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# A STUDY OF THE SYNUSIA OF SMALL TERRESTRIAL MAMMALS (INSECTIVORA, RODENTIA) OF THE KELEČSKÁ PAHORKATINA UPLAND – CZECH REPUBLIC

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**Abstract**

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In 2006 to 2007, the community of small terrestrial mammals was studied in a natural forest area of the Kelečská pahorkatina Upland situated on the boundary-line of the Oderské and Hostýnské vrchy Hills (district of Přerov, Czech Republic). Biotopes under study represented artificial plantings of beech, mature production forest stands and forest reserves. In total, 83 small terrestrial mammals of six species were caught by means of snap traps laid in lines. The majority of species colonized young plantings (n = 6, H′= 1.35), high forests showing lower diversity (n = 4, H′= 0.76). In 2006, population densities of small mammals were very low. In 2007, an increase in the population density of some species occurred, which was evidently affected by the in creased offer of food in the form of excessive seed crop (mainly of beech) in 2006. The most abundant species was *Apodemus flavicollis*, which represented more than half of all trapped small mammals. Arvicolidae and Insectivora showed very low populations. The high relative abundance of *Apodemus agrarius* in plantings of woody species was an interesting finding. These plantings are, with respect to low moisture and food offer, an atypical site for this species.

small mammals, Rodentia, Insectivora, natural regeneration, forest reserves, planting

Under conditions of our country, communities of small terrestrial mammals are studied in a number of forest ecosystems from floodplain forests (eg ZEJDA, 1976, 1991; BRYJA and ŘEHÁK, 1998), lowland temperate forests with a normal hydric regime (SUCHOMEL and HEROLDOVÁ, 2004), through uplands (ČERMÁK and JEŽEK, 2005) up to mountain forest ecosystems (eg HEROLDOVÁ and ZEJDA, 1995; ČAPEK et al., 1998; BRYJA et al., 1999, 2001 etc.). Within the research plan of the Faculty of Forestry and Wood Technology of Mendel University of Agriculture and Forestry in Brno, research into communities of small mammals began in 2006. The research was aimed at obtaining information on changes in the community structure and its effects on the natural regeneration of forests and planting. Considering succession changes of studied localities and changes in forest management it is possible to expect also changes in communities of small mammals mainly with respect to their species dominance or diversity and their effects on forest regeneration regarding changes in the tree species composition. The paper brings preliminary results concerning basic information on the character of the community of small terrestrial mammals of forest ecosystems from the area of the Kelečská pahorkatina Upland (Oderské and Hostýnské vrchy Hills). A similar study has not been carried out in the area yet. As for studies coming from the region, only the publication of BRYJA and ŘEHÁK (1998) is considered to be

important. The paper is related to the Oderské vrchy Hills and concerns communities of small mammals in the Poodří Protected Landscape Area (PLA). However, the authors aimed only at the synusiae of floodplain forests and natural wetland ecosystems while the area studied by our team was the area of forests with normal hydric regime and specific anthropogenic effects in the form of forest management.

## MATERIAL AND METHODS

For the study of populations experimental plots were used in the Valšovice Training Forest Range (district of Přerov), which is a special-purpose area of the Secondary Forestry School in Hranice na Moravě. The studied plots are situated in the natural forest area No. 37 – the Kelečská pahorkatina Upland (in total 1003.47 ha) on the boundary-line of the Oderské and Hostýnské vrchy Hills. They create a projection of the Oderské vrchy Hills terminated by the plateau of Maleník. The highest top in the management-plan area (MPA) is Maleník with its altitude of 479 m. Mean altitude ranges between 300 and 400 m. The lowest point of the MPA is situated on the Bečva riverbank in the northern part at an altitude of about 240 m. As for climate, the locality belongs to a slightly warm region with a slightly warm sub-region B3, hilly country, slightly humid, with mild winter. Mean annual temperature is 7 to 8°C. Mean annual precipitation reaches 600–700 mm, in recent years only 450–500 mm. Prevailing winds come from NW – W – SW (according to the Forest Management Plan 2001–2010). In total, seven experimental plots were chosen:

P1 (49.525658 N, 17.6862752 E) – a seed producing monoculture of *Fagus sylvatica*, age 142 years, a plus seed stand with *Lathyrus vernus*, *Convallaria majalis* and *Carex pilosa* in its undergrowth.

