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Distribution of the common hamster in the Czech Republic after 2000: retreating to optimum lowland habitats

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Abstract. Abundances of the common hamster in western Europe declined dramatically over the last 30 years. Recently, severe restrictions in distribution range have also been reported from central European countries. Here we update knowledge of the hamster distribution range in the Czech Republic based on information from six independent sources: (1) monitoring programme for the common vole carried out by State Phytosanitary Administration, (2) monitoring carried out directly by us, (3) questionnaire data from farming companies, (4) questionnaire data from district museums, (5) data from a public server BioLib for mapping species distribution, and (6) observations from nonrelated research activities and persons taking interest in hamsters. The comparison of locations detected after 2000 with those from the last survey > 30 years ago suggests that the range is severely reduced with hamsters retreating to the optimum lowland habitats along large rivers. These results suggest that the demographic mechanisms causing population decline in western populations operate in central Europe as well.

Key words: *Cricetus cricetus*, questionnaire, Rodentia

Introduction

Western European populations of the common hamster (*Cricetus cricetus*) have declined in numbers severely over the second half of the 20th century (Stubbe & Stubbe 1998, Nechay 2000, Weinhold 2008). The decreased numbers have long been perceived as a problem of exclusively western European populations. However, a similar range reduction has recently been reported from central Europe, such as Germany (Stubbe & Stubbe 1998), Poland (Ziomek & Banaszek 2007), Hungary (Nechay 1998) and Ukraine (Gorban et al. 1998). In Poland, the number of known localities was dramatically reduced from > 1000 in 1970 to only 100 today (Ziomek & Banaszek 2007). Moreover, the Polish population was split into two isolated fragments, thereby losing its contact to German populations on the west and Belorussian ones on the east. These new data suggest that demographic processes underlying the decline in western populations spread eastward to populations in central Europe.

The Czech populations have traditionally been considered as stable. The last systematic surveys of the distribution range were carried out during the 70's (Grulich 1975, Vohralík & Anděra 1976). At that time, hamsters occurred regularly on about two thirds of the Czech territory by inhabiting open areas in farmland at elevations mostly below 300 m but sometimes up to elevations of 600 m. Since then there has been no interest to monitor the distribution or conduct any field research in hamsters. Consequently, its present distribution status is unclear.

To fill this gap in knowledge, we gathered and mapped six different types of information on the occurrence of hamsters in the Czech Republic following 2000 and compared it with the previous one reported by Grulich (1975). Despite varying reliability of the data sources

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used, we show that the pattern of spatial distribution resulting from all three sources is congruent suggesting the reduction in range.

Material and Methods

We gathered and analysed data on the distribution range of hamsters from several independent sources. The first source of information was represented by the data from a common vole monitoring programme conducted regularly twice a year by the State Phytosanitary Administration. Starting with 2000, about 10 to 50 fields under various crops were examined in spring and autumn not only for the presence of vole burrow entrances but also for the presence of hamster burrows in each of the 57 districts with a mean surface area of about 1000 km^2. Although historically there are 77 districts in the Czech Republic, not all of them are relevant to intense farming and hamster occurrence (e.g., big cities, mountains). In total, more than 17000 of fields were examined across the Czech Republic from spring 2000 to spring 2010. The effort made by field workers to record hamsters varied over years, with the campaign being run most carefully in 2004. Hence, we excluded districts monitored irregularly or less intensely from further analysis, leaving them as unexamined. All of them were negative for hamster occurrence. In each sampled field, the presence of hamster burrows was recorded by walking along the four 100-m transects 2.5 m wide each. The records of hamster presence can be considered reliable as they were collected by a group of field workers experienced in plant protection. The second source of information contains our own observations from a monitoring survey carried out in autumn 2010. We collected data in 23 selected districts with the longest and most regular vole monitoring programme. In total, we checked 207 fields for the presence of hamsters mostly in lowland districts which are typical of hamster occurrence in the Czech Republic. Altitudes of all the checked fields were noted using GPS devices.

