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Influence of some methodological modifications on trapping efficiency and mortality of small terrestrial mammals (Rodentia)

Vplyv niektorých metodických modifikácií na efektivitu odchytu a mortalitu drobných zemných cicavcov (Rodentia)

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Abstract. Live trapping of small terrestrial mammals was carried out in a mature fir-beech forest. Influence of trap type, bait type and frequency of checks on trapping effectiveness and mortality was examined. Two dominant rodent species *Apodemus flavicollis* and *Myodes glareolus* were used as model animals. The mean effectiveness of the Chmela-type live traps reached 37.27%. On the contrary, the effectiveness of pitfalls was only 0.56%. An extremely low number of shrews was captured using both trap types. Trapping efficiency was similar for dry cat food and rolled oats, regardless of the rodent species. *Apodemus flavicollis* showed a significant difference in trapping frequency between day and night. The activity of *Myodes glareolus* was more even. Both species showed a higher mean number of individuals captured from sunset to midnight than from midnight to sunrise. Mortality of the model species was 5–17 times lower when carrying out four checks per day in comparison to the standard number of two checks.

Key words. Live traps, pitfall traps, trapping efficiency, bait, time activity, mortality, *Apodemus flavicollis*, *Myodes glareolus*.

INTRODUCTION

The study of small mammal assemblages requires trapping data. The effort to obtain these data is complicated by differences in body size and microhabitat use among species, which can affect species- and trap-type-specific probabilities of captures (McCay et al. 1998, Whittaker & Feldhamer 2000). Many studies have showed that different trap types show different effectiveness in capturing a particular species or group of species (Wiener & Smith 1972, Pelikán et al. 1977, Slade et al. 1993, Woodman et al. 1996, Whittaker et al. 1998, Stanko et al. 1999). The capture probability of different species may also be influenced by choice of the bait used for trapping (Beer 1964, Laurance 1992, Willan 1986, Woodman et al. 1996) and by the trapping design (Pelikán et al. 1975, Zukal & Gaisler 1992, McCay et al. 1998).

In the present study, we tested two types of live traps, two types of bait and capability in different times of day. The influence of doubled trap checks was also discussed in relation to mortality and calculated density.

MATERIAL AND METHODS

Study plots

The research locality is situated in the Kremnické vrchy Mts. (Central Slovakia), geomorphologically belonging to the West Carpathians. Geographical coordinates of the plot centre are 48° 38' N, 19° 02' E. The altitude ranges from 660 to 680 m above sea level, exposure is west, average slope 40%. The locality is situated within an extensive forest complex. The forest stand on the locality is composed of beech (*Fagus sylvatica* – 70%), fir (*Abies alba* – 25%), sycamore (*Acer pseudoplatanus* – 3%) and ash (*Fraxinus excelsior* – 2%). The age of the canopy is around 100 years. Shrub layer is developed moderately, being composed of natural regeneration of the parent stand. The composition and density of herbaceous vegetation was variable. The site typologically belongs to the *Fagetum typicum* forest type group.

Trapping methods

The study plot 60×60 m in size was divided into a trapping grid. Trapping stations were spaced every 10 m. In total 49 trapping stations (7×7) were established. One pitfall (designated for shrew trapping) used as a live trap (set flush with the ground surface; diameter 11 cm, depth 18 cm) and one Chmela-type live trap were placed at each station. Each trap was provided with a small roof made of tar paper, placed on three wooden sticks. During freezing days each trap was provided with cotton bedding. Carrot slice was put into each trap during hot summer days. Traps were placed without regard to microhabitat conditions. Pitfalls were provided with wood shavings and dry cat food to increase the survival of shrews. Chmela-type live traps were baited with two types of bait – dry cat food and rolled oats. The type of bait was altered in 2005, even traps with oats, odd traps with cat food. We compared the number of captures in traps with different bait to determine whether each type of bait provided equal numbers of captures and similar proportions of each of two the most frequently captured species.

Trapping was conducted in 2005–2006, being equally distributed from mid April to the end of October. Five trapping sessions were performed in 2005, four in 2006. Pitfalls were not used in 2006 due to very low trapping efficiency in the previous season. Each session consisted of 2–3 consecutive days of trapping. Traps were checked four times per day – sunrise, noon, sunset, and midnight to quantify and compare time activity of the captured species.

