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Harvest mice *Micromys minutus* and common dormice *Muscardinus avellanarius* live sympatric in woodland habitat

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In an overgrown clearing, which occupied an area of 5 ha within mixed spruce-deciduous forest, 106 and 20 nests of the harvest mouse *Micromys minutus* (Pallas, 1771) and 81 and 59 nests of the common dormouse *Muscardinus avellanarius* (Linnaeus, 1758) were recorded in the fourth and fifth years after clear-felling, respectively. The highest densities of nests of *M. minutus* and *M. avellanarius* were 46 nests/ha and 39 nests/ha, respectively, in two different plots. The affinity between *M. minutus* and *M. avellanarius* was negative in overgrown clearings according to the distribution of their nests. Such a result was expected because *M. minutus* and *M. avellanarius* used different nest supporting plants: *M. minutus* used tall grasses, while *M. avellanarius* used young trees and shrubs. However, no positive relationship was found between the number of nests of *M. minutus* and cover of grass vegetation in plots with the highest density of nests of *M. minutus*. Most nests of *M. minutus* were situated in areas covered by young trees among which tall grasses, mainly *Calamagrostis epigeios*, grew, often on the borders with the areas covered by grass vegetation. The successionary stage when woody vegetation reached 4–5 years old did not choke grass vegetation yet was favourable for both *M. minutus* and *M. avellanarius* in overgrowing clearings.

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Introduction

The harvest mouse *Micromys minutus* (Pallas, 1771) and the common dormouse *Muscardinus avellanarius* (Linnaeus, 1758) have several similarities in their life histories. They both are adept climbers, able to exploit a three-dimensional environment, and they both make similar closed ball-shaped nests among vegetation above the ground. However, these two species usually live in completely different habitats.

M. avellanarius is a woodland species, which prefers early successional stages of woody vegetation (eg Bright and Morris 1990, Berg 1996). Their ball-shaped nests were found abundantly

in overgrown clearings, coppices, scrub vegetation, in bramble and other low-growing shrubs, particularly on forest edges (eg Wachtendorf 1951, Hurrell and McIntosh 1984, Berg 1996, Foppen *et al*. 2002).

M. minutus and their nests were found in a wide variety of open habitats. The preferred habitats of this species were tall, thick and rough grasslands and reed-beds mixed with grasses (Piechocki 1958, Böhme 1978, Trout 1978, Feldmann 2002, Haberl and Kryštufek 2003, Surmacki *et al*. 2005, Kuroe *et al*. 2007). They were often situated in wet places near water bodies (Kminiak 1968, Böhme 1978, Feldmann 2002). *M. minutus* occurred also in anthropogenic habitats such as fields of corn, rice or beet, weedy road ditches and hedgerows (Böhme 1978, Harris 1979, Spitzenberger 1999, Feldmann 2002).

M. minutus can also be found in woodland habitats such as willow and poplar forests near river banks, clearings, and the edges of humid forest (Piechocki 1958, Böhme 1978, Kryštufek and Kovačić 1984, Spitzenberger 1999). In Great Britain, *M. minutus* were recorded in scrub, woodland borders, young plantations, grassy rides between blocks of mature trees and hazel coppice (Harris 1979). However, despite many findings of *M. minutus* in woodland habitats, only two published records are known to us on the sympatric occurrence of *M. minutus* and *M. avellanarius*. Both species were recorded in overgrown clearings in two separate forests in Lithuania (Mažeikytė 1995, Ulevičius and Juškaitis 2003).

The aims of the present study are to analyse the localization of nests and the relationship of sympatric *M. minutus* and *M. avellanarius* in overgrown clearings within a forest tract and to discuss some peculiarities of occurrence of *M. minutus* in woodland habitats.

Study area

The study area was situated in mixed coniferous--deciduous forest in south-western Lithuania, Šakiai District (55°03'N, 23°04'E), at dormouse study site A, where long--term studies of *M. avellanarius* population were carried out (eg Juškaitis 2005, 2006). In winter 2001–2002, this area of about 5 ha (90 × 560 m) was clear-felled within the forest body (Fig. 1). The distances to the forest edges were 200 m and 350 m from the northern and southern ends of the clearing, respectively. The clearing was bordered by young birch *Betula* spp. dominated stand to the east, and was surrounded by mixed stands dominated by Norway spruce *Picea abies*, birches and black alder *Alnus glutinosa* from other sides.