The third source of information is represented by data from a questionnaire research. In 2008 to 2010, we queried by e-mail 457 farming companies about the presence of hamsters on their lands after 2000. These companies were systematically located through the internet to cover the whole territory of the Czech Republic (75 districts). We obtained 109 responses. Although the reliability of these data may be questioned, we believe that farmers usually know well the pests causing damage to their crop. There is only the ground squirrel (*Spermophilus citellus*) in the Czech Republic that could build burrow systems of similar size. However, the ground squirrels in the Czech Republic do not live in farmland. Hence, we believe that the data from farmers are fairly reliable.

The fourth source of information comprises data from district museums distributed across the Czech Republic. All of the 47 museums queried have responded to our question. By this, we received information on 22 hamster locations from five district museum zoologists collecting local data on hamster occurrence. The remaining museums were either not specialised for zoological research or did not record the occurrence of hamsters. The fifth source of information is represented by data from a public server BioLib (http://www.biolib.cz/) which maps species distribution of mammals in the Czech Republic (Anděra 2010). Only carefully documented observations are reported by this server. We used the locations from 2000 to present (n = 104). Finally, the last source of information is formed by our own observations from other nonrelated research activities conducted directly by us (13 locations) or other people interested in mapping Czech mammals (9 locations). Although positive records from sources 4, 5 and 6 can be trusted, the resulting pattern of distribution cannot, being greatly affected by the spatial bias of our own investigations and people willing to report observations.

Data from all sources were mapped along with the line depicting the former hamster distribution range reported by Grulich (1975). At that time, the hamsters occupied about 65 % of the territory. A similar border line for hamsters was published one year later by Vohralík & Anděra (1976). To emphasize the close relationship of distribution range to altitude, we superimposed the location data on the physical map of the Czech Republic using the program ArcGIS (McCoy & Johnston 2001). Using R (R Development Core Team 2010), we fitted logistic regression model with a binary response (presence = 1/absence = 0) to test formally for the dependence of hamster occurrence on altitude using the data we collected in autumn 2010. The drop in AIC > 2 was considered as significant evidence for a model with altitude against the null model without it. In addition, we fitted a logistic regression model in which a quadratic term for altitude was included to accommodate a high degree of nonlinearity of a response curve.

Results

We obtained 134 positive hamster locations from the vole monitoring program (Fig. 1), 39 out of them

