Lynx (Praha), n. s., **37**: 201–228 (2006). ISSN 0024–7774

Areal and altitudinal distribution of bats in the Czech part of the Carpathians (Chiroptera)

Plošné a výškové rozšíření netopýrů v české části Karpat (Chiroptera)

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received on 20 December 2006

Abstract. All available bat records from the Outer Carpathians, situated in the eastern part of the Czech Republic, were summarized, divided into old (before 1956), winter and summer records and evaluated with respect to orographical units, quadrats of grid maps and elevation. In total, 20 bat species and/or two pairs of sibling species were recorded in 9 orographical units and 41 quadrats covering the area under study. Hitherto, thirteen species of bats were recorded as hibernating and in 10 species maternity colonies were found in the Czech Carpathians. The areal distribution of particular species was presented via grid maps. *Plecotus* spp. (50.0% of the studied area), *Myotis myotis* (46.7%) and *M. daubentonii* (40.0%) can be considered the most distributed of them. Altitudinal distribution of sites where bats were recorded, expressed as medians of their elevation, shows that *P. austriacus* significantly preferred low elevation both in the winter and summer periods (259 and 298 m above sea level, respectively) while the hibernacula of the *M. mystacinus* group and *M. nattereri* prevailed at higher elevations (872 m and 1050 m, respectively). During the non-hibernation period the highest medians of elevation were recorded in *M. brandtii* and again in *M. nattereri* (765, resp. 665 m a. s. l.). The causes of preferences for such high elevated sites are discussed.

INTRODUCTION

The knowledge of the distribution of bats enables to estimate their species diversity over reasonable geographical units and, consequently, to assess the ecological value of individual segments within a given territory. At the same time, bats' distribution reveals the differences in conditions favourable to the life of these mammals among various areas of the same territory. Differences in the composition and abundance of bat communities then reflect different habitat demands of individual species the communities consist of. Information on the distribution of bats, therefore, represents a starting point for both synecological and autecological studies of the respective chiropteran fauna.

Faunistic review of all available records of bats in a particular area is a condition *sine qua non* to analyse the distribution of the respective bat assemblage or assemblages. Within the territory of the Czech Republic, the Carpathians were relatively neglected in this respect until quite recently. The history of chiropterological research there, not very ample so far, was dealt with in previous papers by the author (Řehák 1998, 2001). The first faunistic review of bats on the territory of the Czech (Moravian-Silesian) Carpathians was published by Řehák (1998).

In the present paper, the data of the former one gathered up to 1998 are supplemented by new records till 2006, both published and unpublished, to get a real image on the bat fauna of the easternmost part of the Czech Republic. New data were obtained mainly by the results of systematic research in the Hostýnské vrchy Mts (Lučan 2000, Lučan & Svačina 2001), of acoustic detectoring in Wallachia (Řehák 2001 and unpublished) or of an intense research of bat activity at the Hranická propast Chasm, including a maternity colony roosting in a cave of the chasm (Baroň & Řehák 2001, Řehák & Baroň 2002 and unpublished). Further data resulting from long-term monitoring of hibernacula, *Myotis myotis* maternity colonies and bat-detectoring of forest bats and sibling species *Pipistrellus pipistrellus* and *P. pygmaeus* (Řehák et al. 2005) were included as well. Numerous data, even from regions omitted so far, were obtained thanks to the improvement of species determination from bat detector samples, by tape recording the ultrasound signals and their subsequent digitalization and computer analysis.

Although mountain and hilly elevations (up to 1323 m a. s. l.) prevail on the territory, large underground spaces serving to bats as their natural hibernacula are relatively rare there, compared to similar mountain regions elsewhere. Warm pseudo-karstic caves at higher elevations, situated mainly in the eastern part of the territory, are exception. Some of them have been known for years as bat hibernacula (Rumler 1985, Baroň & Řehák 1997, Wagner 2001). Neither the mining was common in the Moravian-Silesian Carpathians, except for a few slate quarries and galleries (Kirchner & Řehák 1990, Řehák & Baroň 1997, Šafář & Rumler 2001). Winter records of bats are particularly rare in the southern and western hilly grounds where only subterranean vaults and cellars of houses are known as bat hibernacula. In contrast, summer records of bats are relatively numerous. They concern checks of bats roosting in lofts, mainly of sacral buildings and castles, netting of bats in the field and, during the last 15 years, acoustic bat-detectoring. It was demonstrated that the occurrence of bats in summer was not limited to warmer lower elevated sites with a higher food supply, but bats occurred also at higher elevations, mainly in the second half of summer. Records of bats were made close to underground spaces where some of them later hibernate, bat detectoring in the massif of the Lysá hora Mt. revealed bats foraging on the mountain ridges at the elevation of 900 m and more.

There are two goals of the present paper: (1) to evaluate all records and to show the geographical distribution of bat species on maps with a standard girid, and (2) to analyse the altitudinal distribution of individual species with respect to main periods of their life cyle.

MATERIAL AND METHODS

Study area

As in the previous paper (Řehák 1998), the territory on the right bank of the Morava River was excluded from the study area (Fig. 1). The area under study consists of 10 orographic units which are, approximately in the north-south direction: Slezské Beskydy Mts, Jablunkovská brázda Furrow, Jablunkovská vrchovina Highland, Moravskoslezské Beskydy Mts, Podbeskydská pahorkatina Upland, Rožnovská brázda Furrow, Javorníky Mts, Hostýnsko-vsetínská hornatina Mts, Vizovická vrchovina Highland and Bílé Karpaty Mts (Demek & Střída 1971). No research concerning bats was made in only one of them, the Jablunkovská brázda Furrow, and there have been no records of bats there. The whole territory with its orographic and hydrologic situation is shown by a map (Fig. 2). Mountains at the border between the Czech Republic and Slovakia represent the highest part of the area, the elevation then decreases towards the west down to the river valleys of Bečva and Morava. The elevation decreases also in the southward direction where it is difficult to find the border between the Carpathians and the Dolnomoravský úval Valley.

Table 1. List of bat species recorded in the area of the Czech Carpathians and abbrevations for bat taxa
Tab. 1. Seznam druhů netopýrů zjištěných na území českých Karpat a zkratky jejich názvů

species	abb.	species	abb.
Rhinolophus hipposideros	Rhip	*Eptesicus serotinus*	Eser
Myotis mystacinus	Mmys	*Nyctalus noctula*	Nnoc
Myotis brandtii	Mbra	*Nyctalus leisleri*	Nleu
M. mystacinus seu *M. brandtii*	Mmys/bra	*Pipistrellus pipistrellus*	Ppip
Myotis emarginatus	Mema	*Pipistrellus pygmaeus*	Ppyg
Myotis nattereri	Mnat	*P. pipistrellus* seu *P. pygmaeus*	Ppip/pyg
Myotis bechsteinii	Mbec	*Pipistrellus nathusii*	Pnat
Myotis myotis	Mmyo	*Barbastella barbastellus*	Bbar
Myotis oxygnathus	Moxy	*Plecotus auritus*	Paur
Myotis daubentonii	Mdau	*Plecotus austriacus*	Paus
Vespertilio murinus	Vmur	*P. auritus* seu *P. austriacus*	Paur/aus
Eptesicus nilssonii	Enil		

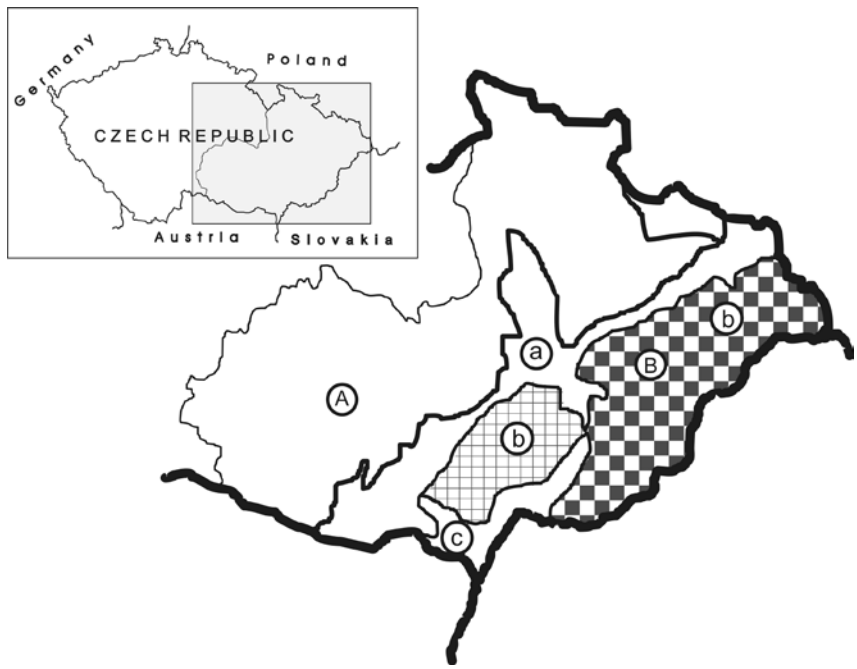

Fig. 1. Map of Moravia including the W-Carpathian area under study.
Obr. 1. Mapa Moravy s vyznačením studovaného území Západních Karpat.
Explanations / vysvětlivky: A – Bohemian Highlands / Česká vysočina; B – Western Carpathians / Západní Karpaty; a – Outer Carpathian Depressions / Vněkarpatské sníženiny; b – Outer Carpathians / Vnější Karpaty; c – Inner Carpathian Depressions / Vnitrokarpatské sníženiny; thick line / silná čára – state border / stární hranice; middle line / středně silná čára – geomorphological system borders / hranice geomorfologických provincií; thin line / tenká čára – geomorphological subsystem border / hranice geomorfologických podprovincií; chequered area / kostkovaná plocha – study area / studované území.

