

Development of the *Rhinolophus hipposideros* population in southern Moravia, Czech Republic

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Abstract. A *Rhinolophus hipposideros* population inhabiting a small area (ca. 260 km²) of the Czech Republic bordering Austria was monitored mainly in winter. In the largest hibernaculum, bat census started already in 1958 and was carried out yearly in the period 1968–2012. A significant increase was recorded after the cave was locked to prevent unauthorized visits in 1975, with a maximum number of 276 individuals of *R. hipposideros* documented in 2012. A similar trend was observed in other hibernacula, mostly those monitored since 1991. In summer, five known maternity colonies were checked irregularly, however, none of them disappeared within the last three decades. Actually the numbers of *R. hipposideros* have been increasing in the area, with at least 400 bats present at the end of this study. The monitoring is further going on.

Population size, long-term monitoring, *Rhinolophus hipposideros*

Introduction

Distribution, ecology, reproduction and activity of the lesser horseshoe bat, *Rhinolophus hipposideros* (Borkhausen, 1797), in the southeastern part of the Czech Republic, bordering Austria, were dealt with in numerous papers, e.g. Gaisler (1963, 1966, 2010), Gaisler et al. (1990), Gaisler & Chytil (2002), Hanák & Anděra (2005), and Anděra & Gaisler (2012). Data from the study area were also used in two summary papers: monitoring of bats hibernating in the Na Turoldu cave by Chytil & Gaisler (2001) and results of bat banding by Gaisler et al. (2003). Already the pioneer paper by Šebek (1956), though primarily focussed on a unique record of *Rhinolophus ferrumequinum*, demonstrated *R. hipposideros* as a common species in the region. There were no signs of its decrease in numbers, even not in the second half of the 20th century when population declines were reported from many European countries (Mitchell-Jones et al. 1999). Nevertheless, the only south-Moravian locality where fluctuations in numbers of *R. hipposideros* over a long time span were documented, is the Na Turoldu cave.

The aim of this paper is to present records from this and other localities in the region, supplemented by recent, so far unpublished data. An additional aim is to correct the map of distribution of *R. hipposideros* in the Czech Republic, as it is explained in Appendix 2. In the recent IUCN List of Threatened Species, *R. hipposideros* is considered a species with a generally decreasing population trend, although locally stable or recovering populations have been recorded as well (Jacobs et al. 2012).

Study Area

Our study area covers the southern part of the Břeclav district in the southeastern corner of the Czech Republic. This area is delineated by the following coordinates: 48° 53' 16.2" N, 16° 36' 32.8" E and 16° 59' 08.3" E respectively. In the grid

map of the Czech Republic, the study area roughly corresponds to the squares 7165–7167, 7265–7267 and 7367 (Fig. 2). Its southern boundary is a border with Austria. About 260 km² consist of very different natural habitats from very dry southeastern slopes of the limestone Pálava hills with rocky steppes and forest steppes, on the other side montane elements on north-facing slopes. An important part of the area is covered by the Pannonian thermophilous oak forests, majority of them being situated within two game reserves in the Milovice forest. Floodplain forests along the Dyje and Morava rivers are the most important in the Czech Republic. The whole study area has been significantly influenced by man since the times of mammoth hunters. In the Middle Ages, an important system of the Lednice fishponds was built between Sedlec and Lednice, covering nearly 660 ha. The core of the area, cultural landscape between Lednice and Val-tice, was created in the 19th century. Many old buildings such as castles, chateaux, small hunting castles, and churches are other structures important for bats in this area. The study area, however, includes only a few underground wintering spaces: there is only one rather large natural hibernaculum with constant microclimate, the Na Turoldu cave. This cave is a natural Jurassic limestone cave with more than 2,500 m of known corridors (together with the Liščí cave) but only a small part of it is used by bats (and regularly checked). The cellars under the Lednice chateau represent several hundreds of metres of former heating systems and a narrow corridor connecting these cellars with the Lednice greenhouse winter roost. The most important characteristics of the area under study are markedly different ecosystems within a relatively small area, with many natural habitats and also human influence and very high biodiversity. For closer description of the area see e.g. Mackovčín et al. (2007).

