

Lesser horseshoe bat (*Rhinolophus hipposideros*) in the south-western Bohemia (Czech Republic): history of occurrence and current population trends

Luděk Bufka^{1,2*}, Libor Dvořák¹, Jaroslav Červený² & Hana Srbková³

¹Šumava National Park and Protected Landscape Area Administration, Sušická 399,
CZ-34192 Kašperské Hory, Czech Republic

²Faculty of Forestry and Environment, Czech University of Agriculture Prague, Kamýčká 1176,
CZ-16521 Prague, Czech Republic

³Faculty of Natural Sciences, Charles University Prague, Viničná 7, CZ-12843 Prague, Czech Republic

*ludek.bufka@npsumava.cz

Abstract

An oscillation of a small isolated population of the lesser horseshoe bat was observed during the last fifty years in the Bohemian Forest and its foothills (= Šumava Mts.). The population of that species has a relict character. We collected all available data on the distribution and population trends. The occurrence of the species was described at 54 localities in 12 mapping quadrats. The area of its distribution is limited to a belt of the foothills. The majority of findings are from 600 to 800 m a.s.l. The small limestone localities in lower altitudes represent a primary core areas of the distribution. Secondly, the lesser horseshoe bat uses the artificial underground spaces, mainly remains of old mines and cellars. The most numerous winter roosts are found in old galleries. Certain smaller shelters are used temporarily during spring and autumn season. There is a continuous population increase during last ca. 10 years, documented by a long-term monitoring of winter roosts as well as a summer colony.

Key words: *Rhinolophus hipposideros*, distribution, Šumava Mts., population trends

INTRODUCTION

Since the 1950s and 1960s the dramatic decline of the lesser horseshoe bat populations is described from many areas of Europe, especially the western and northern, partly central part of the area of distribution (e.g. STEBBINGS 1988, OHLENDORF 1997, SCHOFIELD 1999, ROER & SCHÖBER 2001). It became nearly to extinction in Benelux, Poland, it is rare also in France and Germany (OHLENDORF 1997), where the population is fragmented. There is no clear cause of the decline, a complex of negative factors was summarized by BONTADINA (2002).

The similar situation is in the Czech Republic. Recently, there are only island populations remaining from more continuous distribution in the past. The species absent in the intensive agricultural areas, bigger population numbers are in the eastern part of the country (ANDĚRA & HANÁK 2005). It is not clear, if the subpopulations communicate within the metapopulation. More likely there are isolated relict populations. The islands of occurrence are connected with the presence of natural underground spaces (limestone and limestone-karstic areas). The strong decline in the population in the Bohemian Forest region was documented during the 1970s and 1980s (ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994). Then, the increase of the population has been registered since the second half of the 1990s, more in the eas-

tern part of the Czech Republic (Moravia and Silesia – e.g., GAISLER 1997, ANDĚRA & HANÁK 2005, HORÁČEK et al. 2005). The trend of a slight increase has been also observed in the Bohemian Forest and its foothills in the last decade.

MATERIAL AND METHODS

The study area is situated at the south-western border of the Czech Republic with Germany (Bavaria) and Austria. It covers the Czech side of the Bohemian Forest, and it is represented by the whole geographic unit the Bohemian Forest (= Šumava Mts.) and the Bohemian Forest foothills (= Šumavské Předhůří piedmont) (DEMEK & STRÍDA 1971).

The collecting of data about the occurrence, distribution and changes of the population numbers of the lesser horseshoe bat were made during winter census within a long-term monitoring of the valuable hibernacula. The whole area is covered together by 50 mapping quadrats (central European mapping grid system) similarly used in the previous publications (e.g., ANDĚRA & ČERVENÝ 1994) summarising the distribution of mammals in the Bohemian Forest and its foothills. The most important sites were checked more times during the winter season to register seasonal dynamics and changes of bat community. Also the smaller shelters were checked to find out the use by bats especially during the late summer and autumn. During the summer season, the known maternity and summer colonies were checked as well as netting was conducted at the entrances of the caves and galleries and old mines.

Long-term monitoring data are saved in the database and available for next analysis. The analyses of the population trends from model localities were made using the program Statistica (StatSoft).

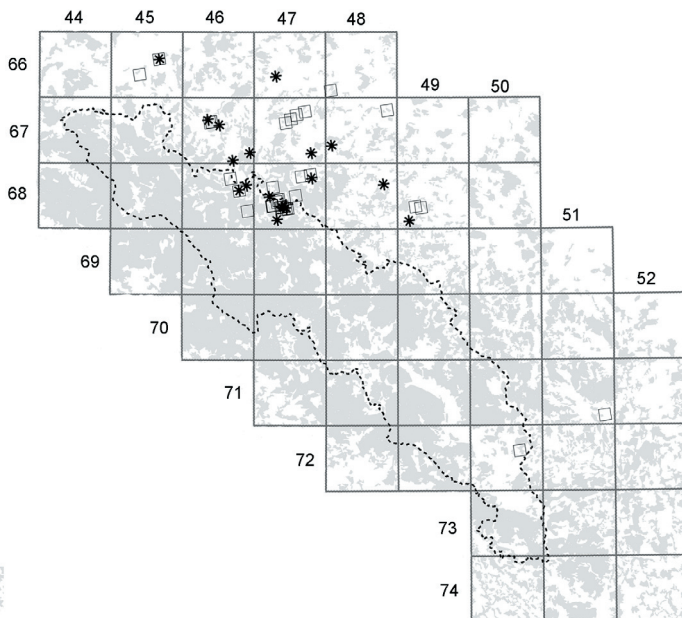


Fig. 1. The distribution of the lesser horseshoe bat in the Bohemian Forest (all data). Explanations: square – winter roosts, asterisk – summer findings and colonies

RESULTS

The paper summarizes results of all research and monitoring activities from the area under study. For a complete overview, a survey of all available data is presented, including those published in partial papers, as well as in complete faunistic publications. The only known information about the occurrence of the lesser horseshoe bat in the region during the first half of the 20th century was published in BAŘA (1933) – the locality of Křemže, mapping quadrat 7051. Altogether 406 records of occurrence or recaptures have been collected since the 1950s, when the systematic research on the bat fauna had started. All recent and unpublished data till 2005 are the main part of the present paper. The data until 2008 were used for the long-term population trends in the model localities (Kristýna and Bedřich galleries, Žihobce castle).

Areal distribution

The occurrence of the species since the 1950s was described at 54 localities in 12 mapping quadrats (Figs. 1, 2). In total, 220 records were from winter seasons (33 localities), 76 records were made at summer colonies (16 localities). During the whole period, 24 netting efforts were conducted at 5 localities. High number of observations (in total 86) is from the period of autumn migrations (in total 25 localities).

The list of localities and data

The list of data (see below) is structured as follows: mapping quadrat, citation (if exists), all primary data (date, number of individuals, f – female, m – male).