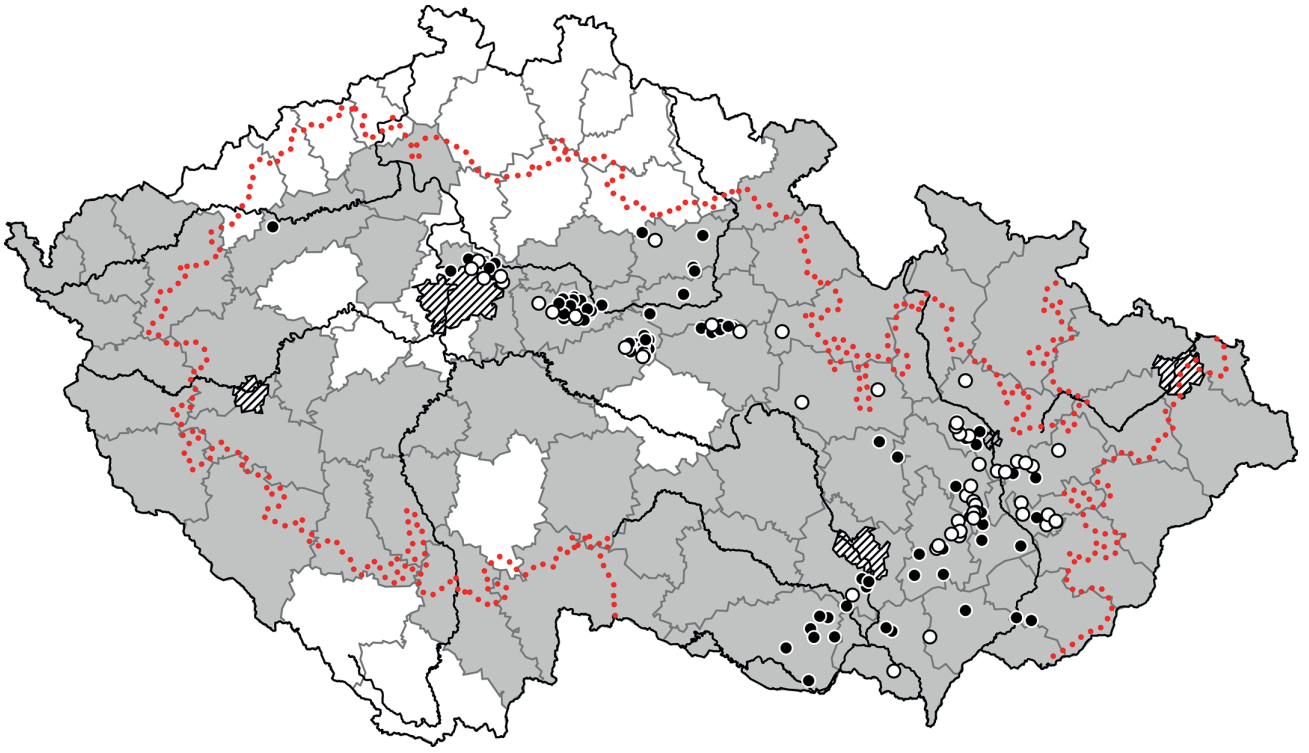

Fig. 1. *Map of hamster locations detected by State Phytosanitary Administration (black circles) between 2000 and 2010 and those detected by us (white circles) in autumn 2010. The shaded districts are those where the monitoring programme for the common voles was regularly conducted. The Grulich line in red depicts the range from the 70's of the 20th century.*

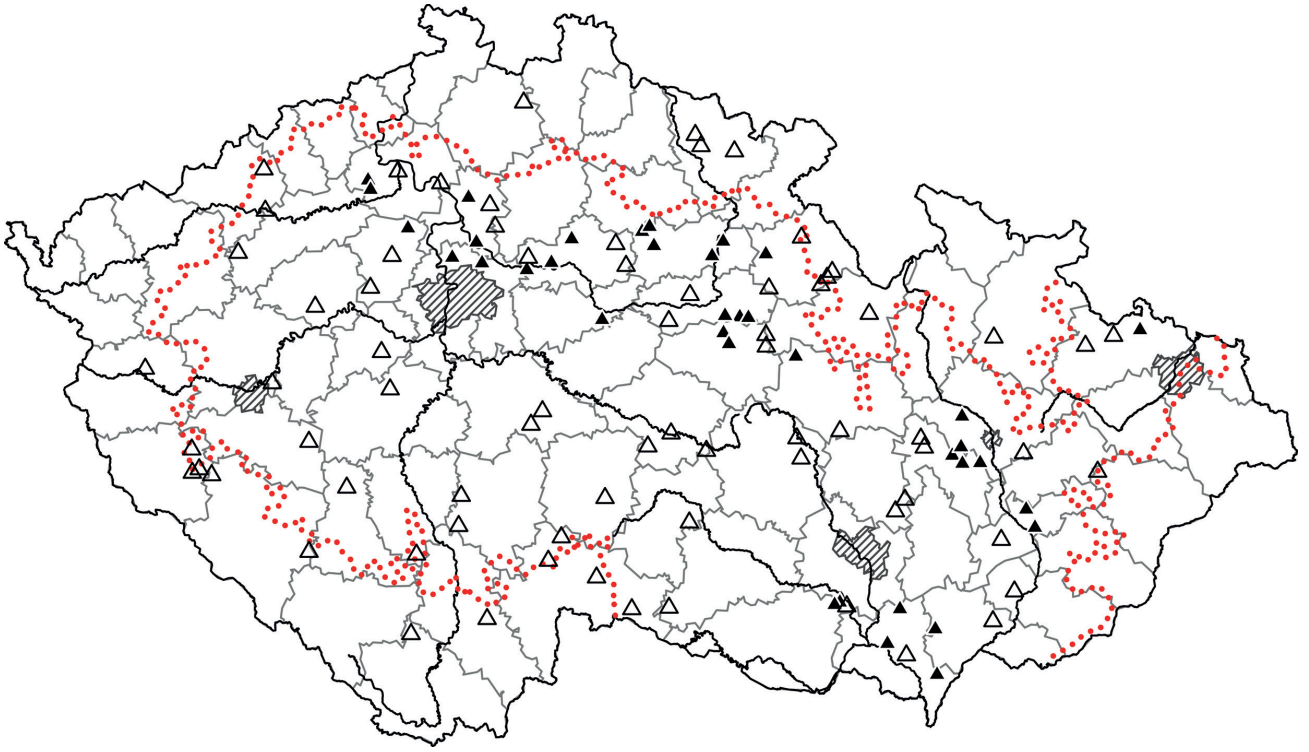

Fig. 2. *Questionnaire data showing the presence (black triangles) and absence (white triangles) of hamsters in the Czech Republic according to farmers. The Grulich line in red depicts the range from the 70's of the 20th century.*

