

## *Rhinolophus ferrumequinum* in Moravia – an irregular migrant in the Czech bat fauna

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**Abstract.** Prior to this study, the greater horseshoe bat (*Rhinolophus ferrumequinum*) had previously been recorded in Moravia just six times at five locations, always in winter. Occurrences recorded in the Javoříčské caves and their surroundings in May and June 2006, and subsequently in July 2007, represent the first evidence for summer occurrence of this species in the Czech Republic. Furthermore, recordings in the Císařská cave confirm the occurrence of the species in the Moravian Karst after a 35-year absence following its first finding in the Beskydy Mountains. The timing of these findings suggests the possibility for successful survival of solitary individuals in Moravia over the summer.

***Rhinolophus ferrumequinum*, distribution, hibernation, Moravia**

### Introduction

The greater horseshoe bat, *Rhinolophus ferrumequinum* (Schreber, 1774), is the largest horseshoe bat species in Europe, making it easily distinguishable from other species. The species is distributed across the Palaearctic from the United Kingdom to Japan (Csorba et al. 2003), but is presently endangered throughout most of its European range. Numbers declined sharply over much of central Europe over the second half of the 20th century and the species is now considered rare or extinct in this region (Ransome & Hutson 2000, Gaisler 2001).

In Great Britain, a dramatic population decline in the 20th century resulted in the loss and isolation of many maternity colonies. Previously found throughout much of southern Britain, the current population of approximately 4000–6600 bats (Harris et al. 1995) is highly fragmented and confined to parts of south-west England and southern Wales. Local population declines and loss of colonies are also well documented for most countries north of the Alpine arch (Ohlendorf 1997). Despite this dramatic decline, small remnant colonies, often isolated from each other, persist along the northern German border of its European distribution. In the Slovakian Karst (SE Slovakia), however, where almost the complete Slovakian population of the species is concentrated during the vegetation period (Uhrin et al. 1996), Uhrin et al. (2010) have documented an increase of *R. ferrumequinum* in numbers. In other Slovakian regions, *R. ferrumequinum* populations appear to be stable or changes in number remain uncertain. The Slovakian population is believed to form part of a meta-population occupying the northern margin of the Pannonian lowlands of

southern Slovakia and northern Hungary (Bihari 2001). At several sites in northern Hungary, *R. ferrumequinum* maintain stable population, though numbers fluctuate remarkably (Bihari 2001). In Switzerland, a small isolated summer colony of *R. ferrumequinum* at a restored roost increased in number between 1986 and 2006 (Bontadina et al. 2008).

The aim of this paper was to supplement recent data on *R. ferrumequinum* in Moravia (Czech Republic) with new findings from the last few years, and place this in the broader context of changes in the abundance of this species in Central Europe.

### Study Area, Material and Methods

More than 1,200 caves are located in the Moravian and Javoříčský Karst regions, many of which host significant and regularly-monitored bat hibernacula. Three of these (Javoříčské caves, the Sloupsko-šošůvské caves and the Býčí skála cave) represent the largest bat hibernacula in the Czech Republic. The Kopce Natural Monument, on the other hand, while very small (one hectare), is equally important in terms of hibernating bats (Fig. 1).

The Moravian karst of the south-western Drahanská Highlands (Moravia) comprises a 3–6 km wide and 25 km long strip (area 85 km<sup>2</sup>) of the Devonian and Early Carboniferous limestones. To the north, on the southern edge of the Bouzovská Highlands, the smaller Javoříčský karst (area 6 km<sup>2</sup>) is comprised of a discontinuous series of Devonian limestone islands (Demek et al. 1987). The Kopce Natural Monument, on the northern border of the Vizovická Highlands, comprises 12 pseudo-karst fissure and debris caves formed in the Eocene sandstones by massive gravity sliding (Baroň & Dobeš 2000).

Between 2004 and 2014, bats were observed during regularly organized summer and winter roost monitoring and mist-netting at the entrances of selected hibernacula. Captured bats were sexed, aged and their reproductive status assessed based on the state of the epiphyseal fusion on the carpal joints (Kunz & Parsons 2009).

