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Species diversity of small mammals in a highland recreation cottage within 40 years (Rodentia, Eulipotyphla, Chiroptera)

Druhová diverzita drobných savců v horské rekreační chatě během 40 let (Rodentia, Eulipotyphla, Chiroptera)

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Abstract. In 1969–2012, the following species of small mammals were recorded in a recreation cottage on the ridge of the Orlické hory Mts. (990 m a. s. l.) by trapping, collecting of dead specimens or by other methods: *Apodemus flavicollis*, *A. sylvaticus*, *Clethrionomys glareolus*, *Microtus arvalis*, *M. subterraneus*, *Mus musculus*, *Rattus norvegicus*, *Sorex araneus*, *S. minutus*, *S. alpinus*, *Crocidura suaveolens*, *Myotis mystacinus*, *M. brandtii*, and *Eptesicus nilssonii*. This sample, excluding bats (n=456), was compared with a sample of rodents and insectivores from the nearby primeval forest of Bukačka from the years 1970–2006 (n=585, 10 species). In the forest sample, synanthropic and hemisynanthropic species *M. musculus*, *R. norvegicus* and *C. suaveolens* were missing but *Microtus agrestis* and *Muscardinus avellanarius* were present in addition to the building sample. The Shannon index of species diversity was significantly higher in the forest sample (LME model, F=22.9, p<0.0001). The comparison of yearly totals within the 37 years of coincident monitoring showed a significant correlation of fluctuation in numbers on the two localities studied (GLS model, F=9.556, p=0.004). While *Sorex* species are the most abundant in the forest sample, the building sample is dominated by *Apodemus* species. The abundance of *Apodemus* mice fluctuates during the years, but their total shows conspicuous seasonal dynamics with the maximum immigration in late summer and in autumn. Our results are compared to the series of publications by Porkert & Vlasák (1968–1989) who trapped rodents and insectivores in another building in the Orlické hory Mts. (870 m a. s. l.) and evidenced the impact of temperature and precipitation on the immigration of small mammals, mainly *A. flavicollis*. During the season, the course of mammal occurrence inside the building was similar as in our case. In the two buildings pooled, 9 rodent, 6 insectivore, 3 bat and one carnivore species were recorded. Differences between the methods of trapping of small mammals in the buildings and in the forest make it impossible to disclose the tendency of various species to immigrate into buildings exactly. However, it seems probable that *Apodemus* mice and *Sorex* shrews most tend to immigrate into solitary buildings in highland landscapes.

Key words. Small mammals, long-term monitoring, species diversity, fluctuation in numbers, solitary building and forest: a comparison.

INTRODUCTION

Since ancient times, terrestrial small mammals, mainly rodents, have been known as pests in human buildings of various types. More recently, papers and books dealing with methods of their control have been published (e.g. Chitty & Southern 1954). Communities of small mammals living in urban habitats have been studied (e.g. Obara et al. 1977, Pelikán et al. 1983, Jentzsch 1992, Stanik & Woloszyn 2006). However, reports on small mammals in rural habitats or solitary buildings in highland and mountain landscapes are rare. In the years 1968–1989, Porkert and Vlasák published a series of papers on the community of small mammals in a building, originally a gamekeeper's lodge, in the Orlické hory Mts. at the elevation of 870 m (Porkert & Vlasák 1968, Vlasák & Porkert 1973, 1982, Porkert 1975, 1984, 1987, 1989). The authors were interested mainly in the impact of precipitation and other meteorological factors on immigration of rodents and shrews into the building. They did not sample small mammals in natural habitats surrounding the locality, a small settlement of scattered buildings called Luisino údolí.

Independent of the research by Porkert and Vlasák, the first author of this paper studied the community of rodents and insectivores on the ridge of the Orlické hory Mts. (Gaisler 1983, 1998) and, in cooperation with other colleagues, compared the abundance and diversity of small mammals in different forest ecosystems (Gaisler & Šebela 1975, Nesvadbová & Gaisler 2000). In addition to sampling of mammals in forests of the Orlické hory Mts., traps were also laid in a recreation cottage, originally a one-classroom school, built in 1932 at the elevation of 990 m on the slope of Mt. Šerlich. The distance between this building and the one where Porkert & Vlasák trapped mammals at Luisino údolí is 4180 m.