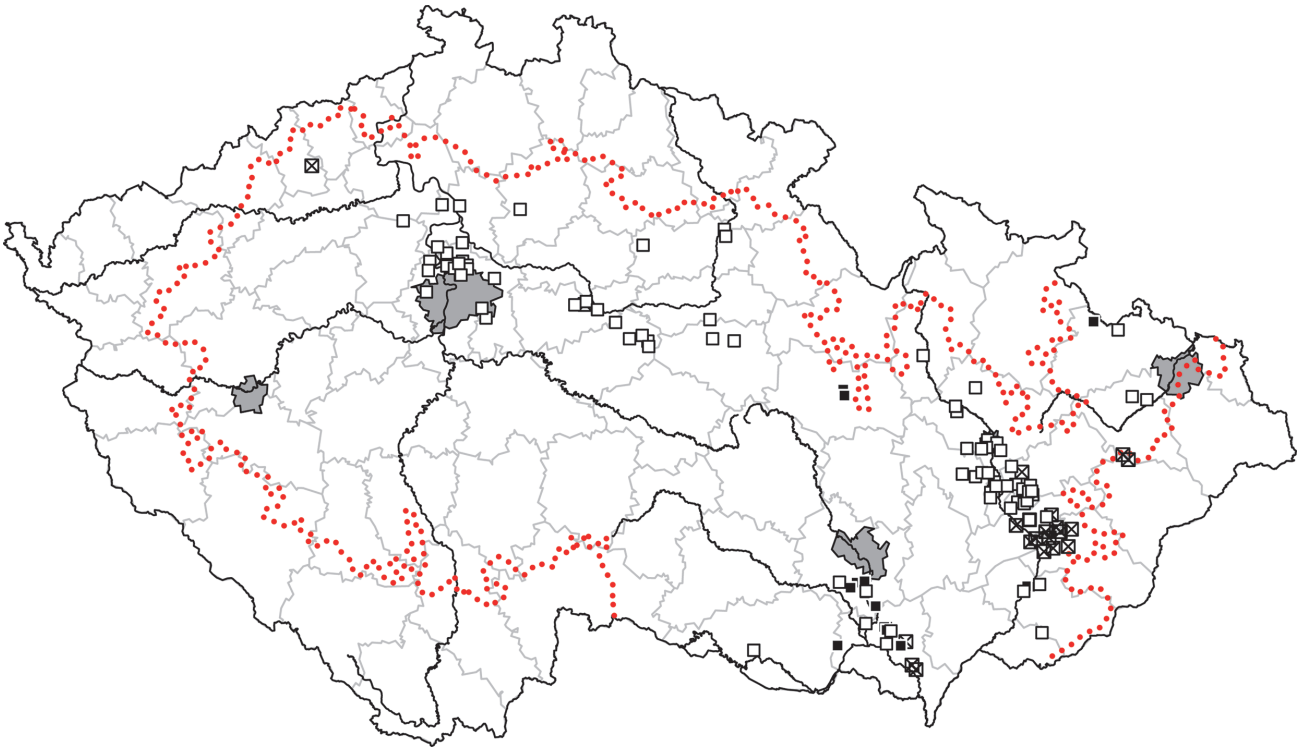

Fig. 3. *Map of hamster locations after 2000 based on museum data (squares with cross inside), BioLib database (white squares) and nonrelated research (black squares). The Grulich line in red depicts the range from the 70's of the 20th century.*

having been reported in 2004. In autumn 2010, we revealed ourselves another 50 positive locations in the 207 fields sampled. When mapped (Fig. 1), these data show that the present distribution range of the common hamster is restricted to plain lowlands along the big rivers. In the western part of the Czech Republic (Bohemia), the range is formed by productive areas along the rivers Elbe and Ohře. In the eastern part (Moravia), hamsters occur regularly in lowlands along the rivers Morava and Dyje.

