root vole between Váh–Ipeľ Rivers are currently ensured by law with a system of protected areas of different categories and different degrees of protection. From the previous parts follows that the systematic protection of root vole is not only based on the protection of the areas in which the population of species occurs in real time. It is necessary to consider also those areas that are the vole's potential topic, trophic and migratory habitats.

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Appendix 1. Site name – as it was named according to the collector or as it was quoted in literature, Code of basic map unit of the Databank of Slovak Fauna (DFS), site coordinates in coordinate system (WGS84 format), municipality cadastre (m.c.), date (day, month and year) of collecting, number of trapped individuals of *Microtus oeconomus mehelyi* (ind. MOE) and name of the collector (coll.).

1. Hantovský channel, DFS 8074, longitude (lon.): 18.061124; latitude (lat.): 47.911893, m.c. Nesvady, 12 May 2011, 1 ind. MOE, coll.: Ambros; 2. Malá Aňala, channel, DFS 8074, lon.: 18.095607; lat.: 47.928989, m.c. Nesvady, 6–7 October 2011, 4 ind. MOE, coll.: Stollmann; 3. Stará Guta, DFS 8074, lon.: 18.098418; lat.: 47.943811, m.c. Nesvady, 7 October 2011, 1 ind. MOE, coll.: Ambros; 4. channel Ďotva, DFS 8174, lon.: 18.109175; lat.: 47.887785, m.c. Imeľ, 17 June 2011, 1 ind. MOE, coll.: Ambros, Stollmann; 5. Detvické meadows, DFS 8174, lon.: 18.116362; lat.: 47.866270, m.c. Martovce, 29 April 2011, 3 ind. MOE, coll.: Ambros, Stollmann; 6. Martovský channel, reed 1.5 km north west of the village, DFS 8174, lon.: 18.106083; lat.: 47.867450, m.c. Martovce, 12 May 2011, 2 ind. MOE, coll.: Ambros; 7. channel Tátoš, DFS 8174, lon.: 18.082606; lat.: 47.867503, m.c. Martovce, 16 June 2011, 4 ind. MOE, coll.: Ambros, Stollmann; 8. Katica Szög, DFS 8174, lon.: 18.134639; lat.: 47.831307, m.c. Hurbanovo, 13 September 2011, 3 ind. MOE, coll.: Ambros; 9. Horný Komočín, DFS 8174, lon.: 18.157092; lat.: 47.827449, m.c. Hurbanovo, 16 August 2012, 28 August 2012, 17 ind. MOE, coll.: Ambros; 10. Hurbanovo, Konkoly, DFS 8175, lon.: 18.186060; lat.: 47.833929, m.c. Hurbanovo 16 August 2012, 4 ind. MOE, coll.: Ambros, Dudich, Stollmann; 11. Dolný Komočín, DFS 8175, lon.: 18.169900; lat.: 47.818393, m.c. Svätý Peter, 16 August 2012, 2 ind. MOE, coll.: Ambros, Stollmann, Dudich; 12. Hliník, Hlinický channel, DFS 8174, lon.: 18.081791; lat.: 47.840147, m.c. Vrbová nad Váhom, 12 July 2011, 23 April 2013, 13 October 2013, 9 ind. MOE, Ambros, Horváth; 13. Kava, Vrbovský channel 1, DFS 8174, lon.: 18.094195; lat.: 47.824523, m.c. Komárno, 12–13 July 2011, 2 ind. MOE, coll.: Ambros; 14. Landor, channel, DFS 8174, lon.: 18.120599; lat.: 47.810330, m.c. Komárno, 13 July 2011, 1 ind. MOE, coll.: Ambros; 15. Fialkový channel 1, DFS 8275, lon.: 18.228527; lat.: 47.794099, m.c. Chotín, 15 April 2012, 28–29 October 2014, 15–17 April 2015, 28–30 July 2015, 16–19 October 2015, 8 ind. MOE, coll.: Ambros, Baláž, Horváth, Klimant, Somogyi, Tulis; 16. Fialkový channel 2, DFS 8275, lon.: 18.229163; lat.: 47.789662, m.c. Chotín, 15 April 2012, 28–29 October 2014, 15–17 April 2015, 28–30 July 2015, 16–19 October 2015, 8 ind. MOE, coll.: Ambros, Baláž, Horváth, Klimant, Somogyi, Tulis; 17. Želiarske field, DFS 8275, lon.: 18.248764; lat.: 47.782723, m.c. Krátke Kesy, 28–29 October 2014, 15–17 April 2015, 28–30 July .2015, 16–19 October 2015, 17 ind. MOE, coll.: Ambros, Baláž, Horvath, Klimant, Somogyi, Tulis; 18. Lieskovský channel, DFS 8275, lon.: 18.289806; lat.: 47.760844, m.c. Marcelová, 28–29 October 2014, 15–17 April 2015, 28–30 July 2015, 16–19 October 2015, 11 ind. MOE, coll.: Ambros, Baláž, Horváth, Klimant, Somogyi, Tulis.