So far, the sample of mammals from the Šerlich building has been dealt with only partially (Gaisler 1983, Gaisler & Schenková 2013). The aim of this paper is to evaluate the whole

Fig. 1. Recreation cottage in which small mammals were sampled by trapping and other methods in 1969–2012.
Obr. 1. Rekreační chata, kde byli v letech 1969–2012 sbíráni drobní savci odchytem do pastí a jinými metodami.

Fig. 2. Bukačka National Nature Reserve where small mammals were sampled on a square plot 75 by 75 m with 36 trapping stations in 1970–2006.
Obr. 2. Národní přírodní rezervace Bukačka, kde byli v letech 1970–2006 odchytáváni drobní savci na kvadrátní ploše 75×75 m s 36 odchytovými body.

sample obtained in the years 1969–2012, including a few incidental records of bats. Another aim is the comparison of the composition of species (without bats) and their fluctuation in numbers in the building and in a nearby natural forest. A hypothesis will be tested that within the coincident sampling in the years 1970–2006, the general trends of long-term fluctuation are similar but species living in the forest differ by their tendency to immigrate into the building. The composition of mammal community in the building will also be compared with that recorded by other authors. However, except in the papers by Porkert and Vlasák mentioned above, we failed to find any published results of a long-term monitoring of small mammals in a solitary building in a highland or mountain landscape.

STUDY SITE

The recreation cottage (50° 19' 28" N, 16° 23' 16" E; Fig. 1) is a two-storey wooden house surrounded by a large meadow on the slope of Mt. Šerlich. The cottage has a cellar with a drain functioning as one of the corridors through which rodents and shrews can penetrate into the building. There are further six solitary cottages in the meadow and a large chalet called Masarykova chata. The meadow is surrounded by a mostly coniferous forest from all sides. The smallest distance of a continuous forest stand to the cottage where mammals were sampled is 90 m. Solitary trees and groups of trees, mostly spruce, are scattered at several places over the meadow.

Table 1. List of all individuals of small mammals recorded in the building in 1969–2012
Tab. 1. Přehled všech úlovků, odchytů a nálezů drobných savců v letech 1969–2012 v budově

	1969–1979		1980–1990		1991–2001		2002–2012		total celkem	
species / druh	n	%	n	%	n	%	n	%	n	%
Sorex araneus	11	8.9	10	13.9	7	5.5	9	6.5	37	8.0
Sorex minutus	6	4.8	6	8.3	3	2.4	9	6.5	24	5.2
Sorex alpinus	–	–	1	1.4	1	0.8	4	2.9	6	1.3
Crocidura suaveolens	1	0.8	–	–	2	1.6	1	0.7	4	0.9
Microtus arvalis	8	6.5	–	–	2	1.6	0	0.0	10	2.2
Microtus subterraneus	5	4.0	1	1.4	2	1.6	0	0.0	8	1.7
Clethrionomys glareolus	6	4.8	3	4.2	7	5.5	17	12.2	33	7.1
Apodemus flavicollis	55	44.4	36	50.0	20	15.7	23	16.5	134	29.0
Apodemus sylvaticus	14	11.3	6	8.3	11	8.7	7	5.0	38	8.2
A. flavicollis / A. sylvaticus	16	12.9	8	11.1	68	53.5	67	48.2	159	34.4
Mus musculus	1	0.8	–	–	–	–	–	–	1	0.2
Rattus norvegicus	1	0.8	–	–	–	–	1	0.7	2	0.4
Myotis mystacinus	–	–	–	–	1	0.8	–	–	1	0.2
Myotis brandtii	–	–	1	1.4	–	–	–	–	1	0.2
M. mystacinus / M. brandtii	–	–	–	–	–	–	1	0.7	1	0.2
Eptesicus nilssonii	–	–	–	–	1	0.8	–	–	1	0.2
total / celkem	124	100.0	72	100.0	125	100.0	139	100.0	460	100.0

For the comparison, mammals were sampled on a square plot situated in the middle of the Bukačka National Nature Reserve at the elevation of 1000 m (Fig. 2). The distance between the study plot at Bukačka and the recreation cottage is 1640 m. The core of the reserve is a montane dwarf beech forest with interspersed spruce and maple (*Fageto-Aceretum*), the peripheral parts of the reserve consist of secondary spruce stands with a small admixture of other tree species (*Abieto-Piceetum*). The locality is not managed and shows a character of a climax virgin forest, for details see Gaisler (1983).