Material and Methods

Both traditional and modern methods were used for the study of bats in the area. However, due to the specific characteristics of the lesser horseshoe bat, the traditional ones prevail in this case. One of the main reasons is the type of its ultrasound calls which, using a bat detector, are audible only within few metres. Also the netting success is quite low regarding the lesser horseshoe bats, mainly because of their high manoeuvrable flight. Thus the regular counts in hibernacula and summer roosts of maternity colonies were the main sources of data for this study. The winter counts in the Na Turoldu cave are amongst the oldest series of bat counts in the country: the first count was carried out on 6 February 1958, and since 1968 yearly bat censuses have been continuing without any interruption until present. These counts are organized around mid-January and, since 1991, the same time, often the same date, has been used for winter counts of other hibernacula in the area (Table 1). Large hibernating colonies were counted using visual observation until 2002, nowadays digital photographs are taken and the number of bats is checked more precisely using a PC. Only the previously banded specimens are checked in hand.

In addition to the Na Turoldu cave, other hibernacula include: Lednice chateau cellars and underground shelter for greenhouse plants under the chateau greenhouse, which are connected and thus evaluated as one place; Insel cellar (remnants of a simple underground brick corridor as a part of a ruined chateau on a peninsula in the Nový fishpond); Peklo cave (small artificial cave inside the Lednice chateau park, nowadays inaccessible); Janohrad cellar (small cellar

Table 1. Localizations of nursery colonies and hibernacula of the lesser horseshoe bat (*Rhinolophus hipposideros*) in the area under study in southern Moravia

| locality | coordinates | map square |
|----------------------------|--------------------------------------|------------|
| hibernacula | | |
| Na Turoldu cave | 48° 48' 59.410" N, 16° 38' 25.098" E | 7165 |
| Plazivka cave | 48° 50' 33.021" N, 16° 38' 03.720" E | 7165 |
| Lednice chateau cellars | 48° 48' 05.390" N, 16° 48' 21.739" E | 7166 |
| Lednice, Peklo cave | 48° 48' 33.194" N, 16° 48' 29.505" E | 7166 |
| Janohrad cellar | 48° 48' 16.775" N, 16° 49' 56.018" E | 7167 |
| Insel cellar | 48° 47' 01.074" N, 16° 40' 06.169" E | 7266 |
| Valtice, Žabí sklep cellar | 48° 44' 10.324" N, 16° 45' 15.512" E | 7266 |
| nursery colonies | | |
| Panenský mlýn attic | 48° 50' 35.662" N, 16° 43' 37.861" E | 7166 |
| Lednice chateau attic | 48° 48' 08.345" N, 16° 48' 13.976" E | 7166 |
| Rybniční hunting lodge | 48° 47' 03.852" N, 16° 47' 44.536" E | 7266 |
| Tři Grácie hunting lodge | 48° 46' 29.460" N, 16° 47' 48.660" E | 7266 |
| Lány hunting lodge | 48° 42' 44.690" N, 16° 55' 06.309" E | 7267 |

under the Janohrad castle, after reconstruction unsuitable for bat hibernation); Žabí cellar (large wine cellar in the Valtice chateau park); and the Plazivka cave in the Tabulová National Nature Reserve (narrow and deep crack in limestone, only partly accessible). Summer colonies were checked in the sites known from previous investigations as inhabited roosts (see e.g. Gaisler et al. 1988, Hanák & Anděra 2005). In total, there are five known roosts of nursery colonies, however, none of them was checked regularly (Table 1). The respective buildings are usually inaccessible – the Panenský mlýn summer cottage and the Rybníční, Tři Grácie and Lány hunting lodges; the latter two due to technical solution of their reconstruction. These reconstructions were carried out under our supervision with the main goal to save suitable places for lesser horseshoe bat maternity colonies.

Results and Discussion

The population of the lesser horseshoe bat in the area has been increasing. There are several nursery colonies with the number of 10–50 adult females. They could not be checked regularly but none of them disappeared in the last three decades. The numbers in the most important hibernaculum, the Na Turoldu cave, increased after 1975, when the cave was locked up to prevent the visits of unauthorized persons. Ten years later, the numbers started to increase more significantly and in 1995, more than 200 hibernating individuals were found for the first time. A minor decrease in the years 2004–2006 has been compensated by the increasing numbers of bats in the Lednice chateau cellars (Fig. 1). Both increases are highly significant (Na Turoldu cave: $r^2=0.8171$; $P<0.0001$; Lednice chateau cellars: $r^2=0.6569$; $P<0.0001$). Previous mark-recapture results showed that these roosts were used by the same subpopulation (Gaisler & Chytil 2002). The total numbers of