M a t e r i a l

A data base has been developed from all available sources since the twentieth of the 20th century until the year 2006. It has 1447 items with records of 20 bat species. The species, including abbreviations of their names, are listed in Table 1. Records with unspecified location or timing were excluded from the evaluation of bats' distribution. Mostly they concern old data (Remeš 1927, Gaisler 1956, Hanák 1960). In addition to previous publication (Řehák 1998), the data base was completed by records published in the papers by Lučan (2000), Lučan & Svačina (2001), Šafář & Rumler (2001), Wagner (2001), Jahelková (2003) and, in certain species, missing data were assumed from Hanák & Anděra (2005). Unpublished own data were added too.

Three categories of data are recognized. The first category is represented by old records before the year 1956 when the first thorough faunistic review of bats in the then Czechoslovakia was published (Gaisler 1956). The records made since 1956 were divided into winter and summer ones. The second category (winter records) are those made in hibernacula and concerning torpid bats. In most cases, winter season has formally been fixed to 15 October – 30 April (Gaisler et al. 1988, cf. Hanák & Anděra 2005). Irrespectively of this time span, findigs of torpid bats in May in hibernacula situated at high elevations were considered winter records as well. The third category (summer records) comprises mostly the findings made from 1 May to 14 October but, as in the case of winter records, this delimitation was not absolutely observed. Finds and observations outside a shelter, e.g., made at the beginning of April or at the end of October, were ranged to this category. Records of colonies were specified and evaluated separately from the rest of summer records. Except in *Vespertilio murinus*, they concerned maternity colonies. All records

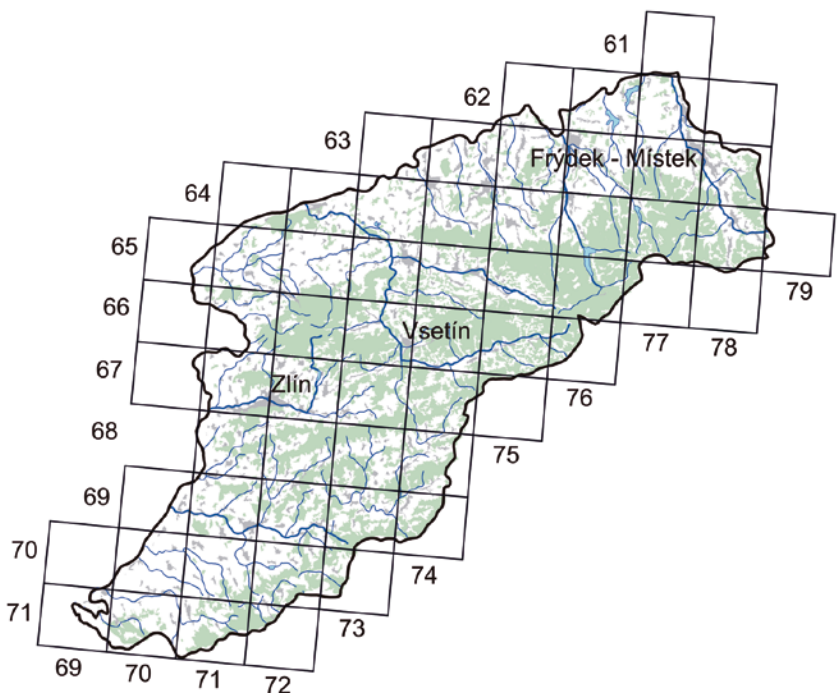

Fig. 2. Geographical map of the area under study.
Obr. 2. Geografická mapa studovaného území.

were assigned to the orographic units, quadrats of the mapping grid and their elevation was determined (see Řehák 1998).

Methods

Various methods were used to get the data. Winter records were made either by occasional checks in house cellars and vaste subterranean vaults of castles (Hanák 1960, Vlašín et al. 1993, 1995), or by regular winter monitoring in former mine galleries (Baroň & Řehák 1997) and natural pseudo-karstic clefts (ibid., Wagner 2001). All winter records of *Vespertilio murinus* came from above ground rooms of buildings (Řehák 1998, Kašpar in litt.). Summer records were made by searching in lofts and under roofs of buildings, namely churches and castles, by netting at the entrances to underground or on potential bat hunting grounds, namely above brooks and on banks of water reservoirs. Important data have also been obtained by the collection and analysis of owl pellets. Except in some cases, the detection of echolocation signals yielded important data. Acoustic determination was often limited in cases where species identification based on external morphology was difficult as well. In sibling species such as *M. mystacinus* and *M. brandtii*, or *P. auritus* and *P. austriacus*, visual identification from a distance is problematic (cf. Bartonička 2004), in *Pipistrellus* bats it is nearly impossible vithout manipulation of them. In *P. pipistrellus* and *P. pygmaeus* their identification based on morphology is problematic in any case (Řehák et al. 2005) but they can be recognized by detecting their ultrasound signals. Acoustically based determination of the two *Pipistrellus* species mentioned above, however, has been done only since 2000, some earlier records therefore have to be assigned to *Pipistrellus pipistrellus* sensu lato. The relatively recently discovered species *P. pygmaeus* (Jones & van Parijs 1993, Barratt et al. 1997) was acousticly detected only in three places at lower elevations on the periphery of the territory studied (own unpublished data). Therefore, records prior to 2000 made at higher elevations are assigned to *P. pipistrellus* sensu stricto.

Areal distribution of records belonging to the respective category was visualized with the aid of the mapping grid (cf. Řehák et al. 2003). Relative representation of each species is then calculated as a percent of quadrats where it was recorded out of the total of all quadrats of the area. Altitudinal distribution was evaluated after the variance of elevations of the localities, divided again according to summer records, winter records and records of maternity colonies. Non-parametric tests were applied, the Kruskal-Wallis H test to the comparison among species and the Mann-Whitney U test to compare species pairs. All statistical operations were made using the software Statistica for Windows.

RESULTS

Bat fauna in particular orographical units

The number of localities with records of bats in particular orographic units, supplemented by the number of recorded species, are given in Table 2. It is evident from the table that the Podbeskydská pahorkatina Upland and the Hostýnsko-vsetínská hornatina Mts have the most rich bat fauna. Both orographic units are situated in the north-western part of the territory which gradually fades away into the lowlands of Outer Carpathians. There the number of both hibernacula and localities with summer occurrence of bats is the highest which is reflected in the highest number of bat species in winter as well as in summer. In contrast, Slezské Beskydy Mts and Jablunkovská vrchovina Highland in the northern part of the territory have the lowest number of both localities and bat species. In most orographic units, the number of localities with summer records is higher than that with winter records (Table 2). All localities arranged according to their situation in individual orographical units and quadrats are listed in Appendix 1.

Table 2. The total number of bat species and localities with records of bats in particular orographical units
Tab. 2. Celkový počet druhů netopýrů a lokalit s nálezy netopýrů v jednotlivých orografických celcích
Explanations / vysvětlivky: NoL – number of localities / počet lokalit; NoS – number of bat species / počet druhů netopýrů; W – winter season – records of torpid bats at hibernacula and all winter records of *V. murinus* / zimní období – nálezy letargujících netopýrů na zimovištích a všechny zimní nálezy *V. murinus*; G – growing season – other records of bats, especially from summer / mimohibernační období – ostatní nálezy netopýrů, především letní

orographical unit / orografická jednotka	NoL		NoS		
	W	G	W	G	W+G
Slezské Beskydy Mts	0	2	0	3	3
Jablunkovská vrchovina Highland	1	0	3	0	3
Moravskoslezské Beskydy Mts	6	20	9	14	14
Podbeskydská pahorkatina Upland	10	53	10	17	17
Rožnovská brázda Furrow	1	25	1	15	15
Javorníky Mts	1	12	4	14	14
Hostýnsko-vsetínská hornatina Mts	9	41	11	18	18
Vizovická vrchovina Highland	9	30	8	13	13
Bílé Karpaty Mts	2	34	4	13	14

Areal distribution

The area studied covers altogether 60 quadrats of the mapping grid but 19 of them by less than 50% only. Some of the peripheral quadrats belong to the area by a very small territory. There are no records of bats in 19 quadrats, 15 of them are the same as above. Bats were recently found in all quadrats with old records prior to 1956. Winter records cover 19 quadrats (31.6%), in one of them, 6478, only hibernating bats were recorded (Na Gírové cave in the Jablunkovská vrchovina Highland). There are 6 quadrats (10%) with five and more hibernacula in each or with an important hibernaculum where 10 or more individuals of one bat species were recorded during a single check. The most important natural hibernacula include the pseudo-karstic cleft