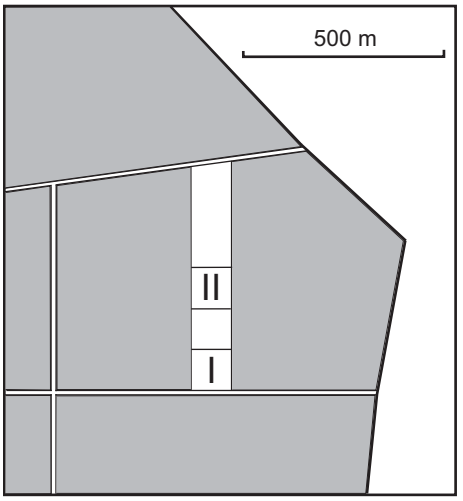

Fig. 1. Location of the overgrown clearing (white area) within the forest body (grey shaded area), and locations of plots I and II within the clearing.

In 2006, when the study was carried out, young trees and shrubs covered about 2/3 of the clearing area and grass vegetation covered about 1/3 of the area. Young birches *Betula pendula* and *B. pubescens*, aspen *Populus tremula* and glossy buckthorn *Frangula alnus* were prevalent among woody vegetation. Other abundant species were raspberry *Rubus ideus*, black alder, hazel *Corylus avellana*, and Norway spruce. Foresters have planted young oak *Quercus robur* trees and additional spruce trees.

Tall grasses grew among woody vegetation, where young trees were sparse enough, and *Calamagrostis epigeios* was dominant in dry places, while *Calamagrostis canescens* dominated wetter places; small areas were covered by *Deschampsia caespitosa*. All these grass species also grew in open areas, but they were absent in the wettest places, where *Scirpus sylvaticus*, *Filipendula ulmaria*, *Carex acutiformis*, *Juncus effusus* and *Iris pseudacorus* were prevalent in different plots.

Material and methods

The whole area of the clearing was divided into 10 × 10 m quadrats (n = 504) using a 10 m tape-measure in April 2006. The corners of all quadrats were marked with numbered labels. Searches for nests of *M. minutus* and *M.*

Table 1. Characteristics of two 90 × 100 m plots within an overgrown clearing in south-western Lithuania.

Characteristics	Plot I	Plot II
Total woody vegetation cover, %	63	63
Grass vegetation cover, %	33	36
Area covered by heaps of branches, %	4	1
Cover of *Betula* spp., %	27	10
Cover of *Frangula alnus*, %	3	27
Cover of *Picea abies*, %	< 1	4
Cover of *Rubus ideus*, %	12	6
Number of *M. minutus* nests found in 2005 and 2006	41 and 8	10 and 2
Number of *M. avellanarius* nests found in 2005 and 2006	15 and 11	35 and 13

avellanarius were carried out in non-growing period: in April 2006, for nests from the previous year (2005), and in November 2006, for nests from the current year. The locations of all nests of *M. minutus* and *M. avellanarius* found were mapped with an accuracy of 1 metre on the schemes. Grass nests of *M. avellanarius* (classification by Wachtendorf 1951) were distinguished from nests of *M. minutus* by the lengthways fine shredded leaves of grasses in nests of *M. minutus*. The number of nests found was a minimum estimate because some nests could remain undetected.

In June 2006, percentage covers of woody plants and grasses were mapped in two 90 × 100 m plots (Fig. 1) which differed in the composition of woody vegetation and numbers of nests found (Table 1). Mapping of the vegetation was carried out in the marked 10 × 10 m quadrats, which were divided into smaller quadrats for easy application.

To analyse the relationship between *M. minutus* and *M. avellanarius*, expected numbers of 10 × 10 m quadrats with joint occurrence of nests of the two species were calculated according to the formula $J = n_A n_B / n_A + n_B$ (Fager 1957), where n_A is the total number of quadrats with occurrence of nests of *M. minutus*, and n_B is the total number of quadrats with occurrence of nests of *M. avellanarius*. Expected numbers of quadrats with joint nest occurrence were compared with the observed numbers of quadrats with occurrence of nests of both species.

Relations between the number of nests found and vegetation cover in quadrats of two plots were analysed using Spearman rank correlations. All statistical analyses were performed using the STATISTICA 6.0 program package (StatSoft 2001).

Results

In total, 126 nests of *M. minutus* and 140 nests of *M. avellanarius* were found in overgrown clearings in the fourth and fifth years after clear-felling (Table 2). *M. minutus* could find their way to the overgrown clearing surrounded by forest stands by travelling from the field along grassy rides, where nests of *M. minutus* were found near the northern end of the clearing in 2002. In 2005, there was a peak of abundance of *M. minutus* in the study area, and the number of nests found decreased significantly in 2006 ($\chi^2 = 58.70$, $p < 0.0001$, df = 1).