MATERIAL AND METHODS

It was impossible to sample small mammals in the building at regular intervals and by an invariable number of traps. Usually 40–50 standard mouse snap-traps were set from late summer till the spring of the next year in most rooms of the house including the cellar. They were baited by a "standard" bait, a wick soaked with fat (Kratochvíl & Gaisler 1964). Within the trapping season, the traps were inspected on the days of trapping in the forest (see below) and during the visits to the cottage for recreation purposes. The trapped mammals were preserved, the clapped traps were reset and rebaited, if necessary. Species determination was carried out by the first author of the paper, sometimes with a delay if the trapped specimens were found by another person. The exact number of days when the traps were checked inside the cottage was not recorded, the estimated average number is 30 days per year.

In addition to snap-traps, up to six metal live traps (Rödl 1975) were sometimes used, mainly to catch *Apodemus* spp. during their mass immigration. Traps with live-trapped *Apodemus* were transported to a forest 2 or more km away from the cottage. The animals were released there, mostly without their determination to species. Live trapping was only performed within the days of our visits to prevent starvation of animals in the traps. In one case the presence of *Rattus norvegicus* was identified by faeces and traces of gnawing and a few large rat snap-traps were set. As a result, one brown rat was trapped, another one was identified independently (30 years later) by a finding of its mummy. Other animals found dead but not trapped included various species, mostly shrews, in one case a bat. Very rarely, bats were caught in the house by a hand net or a mist net. In one case the presence of a bat was recorded from a photograph which enabled to identify it only as *Myotis mystacinus/brandtii*.

At the locality of Bukačka, small terrestrial mammals were sampled in a square plot 75 by 75 m, including 36 trapping stations spaced at 15 m intervals, each trapping station having been equipped with one pitfall trap and one snap-trap. The pitfall traps were galvanized iron sheet cones, 40 cm deep, buried in the ground so that their rim was flush with the soil surface. In 1970–1994 there were two trapping sessions per year, in May–June and September–October, in 1995–2006 only one, in July–August. No sampling was made in 1983 and 1984 due to the absence of the author. Each trapping session lasted three days and three nights, the traps were inspected once a day in morning hours. During trapping the pitfalls were open but not baited nor sheltered with a roof. They were closed by covers outside the trapping days. The snap-traps were baited by the same standard bait as in the building. For details see Gaisler (1983) and Nesvadbová & Gaisler (2000). Bats were observed irregularly by recording of their ultrasound signals but not netted, therefore they were excluded from the comparison of mammal communities.

For statistical evaluation of the data, the following methods were used. Since the samples showed temporal dependence, we used the generalized estimating equations (GEE) with autoregressive (AR1) correlation structure and Poisson distribution for evaluating differences in abundance between the building and forest sample. For the comparison of species diversity between the building and forest sample, a linear model with mixed effects (LME) was used. The time series of annual records from the building and the forest were compared using the generalized least squares (GLS) model. All analyses were performed in R (version 2.12.0 R Development Core Team, 2010) with the use of 'nlme' (Pinheiro et al. 2013) and 'geepack' (Hojsgaard et al. 2006) packages.

RESULTS

Diversity of species in the building

In the total sample from the cottage, 460 specimens of 14 species were recorded, of which seven were rodents, four insectivores and three bats (Table 1). When the material was divided according to "decades", actually 11 year intervals, three rodent and two insectivore species were recorded in all of them, the remaining species in only some of the decades. The most common rodent was *Apodemus flavicollis* followed by *A. sylvaticus* and *Clethrionomys glareolus*, the most common insectivores were *Sorex araneus* and *S. minutus*. While *A. flavicollis* was by far the most common mammal species, *A. sylvaticus* could have been more common than shown in Table 1 but its share in the pooled material of the two species (34.4%) is unknown. Anyway, mice of the genus *Apodemus* dominated the whole sample as well as all particular samples of the decades. Rare species included the shrews *Sorex alpinus* and *Crocidura suaveolens*, the voles *Microtus arvalis* and *M. subterraneus*, the mouse *Mus musculus* and the rat *Rattus norvegicus* and all bats recorded, *Myotis mystacinus*, *M. brandtii* and *Eptesicus nilssonii*.