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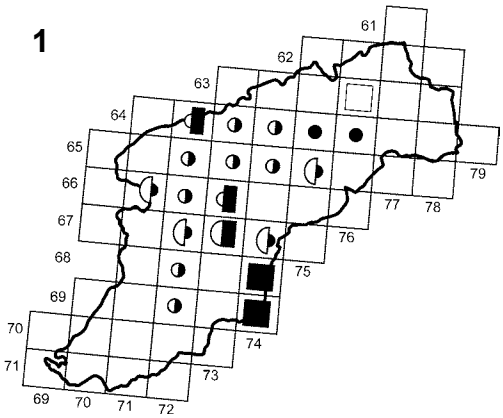
Fig. 3. Distribution maps of individual bat species or pairs of sibling species.
Fig. 3. Mapy rozšíření jednotlivých druhů nebo dvojic podvojných druhů netopýrů.
Explanations / vysvětlivky: empty square / prázdný čtverec – records only before 1956 / jen nálezy před rokem 1956; black square or semisquare / černý čtverec nebo půlčtverec – records of nursery colonies / nálezy letních reprodukčních kolonií; grey square / šedý čtverec – records of male colonies (only *V. murinus*) / nálezy samčích kolonií (jen *V. murinus*); little empty circle or semicircle / malý prázdný kruh nebo půlkruh – records of less than 10 individuals in 1–4 hibernacula / nálezy méně než 10 jedinců na 1–4 zimovištích; big empty circle or semicircle / velký prázdný kruh nebo půlkruh – 5 or more hibernacula or records of 10 or more individuals in one hibernaculum during one check at least / 5 a více zimovišť nebo nálezy 10 a více jedinců nejméně na 1 zimovišti během jedné kontroly; little full circle or semicircle / malý plný kruh nebo půlkruh – less than 5 sites of summer records / méně než 5 lokalit s letními nálezy; big full circle or semicircle / velký plný kruh – 5 or more sites of records of bats or records of 10 or more individuals (excl. colonies) at a site per one survey during growing season / 5 a více lokalit s nálezy netopýrů nebo nálezy 10 a více jedinců (vyjma kolonií) na lokalitě při jedné akci během mimohibernačního období.
1 – *Rhinolophus hipposideros*, 2 – *Myotis mystacinus*, 3 – *Myotis brandtii*, 4 – *Myotis mystacinus* seu *M. brandtii*, 5 – *Myotis emarginatus*, 6 – *Myotis nattereri*.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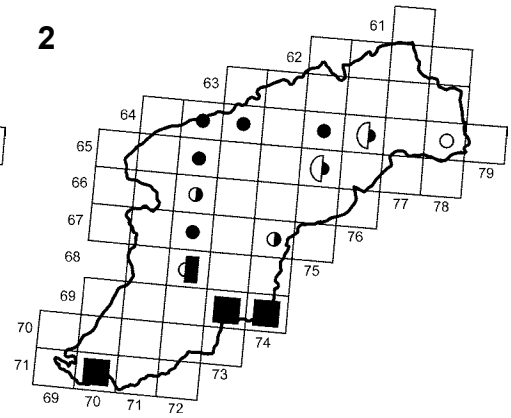
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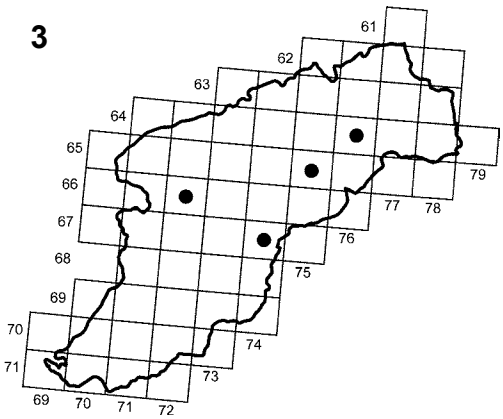
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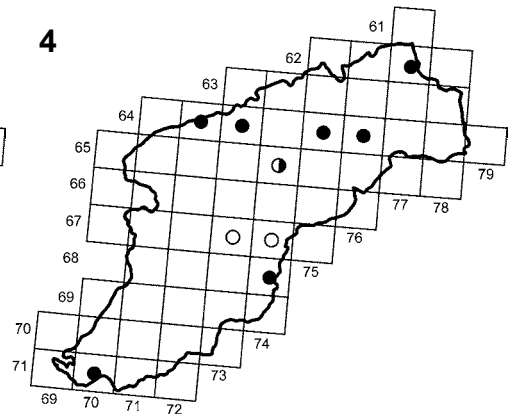
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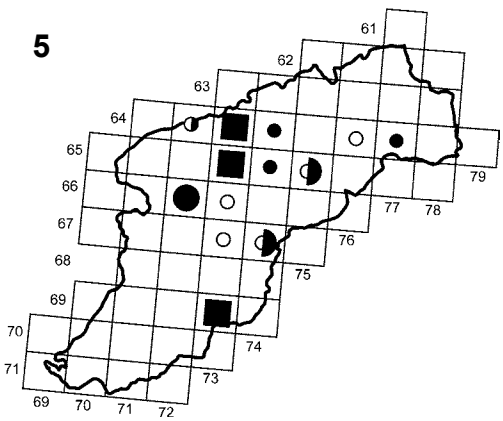
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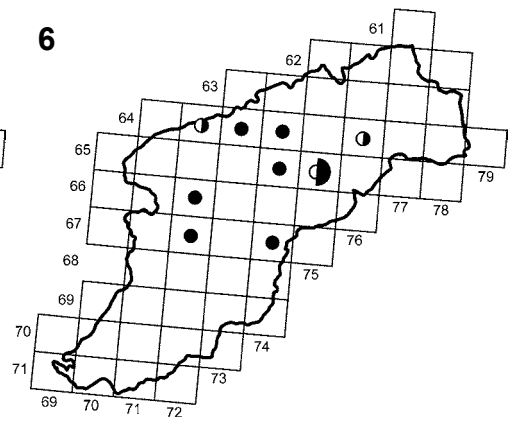
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Table 3. Areal distribution of particular bat species or species groups
Tab. 3. Plošné rozšíření jednotlivých druhů netopýrů či jejich skupin
Explanations / vysvětlivky: NoQ – number of quadrates where bats were recorded (*Myotis mystacinus* group includes *M. mystacinus* and *M. brandtii*, *Pipistrellus pipistrellus* group includes *P. pispistrellus* and *P. pygmaeus* and *Plecotus* group includes *P. auritus* and *P. austriacus*) / počet kvadrátů s nálezy netopýrů (*Myotis mystacinus* group zahrnuje *M. mystacinus* a *M. brandtii*, *Pipistrellus pipistrellus* group zahrnuje *P. pipistrellus* a *P. pygmaeus* a *Plecotus* group zahrnuje *P. auritus* a *P. austriacus*)

species	winter season		growing season		total	
	NoQ	%	NoQ	%	NoQ	%
Rhinolophus hipposideros	15	25.0	19	31.7	20	33.3
M. mystacinus group	8	13.3	16	26.7	18	30.0
Myotis emarginatus	6	10.0	10	16.7	13	21.7
Myotis nattereri	3	5.0	9	15.0	9	15.0
Myotis bechsteinii	4	6.7	9	15.0	9	15.0
Myotis myotis	10	16.7	26	43.3	28	46.7
Myotis oxygnathus	0	0	1	1.7	1	1.7
Myotis daubentonii	7	11.7	22	36.7	24	40.0
Vespertilio murinus	2	3.3	6	10.0	6	10.0
Eptesicus nilssonii	2	3.3	13	21.7	13	21.7
Eptesicus serotinus	3	5.0	18	30.0	19	31.7
Nyctalus noctula	0	0	15	25.0	15	25.0
Nyctalus leisleri	0	0	9	15.0	9	15.0
P. pipistrellus group	0	0	21	35.0	21	35.0
Pipistrellus nathusii	0	0	5	8.3	5	8.3
Barbastella barbastellus	3	5.0	10	16.7	10	16.7
Plecotus group	14	23.3	24	40.0	30	50.0

caves in the Moravskoslezské Beskydy Mts (Cyrilka, Kněhyňská jeskyně and Ondrášovy díry caves), Javorníky Mts (Pod kazatelnou I Cave) and Vizovická vrchovina Highland (three caves in the hill Kopce near Lidečko). Important artificial hibernacula include the Sintrová Gallery near Liptál (Vizovická vrchovina Highland), the subterranean vault of the Holešov Castle and the cellars of buildings in Lukov. Except the Kněhyňská and Ondrášovy díry caves dominated by *Myotis myotis*, all important hibernacula harbour *Rhinolophus hipposideros* as the most abundant species in winter.

Summer records cover altogether 40 quadrats (66.7%); maternity colonies were found in 24 of them (40.0%). Summer male colonies of *Vespertilio murinus* were recorded behind window shutters at two localities in the Hostýnsko-vsetínská hornatina Mts (quadrats 6572, 6672). In addition to the quadrats with records of bat colonies, there are 6 quadrats with at least five localities in each or with an important summer locality where 10 or more individuals of one bat species were recorded during a single check. Numerous bats were netted in late summer at the entrances to caves serving also as hibernacula in three of the quadrats (6575, 6672, 6774). Bats

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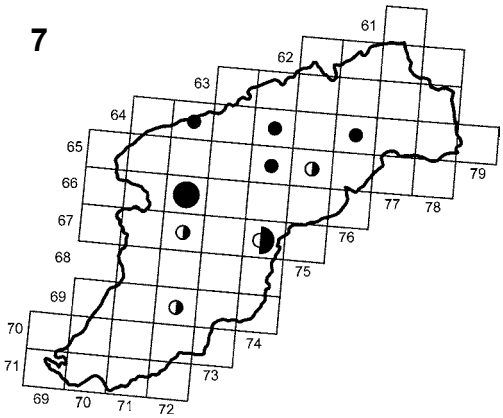
Fig. 3. Distribution maps of individual bat species or pairs of sibling species (continued).
Fig. 3. Mapy rozšíření jednotlivých druhů nebo dvojic podvojných druhů netopýrů (pokračování).
7 – *Myotis bechsteinii*, 8 – *Myotis myotis*, 9 – *Myotis oxygnathus*, 10 – *Myotis daubentonii*, 11 – *Vespertilio murinus*, 12 – *Eptesicus nilssonii*.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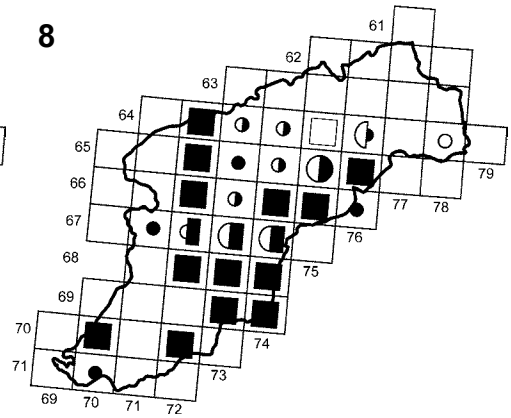
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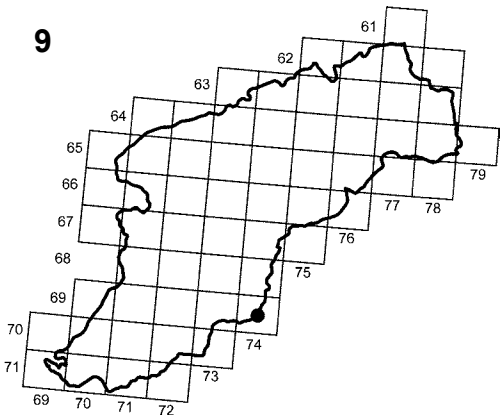
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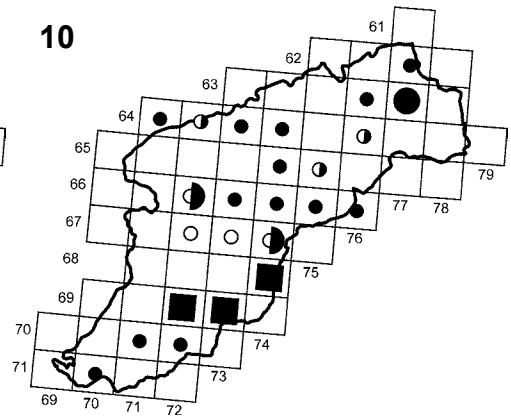
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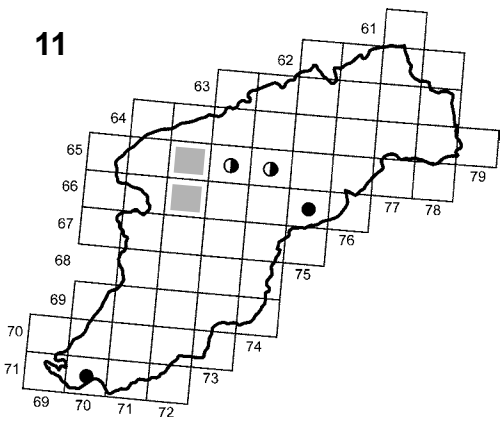
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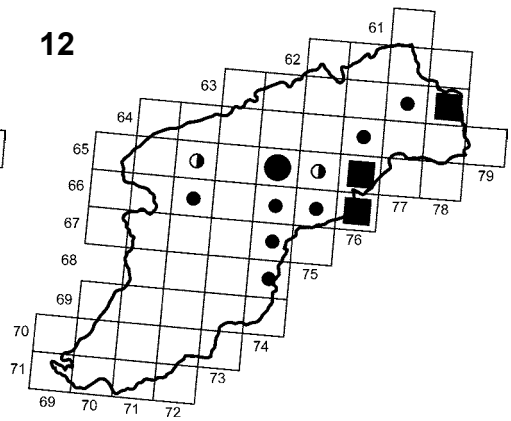
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were recorded at more localities in each of the remaining three quadrats. There the records were made by either systematical bat detectoring (quadrats 6377, 6574) or by regular mist netting (6472 – Hranická propast Chasm).