For the comparison of mortality rate, results from another study plot (similar forest structure and climatic conditions; situated 3 km from the former study plot; for detailed characterization of the site see Lešo et al. 2008) obtained in 2006 were used. The Chmela-type live traps were used on that plot, being checked two times per day (sunrise and sunset).

The Lincoln index was used to calculate density in which two consecutive days represented two samples. Veterinary colours applied on the chest were used to distinguish retrapped individuals. Animals were not marked individually. The colours were recognizable for at least one month. The main effect ANOVA was used to evaluate influence of the bait type and day activity in two rodent species. Statistica 7.0 (StatSoft 2001) was used for all statistical analyses.

RESULTS AND DISCUSSION

Trap type

In total, 203 captures (131 in 2005 + 72 in 2006) of *Apodemus flavicollis* and 138 captures (69 + 69) of *Myodes glareolus* were accomplished in two trapping seasons using the Chmela-type traps. Besides the two dominant species, only six captures of another three species (i.e., *Sorex araneus*, *Sorex minutus*, *Neomys anomalus*) were recorded. The mean effectiveness of the traps was 37.3%. On the contrary, only three captures (once *Sorex araneus*, once *Myodes glareolus* and once juvenile *Apodemus flavicollis*) were recorded in pitfalls during 2005, which means the effectiveness of 0.56%. For this reason, pitfalls were not used in 2006. The very low number of shrews is rather surprising, because pitfalls are recommended as the most suitable traps for shrews and very effective also for voles (Pelikán et al. 1977, Dudich & Stollmann 1985, Dudich et al. 1987, Zukal & Gaisler 1992, Kalko & Handley 1993, Anonymous 1998, Stanko et al. 1999, Whittaker & Feldhamer 2000). Moreover, shrews were extremely rare micromammal species captured in both trap types (in total, seven captures of three species per 1470 trap-nights), in spite of the fact that *Sorex araneus* is generally considered to be one of the most numerous forest mammals.

Bait

No significant preference (p=0.45–0.65) was ascertained when thetwo bait types used in the Chmela traps were compared (Fig. 1). Trapping efficiency was similar for dry cat food and rolled oats, regardless of the rodent species. When cat food and rolled oats were mixed and used in one trap, the cat food was consumed primarily in all cases. Rolled oats are the most frequent bait used by biologists trapping small terrestrial mammals in temperate zones. High quality cat food was used in order to increase survival of shrews in the traps (Whittaker & Feldhamer 2000). According to bait preference testing, the cat food can be fairly used as a bait without influence on capture probability of the two dominant rodent species in comparison to rolled oats. It is not clear whether this bait type can influence capture probability and survival rate of shrews because of the lack of captured animals.

Time activity

Apodemus flavicollis, as a typical nocturnal animal, showed a significant difference (p=0.0003–0.0400) in trapping frequency between day and night in both years of the study (Fig. 2). A higher mean number of individuals was captured from sunset to midnight than from midnight to sunrise, although the difference was not significant (Table 1). The activity of *Myodes glareolus* was more even. No significant difference in capture frequency was ascertained between daytime and both night parts in 2005 (Table 1). In 2006, a significant difference (p=0.02) was noticed

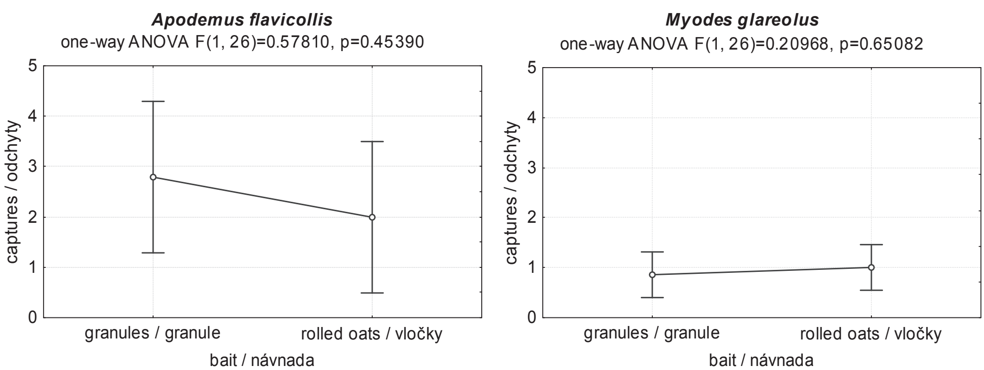

Fig. 1. Influence of the bait type on capture frequency in two rodent species.
Obr. 1. Vplyv druhu návnady na frekvenciu odchytov dvoch druhov hlodavcov.