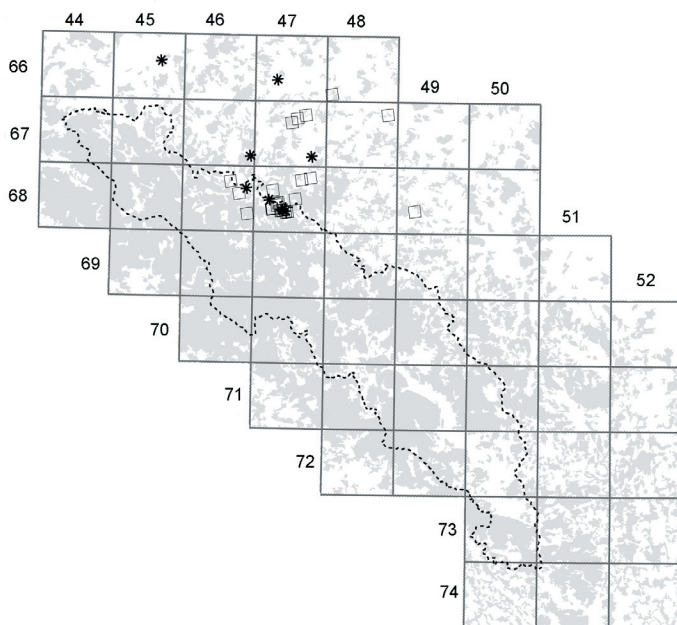


Fig. 2. The distribution of the lesser horseshoe bat in the Bohemian Forest in 1955–2005. Explanations: square – winter roosts, asterisk – summer findings and colonies

6645: Klenová, cellar of a new castle (ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994), 8 Aug 1972, 1 ex.; **Loreta**, gallery (ČERVENÝ & HANÁK 1977, ČERVENÝ 1982, ANDĚRA & ČERVENÝ 1994, BUFKA et al 1999, DVOŘÁK et al. 2001c), 8 Aug 1972, netting 2 m, 9 Aug 1972, netting 2 ex., 29 Sep 1972, netting 1 sad f, 16 Nov 1972, 1 m, 9 Dec 1972 2 m, 1 f, 29 Dec 1972, 2 ex., 13 Jan 1973, 1 ex., 15 Feb 1973, 2 m, 24 Mar 1973, 1 ex., 14 Apr 1973, 1 ex., 10 Aug 1973, netting 1 m, 23 Aug 1973, 1 ex., 20 Feb 1974, 1 ex., 9 May 1974, netting 2 m, 9 May 1974, 1 dead ex., 2 Sep 1974, netting, 1 sad f, 6 Aug 1977, netting, 1 m, 4 Oct 1980, netting, 1 sad f, 31 Dec 1980, 1 ex., 6 Dec 1981, 1 ex., 31 Dec 1981, 1 ex., 24 Jan 1982, 1 ex., 22 Jan 1983, 1 ex., 19 Aug 1990, netting 1 m, 18 Aug 1996, netting 2 m, 19 Aug 1996, netting 1 m.

6647: Nalžovské Hory, attic of the castle (KRÁTKÁ & KRÁTKÝ 1973, ANDĚRA & ČERVENÝ 1994), 6 Jul 1971, colony 5 ex.

6648: Prácheň, gallery (DVOŘÁK et al. 2001c), 27 Nov 1996, 1 ex., 10 Jan 1997, 1 ex., 21 Mar 1997, 1 ex., 8 Aug 1997, netting, 1 m 1 f.

6746: Velhartice, attic of the church (KRÁTKÁ & KRÁTKÝ 1973, ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994) 19 Sep 1970, 1 ex.; **Velhartice**, attic of the castle (KRÁTKÁ & KRÁTKÝ 1973, ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994) 12 Aug 1972, 1 ex.; **Velhartice**, gallery, (ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994) 5 Nov 1977, 1 ex.; **Horní Staňkov**, attic of a castle (ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994), 30 Apr 1972, colony 3 ex., 10 Aug 1973, colony 5 ex., 2 juv.; **Kojšice**, attic of the castle (KRÁTKÁ & KRÁTKÝ 1973, ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994), 30 Apr 1972, colony 6 ex., 13 Jul 1972, colony 36 ex., including juv., 25 Jul 1973, colony 29 ex., 8 juv., 26 Apr 1974, colony 25 ex., 5 juv., 10 Jul 1976, colony 13 ex., 3 juv., 11 Jun 1978, colony 6 ex., 30 Jun 1979, colony 10 ex., 14 Jul 1979, colony 8 ex., 2 Jun 1986, colony 6 ex., 2 juv.; **Volšovy**, attic of the castle (ANDĚRA & ČERVENÝ 1994, DVOŘÁK et al. 2001c), 10 Jul 1976, 1 ex., 14 Jun 1980, 1 ex., 27 Jun 1980, 2 ex., 12 Jul 1980, 1 ex., 28 Jun 1981, 1 ex., 19 Jun 1982, 1 ex., 30 Jun 1985, 1 ex., 3 Jun 1995, 1 ex.

6747: Rabí, cellars of the castle (GAISLER & HANÁK 1972, HÜRKA 1973, ANDĚRA & ČERVENÝ 1994, DVOŘÁK et al. 2001c), 5 Jun 1956, 1 ex., 24 Jan 1963, 2 m, 26 Nov 1968, 2 f; **Čepice**, gallery (ANDĚRA & ČERVENÝ 1994), 22 Nov 1981, 1 ex., 27 Nov 1996, 1 ex., 28 Dec 1996, 1 ex., 10 Jan 1997, 1 ex., 21 Mar 1997, 1 ex., 21 Nov 1997, 1 ex., 28 Dec 1997, 1 ex., 29 Jan 1998, 1 ex., 10 Feb 1998, 1 ex., 24 Mar 1998, 1 ex., 24 May 1998, 1 ex., 26 Oct 2000, 1 ex., 2 Nov 2001, 1 ex., 5 Dec 2001, 1 ex., 18 Jan 2002, 1 ex., 17 Feb 2002, 2 ex., 16 Oct 2002, 1 ex., 7 Nov 2002, 2 ex., 30 Oct 2003, 4 ex., 17 Mar 2004, 1 ex., 21 Oct 2004, 2 ex.; **Dobříšín**, crevices in the rocks (ANDĚRA & ČERVENÝ 1994), 5 Dec 1981, 5 ex.; **Žihobce**, attic of the castle (ANDĚRA & ČERVENÝ 1994, DVOŘÁK et al. 2001c), 23 Jun 1983, 1 ex., 1 Aug 1986, colony 3 ex., 14 Jul 1994, 1 ex., 18 Jul 1995, colony 5 ex., 1 juv., 11 Jul 1996, colony 4 ex., 1 juv., 26 Jun 1998, colony 9 ex., 21 Jun 1999, 1 ex., 20 Jun 2000, colony 9 ex., 26 Jun 2002, colony 19 ex., 28 Jun 2003, colony 20 ex., 9 Jun 2004, colony 16 ex., 16 Jun 2005, colony 45 ex., 15 Jun 2006, colony 45 ex., 21 Jun 2007, colony 40 ex., 20 Jun 2008, colony 60 ex.

6748: Mačice, attic of the castle (ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994), 20 Jul 1971, colony 10 ex., 26 Apr 1974, colony 7 ex.; **Kněží Hora hill**, gallery (ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994), 17 Nov 1975, 17 ex., 10 Jan 2002, 1 ex., 15 Nov 2002, 1 ex.