Comparison with the forest sample

When combining the samples of mammals from the cottage and from the square plot in the forest, excluding only bats, the total of 1,041 specimens of 13 mammal species were recorded (Table 2). In the forest, the rank of species according to the number of individuals differed from that recorded in the building (see above). *S. minutus* was the most common, followed by *C. glareolus*, *A. flavicollis* and *S. araneus*. While *C. suaveolens*, *M. musculus* and *R. norvegicus* were only recorded in the building, *Microtus agrestis* and *Muscardinus avellanarius* were only

Table 2. Comparison of the samples of rodents and insectivores obtained in the building and in the forest of Bukačka
Tab. 2. Srovnání materiálu hlodavců a hmyzožravců získaného v budově a v lese Bukačka

species / druh	building / budova n	building / budova %	Bukačka NR n	Bukačka NR %
Sorex araneus	37	8.1	108	18.5
Sorex minutus	24	5.2	154	26.3
Sorex alpinus	6	1.3	14	2.4
Crocidura suaveolens	4	0.9	–	–
Microtus agrestis	–	–	14	2.4
Microtus arvalis	10	2.2	6	1.0
Microtus subterraneus	8	1.7	12	2.1
Clethrionomys glareolus	33	7.2	130	22.2
Apodemus flavicollis	134	29.3	124	21.2
Apodemus sylvaticus	38	8.3	18	3.1
A. flavicollis / A. sylvaticus	159	34.7	–	–
Muscardinus avellanarius	–	–	5	0.9
Mus musculus	1	0.2	–	–
Rattus norvegicus	2	0.4	–	–
total / celkem	456	100.0	585	100.0

recorded in the forest. However, the abundance of species not represented in the other sample was low, 1.5% in the first (building) and 3.3% in the second one (forest).

The yearly samples were significantly larger in the forest (χ^2=8.664, p=0.003), which also showed a significantly higher value of the Shannon index of species diversity (LME model, F=22.9, p<0.0001; Fig. 3). However, the number of species was higher in the building sample,

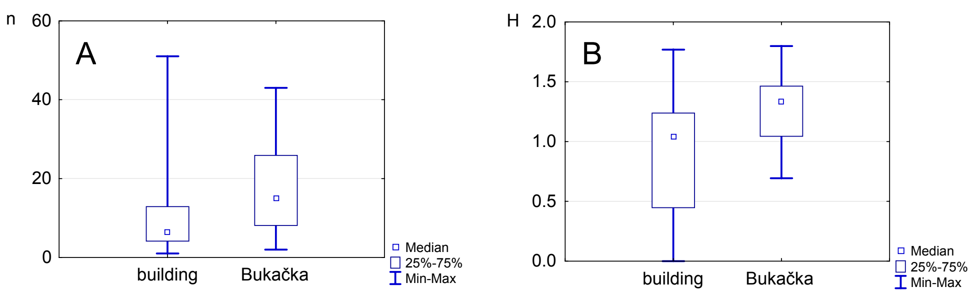

Fig. 3. Comparison of the total abundance (A) and Shannon index of species diversity (B) of small mammal samples (bats excluded) from the building and from the forest of Bukačka; n = mean number of specimens per year, H = mean value of Shannon index.
Obr. 3. Srovnání celkové abundance (A) a Shannonova indexu druhové diverzity (B) vzorků drobných savců (bez netopýrů) v budově a v lese Bukačka; n = průměrný počet kusů za rok, H = průměrná hodnota Shannonova indexu.