P2 (49.526033 N, 17.6875392 E) – a young monoculture of *Fagus sylvatica*, age 62 years, mainly with *Lathyrus vernus*, *Convallaria majalis* and *Carex pilosa* in its undergrowth.

P3 (49.523157 N, 17.6763829 E) – a stand of *Fagus sylvatica* on rock underbed, age 112 years, mainly with *Convallaria majalis* and *Carex pilosa*in its undergrowth.

P4 (49.5156567 N, 17.6964967 E) – a forest reserve with open canopy. A seed stand aged 130 years. In a tree layer, *Fagus sylvatica* with interspersed *Tilia cordata*, *Quercus petraea*, *Carpinus betulus* and *Acer pseudoplatanus* predominate. Dominant species of a herb layer are as follows: *Lathyrus vernus*, *Convallaria majalis*, *Tithymalus amygdaloides*, *Polygonatum multiflorum*, *Petasites albus*, *Carex pilosa*, *Poa nemoralis* etc.

P5 (49.5141806 N, 17.6887167 E) – forest reserve Dvorčák. A seed stand aged 132 years. Area 11.71 ha. In a tree layer, *Fagus sylvatica* with interspersed *Tilia cordata*, *Quercus petraea*, *Carpinus betulus* and *Acer pseudoplatanus* predominate. Dominant species of a herb layer are: *Lathyrus vernus*, *Convallaria majalis*, *Tithymalus amygdaloides*, *Polygonatum multiflorum*, *Petasites albus*, *Carex pilosa, Poa nemoralis* etc.

P6 (49.30889 N, 17.41449 E) – artificial planting of *Fagus sylvatica*, age 22 years. The admixture of *Abies alba*, self-seeding of *Alnus glutinosa*, *Fraxinus excelsior* and *Acer pseudoplatanus*, mainly with grasses (*Calamagrostis arundinacea*) and *Rubus fruticosus* in its undergrowth.

P7 (49.31304 N, 17.41118 E) – artificial planting of *Fagus sylvatica*, age 12 years, the admixture of *Abies alba*, self-seeding of *Alnus glutinosa* and mountain ash (*Sorbus* sp.), the predominance of grasses (*Calamagrostis arundinacea*) and *Rubus fruticosus* in a herb layer.

In 2006, two trappings were carried out in the spring (June) and autumn seasons (October) and in 2007, in the spring season (April). On each of the plots (P1–P5), 80–100 snap traps were laid in a line at 3 m spacing (Tab. I). A kerosene lamp wick parched on oil and flour or smeared by peanut butter was used as bait. On plots P6 a P7, 20 traps were laid. The low number of traps in exclusion fences was affected by a fact that the original intention was to trap small mammals only in order to determine species, which could be potential causal agents of damage to tree plantings without another plan to study the population dynamics or other properties of the community. The smaller number of traps is also given by the limited size of these two experimental plots.

The traps were exposed for the period of 4 days (ie 3 nights) and checked every day in the morning. In caught individuals, species and the body length and weight were determined in the laboratory. In species where confusion can occur (genera *Apodemus* and *Sorex*) also other length measures. Particular animals were dissected in order to determine sex and sexual activities. Stomachs were also sampled for the later analysis of food by means of the NIR method or samples of tissues were taken for parasitological examinations.

In spite of the low number of trapped animals, basic ecological characteristics of the community were evaluated, namely the dominance and relative abundance of selected species (according to LOSOS et al., 1985), diversity (SHANNON and WEAVER, 1963) and equitability (SHELDON, 1969). In total, 82 small mammals were caught (Tab. I).