6846: Palvínov, attic of the building (KRÁTKÁ & KRÁTKÝ 1973, ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994, DVOŘÁK et al. 2001b), 17 Jun 1970, colony 5 ex., 6 Jul 1970, colony 12 ex., 29 Jun 1972, colony 13 ex., 3 juv., 23 Jun 1974, colony 7 ex., 2 juv., 2 Jul 1978, colony 5 ex., 19 Jul 1985, colony 8 ex., 2 Aug 1986, colony 8 ex., 2 juv., 5 Jul 1992, 1 ex., 30 Jun 1998, 1 ex., 19 Jul 2001, 1 ex.; **Kundratice**, attic of the castle (KRÁTKÁ & KRÁTKÝ 1973, ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994, DVOŘÁK et al. 2001b), 13 Aug 1971, colony 15 ex., 26 Jun 1974, colony 12 ex., 2 juv., 8 Jul 1978, colony 4 ex., 19 Jul 1985, colony 8 ex., 2 juv., 2 Aug 1986, 2 ex.; **Kundratice**, cellar of the castle (DVOŘÁK & al. 2001b), 10 Dec 1998, 1 ex., 26 Dec 1998, 3 ex.; **Hartmanice**, cellar of the school building (ČERVENÝ & HANÁK 1977), 18 Oct 1974, 1 sad m; **Peklo**, cave (ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994), 19 Oct 1974, 2 ex., 12 Nov 1974, 2 ex., 15 Mar 1995, 1 ex., 24 Mar 1995, 1 ex., 21 Oct 1998, 1 ex., 13 Jan 2000, 1 ex., 10 Jan 2002, 1 ex., 15 Nov 2002, 2 ex.

6847: Amálino Údolí valley (GAISLER & HANÁK 1972, HANÁK & GAISLER 1972, HÜRKA 1973, ČERVENÝ & HANÁK 1977, ANDĚRA & ČERVENÝ 1994, DVOŘÁK et al. 2001a); **4 galleries**, 11 Jun 1955, 5 ex., 18 Mar 1956, 5 ex., 25 Mar 1958, 10 ex., 30 Mar 1958, 23 ex., 13 Apr 1958, 2 ex., 21 Nov 1959, 2 ex., 11 Feb 1960, 3 ex., 24 Jan 1963, 11 ex.; **gallery I**, 28 Jan 1962, 4 m, 3 f; 24 Jan 1963, 8 m, 2 f, 15 Mar 1964, 1 f, 1 Dec 1965, 1 m; **gallery II**, 1 Dec 1965, 1 m, 1 f, 21 Mar 1967, 1 m, 25 Mar 1970, 1 m, 28 Mar 1970, 1 dead m, 15 Oct 1998, 2 ex., 1 Oct 1999, 1 ex., 6 Oct 2001, 1 ex., 11 Feb 2002, 2 ex., 7 Mar 2003, 1; **gallery V**, 2 Apr 1969, 2 m, 10 Nov 1970, 1 m, 23 Feb 1971, 2 m; **gallery Myší Díra**, 25 Mar 1970, 1 f, 1 m, 28 Mar 1970, 1 f, 1 m, 29 Dec 1970, 2 ex., 10 Jan 1987, 1 ex., 17 Jan 1988, 1 ex., 10 Nov 1989, 1 ex., 5 Mar 1993, 1 ex., 3 Aug 1993, netting 1 m, 22 Feb 1995, 2 ex., 11 Mar 1995, 3 ex., 16 Mar 1995, 3 ex., 22 Sep 1995, 2 ex., 5 Nov 1995, 1 ex., 22 Dec 1995, 1 ex., 28 Dec 1995, 1 ex., 26 Mar 1996, 1 ex., 18 Dec 1996, 1 ex., 20 Nov 1996, 1 ex., 18 Apr