11 against 10. It seems that the lower value of diversity index in the building is a result of a lower equitability with respect to that in the forest. In spite of all differences, from different methods of trapping, through differences in the number of sampling years and timing during a particular year, to differences in abundance and species diversity between the two samples, their yearly totals were tentatively compared (Fig. 4). The two curves of fluctuation in numbers within the 37 years of coincident sampling are surprisingly similar and mutually correlated (GLS model, F=9.556, p=0.004). This suggests that long-term fluctuations in numbers of small mammals in the building are dependent on those in nature, at least concerning the total number of all species pooled.

Sesonal dynamics of immigration into the building

When comparing the numbers of mammals recorded at different times of a year, a few specimens had to be excluded because the month of their trapping was unidentifiable. Therefore the sample (n=450) is a little bit smaller than the total one (Table 3). Furthermore, samples of the two *Apodemus* species were pooled together because most animals captured during their mass immigration into the cottage were not identified as either *flavicollis* or *sylvaticus* (see Methods). Although the checking of traps and collecting of incidentally found carcasses was not quite regular, evident differences in numbers among the monthly samples very likely reflect real differences in numbers of mammals present in the cottage. As seen from Table 3, the differences among monthly totals are mainly due to the differences in numbers of *Apodemus* mice. Their numbers were high from July to December with an increasing trend from July to September (the peak). Further development of *Apodemus* numbers was certainly affected by trapping but the numbers remained high until December. Mice of the genus *Apodemus* thus represent the dominant element immigrating into the cottage towards the end of summer and

Table 3. Monthly totals of the records of rodents and insectivores in the building in 1969–2012. Specimens of an unknown month of collecting were not included; *Apodemus* spp. = *A. flavicollis* + *A. sylvaticus*
Tab. 3. Měsíční úhrny úlovků a nálezů hlodavců a hmyzožravců z let 1969–2012 v budově. Vyloučeny byly kusy nezařaditelné do žádného měsíce; *Apodemus* spp. = *A. flavicollis* + *A. sylvaticus*

species druh	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	total celkem
S. araneus	3	3	7	9	3	–	1	1	–	5	3	1	36
S. minutus	1	3	5	3	1	–	2	1	1	–	1	5	23
S. alpinus	1	1		1	–	–	–	–	1	2	–	–	6
C. suaveolens	–	1	–	–	–	–	–	–		1	1	1	4
M. arvalis	–	1	2	–	1	–	–	–	2	1	1	2	10
M. subterraneus	–	–	–	–	–	–	–	5	1	2	–	–	8
C. glareolus	4	1	4	8	3	1	1	1	4	1	3	2	33
Apodemus spp.	5	5	17	3	5	5	31	40	89	40	60	28	328
M. musculus	–	–	–	–	–	–	–	–	–	–	–	1	1
R. norvegicus	–	–	–	–	–	–	–	–	1	–	–	–	1
total / suma	14	15	35	24	13	6	35	48	99	52	69	40	450
%	3.1	3.3	7.8	5.3	2.9	1.3	7.8	10.7	22.0	11.6	15.3	8.9	100.0