The distribution of records of individual bat species according to three categories of data reflecting the time period, number of localities and number of bats is shown in Fig. 3 (1–23). The data on areal distribution of all species are summarized in Table 3. In cases when sibling species were not distinguished from each other or their determination was questionable, they were lumped together in the table. With respect to the absolute and relative number of quadrats with bat records, the species or groups of species with the largest distribution are *Plecotus* spp., *Myotis myotis* and *M. daubentonii* evidenced on at least 40% of the territory. In addition to them, *Pipistrellus pipistrellus* s. l. and *Rhinolophus hipposideros* were recorded on one third or a little more of the territory. In contrast, *Pipistrellus pygmaeus* (3 quadrats and localities) and *P. nathusii* (5 quadrats and 6 localities) are very rare. *Myotis oxygnathus*, recorded only once and in one locality, is actually the rarest known bat. In the hibernacula, *R. hipposideros* and *Plecotus* spp. have the largest distribution covering ca 25% of the territory. The only other species covering more than 15% of the territory is *M. myotis*. There are no records of hibernating individuals in *Nyctalus* and *Pipistrellus* species. Summer records of *M. myotis*, *Plecotus* spp., *M. daubentonii* and *P. pipistrellus* s. l. cover more than 1/3 of the territory. Other species common in summer are *R. hipposideros* and *Eptesicus serotinus*. In *E. nilssonii* and *Barbastella barbastellus* the summer records cover a significantly larger area than the winter ones.

Altitudinal distribution

Localities situated at the lowest elevations comprise bat hibernacula in house cellars in the Podbeskydská pahorkatina Upland and Vizovická vrchovina Highland and a wine-vault in the slopes of Bílé Karpaty Mts, all under 250 m a. s. l. Single *P. austriacus*, in one case *P. auritus*, were recorded in a total of six cellars. In contrast, five pseudo-karstic caves in the massif of highest peaks of the Moravskoslezské Beskydy Mts, *i. e*. Lysá hora, Kněhyně and Radhošť, represent hibernacula situated at the highest elevations (945 – 1100 m), absolutely highest situation having the Čertova díra Cave, 1100 m a. s. l. However, bats go up to such elevations even in summer. In the Moravskoslezské Beskydy Mts, they were visually observed on the Malá Stolová Mt. and acousticly detected on Lysá hora Mt., both at 900 m a. s. l. or higher and in late summer bats were netted at the entrances of three pseudo-karstic caves (945, 1050 and 1050 m a. s. l).

The range of elevations and their median are shown in Fig. 4 (a–c). The variance of elevations is given for individual species as well as for the whole sample. The sample consists of 38 hibernacula and 14 bat species or species groups but *M. bechsteinii*, *V. murinus*, *E. serotinus* and *P. auritus* seu *austriacus* were recorded in less than five hibernacula and were excluded from the evaluation. The species *M. mystacinus* and *M. brandtii* were lumped together due to the problems of their differentiation. Significant differences among the species were revealed in the distribution of elevations of their hibernacula [Kruskal-Wallis test, H(9, N=112)=33.3,

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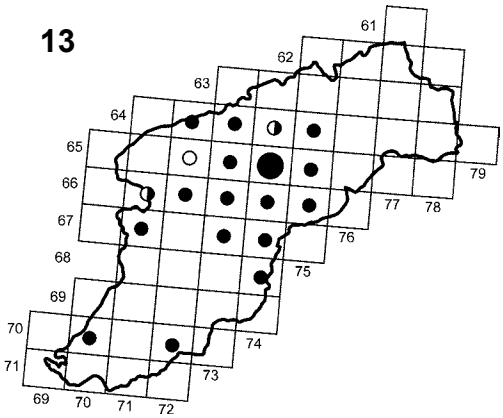
Fig. 3. Distribution maps of individual bat species or pairs of sibling species (continued).
Fig. 3. Mapy rozšíření jednotlivých druhů nebo dvojic podvojných druhů netopýrů (pokračování).
13 – *Eptesicus serotinus*, 14 – *Nyctalus noctula*, 15 – *Nyctalus leisleri*, 16 – *Pipistrellus pipistrellus*, 17 – *Pipistrellus pygmaeus*, 18 – *Pipistrellus pipistrellus* seu *P. pygmaeus*.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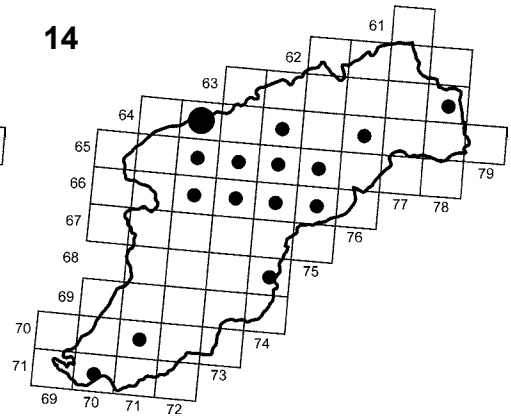
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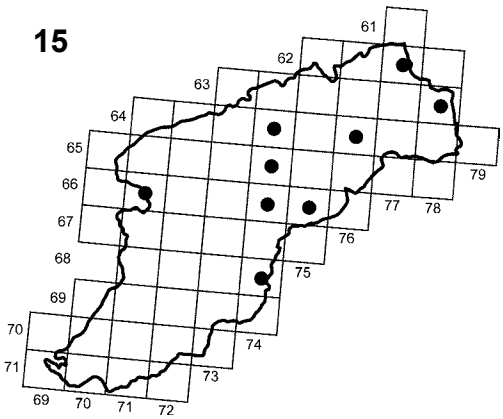
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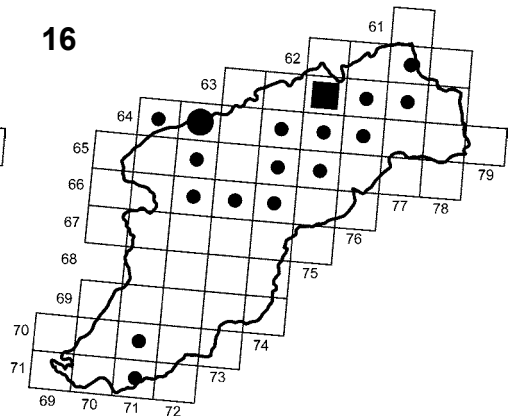
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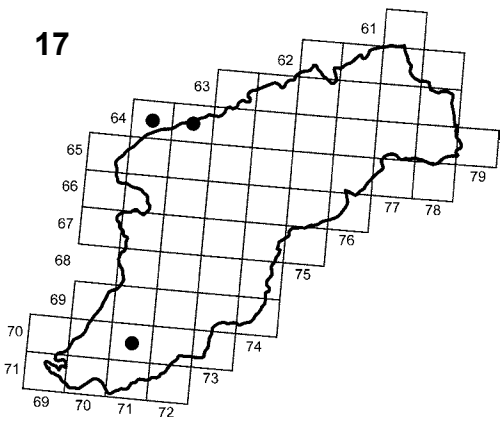
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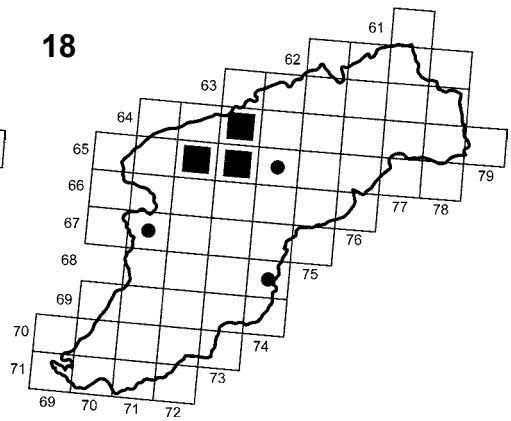
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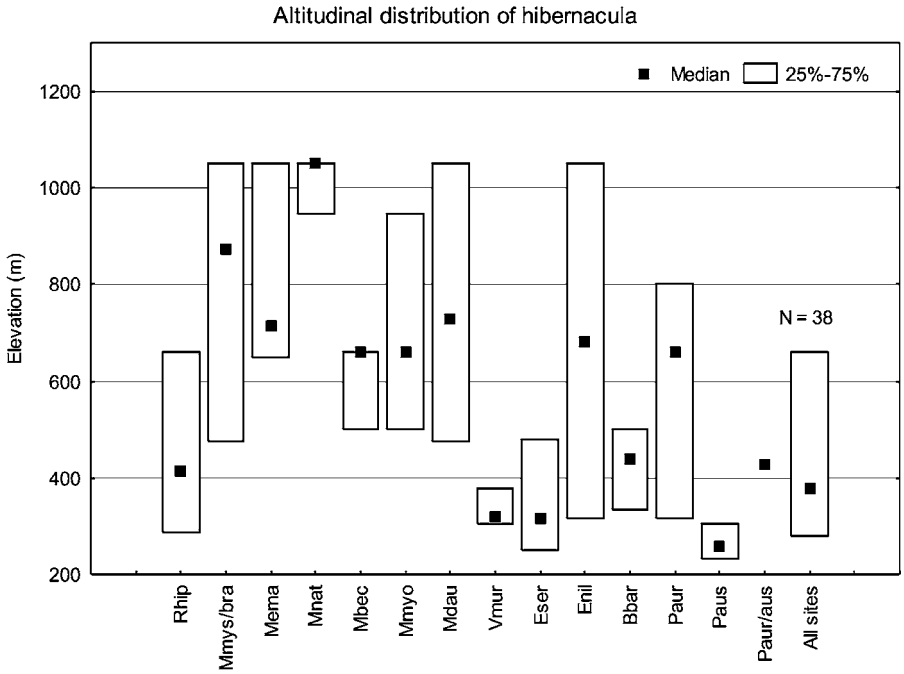