1997, 2 ex., 29 Oct 1997, 2 ex., 27 Nov 1997, 1 ex., 25 Jan 1998, 1 ex., 17 Nov 1998, 1 ex., 17 Dec 1998, 1 ex., 23 Jan 1999, 1 ex., 7 Feb 1999, 1 ex., 16 Sep 1999, 1 ex., 15 Oct 1999, 1 ex., 15 Nov 1999, 2 ex., 14 Dec 1999, 1 ex., 27 Oct 2000, 2 ex., 22 Dec 2000, 2 ex., 3 Jan 2001, 2 ex., 19 Jan 2001, 1 ex., 16 Feb 2001, 1 ex., 16 Mar 2001, 3 ex., 6 Oct 2001, 1 ex., 9 Nov 2001, 1 ex., 11 Jan 2002, 2 ex., 11 Feb 2002, 2 ex., 13 Mar 2002, 2 ex., 6 Nov 2002, 5, 7 Mar 2003, 1 ex., 31 Oct 2003, 2 ex., 22 Dec 2003, 2 ex., 27 Feb 2004, 2 ex., 12 Jan 2005, 2 ex., 23 Feb 2005, 2 ex.; **gallery Veřejné Záchodky**, 25 Mar 1970, 1 m, 28 Mar 1970, 1 m, 29 Dec 1970, 1 ex., 24 Feb 1971, 2 m, 23 Nov 1995, 1 ex., 10 May 1996, 1 ex., 17 May 1996, 1 ex., 23 May 1996, 1 ex., 20 Nov 1996, 1 ex., 18 Apr 1997, 2 ex., 13 Sep 1997, 1 ex., 26 Sep 1997, 1 ex., 25 May 1998, 1 ex., 16 Sep 1998, 1 ex., 15 Oct 1998, 1 ex., 27 Oct 2000, 1 ex., 6 Oct 2001, 1 ex., 9 Nov 2001, 1 ex., 13 Mar 2002, 1 ex., 31 Oct 2003, 3 ex.; **gallery VIII**, 13 Jan 1971, 1m, 1f, 29 Nov 1971, 1 m; **gallery A**, 23 May 1996, 1 ex., 20 Nov 1996, 1 ex., 29 Oct 1997, 1 ex., 15 Oct 1998, 1 ex., 16 Sep 1999, 2 ex., 15 Oct 1999, 1 ex., 15 Sep 2000, 1 ex., 27 Oct 2000, 2 ex., 6 Oct 2001, 1 ex., 9 Nov 2001, 3 ex., 30 Aug 2002, 3 ex., 31 Oct 2003, 3 ex.; **gallery Barbastelí**, 20 Nov 1996, 1 ex., 18 Dec 1996, 1 ex., 17 Dec 1998, 1 ex., 17 Nov 1999, 2 ex., 19 Feb 2002, 1 ex.; **gallery Barbastelí II**, 22 Feb 1995, 1 ex., 20 Nov 1996, 1 ex., 17 Nov 1998, 2 ex., 17 Nov 1999, 1 ex., 23 Nov 2000, 1 ex.; **gallery Bedřich**, 20 Nov 1996, 8 ex., 18 Dec 1996, 7 ex., 23 Jan 1997, 3 ex., 2 Apr 1997, 2 ex., 17 Apr 1997, 1 ex., 26 Sep 1997, 3 ex., 19 Dec 1997, 3 ex., 29 Jan 1998, 3 ex., 16 Feb 1998, 2 ex., 25 Mar 1998, 3 ex., 25 May 1998, 1 ex., 16 Sep 1998, 4 ex., 19 Nov 1998, 3 ex., 23 Dec 1998, 2 ex., 1 Dec 1999, 9 ex., 22 Dec 1999, 9 ex., 14 Jan 2000, 8 ex., 23 Nov 2000, 20 ex., 21 Dec 2000, 20 ex., 15 Feb 2001, 15 ex., 16 Mar 2001, 13 ex., 26 Apr 2001, 3 ex., 3 Oct 2001, 6 ex., 9 Nov 2001, 21 ex., 6 Dec 2001, 20 ex., 4 Jan 2002, 18 ex., 28 Feb 2002, 10 ex., 6 Nov 2002, 14 ex., 22 Nov 2002, 19 ex., 18 Feb 2003, 11 ex., 25 Mar 2003, 11 ex., 31 Oct 2003, 27 ex., 28 Nov 2003, 31 ex., 23 Dec 2003, 22 ex., 19 Feb 2004, 13 ex., 13 Jan 2005, 20 ex., 25 Feb 2005, 21 ex., 13 Jan 2006, 24 ex., 2 Mar 2006, 18 ex., 16 Jan 2007, 16 ex., 24 Mar 2007, 10 ex., 22 Jan 2008, 14 ex.; **gallery Kristýna**, 20 Nov 1996, 1 ex., 23 Jan 1997, 1 ex., 27 Feb 1997, 1 ex., 23 Apr 1997, 1 ex., 19 Dec 1997, 1 ex., 29 Jan 1998, 2 ex., 18 Feb 1998, 3 ex., 25 Mar 1998, 4 ex., 19 Nov 1998, 2 ex., 23 Dec 1998, 3 ex., 21 Jan 1999, 4 ex., 26 Feb 1999, 2 ex., 1 Dec 1999, 3 ex., 29 Dec 1999, 5 ex., 31 Jan 2000, 6 ex., 21 Dec 2000, 4 ex., 18 Jan 2001, 4 ex., 15 Feb 2001, 5 ex., 15 Mar 2001, 5 ex., 4 Jan 2002, 6 ex., 28 Feb 2002, 8 ex., 22 Nov 2002, 6 ex., 18 Feb 2003, 11 ex., 28 Nov 2003, 8 ex., 23 Dec 2003, 14 ex., 19 Feb 2004, 20 ex., 13 Jan 2005, 15 ex., 25 Feb 2005, 19 ex., 13 Jan 2006, 21 ex., 2 Mar 2006, 29 ex., 16 Jan 2007, 26 ex., 24 Mar 2007, 30 ex., 22 Jan 2008, 30 ex.; **gallery Sněmovní**, 15 Oct 1998, 1 ex., 17 Nov 1998, 1 ex., 29 Sep 2001, netting, 1 m; **gallery Štolička**, 15 Sep 2000, 1 ex.; **Ždánov**, gallery (DVOŘÁK et al. 2001c), 26 Dec 2000, 1 ex.; **Tuškov**, historical military bunker, 20 Sep 2001, 1 ex.; **Strašín**, attic of the church (KRÁTKÁ & KRÁTKÝ, 1973, ČERVENÝ & HANÁK 1977), 5 Sep 1970, 2 ex., 3 Jun 1971, colony 15 ex., 25 Jul 1973, colony 10 ex., 19 Jun 1974, colony 10 ex., 19 Jul 1985, colony 4 ex.; **Strašín**, cave (HÜRKA 1973, ČERVENÝ & HANÁK 1997, ANDĚRA & ČERVENÝ 1994, DVOŘÁK et al. 2001c), 16 Feb 1973, 2 ex., 14 Dec 1975, 1 ex., 10 Apr 1977, 2 ex., 6 Aug 1978, netting 5 m, 5 f, 26 Aug 1978, netting 2 m, 1 f, 18 Sep 1978, netting 1 m, 7 Sep 1979, netting, 1 f, 30 Aug 1980, netting, 1 m, 1 f, 10 Nov 1981, 2 ex., 8 Feb 1986, 1 ex., 26 Feb 1989, 2 ex., 28 Dec 1990, 2 ex., 1 Feb 1992, 1 ex., 15 Feb 1992, 1 ex., 19 Jul 1993, netting 1 m, 1 f, 8 Aug 1993, 1 ex. by detector, 25 Jul 1994, 2 ex., 19 Aug 1994, netting 2 ex., 26 Aug 1994, netting 1 m, 22 Oct 1994, 2 ex., 31 Dec 1994, 2 ex., 15 Mar 1995, 1 ex., 27 Sep 1995, 2 ex., 14 Mar 1996, 1 ex., 23 Aug 1996, netting, 1 m, 2 f, 4 Nov 1996, 1 ex., 27 Aug 1997, netting 1 m, 27 Dec 1997, 2 ex., 15 Dec 2003, 1 ex.; **Strašín**, attic of buildings, 25 Jul 1992, 2 ex.; **Podlesí**, attic of a barn (KRÁTKÁ & KRÁTKÝ, 1973), 21 Jul 1971, 1 ex.; **Kašperské Hory**, cellar of the house No. 184, 10 Nov 1995, 1 ex., 25 Mar 1996, 1 ex., 1 Apr 1996, 1 ex., 9 Apr 1996, 1 ex., 21 May 1996, 1 ex., 3 Sep 1996, 1 ex., 13 Sep 1996, 1 ex., 27 Sep 1996, 1 ex., 17 Oct 1996, 1 ex., 7 Nov 1996, 1 ex., 11 Mar 1997, 1 ex., 14 Apr 1997, 1 ex.; **Kašperské Hory**, attic of the church at a graveyard, 6 Jun 1996, 1 ex.; **Kašperské Hory**, cellar of the town hall, 26 Nov 2002, 2 ex., 2 Dec 2003, 1 ex., 14 Jan 2005, 3 ex.; **Kašperské Hory**, cellar of the house No. 210, 21 Oct 2003, 1 ex., 23 Aug 2004, 1 ex.; **Grosswiesel**, historical military bunker, 13 Oct 1999, 1 ex.; **Nezdice**, Fik cave, 3 Feb 2002, 1 ex., 12 Nov 2002, 12 ex., 22 Nov 2002, 8 ex., 25 Mar 2003, 1 ex., 28 Nov 2003, 22 ex., 3 Jan 2004, 13 ex., 26 Feb 2004, 13 ex., 28 Nov 2004, 21 ex., 4 Jan 2005, 6 ex.

6848: Čestice, attic of the small castle (ČERVENÝ & HANÁK 1977, KRÁTKÁ & KRÁTKÝ 1985, ANDĚRA & ČERVENÝ 1994), 18 Jun 1974, colony 20 ex., 5 May 1977, 3 ex., 25 Jun 1986, colony 7 ex.