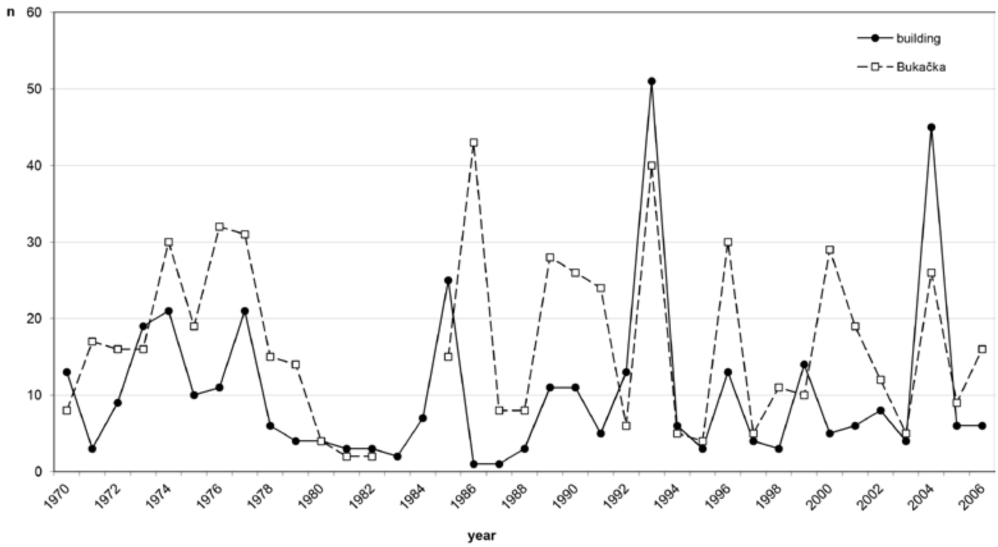

Fig. 4. Fluctuation in numbers (yearly totals) of rodents and insectivores recorded in the building and in the forest of Bukačka during 37 years of coincident sampling.
Obr. 4. Kolísání početnosti (roční úhrny) hlodavců a hmyzožravců zjištěných během 37 let současného odchytu a sběru v budově a v lese Bukačka.

in autumn. Except an additional small peak in March, their numbers were low during the first half of a year, January–June. As mentioned above, trapping in the cottage was mostly finished in spring but only if there evidently were no more mammals.

In most other species of rodents and insectivores no clear trends of their occurrence in the building can be observed. At irregular times of year, small peaks in numbers were recorded in *S. araneus*, *S. minutus*, *M. subterraneus* and *C. glareolus* but no evidence of their increased immigration to the cottage towards the end of summer and in autumn was obtained. The bats were excluded from Table 3 because their records were quite incidental. This is corroborated by the fact that all individuals captured (*M. mystacinus*, *M. brandtii*) or found dead (*E. nilssonii*) were adult males. Bat records come from the months June–July.

DISCUSSION

In various handbooks on European mammals, information can be obtained on species living obligatorily or, more often, facultatively in buildings (e.g. Niethammer & Krapp 1978, 1982, Corbet & Harris 1991, Spitzenberger 2001, Krištofík & Danko 2012). In addition to commensal mice and rats, various species of free living rodents and insectivores sometimes immigrate to buildings and spend several weeks or months there unless they are killed in traps. There are even reports on specialists to mountain and rocky habitats that can be found in buildings, as is the case of *Chionomys nivalis* recorded in solitary houses in Slovakian mountains together with *A.*

flavicollis and *C. glareolus* (Dudich 1970, Štollmann & Dudich 1985). There are certainly more published records of small mammals in scattered buildings, however, no results of their long-term monitoring are available in the literature. In this respect the situation is unique in the small mountain range of the Orlické hory Mts. on the Czech-Polish boundary, with the highest peak reaching 1115 m a. s. l. (Velká Deštná). Here the populations of rodents and insectivores were quite independently monitored in two different buildings for about 25 and 40 years, respectively.

In the dwelling-house at Luisino údolí (originally a gamekeeper's lodge), small mammals were trapped in 1960–1989, but in the first years only the bag of shrews was noted. The records of rodents were made since June 1966. In addition to rodents and insectivores, one *Mustela nivalis* was observed in 1985–1986. This carnivore did not live in the house permanently but penetrated into it to hunt rodents and shrews. The results of monitoring of small mammals in the house at Luisino údolí were published in seven papers (Porkert & Vlasák 1968, Vlasák & Porkert 1973, 1982, Porkert 1975, 1984, 1987, 1989). Unfortunately, summary information on the whole material cannot be found in any of them. Even when combining the respective publications it is difficult to reveal the exact number of specimens obtained during the whole study period, since the years covered by some of the papers are partly overlapping. According to our calculation, the total of 2007 individuals of rodents and insectivores were recorded. This is over three times more than the total number of individuals in our sample from the cottage at Šerlich (n=585), although the time span of our monitoring was significantly longer (44 years). Also the number of species differs, eight rodents and six insectivores at Luisino údolí against seven rodents and four insectivores at Šerlich.