Fig. 4a. Box-plots of altitudinal distribution of hibernacula. Abbreviations – see Table 1.
Obr. 4a. Krabicové diagramy výškové distribuce zimovišť. Zkratky – viz tab. 1.

p=0.0001]. From among all species, *P. austriacus* hibernates at the lowest situated localities (median 259 m a. s. l.), being the only species evaluated in which the median of altitude lies below 400 m. The distribution of elevations of hibernacula with *P. austriacus* differs significantly from that in other 9 species (Mann-Whitney tests: U=3.5–27.0, Z=2.17–4.11, p<0.0301). On the contrary, *M. mystacinus seu M. brandtii* and *M. nattereri* hibernate at the highest situated localities (median 872 m a. s. l. and 1050 m a. s. l., respectively). The differences between the elevations of hibernacula of *M. nattereri* and other species except *P. austriacus* are insignificant (Mann-Whitney tests) due to the small sample size. The differences between the elevations of hibernacula in the *M. mystacinus* group and *P. austriacus* as well as *R. hipposideros* and *B. barbastellus* are significant (Mann-Whitney U tests: U=3.5, Z=3.814, p=0.000134, U=53.0, Z=2.532, p=0.0113 and U=9.0, Z=1.967, p=0.049). The medians of elevations of hibernacula range from 400 to 800 m a. s. l. in 7 species, being 400–600 m in *R. hipposideros* and *B. barbastellus* (415 and 440 m, respectively) and 600–800 m in the remaining 5 species (Fig. 4a).

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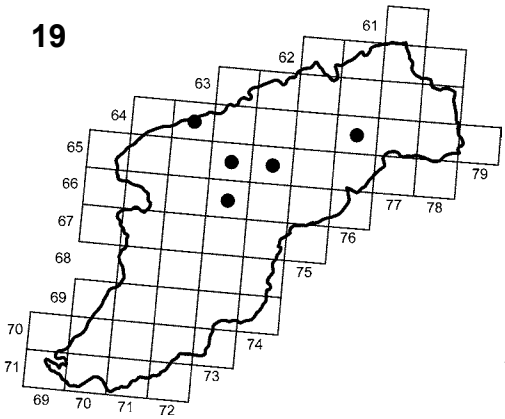
Fig. 3. Distribution maps of individual bat species or pairs of sibling species (continued).
Fig. 3. Mapy rozšíření jednotlivých druhů nebo dvojic podvojných druhů netopýrů (pokračování).
19 – *Pipistrellus nathusii*, 20 – *Barbastella barbastellus*, 21 – *Plecotus auritus*, 22 – *Plecotus austriacus*, 23 – *Plecotus auritus* seu *P. austriacus*.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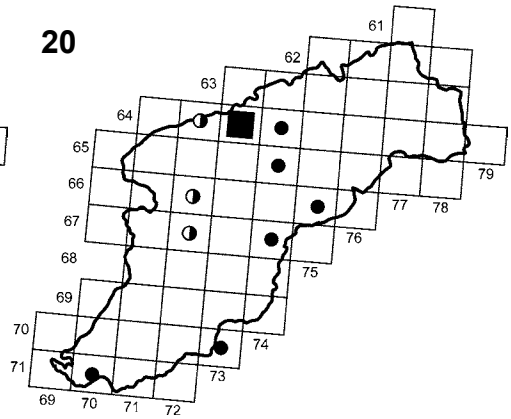
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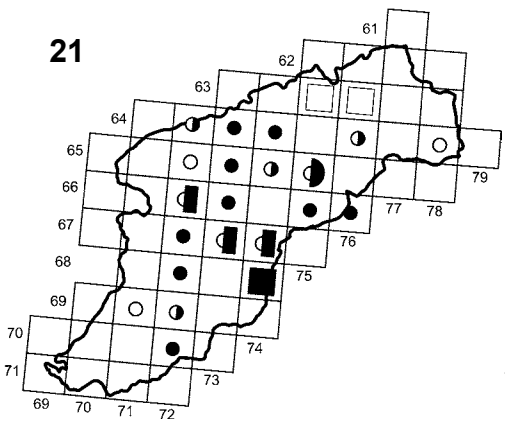
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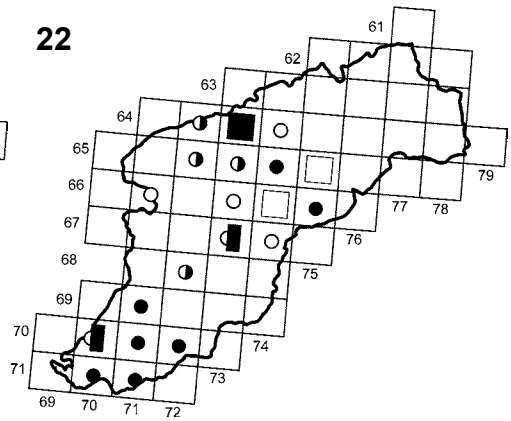
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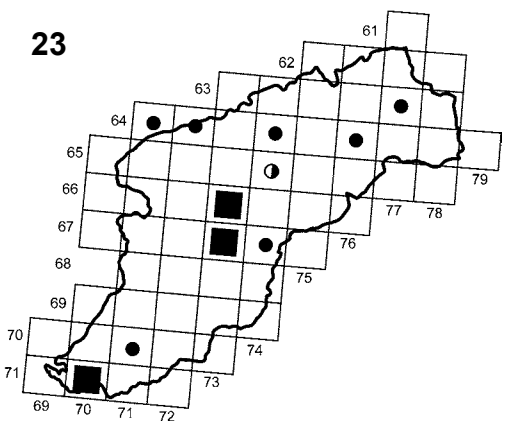
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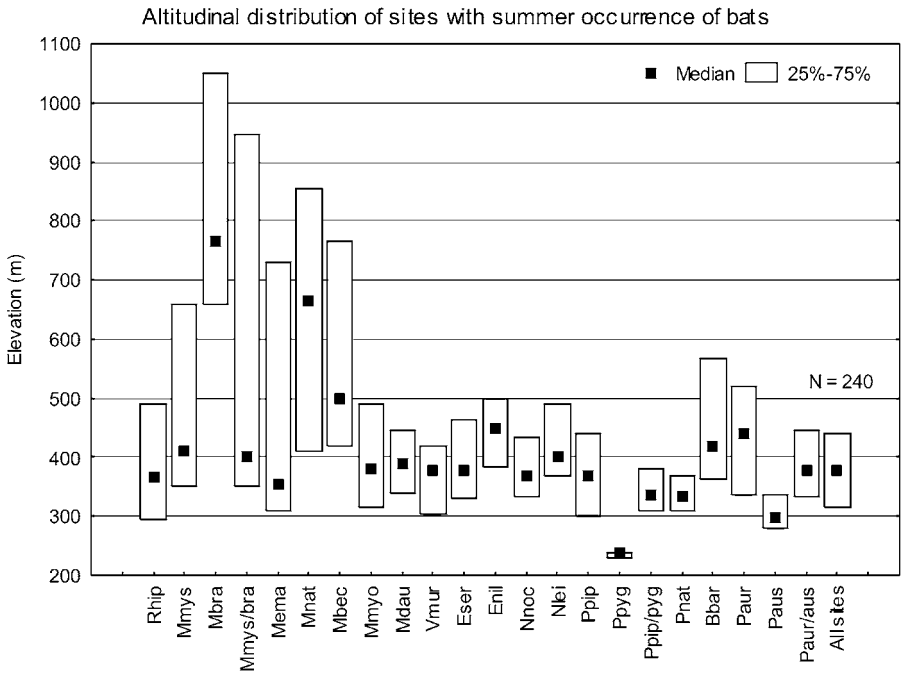

Fig. 4b. Box-plots of altitudinal distribution sites with occurrence of bats during growing season. Abbreviations – see Table 1.
Obr. 4b. Krabicové diagramy výškové distribuce lokalit s výskytem netopýrů v mimohibernačním období. Zkratky – viz tab. 1.