6849: Lčovice, attic of the small castle (ČERVENÝ & HANÁK 1977, KRÁTKÁ & KRÁTKÝ 1985, ANDĚRA & ČERVENÝ 1994), 1974, colony 3 ex., 11 Jun 1975, 1 ex.; **Malenice**, Jiříčkova Sluj cave (ANDĚRA & ČERVENÝ 1994), 31 Jan 1976, 1 ex., 26 Apr 1986, netting 1 m; **Malenice**, cave at the hill Betaň (ANDĚRA & ČERVENÝ 1994, DVOŘÁK et al. 2001c), 6 Dec 1996, 2 ex., 29 Dec 2000, 2 ex.

7151: Český Krumlov, 3 galleries (GAISLER & HANÁK 1972, HANÁK & GAISLER 1972, ANDĚRA & ČERVENÝ 1994), 24 Mar 1958, 1 ex.

7250: Černá v Pošumaví, Svatý Josef gallery (GAISLER & HANÁK 1972, HANÁK & GAISLER 1972, ANDĚRA & ČERVENÝ 1994), 24 Mar 1958, 1 ex.

Winter roosts

The lesser horseshoe bat uses different types of shelters for hibernating in the area under study, primarily, the natural underground spaces in the limestone areas in the Šumava foothills. The occurrence during winter season was registered in all known limestone caves and cavities (7 localities – Loreta, Peklo cave, Nezdice – Fík cave, Strašinská cave, Dobršíň, Malenice – Jiříčkova cave, Malenice – cave at Betaň). Those primary localities together with their surroundings represent probably a core area of distribution of the relatively isolated and relict population in the Bohemian Forest. The numbers of hibernating bats are relatively low, usually only few individuals, highest abundance was found out at the locality Nezdice – Fík cave (maximally 22 individuals). Secondly, the lesser horseshoe bat hibernates in other underground spaces, especially in the remains of the old mines. The main area of the occurrence of this type of shelters is situated in surroundings of the Kašperské Hory town, where a big number of old gold mines persist from the middle age. The occurrence was registered in many mines in the area and the numbers are the highest observed in the region (e.g., galleries Kristýna and Bedřich, maximum 47 individuals). The cellars of buildings are another type of shelter, used temporarily in the lower numbers by bats for hibernation. Many winter shelters, especially smaller ones are used as a temporal shelters by bats during spring and autumn migrations. From those parts of season the occurrence is registered also at the localities, where the bats are absent during winter (many small mines, crevices, cellars, small historical military bunkers).

Summer roosts

The summer colonies are known only from the attics of certain, usually bigger, buildings. The maximal registered numbers were 20–60 (e.g., locality Kojšice – 29, Žihobce – 60). Usually, there are mixed colonies of females and males.

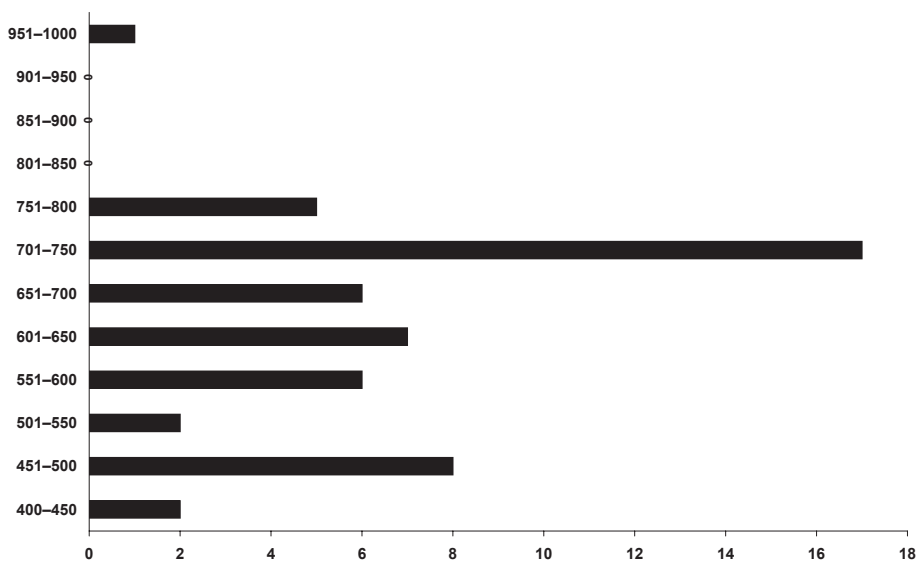


Fig. 3. Hypsometrical distribution of the Lesser horseshoe bat in the Bohemian Forest.

Altitudinal distribution

The occurrence of the lesser horseshoe bat was registered in the altitudes from 430 m a.s.l. (locality Kněží Hora hill) to 970 m a.s.l. (locality Ždánov). The summer distribution is known mainly from lower altitudes up to 700 m, the findings from the highest places are from the autumn and winter season. The majority of localities are situated between 600 and 800 m a.s.l. (Fig. 3). It is not clear, if the altitudinal distribution found is caused by bat requirements or the supply of suitable shelters in certain areas.

The current population trend

The long-term changes of numbers of hibernating bats were studied in the area of the Amá-lino Údolí valley. The old gold mine system of Kristýna–Bedřich was used as a model locality. There is the system of two galleries (Kristýna and Bedřich) situated above at the slope and connected by a shaft. The total length of corridors is ca. 600 m. The connecting shaft is situated at 210 m of the lower gallery (Kristýna). The temperatures in the system range from 7°C to 9°C, with 80–100% relative humidity during the winter season. The coldest part is the bottom entrance corridor (the front part of the gallery Kristýna), where the temperatures fluctuate more and reflects partly the outside temperatures and humidity changes. Within the first 50 m, the gallery can freeze through during the extreme winter conditions. Starting from 200 m, the microclimate is stable with a minimal fluctuations (Fig. 4). In typical winter conditions, the wind circulates from the warmest back part of the Kristýna gallery through the shaft up and then flocks out from the entrance of the gallery Bedřich. The bats spend the winter at the places with temperature range of 7.1–9.4°C, on average 8.2°C (Fig. 4). There was a tendency to aggregation of individuals in a short sector of the upper part (Bedřich) during the beginning of a winter season (November) and to a bigger dispersion to the whole mine system during the winter course. This gallery is the biggest known hibernaculum of

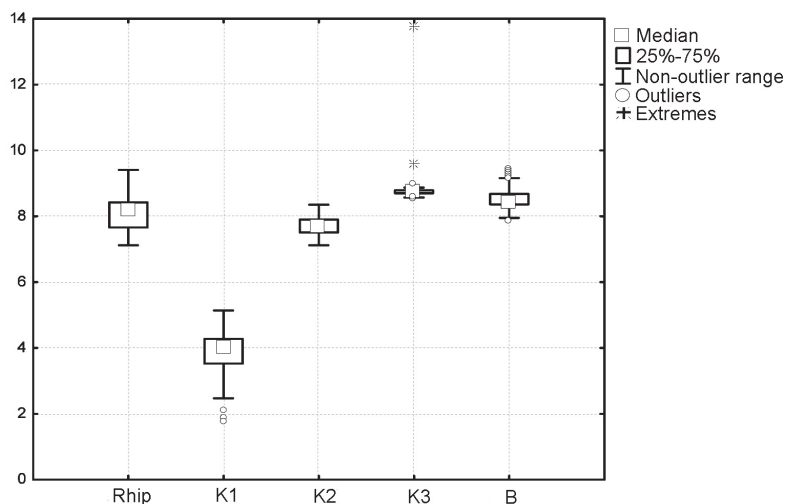


Fig. 4. The temperature in the systém of the Kristýna-Bedřich gallery during the winter season (K1 – Kristýna gallery 100 m from the entrance, K2 – 200 m, K3 – 400 m, B – Bedřich gallery 18 m from the entrance, Rhip – the temperature in surroundings of hibernating lesser horseshoe bats).