The above differences can have several reasons. The time of trapping probably has little impact since the greater part of trapping by Porkert and Vlasák coincided with the first half of our trapping. A more important fact is the less exposed situation of the locality with respect to harsh climatic conditions. What seems essential is that unlike our cottage, the house at Luisino údolí was inhabited continuously, not only for recreation purposes. The traps, about 30 snap-traps and 2–4 live traps, were checked daily during the whole year. There was a wet meadow with thin streams around the house and a spruce forest in the vicinity of the meadow. The moist environment can explain the records of more or less amphibious species *Neomys fodiens*, *N. anomalus*, *Arvicola amphibius* (mentioned as *A. terrestris*), and *Microtus agrestis* that are missing in our sample. The only rodent species present in our sample and absent in that of Porkert and Vlasák is *Apodemus sylvaticus* but this may be due to misidentification. The habitats at Luisino údolí fit well the ecological requirements of this species (cf. e.g., Spitzenberger 2001, Anděra & Gaisler 2012) and it is unlikely that *A. sylvaticus* would not immigrate into local houses and cottages. We speculate that all *Apodemus* mice trapped in the house were automatically lumped together as *A. flavicollis* without any attempt to discover specimens belonging to *A. sylvaticus*. There are other two *Apodemus* species living in the Czech Republic, viz., *A. uralensis* and *A. agrarius*, but they were never recorded in the respective territory (Anděra & Horáček 2005, Anděra & Gaisler 2012). *A. flavicollis*, anyway, dominated both our sample and that of Porkert & Vlasák and was the main immigrant into the two buildings. At the same time, this species displayed great fluctuations in numbers. In the gradation year of 1981, altogether 86 *A. flavicollis* were trapped at Luisino údolí, of them 37 in September and 31 in October. A year later, in 1982 year, only three specimens were recorded, one in May and two in September (Porkert 1984). This corresponds to our results with the difference that we took two species into account but could not separate them when considering their fluctuations in numbers. A maximum of 51 *Apodemus* individuals were recorded in 1993 while only one specimen in 1971, 1994, 1998 and 2003, and there were even years without *Apodemus* mice in the cottage at Šerlich.

A small meteorological station was operated by the Porkert family at Luisino údolí and the results of the respective measurements were correlated with those of monitoring of small mammals. Considerations on the impact of climate upon the immigration of small mammals into the building have been included in practically all publications by Porkert & Vlasák mentioned above. Among different factors, the most important were air temperature and precipitation. Under the local conditions the amount of precipitation, its timing during the year and its quality (vertical/horizontal, liquid/solid) regulate the fluctuation in numbers of small mammals (mainly *Apodemus* and *Sorex* species) in at least the same way as food supply (Porkert 1989).

Although we did not study the climatic parameters, the impact of low temperature and high precipitation on the immigration of small mammals into the building towards the end of summer and in autumn seems to be evident. In a long-term perspective, however, the numbers of small mammals in natural habitats outside the building must be essential for numbers inside the building. This is in accordance with the comparison of fluctuation in numbers of small mammals in the building and in the natural forest of Bukačka within the same years of study (1970–2006). Only two real synanthropes were recorded in the building, *M. musculus* and *R. norvegicus*, and their numbers were negligible. The situation is obscure concerning the shrew *C. suaveolens* which shows some features of a synanthrope but is able to live in various natural habitats as well (Anděra & Gaisler 2012). Although a specimen of *C. suaveolens* was trapped in a nearby meadow outside the building (Gaisler, unpubl.), the existence of a permanent free living population at Šerlich is unlikely. All other species are exoanthropes and must have immigrated to the cottage from the surrounding habitats. To conclude, long-term fluctuations in numbers of rodents and shrews in the building are dependent on those in nature.