In questionnaire research, we received 109 responses from companies farming in 46 districts. The presence of hamsters on their lands was confirmed by 37 of them farming in 17 districts (Fig. 2). The remaining 72 companies from 29 districts reported no occurrence. The pattern of hamster distribution was similar to previous data, with the positive answers coming only from the farmers in fertile lowlands along big rivers. In addition, this source confirmed the occurrence of hamsters in the northeast of the Czech territory around Opava. No presence has been reported from hilly areas in southern Bohemia and the Bohemian-Moravian highlands.

Combining observations received from museum zoologists with information from public database, and data from nonrelated research, we obtained 148 locations. The map of these locations (Fig. 3) shows basically the same pattern of distribution as with monitoring and questionnaire data. Moreover, this source provided hamster occurrences situated in lowlands along the River Odra up to Ostrava and the Opava area in the northeast of the Czech Republic (Silesia).

Confronting the present data with the Grulich demarcation line from 1975, the range is severely reduced. A physical map with the data superimposed on it shows in a more informative way the close match between the hamster distribution area and land altitude. The positive hamster locations are largely restricted to lowlands by hamsters emptying the vast hilly areas in southern parts of Bohemia and Moravia (Fig. 4). By fitting logistic regression to our own monitoring data from autumn 2010, we confirmed that the probability for hamsters of being present decreases with increasing altitude (drop in AIC by 10.4). Adding a quadratic term for altitude into the logistic regression model further improved the fit (another drop by 5.9), suggesting that hamsters are most likely to be found at low altitudes between 200 and 300 m a.s.l. (Fig. 5).