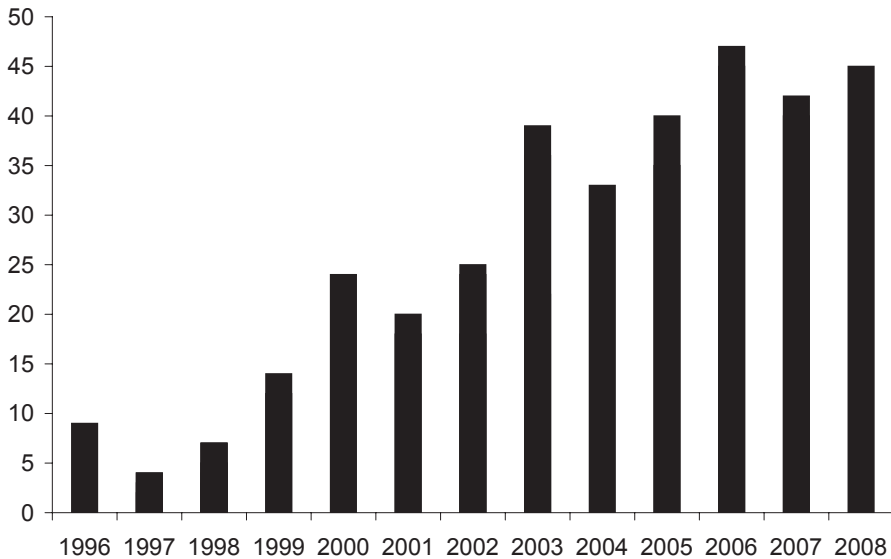


Fig. 5. The long-term changes of the numbers of the lesser horseshoe bat in the Kristýna–Bedřich gallery at the locality Amáline Údolí valley.

the species in the area under study. The locality was monitored regularly since 1996. The statistically significant increase of numbers was registered during last 13 years ($r = 0.967$, $p < 0.05$, $n = 31$) (Fig. 5).

The biggest recently known summer colony is in a loft of a small castle at the locality Žihobce. The animals are concentrated in lower parts and the corner of the loft. The continuous increase of numbers was registered in comparison with the status in the 1980s (Fig. 6). This trend is highly statistically significant ($r = 0.767$, $p < 0.001$, $n = 16$).

Banding, movements, age

The banding of the lesser horseshoe bat was made in the beginning of the systematic research in the 1950s to 1970s only. Some results were already published by HŮRKA (1973) and ČERVENÝ & HANÁK (1977). No banding was made in this sensitive species during the present regular monitoring and netting efforts. Recently, we have one finding of banded animal, as an adult female ringed on the 20 July 1971 in the summer colony in the locality of Mačice, found again during hibernation (cave at the locality Betaň), 29 Dec 2000. The distance between the localities is 17.6 km, the minimal age of the individual is 29 years, 7 months (see also GAISLER et al. 2003).

DISCUSSION

The core area of the population of the lesser horseshoe bat in the Bohemian Forest Region is located in the limestone area in the foothills of the mountain range. The other recent nearest populations are in the middle Bohemia (the Czech Karst and the Sedlčansko areas; 100 and 80 km, respectively) (NOVÁ et al. 2001). The other populations exist in Bavaria (ZAHN & WEINER 2004), the nearest in the vicinity of towns Straubing and Regensburg (ca. 100 km). Longer distances are to the populations in the Alps region as well as to those in Austria

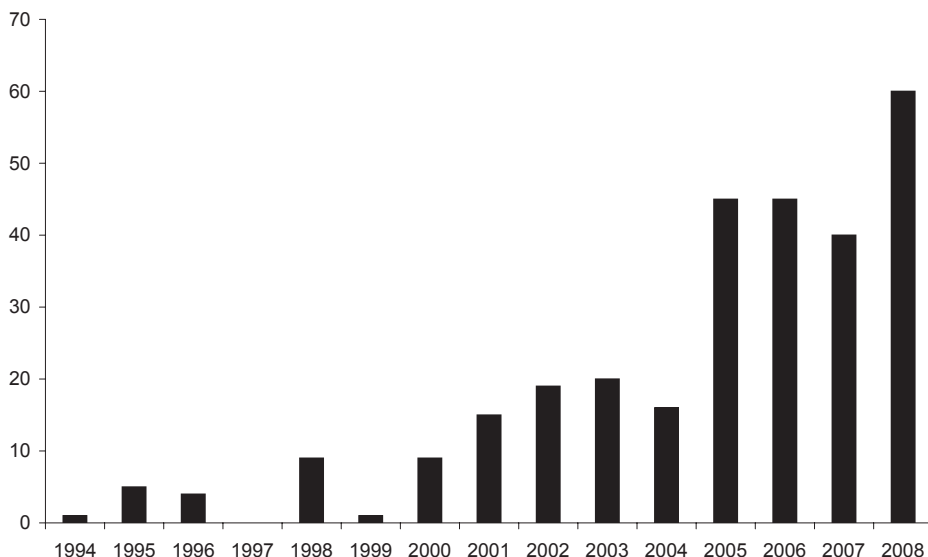


Fig. 6. The long-term changes of numbers of the lesser horseshoe bat in summer colony at the locality Žihobce in the period 1994–2008.

(SPITZENBERGER 2001). The population in the Bohemian Forest is isolated and has a relict character. The distribution is limited to a relatively narrow belt along the mountain ridge, exclusively in the foothills. The occurrence of the lesser horseshoe bat was not confirmed during last period in some historical localities in the southeastern part of the area. The interesting isolated finding of one hibernating individual is from the South Bohemia during the winter 2005–2006, the source of its occurrence is unclear (LUČAN 2006). Similarly, new finding of one hibernating animal exists from the Bavarian side of the mountains near the town of Zwiesel from the winter 2008–2009 (MORGENROTH, unpubl.). There are no new data from the neighbouring areas to the north (BUFKA et al. 2001), but recently, there is a lack of survey activities there.

The altitudinal distribution is comparable with the other populations in the Czech Republic, with a certain shift to higher elevations in comparison to some areas (e.g., ŘEHÁK 2006). In Bavaria, the findings are mainly from 400 to 600 m a.s.l., maximum 930 m a.s.l. in summer (HOLZHAIDER 1998) and 1252 m a.s.l. from the winter. The data are from relatively high positions (max. 1450 m a.s.l.) in the Austrian and Swiss Alps (STUTZ 1989, SPITZENBERGER 2001).