Our samples are not large enough to reveal significant differences in numbers among all species recorded in the building and in the forest. Nevertheless, there are conspicuous differences in numbers between groups of species (here represented by genera): *Sorex* 14.6% building, 47.2% forest; *Microtus* and *Clethrionomys* 11.1% building, 25.6% forest; *Apodemus* 72.3% building, 24.3% forest. The differences can be explained in part or entirely by different trappability. While in shrews and voles the samples from pitfalls are significantly larger than the samples from snap-traps, in mice the samples from snap-traps are significantly larger than those from pitfalls (Dudich et al. 1987, Handley & Kalko 1993, Gaisler 1998). The differences in percentage representation between the material from the building and that from the forest can easily be explained by the fact that no pitfall traps could be laid in the building. The situation is further complicated by occasional application of very efficient live traps in the building only. In spite of that, it seems likely that in *A. flavicollis* and its less common sibling *A. sylvaticus*, the tendency to immigrate is really greater than in any other mammal species recorded in the building. The shrews *S. araneus*, *S. minutus* and even the rare *S. alpinus* seem to be attracted to the building next to *Apodemus* mice. Further research based on the application of the same methods, mainly the same type and number of traps, in a building and in a natural habitat close to it, has to confirm or reject the prediction that species living in nature differ by their tendency to immigrate into the building. When the samples of Porkert & Vlasák and the samples from the cottage referred to in this paper are combined, nine species of rodents, six species of insectivores, three species of bats and one carnivore species were recorded in two small buildings situated on the ridge of the Orlické hory Mts. at the elevation of 870–990 m a. s. l. This rather high species diversity was only revealed during many years of monitoring. With rare exceptions such as *Muscardinus avellanarius*, all species of rodents and insectivores living in natural habitats sometimes immigrate into buildings.

Concerning bats, the most interesting are records of *Myotis mystacinus* and *M. brandtii*. On the ridge of the Orlické hory Mts., they were only recorded in flight as a couple of species, since standard ultrasound detectors do not enable to determine them according to their echolocation signals. However, the records inside the building proved that both species inhabit this environment. *Eptesicus nilssonii* is a common bat foraging in this habitat under favourable weather conditions in summer. Further two species recorded in flight close to the cottage were *Vespertilio murinus* and *Nyctalus noctula*, but they were observed only rarely (Gaisler 2005).

SOUHRN

V letech 1969–2012 byly odchytem do pastí, sběrem mrtvých kusů nebo jiným způsobem zjištěny v rekreační chatě na hřebeni Orlických hor (990 m n. m.) tyto druhy drobných savců: *Apodemus flavicollis*, *A. sylvaticus*, *Clethrionomys glareolus*, *Microtus arvalis*, *M. subterraneus*, *Mus musculus*, *Rattus norvegicus*, *Sorex araneus*, *S. minutus*, *S. alpinus*, *Crocidura suaveolens*, *Myotis mystacinus*, *M. brandtii* a *Eptesicus nilssonii*. Tento vzorek bez netopýrů (n=456) byl srovnán ze vzorkem hlodavců a hmyzožravců z nedalekého pralesa Bukačka z let 1970–2006 (n=585, 10 druhů). Ve vzorku z pralesa chybějí synanthropní a hemisynanthropní druhy *M. musculus*, *R. norvegicus* a *C. suaveolens*, navíc jsou zde druhy *Microtus agrestis* a *Muscardinus avellanarius*, Shannonův index druhové diversity je průkazně vyšší než u vzorku z budovy (LME model, F=22,9, p<0,0001). Srovnání celkových ročních úlovků během 37 let současného monitoringu ukázalo průkaznou korelaci početního vývoje na obou lokalitách (GLS model, F=9,556, p=0,004). Zatímco v materiálu z pralesa jsou nejhojnější rejsci rodu *Sorex*, v materiálu z budovy dominují myšice rodu *Apodemus*. Jejich početnost během let kolísá, ale celkový vzorek vykazuje výraznou sezónní dynamiku s maximem imigrace koncem léta a na podzim. Výsledky jsou srovnány se sérií publikací Porkerta & Vlasáka (1968–1989), kteří monitorovali výskyt hlodavců a hmyzožravců v jiné budově v Orlických horách (870 m n. m.) a prokázali vliv srážek a teploty na imigraci drobných savců, především *A. flavicollis*. Průběh osídlování budovy během sezóny byl podobný jako v našem případě. V obou sledovaných budovách dohromady bylo zjištěno 9 druhů hlodavců, 6 druhů hmyzožravců, 3 druhy netopýrů a jedna šelma. Metodické rozdíly mezi odchytem v budovách a odchytem v lese znemožňují exaktní posouzení afinity různých druhů k pronikání do budov, zdá se však, že největší tendenci osídlovat horská stavení mají myšice a rejsci.

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