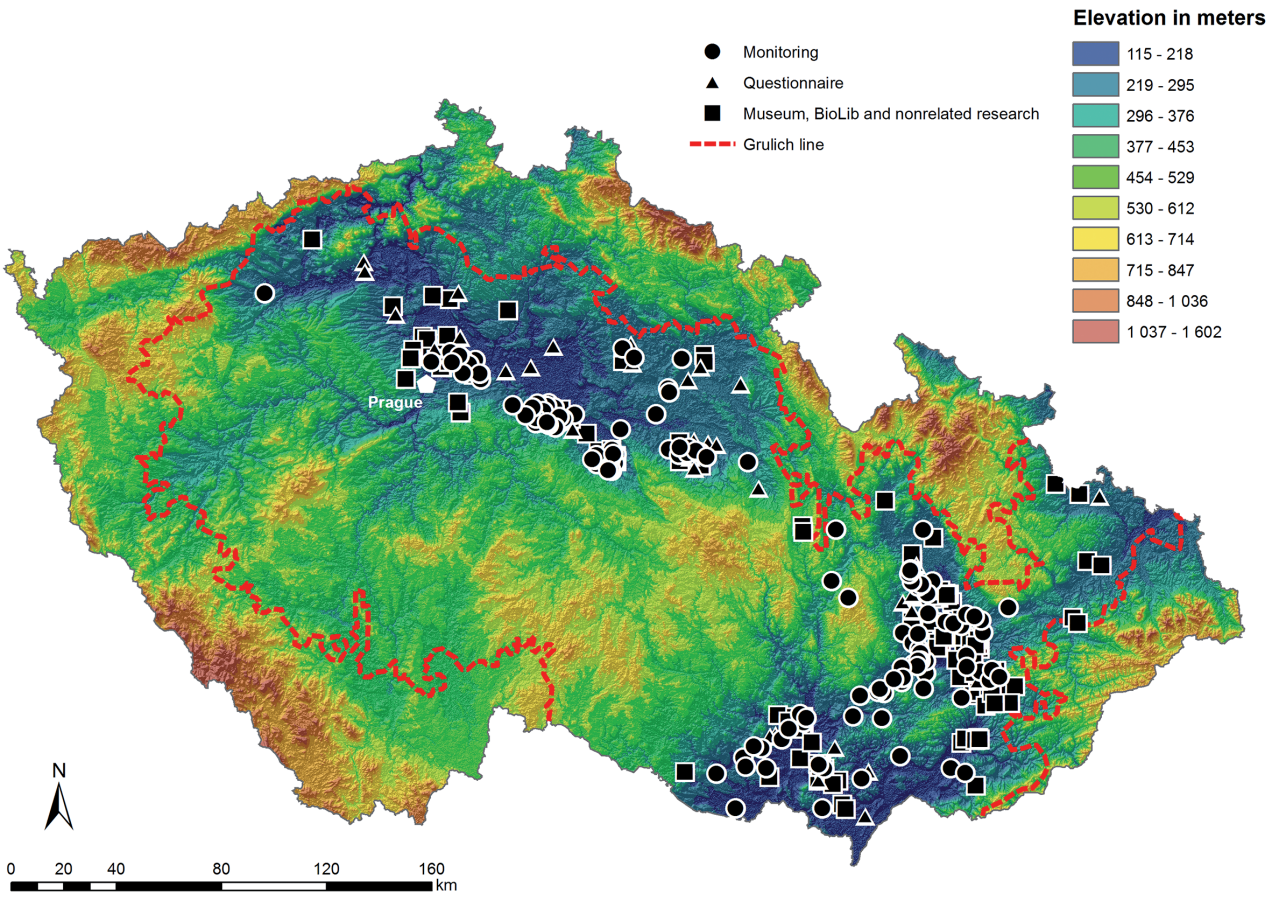

Fig. 4. *A physical map of the Czech Republic showing a close match between the distribution of hamsters and land altitude when all data are superimposed on it, including the Grulich border line in red. Monitoring data comprise locations from both State Phytosanitary Administration and us (source 1 and 2). Questionnaire data show locations obtained from farmers (source 3). Museum, BioLib and nonrelated research data are sources 4 to 6, see Methods).*

Discussion

The present paper attempts to update more than 30 years old information on the distribution range of the common hamster in the Czech Republic (Grulich 1975, Vohralík & Anděra 1976). By assembling data from six independent sources, we found that the distribution range after 2000 has shrunk in size when compared to that described in the 70's of the 20th century. The hamsters clearly retreated from previously occupied hilly areas to optimum habitats in lowlands along the big rivers. Together with information from other central European countries, such as Germany (Stubbe & Stubbe 1998), Poland (Ziomek & Banaszek 2007), Hungary (Nechay 1998) and Ukraine (Gorban et al. 1998), these data adds further evidence that demography of central European populations may be affected in a manner similar to that in western European populations.

Our data indicate that the hamsters in the Czech Republic abandoned the previously densely occupied areas at higher elevations as documented by detailed questionnaire data by Vohralík & Anděra (1976). Among these areas, the Bohemian-Moravian highlands, forming the border between Bohemia and Moravia, is the most prominent one. The highlands runs over 150 km in a north-easterly direction across the Czech Republic and form the region of rolling hills and low mountains with heights between about 500 and 800 m. In particular, the hamster now seems to be absent from vast areas in southern part of highlands west of Brno, previously regularly occupied in a range from Jindřichův Hradec in the west to Brno in the east (see Vohralík & Anděra 1976). The second large area abandoned by hamsters is the western part of Bohemia south of Plzeň extending formerly up to the Bohemian Forest. This is also hilly country with elevations ranging from 300 to 550 m a.s.l. These findings indicate that hamsters retreated to optimum habitats in lowlands with high crop productivity and most suitable soil conditions. This has also been