In 240 localities 22 species or species groups were recorded in summer. Three couples of sibling species and *P. pygmaeus* (3 localities only) are excluded from the evaluation. In 11 out of the 18 evaluated species, the maximum median of elevations is 400 m, it exceeds this value in the remaining species (Fig. 4b). Significant differences were found in the distribution of elevations of summer localities among the species [Kruskal-Wallis test: $H(17, N=435)=65.6$, $p<0.0001$]. As in the hibernacula, the lowest median of summer elevations concerns *P. austriacus* (298 m). Again, the distribution of elevations of summer localities with *P. austriacus* differs significantly from that in most other species (Mann-Whitney tests: $U=4.0–338.0$, $Z=2.264–5.159$, $p<0.0236$), the only exception being *P. nathusii* ($p>0.05$). The distribution of elevations of *P. nathusii* summer localities (median 332 m) differs significantly only when compared with that of *M. brandtii* ($U=5.0$, $Z=2.286$, $p=0.0223$), *M.bechsteinii* ($U=14.5$, $Z=2.149$, $p=0.0317$) and *E. nilssonii* ($U=37.0$, $Z=2.307$, $p=0.0210$). The highest values of medians concern the elevations of localities in *M. brandtii* (765 m) and *M. nattereri* (665 m). The difference between the data of *M. brandtii* and that of most other species are significant (Mann-Whitney tests: $U=3.5–50.0$, $Z=2.185–3.780$, $p<0.0289$), exceptions are that of *M. nattereri* and *M. bechsteinii*, both insignificant. The distribution of elevations of *M. nattereri* summer localities differs significantly from that in 9 species (Mann-Whitney tests: $U=22.5–195.5$, $Z=2.239–3.691$, $p<0.0252$), while the differences against the remaining 8 species are insignificant. Following are the results when

comparing two related species of the same genus: *P. auritus* prefers higher situated summer localities than *P. austriacus* (U=125.0, Z=3.985, p=0.000068), *M. brandtii* than *M. mystacinus* (U=30.0, Z=2.308, p=0.0210) and *E. nilssonii* than *E. serotinus* (U=363.5, Z=2.849, p=0.00438). Only the differences between elevations of summer localities in *N. leisleri* and *N. noctula* are insignificant.

No significant differences, probably due to a small sample size, were revealed when comparing the elevations of 43 shelters of summer colonies among 9 bat species (Kruskal-Wallis test). *B. barbastellus* was not evaluated due to the evidence of only one colony. Maternity colonies at the highest elevations were found in *E. nilssonii* (n=3, median 500 m a. s. l.), maternity colonies at the lowest elevations in *P. austriacus* (n=4, median 295.5 m a. s. l.).

DISCUSSION

So far, 20 bat species were recorded on the studied territory belonging to the province of W Carpathians. At least 13 of them were found hibernating, this number being similar to that of species recorded in hibernacula of near Oderské vrchy Mts where 11 bat species were recorded (Šafář & Rumler 2001, Wagner 2001, 2004). No winter occurrence of *Myotis brandtii* was recorded

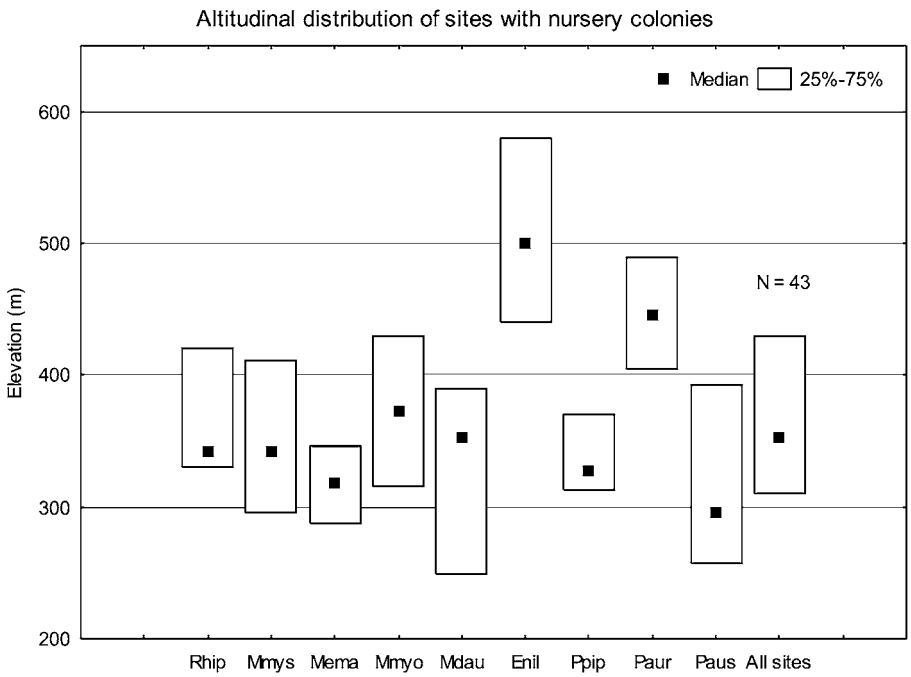

Fig. 4c. Box-plots of altitudinal distribution of sites with occurrence of nursery colonies. Abbreviations – see Table 1.
Obr. 4c. Krabicové diagramy výškové distribuce lokalit s výskytem reprodukčních kolonií. Zkratky – viz tab. 1.

so far but it is probable. When checking torpid bats in hibernacula visually without touching them it is impossible to distinguish safely between *M. brandtii* and *M. mystacinus* and, therefore, *M. brandtii* could be overlooked between bats labelled as *M. mystacinus* (cf. Bartonička 2004). Most records of *M. brandtii* concern bats netted in late summer at entrances to caves where the bats later hibernate, including *M. mystacinus*, which corroborates the hypothesis of *M. brandtii* hibernation in the area studied. Due to this potential confusion, all winter records of *M. mystacinus* were considered records of the *M. mystacinus* group. Another confusion concerning *M. brandtii* possibly results from the fact that the localities of its netting records are situated at high elevations, *M. brandtii* thus appearing to be a mountain species. Similar problem of distinguishing in winter concerns the siblings *P. auritus* a *P. austriacus* and, accordingly, their winter records were consider records of the *P. auritus* group. *V. murinus*, although recorded in winter, was never found in an underground hibernaculum or even in a deep torpidity. Its recods invariably concern single individuals in rooms of buildings above ground or observations of flying bats. Compared to previous data (Řehák 1998) new hibernating species was found, viz., *E. serotinus* which was repeatedly recorded in castle vaults of Bystřice pod Hostýnem and Holešov (Lučan & Svačina 2001). So far, no winter records of *Nyctalus* and *Pipistrellus* bats in the area of study exist. Since bats of the genus *Nyctalus* do not hibernate underground, they possibly either migrate to warmer regions of southern Europe or they hibernate in large tree cavities. *N. noctula*, however, is known to hibernate in rock crevices and in various fissures under the roofs and in the outer walls of buildings including the relatively newly built blocks of prefabricated panel houses in towns and cities (Gaisler 1997, Lehotská & Lehotský 2000). Such records are missing in the area so far. Low number of winter records of psychrophilous hibernants, namely *B. barbastellus* and *E. nilssonii*, is probably due to the character of pseudo--karstic caves and galleries, all of them being relatively warm in winter with temperatures up to 8 °C (Baroň & Řehák 1997), which are too high to ensure their winter torpor. On the other hand, such hibernacula suit well to species which are dominant in the study area – *M. myotis* and mainly *R. hipposideros*. Both species were found to be relatively abundant in all larger hibernacula (Řehák 1998, Wagner 2001). The situation is very different from that in the near Oderské vrchy Mts and Jeseníky Mts with vaste systems of abandoned galleries where winter temperature is close to 0 °C at places and both *B. barbastellus* and *E. nilssonii* are very abundant (Rumler 1985, Řehák & Gaisler 1999, Wagner 2001, 2004). At the same time, the hibernating bat assemblages are much larger in that two mountain systems and include high numbers of both eurytherm *M. myotis* and thermophile *R. hipposideros* (Buřič & Šefrová 2001, Řehák & Gaisler 2001, Šafář & Rumler 2001). The pseudo-karstic cleft caves of the Moravskoslezské Beskydy Mts are among the highest situated bat hibernacula in the Czech Republic. In four of them, their elevation is above 1000 m. There is only one further hibernaculum in the Czech Republic situated at such elevation, in the Jeseníky Mts (Souček 1969).

All 20 bat species evidenced in the area of study were recorded in the summer season. Compared to previous data on bats in the Czech Carpathians (Řehák 1998), *P. pygmaeus* is a new species which can be reliably determined in the field by the detection of its ultrasound signals (Jones & van Parijs 1993). So far, this species was recorded in only three localities at low elevations, invariably close to water streams or reservoirs (cf. Řehák et al. 2004, 2005). Its sibling *P. pipistrellus*, in contrast, is abundant from lowlands to mountains over 900 m a. s. l. (Řehák ibid.). As the probability of former recording *P. pygmaeus* at medium and higher elevated localities is negligible, most older records are considered to represent the species *P. pipistrellus*. Reproduction was evidenced in 10 bat species in which maternity colonies were

recorded. Although some of the colonies disappeared during the research the number of reproducing bat species is still high with respect to the relief of the area studied. Most maternity colonies were recorded at low elevations, only three colonies of two species (*E. nilssonii* and *M. myotis*) were discovered in the lofts of buildings at elevations higher than 500 m. In the mounatins, maternity colonies were typically coupled to human settlements in river valleys. The largest number of maternities (20) was found in *Myotis myotis*, at the same time being the largest bat assemblages in the region (Řehák 1998). As elsewhere, large lofts of churches and castles shelter maternity summer colonies of *M. myotis*. Large maternity colony in the nearly inaccessible (to humans) Rotunda Cave belonging to the system of Hranická propast Chasm is the only exception. It is the only maternity colony of *M. myotis* known from a cave in the Czech Republic (Baroň & Řehák 2001, Řehák & Baroň 2002). This *M. myotis* summer colony is unique in many respects, e.g. concerning its size: the maximum number of pregnant females (young excluded) was estimated to 1,044 individuals, that of lactating females plus young to more than 2,000 individuals (Řehák 2006, unpublished).