Table 1. Tuckey test: influence of the time of day on capture frequency. Significant differences are given in bold. AF – *Apodemus flavicollis*, MG – *Myodes glareolus*
Tab. 1. Tuckeyov test: vplyv dennej periódy na frekvenciu odchytov. Signifikantné rozdiely sú vyznačené tučným písmom. AF – *Apodemus flavicollis*, MG – *Myodes glareolus*

		day deň	sunset-midnight súmrak-polnoc	midnight-sunrise polnoc-svitanie
AF – 2005	daytime	x	**0.000303**	**0.000792**
	sunset-midnight	**0.000303**	x	0.898579
	midnight-sunrise	**0.000792**	0.898579	x
AF – 2006	daytime	x	**0.006797**	**0.036508**
	sunset-midnight	**0.006797**	x	0.728869
	midnight-sunrise	**0.036508**	0.728869	x
MG – 2005	daytime	x	0.118891	0.570142
	sunset-midnight	0.118891	x	0.570142
	midnight-sunrise	0.570142	0.570142	x
MG – 2006	daytime	x	**0.020599**	0.186195
	sunset-midnight	**0.020599**	x	0.515788
	midnight-sunrise	0.186195	0.515788	x

between daytime and the first half of night. The difference in capture numbers between the two night parts was similar as in the former species (Table 1). A higher mean number of individuals was captured from sunset to midnight.

M o r t a l i t y

Trap mortality is an unwanted, but inseparable part of micromammal studies. It is not common to mention mortality rate along with the main results. In general, under favourable climatic conditions (temperature not dropping under the freezing point and not exceeding 30 °C), rodents can survive in the trap for at least 12 hours, which is the most common interval between checks. Shrews cannot survive for more than several hours, under bad conditions they perish soon. The-

Table 2. Influence of the number of checks on species-specific mortality
Tab. 2. Vplyv počtu kontrol na druhovo špecifickú mortalitu

	no. of trap-nights počet pascanocí	no. of dead animals počet úhynov	no of all trapped animals počet odchytov	relative mortality (%) relatívna mortalita
Apodemus flavicollis				
four checks	931	1	203	0.49
two checks	1300	9	106	8.49
Myodes glareolus				
four checks	931	2	138	1.45
two checks	1300	11	187	5.88

refore, in shrew studies more frequent checks are used (Churchfield et al. 1997, Anonymous 1998, McCay et al. 1998, Rychlik 2000). Difference in mortality rate was compared between the standard number of checks (every 12 hours) and a double number of checks (sunrise, noon, sunset, midnight). For this comparison, results from another study plot (see above) obtained using the Chmela-type live traps in 2006 were used. Judging from Table 2, the mortality of *Apodemus flavicollis* was 17 times lower when carrying out four checks per day. In the case of *Myodes glareolus*, the mortality was four times lower when carrying out four checks. This fact should be considered when rare mammal species are studied or the study is performed in an area of special interest. During freezing days the cotton bedding was provided which practically reduced the mortality to zero.

O t h e r   c o m m e n t s

Besides lower mortality, more frequent checks must have also influenced total density calculated using the number of captured animals, regardless of the calculating procedure. The use