I: *The number of individuals of small terrestrial mammals*

| Date | Line | Af | As | Aa | Mg | Sa | Te | Ppn |
|---|---|---|---|---|---|---|---|---|
| VI. 06 | P1 | 4 | 1 | - | - | - | - | 300 |
| | P2 | 2 | 1 | - | - | - | - | 300 |
| | P3 | - | 1 | - | - | - | - | 240 |
| | P4 | - | - | - | - | 1 | - | 300 |
| | P5 | - | - | - | - | - | - | 240 |
| | P6 | 1 | 2 | - | 1 | - | 1 | 60 |
| | P7 | 2 | - | - | - | 3 | - | 60 |
| X. 06 | P1 | 3 | - | - | - | - | - | 300 |
| | P2 | - | - | - | - | - | - | 300 |
| | P3 | 1 | - | - | - | - | - | 240 |
| | P4 | 2 | - | - | - | - | - | 300 |
| | P5 | - | - | - | - | - | - | 240 |
| | P6 | - | - | - | - | - | - | 60 |
| | P7 | - | - | 4 | - | - | - | 60 |
| IV. 07 | P1 | 17 | 2 | - | - | - | - | 300 |
| | P2 | 2 | - | - | 1 | - | - | 300 |
| | P3 | 3 | - | - | 2 | - | - | 240 |
| | P4 | 2 | - | - | 3 | - | - | 300 |
| | P5 | 6 | - | - | 1 | - | - | 240 |
| | P6 | 2 | - | 8 | - | - | - | 60 |
| | P7 | 1 | - | 2 | - | - | - | 60 |
| Total | | 48 | 7 | 14 | 8 | 4 | 1 | 4 500 |

Explanatory notes: Af – *Apodemus flavicollis*, As – *Apodemus sylvaticus*, Aa – *Apodemus agrarius*, Mg – *Myodes glareolus*, Sa – *Sorex araneus*, Te – *Talpa europaea*, Ppn – the number of trap-nights

## RESULTS

In total, 6 species of small terrestrial mammals were trapped in the studied area during the given period. Of the number, there were four species of rodents (Rodentia) and two species of insectivores (Insectivora). *Apodemus flavicollis* was most abundant its dominance reaching 58.5%, which is more than half of all small mammals sampled. It shows evidence of the high adaptability and vitality of this eryvalent species strictly occuring in growths of trees, which occupied all examined areas (Tab. I). The highest relative abundance of the species was found at site P1 (the oldest beech forest at the locality, a seed stand), which is evidently related to the sufficient food supply in the form of beechnuts. *Apodemus agrarius* showed a relatively marked dominance, viz. 7.1%, *Myodes glareolus* 9.8% and *Apodemus sylvaticus* 8.5%. Insectivores were trapped rather rarely. It referred to *Sorex araneus* (4.9%) and *Talpa europaea* (1.2%). A list of the number of individuals in particular lines in relation to particular trapping actions is given in Tab. I.

As for the species richness, this area is comparable with other areas of uplands. According to Shannon and Weaver, the community diversity (H´) reached 1.26 and equitability (E) according to Sheldon 0.70. However, data obtained do not make possible for the present more detailed studies of the population dynamics of particular species. Nevertheless, it is evident that populations of the majority of species were minimal in 2006. In 2007, their increase occurred, which was also corroborated by values of the relative abundance during the examined period. In spite of intensive trapping activities we have not yet succeeded to obtain the sufficient number of data for statistical treatments to compare the communities in particular plots. According to the data it is evident that *Apodemus flavicollis*, *Apodemus agrarius* and *Myodes glareolus* are the most abundant species. In the future, the species can markedly effect the regeneration of forest ecosystems both through the consumption of seeds and browsing the bark of trees.

Because at the studied locality, it is possible to differentiate two main types of sites, namely plantings of young trees with the undergrowth of forest weed (plots P6 and P7) and closed mature forest stands with an open herb layer (plots P1–P5), communities of small mammals were also compared in both types of the biotopes.