With respect to the landscape of the area studied, the total of 20 bat species is high and ranges well to the lowland and middle elevated regions where bats have been studied for a long time. There were only a few mountain systems in the Czech Republic the chiropteran fauna of which was studied systematically, namely the Šumava Mts (17 species, Anděra & Červený 1994), Žďárské vrchy Mts (15 species, Řehák et al. 2000) and Železné hory Mts (13 species, Benda et al. 1997). Nineteen bat species were reported from the Krkonoše Mts (Anděra et al. 1974) but the records of two of them (*N. leisleri*, *R. ferrumequinum*) are very old and doubtful.

Recently, faunistic data on bats were published from eastern Bohemia (Lemberk 2004) and southwestern Moravia (Reiter et al. 2003). In the former region, 21 bat species and 14 species with maternity colonies were recorded. In the latter region, 19 bat species were evidenced of which in 17 the reproduction was proved. The only large region with a more rich chiropterofauna is represented by southern Moravian lowlands in which 22 or 21 species (if one excludes the problematic *N. lasiopterus*) were recorded and in 11 species reproduction was evidenced (Gaisler et al. 1990, 2002, Řehák et al. 2003). Concerning the lowlands of northern Moravia which, similarly to southern Moravian lowlands, are situated close to the Carpathians, there are faunistic data on bats from the Poodří and Litovelské Pomoraví. In the lowlands of Poodří, 17 species including *P. pygmaeus* (Řehák & Bryja 1998, unpubl. data) and in that of Litovelské Pomoraví as many as 18 species were recorded (Bartonička et al. 2002). It can be concluded that the regions are mutually similar concerning the numbers of their bat species.

In the orographic units, the representation of localities and bat species is uneven. There may be double reasons of it, the differences in their geomorphology, mainly in the elevation, and the differences in research activity concerning the bat faunistics. Important bat hibernacula in the Moravskoslezské Beskydy Mts, Hostýnsko-vsetínská hornatina Mts and Vizovická vrchovina Highland were systematically studied, while hibernacula suitable to such a study are missing in the southern part including the Bílé Karpaty Mts. Summer records reflect mainly the search of bats in large lofts of churches and castles which also are unevenly distributed, this fact again may be responsible of the differences between the orographic units concerning their bat fauna.

The rank of species most common from the point of view of areal distribution is similar as in other regions where the mapping grid was applied. The Czech Carpathians (60 quadrats in total) can be compared with the Šumava Mts (50 quadrats, Anděra & Červený 1994), eastern Bohemia (68 quadrats, Lemberk 2004) and southwestern Moravia (38 quadrats, Reiter et al. 2003). Generally, the quadrats of Carpathians are covered less by the records of bats than that

in other regions mentioned above what can be due to both worse living conditions for bats and lesser activity of researchers in the Carpathians (Řehák 1998, 2001).

Plecotus species were recorded on 50% of the Carpathian territory but their abundance has to be estimated with caution since the taxon comprises two species. Further bats common in the Carpathians are *M. myotis* and *M. daubentonii*. The situation is similar in eastern Bohemia and southwestern Moravia. In eastern Bohemia, *P. auritus* and *M. myotis* are the most distributed species while *P. austriacus* ranges fifth; in southwestern Moravia, *P. austriacus* ranges first followed by *M. myotis* while *P. auritus* together with *M. daubentonii* occupy the third and fourth places. The differences in abundance of *P. austriacus* and *P. auritus* in eastern Bohemia and southwestern Moravia probably reflect different geomorphological situation and climatic conditions between these two regions. While *P. austriacus* prefers warmer open lowland, *P. auritus* is more common in colder woodland of highlands and mountains. As shown by this paper, in the Carpathians the former species is more common in the warmer south at low elevation and few woods, the latter is more common at higher elevated woodland of the northeast. *M. daubentonii* followed by *P. auritus* represent the two most common species in the Šumava Mts where *P. austriacus*, by the number of quadrats where it was recorded, ranges as far as sixth. This can easily be explained by the lack of warm Pannonian lowlands in the region of Šumava and its foothills. In southern Moravia, in contrast, the impact of warm lowland habitats on the chiropteran fauna is evident (Reiter et al. 2003).

When evaluating the altitudinal distribution, uneven representation of most bat species is striking. Often bats were recorded in lowland habitats and then relatively high in the mountains. This in part reflects the situation of most important and regularly checked hibernacula at higher elevations. Therefore the average elevation of winter bat records is higher than that of summer records. Nevertheless, certain species were recorded at high elevations even in summer as in the case of acoustic detection of bats foraging on the massif of the Lysá hora Mt., more than 900 m a. s. l. (Řehák & Bartonička, unpubl.). Summer netting at the entrances to high situated caves of the Beskydy Mts then raised the upper limit of summer occurrence in 10 bat species up to 1050 m a. s. l. which influenced the hypsometric distribution mainly of rare species difficult to monitor by methods other than netting (*M. brandtii*, *M. nattereri*). In contrast, summer maternity colonies were significantly more often found at lower elevations.

In any study of the distribution of bats over a large territory, the impact of the respective scientist or scientists can not be excluded: the number of records is not only a function of bats' occurrence but also of human activity. The number of records reflects the extent of monitoring in both space and time. Acoustic bat-detectoring, in spite of certain limits (difficult or even impossible determination of some species), substantially increases the capacity of field work with bats enabling to monitor even less attractive habitats and localities neglected so far.

SOUHRN

V práci jsou shrnuty dostupné údaje o výskytu netopýrů pocházejících z území Vnějších Karpat ve východní části České republiky. Nálezy jsou rozděleny na zimní, letní a na nálezy letních kolonií a poté hodnoceny podle jejich příslušnosti k orografickým jednotkám, kvadrátům síťové mapy a podle nadmořské výšky.

Celkem bylo v 9 orografických jednotkách a 41 kvadrátu, pokrývajících studované území, evidováno 20 druhů netopýrů a dvě dvojice podvojných druhů. Dosud bylo na zimovištích v českých Karpatech zjištěno 13 druhů netopýrů a u 10 druhů byly v létě nalezeny reprodukční kolonie samic.

Plošnou distribuci jednotlivých druhů znázorňují síťové mapy. Za nejrozšířenější druhy lze považovat netopýry rodu *Plecotus* (50,0 % kvadrátů pokrývajících studované území), *Myotis myotis* (46,7 %) a *M. daubentonii* (40,0 %).

Výšková distribuce lokalit, kde byli nalezeni netopýři, je vyjádřena mediány a kvantily jejich nadmořských výšek a znázorněna pro jednotlivé druhy krabicovými diagramy podle období nálezů (zimní, letní). Lokality s letními koloniemi jsou hodnoceny samostatně. *P. austriacus* preferoval průkazně nižší polohy než ostatní hodnocené druhy, a to jak v zimě, tak v létě (medián 259, resp. 298 m n. m.). Naopak, výše položená zimoviště využívali nejvíce netopýři skupiny *M. mystacinus* a *M. nattereri* (medián 872 m, resp. 1050 m n. m.). Vysoké hodnoty jsou ale ovlivněny relativně nízkým počtem zimovišť vhodných pro hibernaci těchto těžko nalezitelných druhů. Většinou se jedná o vysoko položené pseudokrasové jeskyně. V mimohibernačním období byli ve vyšších polohách nalézáni *M. brandtii* a opět *M. nattereri* (medián 765, resp. 665 m n. m.). Výšková distribuce letních nálezů je u méně častých druhů do jisté míry ovlivněna odchytem před vchody do jeskyní, nalézajícími se ve velkých nadmořských výškách. Zvláště je to patrné u druhů, které se jinými metodami v létě zjišťují obtížně. Rozdíly v nadmořských výškách lokalit s letními koloniemi jsou vzhledem k nízkému počtu lokalit statisticky neprůkazné.

ACKNOWLEDGEMENT

I am oblidged to Prof. Jiří Gaisler for all his comments on the text and its translation to English. I am also grateful to Dr. Tomáš Bartonička for his help with statistical evaluation. The study was supported by the Long-term Research Project of Ministry of Education, Youth and Sports of the Czech Republic No. MSM0021622416.

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APPENDIX

The list of localities with records of bats / seznam lokalit s nálezy netopýrů
Explanations / vysvětlivky: SN – quadrate number of the Czech mapping grid / číslo kvadrátu české mapovací sítě; SPN – number of bat species / počet druhů netopýrů; S – season / období; G – growing season – "summer" records of bats / mimohibernační období – "letní" nálezy netopýrů; W – winter season – records of torpid bats at hibernacula and all winter records of *V. murinus* / zimní období – nálezy letargujících netopýrů na zimovištích a všechny zimní nálezy *V. murinus*.