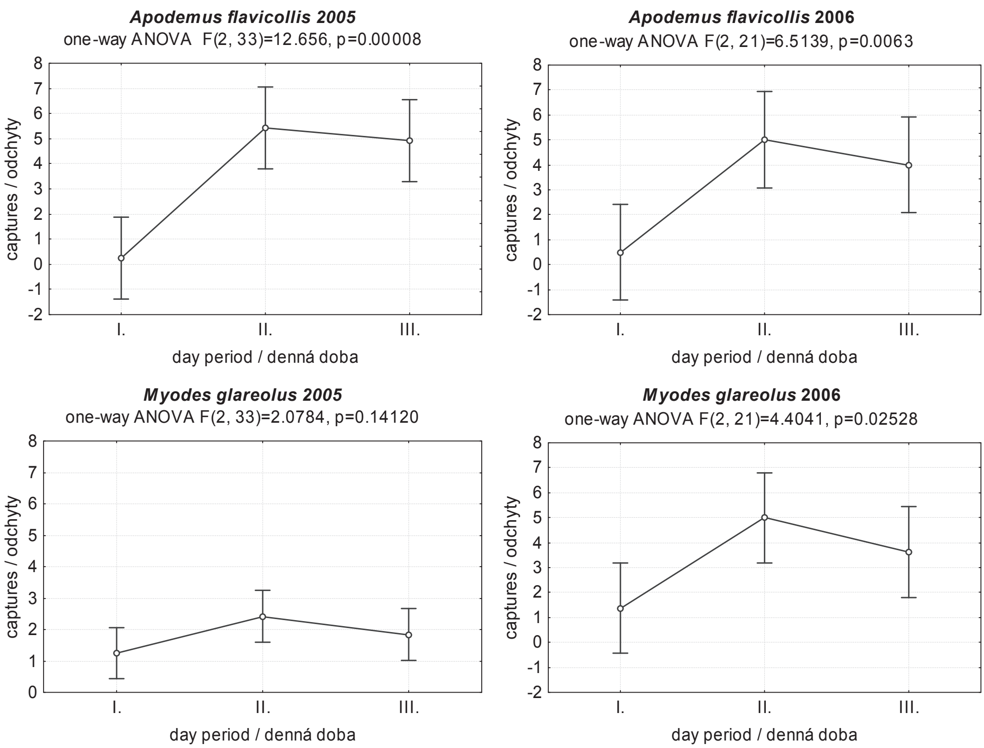

Fig. 2. Influence of the time of day on capture frequency in two rodent species in 2005 and 2006; I. = day, II. = sunset-midnight, III. = midnight-sunrise.
Obr. 2. Vplyv dennej periódy na frekvenciu odchytu dvoch druhov hlodavcov v r. 2005 a 2006; I. = deň, II. = súmrak-polnoc, III. = polnoc-svitanie.

of double checks may reflect a similar effect as when using a double number of traps on each trapping point. During one night, two different individuals might be captured in the same trap. Therefore, comparability of the results obtained by using a different number of checks seems to be questionable.

SÚHRN

V rokoch 2005–2006 bol počas dvoch vegetačných období uskutočnený výskum drobných zemných cicavcov v podmienkach jedľovo-bukového lesa. Cieľom bolo odhaliť vplyv niektorých metodických postupov na efektivitu odchytu a mortalitu vybraných druhov mikromamálií. Sledovala sa aj efiktivita odchytov v rôznych častiach dňa. Použité boli 2 typy živolovných pascí – drevené pasce typu Chmela a pre hmyzožravce aj zemné pasce (iba v r. 2005) s hĺbkou 18 cm a priemerom 11 cm. Spolu bolo v pasciach typu Chmela uskutočnených 203 odchytov *Apodemus flavicollis* a 138 odchytov *Myodes glareolus*. Okrem týchto dominantných druhov bolo uskutočnených len 6 odchytov iných druhov (*Sorex araneus*, *Sorex minutus*, *Neomys anomalus*). Priemerná efektivita odchytu v pasciach typu Chmela predstavovala 37,27 %. Naproti tomu do zemných pascí boli odchytené v r. 2005 iba 3 jedince (z toho len 1 hmyzožravec), čo predstavuje efektivitu 0,56 %. Porovnávaná bola mortalita dvoch druhov hlodavcov pri dvoch (skoré ráno, neskoré popoludnie) a štyroch (skoré ráno, poludnie, súmrak, polnoc) kontrolách pascí v priebehu 24 hodín. Mortalita *Apodemus flavicollis* bola 17× nižšia pri štyroch kontrolách oproti dvom. U druhu *Myodes glareolus* bola mortalita pri štyroch kontrolách päťnásobne nižšia oproti štandardným dvom kontrolám. Pri porovnávaní dvoch druhov návnady (ovsené vločky, granule pre mačky) nebol zistený signifikantný rozdiel v ich preferovaní u dvoch dominantných druhov hlodavcov. Pri vnadení kombináciou oboch návnad boli vo všetkých prípadoch konzumované prednostne granule. Druh *Apodemus flavicollis* prejavoval signifikantný rozdiel v aktivite medzi dňom a nocou, pričom väčšia aktivita bola zaznamenaná v prvej polovici noci (od súmraku do polnoci). Aktivita u druhu *Myodes glareolus* bola vyrovnanejšia a signifikantný rozdiel bol iba medzi dňom a prvou polovicou noci v r. 2006. Aj u tohto druhu sa väčší počet jedincov odchytil v prvej polovici noci.

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