In young plantings, more species were found. The presence of all six species was demonstrated there. The species diversity was rather high (H´= 1.36). The marked dominance of *Apodemus agrarius* (51.9%)

was of interest. The species occurred only in these biotopes (Tab. I) reaching also the highest relative abundance being at the same time highest of all small mammals caught (13.3% at P6 locality in 2007 and 3.33% at P7 locality in both studied years). On the other hand, in old mature forest stands, only 4 species were found with the marked dominance of *Apodemus flavicollis*, which reached 76.4% in these types of biotopes. *Apodemus flavicollis* showed the highest relative abundance at P1 locality (1.17% in 2006 and 5.67% in 2007), which could be caused by the high number of seed-bearing beech trees and also by a fact that in 2006, the excessive crop of seed occurred. The species diversity was substantially lower there than in the plantings (H´= 0.76).

## DISCUSSION

Comparing data obtained so far with results published from research carried out in other forest sites within the Czech Republic the species composition of the given area community is in principle consistent with communities of small mammals of lower and medium locations (eg SUCHOMEL and HEROLDOVÁ, 2004; ČERMÁK and JEŽEK, 2005). The same dominant species are noted (*Apodemus* spp., *Myodes* sp.) and the general composition of the synusia is changed only due to the presence or absence of some specific species, the occurrence of which is not virtually conditioned by the effect of management but rather by specific ecological requirements of selected species (eg *Microtus agrestis*) or zoogeographic factors (*Apodemus agrarius*). Therefore, eg *Microtus agrestis*, a typical species and important pest of forest plantings (HEROLDOVÁ, 1995; HEROLDOVÁ and ZEJDA, 1995), has not yet been found in this area. Otherwise, it was found in this region in wetland ecosystems of the Poodří Protected Landscape Area (BRYJA and ŘEHÁK, 1998). On the other hand, the presence has been proved of *Apodemus agrarius*, which affects this area through the margin of its NE natural range and in the majority of other areas of Bohemia and Moravia, it is, therefore, absent (ZEJDA, 1967; BRYJA and ŘEHÁK, 1998; ZEJDA et al., 2002).

The general diversity of the studied synusia (H´ = 1.26) somewhat differs from other studied areas being given both by the number of species and their relative abundance (LOSOS et al., 1984). For example, ČERMÁK and JEŽEK (2005) mention the diversity of communities studied in the Drahanská vrchovina Upland (H´ = 1.43–1.6), SUCHOMEL and HEROLDOVÁ (2004) in large forest complexes of southern Moravia (H´ = 1.5) and ZEJDA (1976) in floodplain forests (H´ = 0.97–1.04). Mountain ecosystems appear to be somewhat richer. For example, BRYJA et al. (1999, 2001) determined H´ = 1.27–1.67 on the basis of research carried out in the Moravian-Silesian Beskids.

The abundant occurrence of *Apodemus agrarius* only in young plantings of the area is interesting. It refers to relatively atypical sites if they are not waterlogged because this field mouse is the species of rather moist sites (BRYJA and ŘEHÁK, 1998; ZEJDA et al., 2002) although it was already noted in stands of trees (BABINSKA-WERKA et al., 1981) though mainly in town parks. In addition to biotopes mentioned above, it occurs largely only in field crops (ZEJDA, 1967). In larger forest complexes, only migrating individuals are noted. At drier sites, it occurs rather rarely (ZEJDA et al., 2002). Thus, the occurrence of the higher number of *Apodemus agrarius* can implicitly bear evidence of the more humid and moister microclimate of the given site of plantings although we cannot demonstrate it by actual measurements.