SN	site / lokalita	habitat / stanoviště	SPN	S
Slezské Beskydy Mts				
6378	Nýdek	cottage	1	G
		in the open air	3	G
Jablunkovská vrchovina Highland				
6478	Girová, Na Girové cave	cave	3	W
Moravskoslezské Beskydy Mts				
6377	Řeka	in the open air	2	G
	Smilovice	above a stream	1	G
	Komorní Lhotka	above a stream in a village centre	1	G
		near a stream at the end of a village	3	G
6475	Frenštát p. R.	church loft	1	G
	Malá Stolová, Leopoldka	in the open air	1	G
6476	Čeladná	cottage	1	G
	Lukšinec, Ondrášovy díry cave	cave	6	W
		cave entrance	8	G
	Lukšinec	mountain forest	1	G
	Lysá hora, Malenovice canyon	mountain forest	7	G
	Lysá hora, Pod Ivančenou	mountain forest and meadow	6	G
	Ostravice	above a stream in a village	1	G
	Ostravice, Mazák	above a stream	1	G
6477	Morávka	cottage	1	G
6575	Čertův mlýn, Čertova díra cave	cave	7	W
	Dolní Bečva, Kamenné	in the open air	1	G
		cottage celllar	1	G
	Kněhyně, Kněhyňská cave	cave	7	W
		cave entrance	10	G
	Kněhyně, Kyklop cave	cave	2	W
	Pustevny, Cyrilka cave	cave	8	W
		cave and cave entrance	9	G
	Vasko	cave	2	W
6576	Staré Hamry	church loft	1	G
		house roof	1	G
Podbeskydská pahorkatina Upland				
6277	Ropice	above a stream	4	G
	Třanovice	above a stream	1	G
6375	Hukvaldy	cottige roof	1	G
		a game preserve	1	G
6376	Baška	dam	1	G
	Dobrá	unknown	1	G
	Frýdek-Místek	free on a pavement	1	G

6377	Hnojník	above a stream	1	G
	Střítež	above a stream, under a bridge	3	G
6471	Helfštýn	in the open air	1	G
	Lipník nad Bečvou	above a river	3	G
6472	Černotín	gallery in a quarry	7	W
		above a river	5	G
	Hranice	above a river	4	G
		above a street-lamp near a autocamp	2	G
	Hranice, Hůrka	chasm	14	G
	Lipník nad Bečvou	cellar	1	W
	Teplice nad Bečvou	above a river	2	G
		boiler room in a spa building	1	G
		cave	2	W
		cave	1	G
6473	Hustopeče nad Bečvou	castle loft, pellets of *T. alba*	4	G
	Hustopeče nad Bečvou, Na Valše	above a pond	2	G
	Lešná u Valašského Meziříčí	castle cellar and corridor	2	W
		castle loft	5	G
		church loft	3	G
	Perná-Bučí	house roof anf loft	5	G
	Poruba	house	1	G
	Starý Jičín	castle	2	G
6474	Hodslavice	church loft, pellets of *T. alba*	3	G
	Nový Jičín	cellar	1	W
		free in a castle park and a city	1	G
	Štramberk	above a pond	2	G
		above a swimming pool	1	G
		in the open air in a park	3	G
	Štramberk, Bílá hora	garden in an abandoned quarry	3	G
		in the open air in the Kamenárka quarry	1	G
	Štramberk, Kotouč	gallery in a quarry	2	W
	Štramberk, Na Horečkách	galleries	2	W
	Štramberk, Šipka	cave and cave entrance	4	G
	Štramberk, Trúba	near a cottage	1	G
	Veřovice-Padolí	above a stream	1	G
6475	Kunčice p. O.	near a cottage	1	G
		above a pond	1	G
		house	1	G
	Kunčice p. O., Skalka	cottage, garden	2	G
6572	Kelč	church and castle lofts, pellets of *T. alba*	3	G
6573	Branky na Moravě	castle loft	1	G
		house loft	1	G
	Poličná	farm loft	1	G
	Poličná-Junákov	stream bank - pellets of S. aluco	1	G
	Poličná-Juřinka	pellets of S. aluco	1	G
	Valašské Meziříčí	buildings, in the open air, pellets of *T. alba*	4	G
		buildings and in the open air	1	W
		castle cellars	1	W
		castle loft	2	G
		castle park	2	G
		house loft	2	G

6671	Holešov	house loft	1	G
		church loft	1	G
		castle cellar	3	G
		house cellars	2	G
	Němčice	house cellar	1	W
Rožnovská brázda Furrow				
6574	Hrachovec	above a river	1	G
	Rožnov pod Radhoštěm	bulding	1	W
		buildings	2	G
		owl box, pellets of *S. aluco*	1	G
		park and above a river	6	G
	Rožnov p. R., Dolní Paseky	beech wood	1	G
	Rožnov p. R., Hradisko	pellets of *S. aluco*	1	G
	Střítež	in the open air	2	G
	Velká Lhota	in the open air	1	G
	Veselá	in the open air	3	G
	Vidče	church loft	1	G
		in the open air	3	G
	Zašová	in the open air	6	G
		church loft, owl pellets	1	G
6574	Zubří	church loft, owl pellets	2	G
		above a stream	1	G
		village and in the open air	2	G
	Zubří-Hamry	tree hole, owl pellets	4	G
		pond banks and in the open air	6	G
6575	Dolní Bečva	river bank	1	G
		in the open air	2	G
	Horní Bečva	church loft	1	G
		in the open air	3	G
		above a dam	2	G
	Rožnov p. R., Rysová	owl box, pellets of *S. aluco*	1	G
	Vigantice	in the open air	1	G
Javorníky Mts				
6674	Hovězí	in the open air	2	G
	Huslenky	church tower	1	G
		above a river	1	G
6675	Velké Karlovice	village	3	G
6676	Malé Karlovice-Tísňavy	school loft, garden	3	G
	Velké Karlovice-Podťaté	house	1	G
6774	Francova Lhota	cottage loft	1	G
	Lužná	in the open air	2	G
	Pulčín-Hradisko	rocks	1	G
	Pulčín-Hradisko, Pod Kazatelnou	cave	4	W
		cave entrance	10	G
6874	Francova Lhota	in the open air	4	G
	Zděchov	church loft	1	
Hostýnsko-vsetínská hornatina Mts				
6572	Bystřice p. Hostýnem	castle cellars	5	W
		castle park	2	G
		church loft	1	G

6573	Bystřička	school loft	1	G
	Podhradní lhota	cadaver on the road	1	G
	Polomsko	cottage	1	G
	Rajnochovice	buildings	1	G
		church loft	1	G
	Rajnochovice, Juhyně valley	above a stream	2	G
6574	Bystřička-Zadrhlov	gallery	4	W
	Malá Lhota, Páleniska	house loft	1	G
6671	Dobrotice-Lysina	cottage	1	G
6672	Chvalčov	road	1	G
		village	3	G
	Chvalčov, Bystřička valley	above a stream	8	G
		clearing	1	
	Chvalčov, Smrdutá	cave	3	W
		cave entrance	10	G
	Rajnochovice, Košový	building	1	G
	Rajnochovice, Uhliska	above a stream	1	G
	Rusava	Protestant church, loft	1	G
		Catholic church - loft	1	G
		cadaver on the road	1	G
	Rusava, Ráztoka	banks of a water reservoir	1	G
	Rusava, Čecheřinka cave	cave	3	W
		cave entrane	8	G
6673	Jablůnka	river bank	1	G
	Kateřinice	school loft	1	G
	Křížový, Zbojnická cave	cave	3	W
	Pržno	church loft	1	G
	Růžďka	loft	1	G
	Vsetín	town, above a river	4	G
		cellar	1	W
		loft	1	G
6674	Halenkov	railway station, in the open air	1	G
	Janová	in the open air	5	G
	Vsetín-Hluboké	in the open air	1	G
6675	Karolinka	in the open air	1	G
	Nový Hrozenkov	church loft and tower	2	G
	Velké Karlovice, Jezerné	above a pond	7	G
6676	Velké Karlovice, Miloňov	loft of a hotel	1	G
6772	Kašava	church loft	1	G
	Lukov	house cellars	1	W
	Lukov, castle	castle cellars	3	W
			6	G
	Lukov - Hradisko c.	cave	3	W
		cave entrance	2	G
6773	Liptál	Protestant church, loft	2	G
		Catholic church, loft	1	G
		school loft	1	

Vizovická vrchovina Highland

6771	Zlín	in the open air	1	G
6772	Lešná u Zlína	cellar	1	W
	Slušovice	church loft	1	G

6773	Bratřejov	church loft	3	G
	Jasenná	church loft	1	
	Liptál, Malá gallery	mine	2	W
	Liptál, Sintrová gallery	mine	5	W
	Pozděchov	Protestant church, loft	3	G
		Catholic church, loft and tower	4	G
	Vizovice	castle cellar	2	W
		castle loft	2	G
		church loft	1	G
		hospital loft	1	G
6774	Kopce u Lidečka, Naděje cave	cave, cave entrance	8	W
	Kopce u Lidečka, Ďáblova díra c.	cave	2	W
	Kopce u Lidečka, Kolonie cave	cave	5	W
	Kopce u Lidečka	3 cave entrances	9	G
	Leskovec	in the open air	1	G
	Lidečko	church loft	2	G
		in the open air	3	G
6872	Březnice	church loft	1	G
	Doubravy	in the open air	1	G
	Horní Lhota	church loft	1	G
	Kaňovice	chapel turret	1	G
	Luhačovice	castle cellar	2	W
		castle loft	3	G
	Pozlovice	church loft	1	G
	Velký Ořechov	church loft	1	G
6873	Újezd	church loft	1	G
6874	Horní Lideč	in the open air	3	G
	Lačnov	church loft	1	G
		above a pond	1	G
6971	Uherský Brod	house cellar	1	W
		church loft	1	G
7070	Blatnice	church loft	1	G
7071	Blatnička	church loft	1	G
		above a pond and a stream	1	G
7072	Bánov	school loft	1	G
	Nivnice	church tower	1	G
Bílé Karpaty Mts				
6874	Nedašov	church loft	1	G
	Poteč	barn	1	G
	Valašské Klobouky	house loft	1	G
		church loft	1	G
		mill loft	1	G
		town hall loft	1	G
		in the open air	2	G
6972	Bojkovice	castle cellar	2	W
		castle loft	1	G
	Nezdenice	church loft	1	G
	Rudice	house loft	1	G
	Záhorovice	house roof	1	G
6973	Slavičín	castle loft	2	G
		church loft	1	G

	Štítná nad Vláří	church loft	1	G
	Štítná nad Vláří, Popov	church loft	1	G
6974	Brumov	old mill	1	G
		house loft	2	G
		cottage	1	G
7070	Lipov	wine cellar	1	W
		church loft and tower	1	G
		below house roof	1	G
7071	Boršice u Blatnice	church tower	1	G
	Horní Němčí	church tower	1	G
		above a pond and around street lamps	4	G
7072	Březová	above a pond	1	G
	Komňa	church loft and tower	2	G
	Strání	church loft	1	G
7073	Starý Hrozenkov, Rasová quarry	cadaver on the road	1	G
7170	Hrubá Vrbka	chaple loft	2	G
	Kněždub	above a pond	2	G
	Kútky	13 wooden hides	2	G
	Kuželov	church, external wall, loft and tower	2	G
	Měsíční údolí	wood hide	1	G
	Radějov	church tower	1	G
	Tvarožná Lhota, Horní mlýn	above a swimming pool	4	G