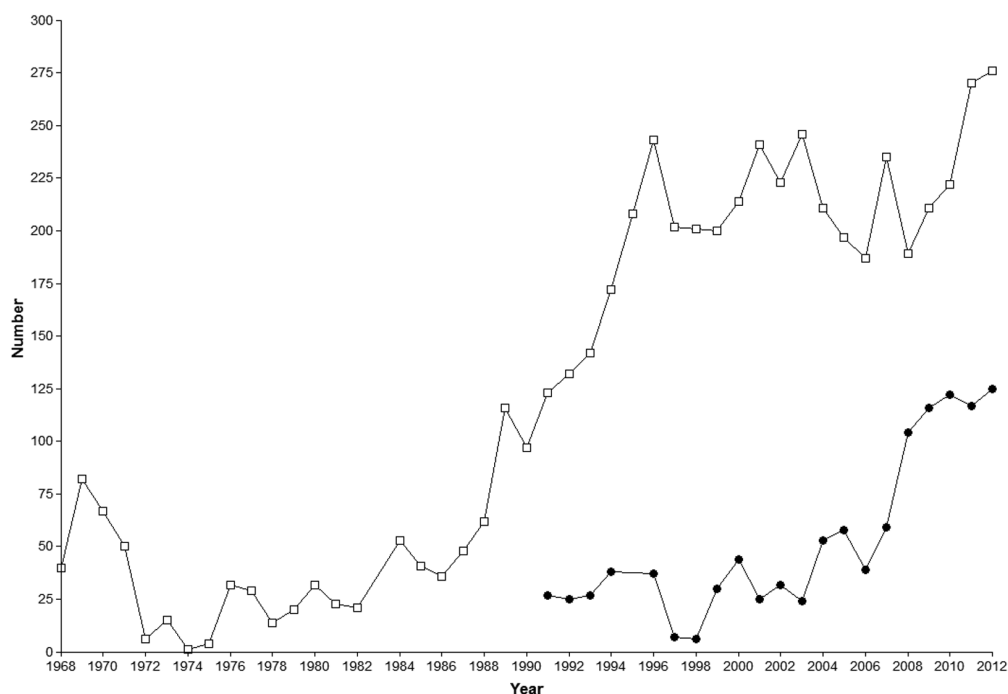


Fig. 1. Numbers of the lesser horseshoe bat (*Rhinolophus hipposideros*) hibernating in the Na Turoldu cave (open squares) and in cellars of the Lednice chateau (closed circles), southern Moravia.

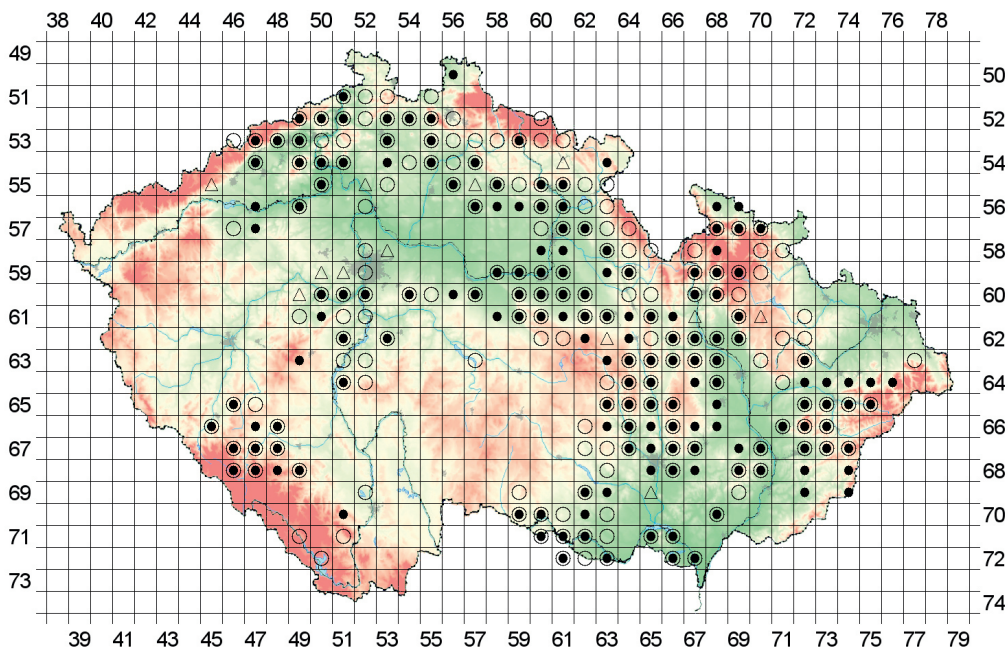


Fig. 2. Distribution of the lesser horseshoe bat (*Rhinolophus hipposideros*) in the Czech Republic. Black circles denote summer occurrence (16 April – 14 October), open circles denote winter occurrence (15 October – 15 April). For details see Appendix 2 (orig. M. Anděra).

wintering bats in the area have been increasing and for the first time exceeded 400 individuals in the last winter (12 January 2012). In the Na Turoldu cave, nearly all lesser horseshoe bats hibernate in “traditional” places, the same every year. Most of them, including the largest colony (210 individuals in 2012), can be found in the Netopýří dóm dome, low numbers are in the Bílá síň dome, Pohádkový dóm dome, Koncový dóm dome and in the approachable corridor. This totals to about 300 m of the Na Turoldu cave, while the remaining parts of the cave host only single individuals. The second largest hibernaculum is in the cellar under the main building of the Lednice chateau, typically ca. 100 bats per winter. The remaining (known) winter roosts host only a negligible part of the subpopulation, not exceeding 10 individuals.