## Results

### Records

*Javoříčské caves* (mapping square 6367, 49° 40' N, 16° 55' E)

**10 May 2006** – an individual found by guide R. Smítal on the tour route of the Javoříčské caves at Pohádková jeskyně; determined by M. Koudelka and J. Šafář based on a photograph taken by S. Vybíral, head of the Javoříčské Caves Administration.

**6 June 2006** – an individual found by guide R. Smítal on the tour route of the Javoříčské caves at Babská jeskyně in a crack by a shaft, determined by M. Koudelka and J. Šafář based on a photograph taken by S. Vybíral (Fig. 2), head of the Javoříčské Caves Administration.

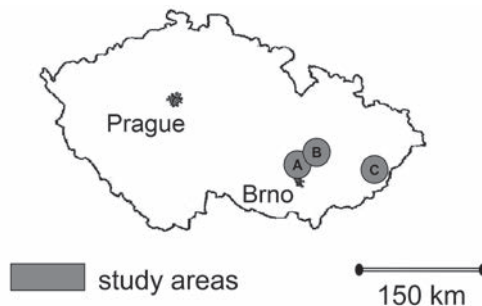


Fig. 1. Location of areas with findings of *Rhinolophus ferrumequinum*. A – Moravian Karst, B – Javoříčský Karst, C – Kopce Natural Monument.

Table 1. Structures of hibernating bat communities in three localities with findings of *Rhinolophus ferrumequinum* in Moravia

species \ locality	Javoříčské caves 20 January 2007	Čísařská cave 14 February 2013	Cave Naděje 7 February 2013
<i>Rhinolophus ferrumequinum</i>	1	1	1
<i>Rhinolophus hipposideros</i>	3046	313	7
<i>Myotis myotis</i>	17	10	5
<i>Myotis emarginatus</i>	302	7	5
<i>Myotis daubentonii</i>	4	–	–
<i>Myotis nattereri</i>	4	–	–
<i>Myotis brandtii</i>	1	–	–
<i>Myotis mystacinus</i>	–	–	1
<i>Plecotus auritus</i>	2	–	1
total	3379	331	20

**20 January 2007** – an individual found dead on the tour route of the Javoříčské caves in the corridor branching to Závrtový dóm (Doline Dome). The animal was difficult to access; hence it was not removed for closer inspection. Photographs were taken by J. Šafář.

*V Habří cave* (mapping square 6367, 49° 41' N, 16° 55' E)

**16 July 2007** – an adult male netted at the entrance of the cave at 21:36 by M. Koudelka. The bat died during manipulation and is stored frozen as supporting evidence in the collection of the Faculty of Science, Masaryk University in Brno.

*Jeskyně Naděje (Překvapení)* (mapping square 6774, 49° 13' N, 18° 02' E)

**7 February 2013** – an individual found by P. Kotrla in the largest pseudo-karst cave at the Kopce Natural Monument.

*Čísařská cave* (mapping square 6666, 49° 23' N, 16° 46' E)

**7 November 2013** – a wintering individual recorded during a regular control of the hibernaculum by J. Zukal. The individual was not accessible (hanging at a height of approx. 8 m). Photographs were taken and species determination was repeatedly confirmed at the site by M. Kovařík and H. Berková using binoculars.

### Ecological notes

The observations during May and June 2006 in the Javoříčské caves probably represent sightings of the same active individual. The first observation was on 6 June 2006 in the morning; the individual had moved prior to the following afternoon inspection, however, and had probably moved to another location in the cave (though it was not observed).

In July 2007, two individuals of *Myotis emarginatus* and one *Myotis mystacinus* were caught in addition to a *R. ferrumequinum* male during netting at the V Habří cave. The individual of *R. ferrumequinum* weighed 21.2 g and the forearm length was 57.8 mm.