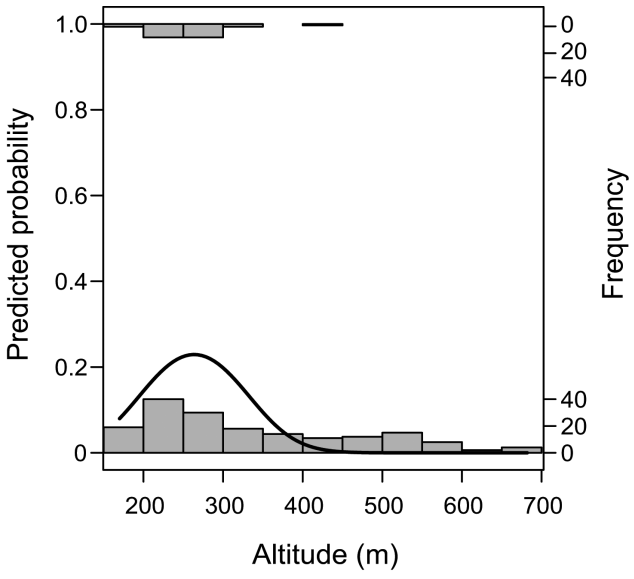

Fig. 5. *The relationship between hamster occurrence and altitude as predicted by a logistic regression model containing a quadratic term for altitude. The bars show frequencies of positive (1) and negative (0) evidence for occurrences of hamsters in autumn 2010.*

observed in Germany where the persisting hamster populations were strictly confined to the agricultural best soils with high portion of clay and silt (Weidling & Stubbe 1998).

Several causal mechanisms have been proposed to explain the decline, such as habitat loss, landscape fragmentation and changes in agriculture, shifting from mosaic plant crop farming to monocultural farming (Weinhold 2008). Although we do not know exactly the mechanisms driving these changes in distributions, we may hypothesize that the underlying causes are complex, being related to both mortality factors, such as predators (Kayser et al. 2003, Bihary et al. 2008, Weinhold 2008), and birth rate factors, such as food availability (Holišová 1977, Grulich 1980, Weinhold 2008) and soil conditions (Eisentraut 1928, Grulich 1975, 1980, Weidling & Stubbe 1998). What is particularly astonishing in this respect is that the acreage of alfalfa fields, a strong stabilizing factor for hamsters in contemporary central European farmland (Górecki 1977, Murariu 1998, Wencel 1998, Bihary & Arany 2001), decreases every year in the Czech Republic as a result of ongoing reduction in livestock due to milk overproduction. According to the Statistical Yearbooks published annually by the Czech Statistical Office, the area under arable fodder crops dropped down from 725000 of hectares in 2000 to 406000 of hectares in 2009.

When the continuous species range dwindles away, population fragmentation is a corollary. The initially continuous range of hamsters in central Europe has now been fragmented into a group of isolated populations. For instance, the Polish populations is now isolated from those in Germany, Belarus and the Czech Republic (Ziomek & Banaszek 2007). From this perspective, the link between the Polish and Czech populations is of particular importance. It is represented by populations of Silesian lowlands which are situated on both sides of the Czech-Poland border. Although only dubious locations have been reported from Polish side, there is still some evidence suggesting the persistence of hamsters on the Czech one (Fig. 4). Hence, there is still hope that some fragments of the hamster population survive in this area connecting Polish and Czech populations. However, we need more detailed data before any firm conclusion is made.

As indicated by the physical map, the Czech hamster population seems to be far from being contiguous. There are several natural geomorphological barriers dividing the range into more or less isolated fragments. The Bohemian populations are link to Moravian ones through a highly complex Svitavy area with many transversal mountain ranges reaching heights > 700 m. Moravian lowland populations naturally split into three large populations corresponding to three geomorphological vales: the Upper Moravian Vale in the north, the Lower Moravian Vale in the southeast, and Dyje-Svratka Vale on the southwest. The Upper Moravian Vale population around Olomouc is separated from the Silesian one by the Moravian Gate, the narrow geomorphological depression. In south, there are the Napajedla Gate and Vyškov Gate separating the Upper and Lower Moravian Vale populations and the Upper and Dyje-Svratka Vale populations, respectively. In addition, these narrow potential migration routes has recently been made even less permeable for rodents by constructing highways with many supporting roads passing exactly through the narrowest points connecting the regions. Hence, it is very likely that the fragmentation is already at work. Information on how much these hamster regions are actually interconnected with one another through individual dispersal is therefore desirable for a well-informed population management of hamsters in the Czech Republic.

Following reports from Germany, Poland, and Ukraine, the data from the Czech Republic clearly indicate a sever restriction of hamster distribution range. This fact is alarming and calls for implementation

of a regular monitoring programme. We need more detailed information on hamster occurrence especially from the geomorphological depressions linking the Bohemian, Moravian and Silesian populations. In particular, data on genetic composition might be of great value to conservation issues giving us more insight into how much important the fragmentation processes are (Banaszek & Ziomek 2012).

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