The presence of limestone in a combination with a highly structured mosaic landscape is typical for the study area. There is only extensive land use and no industrial or larger urban areas. This corresponds well with the data from the other parts of the distribution of the species. Usually the typical habitat is described as a highly forested, natural, highly structured landscape in connection with suitable food habitats and presence of shelters (ROER & SCHÖBER 2001). The survival of the relict populations depends on certain extensive nature-friendly agricultural and forest management (e.g., RICHARZ 1989). The intensity of landscape management influences the distribution of the lesser horseshoe bat also in other European countries (Thuringia, Austria, Switzerland, England – see SCHOFIELD 1996, SPITZENBERGER 1997, STUTZ & HAFFNER 1984). The forest cover, which varies from ca. 40% to 80%, seems to be very important for the species distribution in the Bohemian Forest. The importance of

this factor recently described by REITER (2002, 2004) in Austria, with a positive relationship has been between the forest cover and the numbers in summer colonies. The summer colonies exclusively fixed to the buildings are typical for the whole Central European part of the distribution, monitored colony in the loft of a castle in Žihobce with the numbers of adults more than 50 is one of the biggest known within the Central Europe, where the colonies mostly consist of 15–30 individuals (rarely 100 or more, ROER & SCHÖBER 2001). The individual findings during spring, summer, and mainly from the period of autumn migrations from small shelters, frequently of artificial or technical character (galleries, cellars, bunkers), is a typical phenomenon for the species in the region and is known from the older data and for other areas (HŮRKA 1973, ZAHN & WEINER 2004). The biggest winter roosts are found mainly in secondary underground spaces (galleries) in the Bohemian Forest and its foothills, although caves are probably the primary shelters in the natural limestone. Generally, there is a higher percentage of natural caves used for hibernation in other areas of the Czech Republic or in Europe (e.g., 62% of winter roosts in Bavaria, ZAHN & WEINER 2004). The temperatures during hibernation (on average 8.2°C) correspond with the published data in the range of 6–8.3°C (e.g., ZAHN & WEINER 2004).

The recorded age over 29 years represents the maximum known age within the whole area of distribution of the species (GAISLER et al. 2003). The hitherto maximum known was 21 years (HARMATA 1981). The recorded movement is similar to mean values for the whole period of bat banding in the Czech and Slovak Republics, where only one tenth of the records was more than 30 km (GAISLER et al. 2003).

The recent population increase, documented on the summer colony and winter roosts in the Bohemian Forest, is evidently the part of a general trend in central Europe (ZAHN & WEINER 2004, HORÁČEK et al. 2005).

SUMMARY

There is a relict, relatively isolated small population of the lesser horseshoe bat in the Bohemian Forest. The area of its distribution is limited to a belt of the foothills (a northern part of the mountain range). The majority of findings are from 600 to 800 m a.s.l. The small limestone localities at lower altitudes represent a primary core areas of the distribution. Also the summer colonies, exclusively in the lofts of buildings, are found in those areas. Secondly, the lesser horseshoe bat uses the artificial underground spaces, mainly remains of a old mines and also cellars. The most numerous winter roosts are found in some old galleries. Certain smaller shelters are used temporarily during spring and autumn season. After a big decline during the 1980s, the continuous population increase has been documented by a long-term monitoring on a model localities. That trend is registered during hibernation period as well as in summer occurrence and colonies. Although the evident increase in the population is described in the last decade, the occurrence in the south eastern part of the former area of distribution was not confirmed, and there is only a little evidence of expanding to the other surrounded areas.

Acknowledgement. We kindly thank J. Bartizalová and the staff of the Geophysical Institute of the Academy of Science of the Czech Republic for their help during a long-term winter monitoring of bat communities in the „Kristýna“ mine.

REFERENCES

- ANDĚRA M. & ČERVENÝ J., 1994: Atlas of the distribution of the mammals of the Bohemian Forest (SW-Bohemia). *Acta Scientiarum Naturalium*, 28 (2–3), 1–111.
- ANDĚRA M. & HANÁK V., 2005: *Atlas rozšíření savců v České republice. Předběžná verze. V. Letouni (Chiroptera) – část I. vrápencovití (Rhinolophidae), netopýrovití (Vespertilionidae – Barbastella barbastellus, Plecotus auritus, Plecotus austriacus) [The Atlas of the Distribution of the Mammals of the Czech republic, Preliminary version. V. Chiroptera]*. Národní muzeum, Praha, 120 pp. (in Czech).
- BAŤA L., 1933: *Dosavadní výsledky zoologického výzkumu jižních Čech [The results of the zoological research in South Bohemia]*. Vlastivědná Společnost Jihočeská, České Budějovice, 67 pp. (in Czech).
- BONTADINA F., 2002: Conservation ecology in the horseshoe bats *Rhinolophus ferrumequinum* and *Rhinolophus hipposideros*. Dissertation, Zoological Institute, University Bern, 184 pp. (library of Zoological Institute, University Bern).
- BUFKA L., ČERVENÝ J. & DVOŘÁK L., 1999: The long-term changes of bat communities in the locality „Loreta“ (the Šumava piedmont, Czech republic). In: *VIIIth European Bat Research Symposium – Abstracts*, 23–27 August 1999, Kraków, p. 12.
- BUFKA L., BYTEL J., HANZAL V. & VACÍK R., 2001: The distribution of bats (Chiroptera, Mammalia) in western Bohemia: a review. *Folia Musei Rerum Naturalium Bohemiae Occidentalis, Zoologica*, 41: 1–30.
- ČERVENÝ J. & HANÁK V., 1977: Rozšíření vrápence malého (*Rhinolophus hipposideros* Bechstein, 1900) v Pošumaví. [The distribution of the Lesser Horseshoe Bat (*Rhinolophus hipposideros* Bechstein, 1900) in the Šumava Piedmont] *Časopis Národního Muzea, Oddíl Přírodovědný*, 146: 68–75.
- ČERVENÝ J., 1982: Results of investigation of bats (Chiroptera) at Loreta near Klatovy. *Lynx, Praha, Nová Série*, 21: 41–65.
- DEMEK J. & ŠTRÍDA M. (eds), 1971: *Geography of Czechoslovakia*. Academia Praha, 330 pp.
- DVOŘÁK L., BUFKA L. & ČERVENÝ J., 2001a: Netopýři zimující ve štolách v Amálině údolí u Kašperských Hor [The bats hibernating in the galleries in the Amáline Údolí valley near Kašperské Hory]. *Vespertilio*, 5: 47–56 (in Czech).
- DVOŘÁK L., BUFKA L., ČERVENÝ J., 2001b: Zimoviště netopýřů v NP a CHKO Šumava [The winter roosts of bats in the Šumava National Park and Landscape Protected Area]. *Vespertilio*, 5: 35–46 (in Czech).
- DVOŘÁK L., BUFKA L., ČERVENÝ J., BÜRGER P., 2001c: Zimoviště netopýřů v Pošumaví (lokality ležící mimo hranice CHKO Šumava) [The winter roosts of bats in the Šumava piedmont (localities situated outside the Šumava Protected Landscape Area)]. *Vespertilio*, 5: 57–72 (in Czech).
- GAISLER J. & HANÁK V., 1972: Netopýři podzemních prostorů v Československu [The bats of underground spaces in Czechoslovakia]. *Sborník Západočeského Muzea v Plzni, Příroda*, 7: 1–47 (in Czech).
- GAISLER J., 1997: Preliminary data on the distribution of Rhinolophidae in the Czech Republic and variation in numbers of *R. hipposideros* in S-Moravia. In: *Zur situation zur Hufeisennasen in Europa*, OHLENDORF B. (ed.) IFA, Berlin: 55–57.
- GAISLER J., HANÁK V., HANZAL V. & JARSKÝ V., 2003: Výsledky kroužkování netopýřů v České republice a na Slovensku, 1948–2000 [Results of bat banding in the Czech and Slovak Republics, 1948–2000]. *Vespertilio*, 7: 3–61 (in Czech with an English summary).
- HANÁK V. & GAISLER J., 1972: Přehled netopýřů podzemních prostorů Čech [The bat survey in underground spaces of the Bohemia]. *Práce a Studie – Příroda, Pardubice*, 4: 141–156 (in Czech).
- HARMATA W., 1981: Longevity record for the lesser horseshoe bat. *Acta Theriologica*, 26: 507.
- HOLZHAIDER J., 1998: Untersuchungen zur Fledermausfauna in den Bayerischen Alpen. Diplomarbeit, Technische Universität München. 88 pp.
- HORÁČEK I., HANÁK V., GAISLER J. & ČESON – ČESKÁ SPOLEČNOST PRO OCHRANU NETOPÝŘŮ, 2005: Dlouhodobé změny biodiverzity netopýřů: zpráva o nejrozsáhlejší monitorovací programu 1969–2004. pp.: 105–115 + 1B–22B. In: Vačkář D. (ed.): *Ukazatele změn biodiverzity*. Academia, Praha, 298 pp.
- HŮRKA L., 1973: Výsledky kroužkování netopýřů v západních Čechách v letech 1959–1972 s poznámkami k jejich rozšíření, ekologii a ektoparazitům [The results of bat banding in the Western Bohemia in the years 1959–1972 with remarks to their distribution, ecology and ectoparasites]. *Sborník Západočeského Muzea, Příroda*, 9: 1–84 (in Czech).
- KRÁTKÁ D. & KRÁTKÝ J., 1973: Letní výskyt netopýřů (Chiroptera) vázaných na lidské stavby na Šumavě I, Sušicko [The summer occurrence of bats (Chiroptera) in buildings in the Šumava Mts. I, the Sušicko area]. *Zprávy Muzei Západočeského Kraje, Příroda*, 15: 39–45 (in Czech).
- KRÁTKÁ D., KRÁTKÝ J., 1985: Letní výskyt netopýřů (Chiroptera) vázaných na lidské stavby na Šumavě III, Prachaticko, Strakonicko, Českokrumlovsko [The summer occurrence of bats (Chiroptera) in buildings in the Šumava Mts. III, Prachatice, Strakonice, and Český Krumlov areas]. *Zprávy Muzei Západočeského Kraje, Příroda*, 30–31: 69–78 (in Czech).
- LUČAN R.K., 2006: První nález vrápence malého v českobudějovické pánvi [First record of the lesser horseshoe