The dominant species in the hibernating bat community at all hibernacula was the thermophilous *Rhinolophus hipposideros* and *Myotis emarginatus* dominated in the Javoříčské caves (Table 1) too. In the Čísařská cave, the overwintering *R. ferrumequinum* individual was seen repeatedly, first on 7 November 2013 and on a further six occasions during subsequent controls. The last positive control was on 27 March 2014. The total minimum length of hibernation, therefore, was 141 days while its body temperature was 6.8 °C (27 February 2014).

## Discussion

While *R. ferrumequinum* has been registered in the Czech Republic since the 19th century (Gaisler 1956), it is very scarce and is only documented by isolated findings of hibernating individuals (Hanák & Anděra 2005). Most findings have been located in Moravia, though the latest published records are situated in the Český les Mountains (Červený et al. 2006), with two males recorded in the Černá Řeka gallery during winter monitoring (4 December 2006). This represents only the seventh record in the territory of the Czech Republic since 1950. The last Moravian finding originates from the Moravian Karst region in 1979 (Gaisler 1997). Our findings are increasing the number of known observations of five, however, the number of individuals, may be smaller. In the case of the Javoříčský kras observation, for example, it can be assumed that it was the same individual observed over the course of the year (May 2006 to July 2007). This is also suggested by the lack of further observations of *R. ferrumequinum* in this intensively monitored area. Indeed,



Fig. 2. Photograph of *Rhinolophus ferrumequinum* found in the Javoříčské caves (taken by S. Vybíral).

ringing data from Great Britain indicates that some males return to the same swarming territory repeatedly for up to 16 years (Rossiter et al. 2000). It is quite possible, therefore, that, in the case of Kopce and the Moravian Karst, our findings may represent subsequent records of the same individual that shifted south during summer movement.

The northern border of *R. ferrumequinum* distribution is generally considered to end just south of the Czech Republic (Ohlendorf 1997); hence, the new Moravian findings are probably related to a moderate increase in *R. ferrumequinum* abundance at some Slovakian localities (Lehotská 2002, Uhrin et al. 2010). As a result, some males may have spread into Moravia during their autumn swarming, despite being a sedentary species that does not commonly migrate over long distances (Gaisler 2001, Gaisler et al. 2003, Rossiter et al. 2006). The Slovakian *R. ferrumequinum* population is believed to form part of a meta-population inhabiting the northern margin of the southern Slovakian Pannonian lowlands and northern Hungary (Bihari 2001). In a similar manner to the above, findings from the Šumava Mountains probably represent wanderings from the Danube valley in Bavaria (between Ingolstadt and Regensburg), where a stable population of this species is established (Červený et al. 2006).

The hibernacula in which *R. ferrumequinum* were found are relatively warm and suitable for thermophilic species such as *R. hipposideros* and *M. emarginatus*. The body temperature we measured (6.8 °C) was slightly lower than the average temperature at which this species hibernates in the Western Stara Planina Mountains in Bulgaria (average 8 °C; Pandurska & Beshkov 1998), Slovakia (8 °C; Gaisler & Hanák 1969) and Hungary (7.7 °C; Szatyor 1997). The previous finding from the middle section of the Javoříčko caves (Rumler 1966), where the temperature varies between 7 and 10 °C throughout the year, and the new finding in the Naděje pseudo-karst cave, where temperatures rise to 8 °C in the lower sections due to negligible air flow (Baroň & Dobeš 2000), were also recorded under similar thermal conditions. While lower temperatures are recorded in the Cisařská Cave, these still lie within the species' optimal range, thereby ensuring successful conditions for *R. ferrumequinum* hibernation. This may be the reason for the longer hibernation bout observed in this study, as *R. ferrumequinum* is usually quite active and can even hunt during winter (Gaisler 2001, Ransome & Hutson 2000).

Successful hibernation of *R. ferrumequinum* in Moravian caves, and repeated findings in the summers of 2006, 2007 and 2013, indicate that karst habitats can provide sufficient food and adequate shelter for survival over the species' activity period (Gaisler 2001). It is quite possible, therefore, that this species will become a regular member of the bat community hibernating in Moravian caves in the future.

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