The dominance of *Apodemus flavicollis* as against other studies is rather marked (ZEJDA, 1976; HEROLDOVÁ and ZEJDA, 1995; BRYJA et al., 1999, 2001; SUCHOMEL and HEROLDOVÁ, 2004). In our case, it reaches more than half of all determined small mammals. The study of BRYJA and ŘEHÁK (1998), who also noted the marked dominance of *Apodemus flavicollis* in wetland ecosystems at the near-by locality of the Poodří PLA, is an exception. An increase in the abundance of yellow-necked field (in 2007) can be caused by the increased supply of food in the form of seeds of producing trees (OBRTEL and HOLIŠOVÁ, 1974; HOLIŠOVÁ and OBRTEL, 1980; HEROLDOVÁ, 1994), mainly of beech, which is also documented by the highest relative abundance just at this site. The increased abundance of yellow-necked field can then result in significant losses of seeds of trees (BURSCHEL et al., 1992). The dominance of *Myodes glareolus* is important. The species, in spite of its present low standing crop, represents an important potential as a species markedly affecting the regeneration of local forest ecosystems and their tree species composition because it is able to increase markedly its abundance from the stage of pesimum during a rather short period (ČAPEK et al., 1998). Particularly at present, when changes occur in forest management and coniferous stands are replaced by broadleaved species representing the main food of the species in winter months (HOLIŠOVÁ, 1971; HEROLDOVÁ, 1995) and their areas are extended, a larger proportion and increasing the abundance of the species in the community of small mammals can occur.

In addition to the increase in the abundance of some species of rodents the decrease was noted of *Sorex* spp. as compared with other authors (BRYJA and ŘEHÁK, 1998; BRYJA et al. 1999, 2001). Theoretically, this fall can be related to the general decrease of

soricine insectivores in Moravia after 2000 (SUCHOMEL and HEROLDOVÁ, 2004). In spite of the natural character of some studied plots (eg P4, P5), it is evident that less closed artificial plantings with the dense undergrowth of grasses and raspberry rather meet the requirements of small mammals. Diversity of these sites was markedly higher (H´= 1.36 in relation to 0.76 in closed forests) as well as relative abundance in spite of the relatively small food supply as compared with areas characterised by seed-bearing trees. Higher values of parameters mentioned above can be related to the higher diversity of the environment, ie the presence of the higher number of sites in plantings (both of the steppe and forest character). Thus, their ecotone character then makes possible the occurrence of more species (SUCHOMEL and HEROLDOVÁ, 2004). Dense undergrowth representing a more suitable shelter of small mammals from predators than a thinner herb layer in old forest stands can be another important factor. In old seed stands, the occurrence of other species can be also limited by the high abundance of *Apodemus flavicollis*. This species, as the main consumer of diaspores of trees (beech, oak) (OBRTEL and HOLIŠOVÁ, 1974; HOLIŠOVÁ and OBRTEL, 1980) and the most adaptable species is able to occupy all ecological niches (SUCHOMEL and HEROLDOVÁ, 2004; ČERMÁK and JEŽEK, 2005).

## SOUHRN


### Studium synuzie drobných zemních savců (Insectivora, Rodentia) Kelečské pahorkatiny – Česká republika

Bylo studováno společenstvo drobných zemních savců v letech 2006 až 2007 v přírodní lesní oblasti Kelečská pahorkatina, ležící na rozhraní Oderských a Hostýnských vrchů (okres Přerov, Česká republika). Studované biotopy představovaly umělé výsadby buku, dospělé produkční lesní porosty a lesní rezervace. Celkem se odchytilo 83 ks drobných savců v šesti druzích, pomocí sklapovacích pastí kladených do linií. Nejvíce druhů osidlovalo mladé výsadby (n = 6, H´ = 1,35), vysokokmenné lesy měly diverzitu nižší (n = 4, H´ = 0,76). Populační hustoty drobných savců byly v r. 2006 velmi nízké. V r 2007 došlo k nárůstu populací některých druhů, což zřejmě ovlivnila zvýšená nabídka potravy v podobě nadměrné úrody semen v r. 2006, převážně buku. Nejpočetnějším druhem byla *Apodemus flavicollis*, která představovala více jak polovinu všech odchycených drobných savců. Velmi nízké stavy vykazovali hrabošovití (Arvicolidae) a hmyzožravci. Zajímavým zjištěním byla vysoká relativní abundance *Apodemus agrarius*, ve výsadbách dřevin, které jsou vzhledem k nízké vlhkosti a potravní nabídce netypickým stanovištěm pro tento druh.


drobní savci, Rodentia, Insectivora, přirozená obnova, lesní rezervace, výsadba

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