- bat (*Rhinolophus hipposideros*) in the České Budějovice Basin (southern Bohemia, Czech republic)]. *Vespertilio*, 9–10: 227–228 (in Czech with an English abstract).
- NOVÁ P., MALÝ P., HORÁČEK I., HANÁK V. & SÁDOVSKÁ E., 2001: Zimoviště netopýrů v podzemí Sedlčansko – krásnohorského metamorfovaného ostrova [The winter roosts in underground spaces of the Sedlčansko–krásnohorský metamorphic island]. *Vespertilio*, 5: 187–190 (in Czech).
- OHLENDORF B., 1997: Verbreitungsgebiet der Kleinen Hufeisennase (*Rhinolophus hipposideros*) in Europa. In: *Zur Situation der Hufeisennasen in Europa*, OHLENDORF B. (ed.), IFA, Berlin, pp. 10–11.
- REITER G., 2002: Ökologie, Öko-ethologie und Naturschutzbiologie der Kleinen Hufeisennase (*Rhinolophus hipposideros*) in Österreich. Dissertation, Universität Salzburg, 153 pp.
- REITER G., 2004: The importance of woodland for *Rhinolophus hipposideros* (Chiroptera, Rhinolophidae) in Austria. *Mammalia* 68: 403–410.
- RICHARZ K., 1989: Report of the successful transplantation of a nursery colony of the lesser horseshoe bat (*Rhinolophus hipposideros*) and remarks about the actual status in Bavaria. In: *European Bat Research 1987*, HANÁK V., HORÁČEK I. & GAISLER J. (eds) Charles University Press, Praha: 659–670.
- ROER H. & SCHOBER W., 2001: *Rhinolophus hipposideros* (Bechstein, 1800) – Kleine Hufeisennase. In: *Handbuch der Säugetiere Europas, 4/I*, NIETHAMMER J. & KRAPP F. (eds) Aula Verlag, Wiebelsheim, pp. 39–58.
- ŘEHÁK Z., 2006: Areal and altitudinal distribution of bats in the Czech part of the Carpathians (Chiroptera). *Lynx, Praha, Nová Série*, 37: 201–228.
- SCHOFIELD H.W., 1996: The ecology and conservation biology of *Rhinolophus hipposideros*, the lesser horseshoe bat. Dissertation thesis, University of Aberdeen, 168 pp.
- SCHOFIELD H.W., 1999: *Rhinolophus hipposideros* (Bechstein, 1800). In: *The atlas of european mammals*, MITCHELL-JONES A.J. et al. (eds) The Academic Press, London, pp. 96–97.
- SPITZENBERGER F., 1997: Verbreitung und Bestandsentwicklung der Kleine Hufeisennase (*Rhinolophus hipposideros*) in Österreich. In: *Zur Situation der Hufeisennasen in Europa*, OHLENDORF B. (ed.), IFA, Berlin, pp. 135–141.
- SPITZENBERGER F., 2001: *Die Säugetierfauna Österreichs*. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Graz, 895 pp.
- STEBBINGS R.E., 1988: *Conservation of European bats*. Christopher Helm Ltd., London, 246 pp.
- STUTZ H.P., 1989: Die Höhenverteilung der Wochenstuben einiger ausgewählter schweizerischer Fledermausarten (Mammalia, Chiroptera). *Revue Suisse Zoologie*, 96: 651–662.
- STUTZ H.P. & HAFFNER M., 1984: Areal-verlust und Bestandesrückgang der Kleinem Hufeisennase *Rhinolophus hipposideros* (Bechstein 1800) (Mammalia, Chiroptera) in der Schweiz. *Jahresbericht der Naturforschenden Gesellschaft Graubünden*, 101: 169–178.
- ZAHN A. & WEINER P., 2004: Kleine Hufeisennase, *Rhinolophus hipposideros* (Bechstein, 1800). In: *Fledermäuse in Bayern*, MESCHÉDE A. & RUDOLPH B.-U. (eds) Bayerischen Landesamt für Umweltschutz, Stuttgart, pp. 111–126.

Received: 13 November 2008

Accepted: 20 March 2009