The study area is an important place for *Rhinolophus hipposideros* in both summer and winter periods. Nursery colonies are well protected thanks to good cooperation between nature conservation authorities (here mainly the Pálava Protected Landscape Area administration), Historical Relics Administrations at Valtice, Lednice and Brno and also private owners. In our opinion, public awareness of the occurrence of bats in the area and their protection is a very important issue. Since 2004, the Na Turoldu cave has been re-opened to public, under the Cave Administration of the Czech Republic. There is a clear statement in the Declaration concerning this re-opening: in the case of sharp decline of bat numbers the timing of visits will be re-examined. However, the present situation with the opening time from 1 April till 30 October is suitable for successful hibernation of bats. The numbers of bats in other wintering grounds are too low to provide enough data for the evaluation of trends of the lesser horseshoe bat population in the area. The Na Turoldu cave

and Lednice cellars are by far the most important hibernacula of this species in the study area and our statement about the increasing local subpopulation seems to be significant. This conclusion is in good agreement with the status of *R. hipposideros* in the Czech Republic as described by Hanák & Anděra (2005) and Anděra & Gaisler (2012). The species is common in the eastern part of the country (Moravia) and missing from large parts of the western part (Bohemia) (Fig. 2). In the 1970s, its numbers started dropping, the decline stopped at the end of the 20th century and has been increasing ever since.

To conclude, the present situation of population development of the lesser horseshoe bat in Moravia appears favourable. A similar population increase was recorded in southern Poland (Furmankiewicz et al. 2007) and elsewhere. However, there seem to be different trends in various parts of the species distribution range in Europe (cf. Jacobs et al. 2012).

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Appendix 1 – Review of data

Hibernacula

Na Turoldu cave: 8 February 1958: 84 inds., 21 February 1959: 44 inds., 5 March 1963: 40 inds., 20 February 1968: 40 inds., 10 February 1969: 82 inds., 2 February 1970: 67 inds., 18 February 1971: 50 inds., 10 February 1972: 6 inds., 14 February 1973: 15 inds., 5 February 1974: 1 ind., 6 February 1975: 4 inds., 4 February 1976: 32 inds., 16 February 1977: 29 inds., 7 February 1978: 14 inds., 16 February 1979: 20 inds., 9 February 1980: 32 inds., 22 February 1981: 23 inds., 16 January 1982: 21 inds., 28 February 1984: 53 inds., 4 February 1985: 41 inds., 8 January 1986: 36 inds., 24 January 1987: 48 inds., 15 January 1988: 62 inds., 16 January 1989: 116 inds., 16 January 1990: 97 inds., 14 January 1991: 123 inds., 29 January 1992: 132 inds., 19 January 1993: 142 inds., 20 January 1994: 172 inds., 17 January 1995: 208 inds., 16 January 1996: 243 inds., 9 January 1997: 202 inds., 16 January 1998: 201 inds., 12 January 1999: 200 inds., 19 January 2000: 214 inds., 11 January 2001: 241 inds., 16 January 2002: 223 inds., 17 January 2003: 246 inds., 15 January 2004: 211 inds., 18 January 2005: 197 inds., 19 January 2006: 187 inds., 24 January 2007: 235 inds., 17 January 2008: 189 inds., 15 January 2009: 211 inds., 13 January 2010: 222 inds., 25 February 2011: 270 inds., 12 January 2012: 276 inds.

Lednice: 14 January 1991: 27 inds., 29 January 1992: 25 inds., 19 January 1993: 27 inds., 20 January 1994: 38 inds., 17 January 1995: 37 inds., 16 January 1996: 37 inds., 9 January 1997: 7 inds., 16 January 1998: 6 inds., 12 January 1999: 30 inds., 19 January 2000: 44 inds., 11 January 2001: 25 inds., 16 January 2002: 32 inds., 17 January 2003: 24 inds., 15 January 2004: 53 inds., 18 January 2005: 58 inds., 19 January 2006: 39 inds., 24 January 2007: 59 inds., 17 January 2008: 104 inds., 15 January 2009: 116 inds., 13 January 2010: 122 inds., 25 February 2011: 117 inds., 12 January 2012: 125 inds.

Insel: 19 January 2000: 0, 11 January 2001: 2 inds., 16 January 2002: 4 inds., 17 January 2003: 0, 15 January 2004: 0, 18 January 2005: 1 ind., 19 January 2006: 0, 24 January 2007: 1 ind., 17 January 2008: 1 inds., 15 January 2009: 0, 13 January 2010: 1 ind., 25 February 2011: 0, 12 January 2012: 0.

Valtice, the Žabi cellar: 19 January 2000: 2 inds., 11 January 2001: 3 inds., 16 January 2002: 5 inds., 17 January 2003: 5 inds., 15 January 2004: 4 inds., 18 January 2005: 5 inds., 19 January 2006: 4 inds., 24 January 2007: 4 inds., 17 January 2008: 5 inds., 15 January 2009: 1 ind., 13 January 2010: 1 inds., 25 February 2011: 3 inds.

Plazivka cave: 12 April 1989: 1 ind., 16 January 1990: 7 inds., 30 January 1991: 0, 30 January 1992: 1 ind., 18 January 1993: 2 inds., 21 January 1994: 8 inds., 14 January 1997: 3 inds., 4 February 1998: 8 inds., 22 February 2006: 9 inds.; since 2007 inaccessible.

Lednice, the Peklo cave: 27 October 1990: 4 inds., 20 January 1994: 0, 17 January 1995: 0, 16 January 1996: 0, 9 January 1997: 0, 16 January 1998: 0, 12 January 1999: 0.

Janohrad cellar: 20 January 1998: 5 inds., 6 February 1998: 6 inds., 23 February 1999: 0; after reconstruction inaccessible for bats.

Nursery colonies

Panenský mlýn attic: 9 August 1984: 14 inds., 19 April 1988: 20 inds., 29 May 1988: 28 inds., 3 June 1988: 30 inds. (Gaisler et al. 1988, Vlašín et al. 1993), 9 August 2007: 29 inds.

Tri Grácie hunting lodge: 17 June 1958: 10 inds., 21 May 1959: 20 inds., 3 May 1973: 30 inds., 29 July 1976: 15 inds., 28 June 1977: 3 inds., 12 July 1978: 30 inds., 19 June 1979: 50 inds., 11 September 1980: 20 inds. (Gaisler et al. 1988), 18 July 2002: 30 inds.; since 2003 inaccessible.

Lány hunting lodge: 19 June 1959: 50 inds., 25 July 1963: 50 inds. (Gaisler et al. 1988), 28 August 1986: 2 inds. (Vlašín et al. 1993), 3 June 2005: 18 inds., 7 July 2006: 22 inds.

Lednice chateau attic: 19 June 1956: 60 inds., 17 June 1958: 10 inds., 17 June 1959: 40 inds., 14 June 1963: 1 inds., 28 May 1964: 1 ind., 7 June 1967: 5 inds., 8 September 1969: 30 inds., 4 June 1970: 1 inds., 28 June 1971: 1 ind., 19 August 1974: 20 inds., 12 July 1978: 1 inds. (Gaisler et al. 1988), 28 August 1986: 7 inds., 31 July 1990: 20 inds. (Vlašín et al. 1993).

Rybniční hunting lodge: 18 June 1958: 5 inds., 17 June 1959: 7 inds., 14 June 1963: 15 inds., 28 May 1964: 10 inds., 7 June 1967: 10 inds. (Gaisler et al. 1988), 12 April 1989: 7 inds., 13 July 2005: 14 inds., 21 June 2006: 1 inds., 24 June 2009: 19 inds.

Appendix 2 – Note

Unfortunately, and for unknown reasons, the grid map of distribution on the double-page about *Rhinolophus hipposideros* in the recently published book on mammals of the Czech Republic by Anděra & Gaisler (2012: 64) does not concern this species but the fat dormouse (*Glis glis*). While the same map is correctly attached to the text about the dormouse (p. 130), the correct one concerning *R. hipposideros* is missing. All other distribution maps concerning bat species are correct as well as are quantitative data based on the (unpublished) distribution map of the lesser horseshoe bat. An older version of the map was published by Hanák & Anděra (2005). With a kind permission of the author of the map (M. Anděra in litt.), we include the so far unpublished map of the current distribution of *R. hipposideros* in the Czech Republic in this paper (Fig. 2). The second author of this paper, who at the same time is the second author of the book, apologizes for having overlooked the misprinting of a wrong map in the proof-sheet.