Nests of both species were distributed irregularly within the clearing (Fig. 2). In 2005, the highest density of nests of *M. minutus* was 45.6 nests/ha in plot I (Fig. 2a), whilst the highest density of *M. avellanarius* was 38.9 nests/ha in plot II (Fig. 2b). Although in some quadrats nests of *M. minutus* and *M. avellanarius* were situated only 1–2 m from each other, the observed numbers of quadrats with joint occurrences were significantly lower then the expected

Table 2. Numbers and densities of nests of *M. minutus* and *M. avellanarius* found in a 5 ha overgrown clearing in 2005 and 2006.

Years	Nests of *M. minutus*		Nests of *M. avellanarius*	
	Number	Density per ha	Number	Density per ha
2005	106	21.2	81	16.2
2006	20	4.0	59	11.8

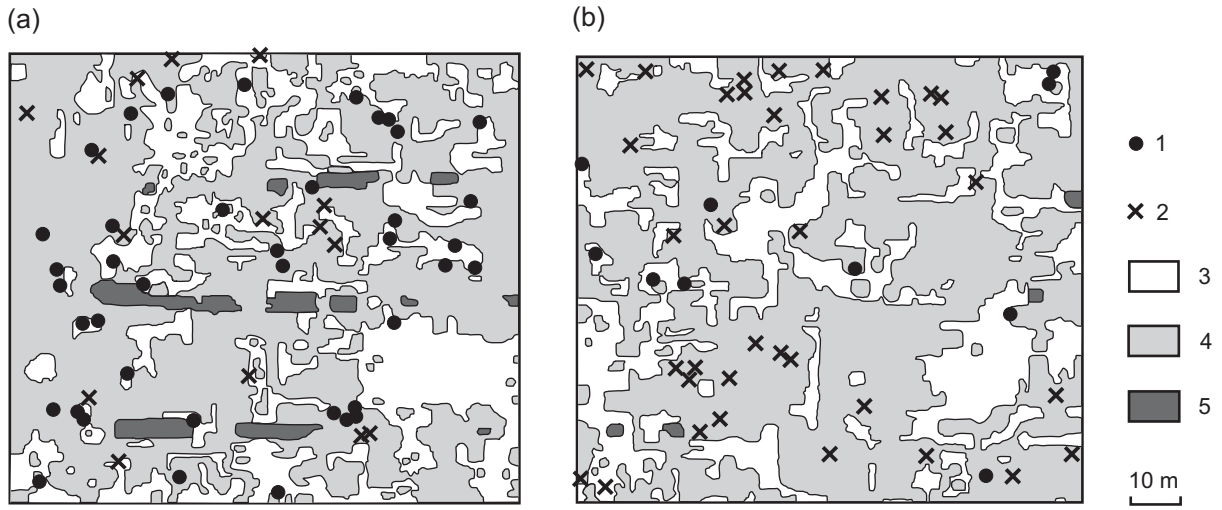

Fig. 2. Location of nests of *M. minutus* and *M. avellanarius* in two plots of an overgrown clearing in 2005: (a) plot I, (b) plot II. 1 – nests of *M. minutus*, 2 – nests of *M. avellanarius*, 3 – grass vegetation, 4 – woody vegetation, 5 – areas covered by heaps of branches.

numbers of such quadrats in plot I (4 quadrats vs 9 quadrats), in plot II (2 vs 7) and in the whole area of the clearing (12 vs 38).

Numbers of nests of *M. avellanarius* were positively correlated with the total woody vegetation cover in plot II ($r_s = 0.33$, $n = 90$, $p < 0.05$), where the highest density of nests was estimated. Young spruce trees were the preferred nest sites for *M. avellanarius* in plot II. It could be expected that numbers of nests of *M. minutus* would be positively correlated with percentage of grass vegetation cover. However, no significant relationships were found between the numbers of nests of *M. minutus* in 10 × 10 m quadrats and percentage of grass vegetation cover in two plots analysed ($r_s = –0.16$, $n = 90$, $p > 0.05$, and $r_s = 0.08$, $n = 90$, $p > 0.05$, respectively).

Discussion

In Lithuania, *M. minutus* have been recorded from woodland habitats many times, mostly in overgrown clearings (Mažeikytė 1995, Ulevičius and Juškaitis 2003, Juškaitis and Uselis 2005, R. Juškaitis, unpubl.), but also in black alder stands (Juškaitis and Ulevičius 2002, Juškaitis and Uselis 2005). In the year of peak abundance of *M. minutus*, four specimens of this species were trapped in dry clear-felled area within Scots pine *Pinus sylvestris* forest in the Viešvilė Strict Nature Reserve (Juškaitis and Uselis 2005), and it was the most unexpected record of *M. minutus* from woodland habitat.

Populations of *M. minutus* may undergo major irregular fluctuations from year to year (eg Kminiak 1968, Feldmann 1975, Trout 1978). According to Böhme (1978), *M. minutus* accidentally penetrate into woodland habitats, especially in years of high abundance, but it is a sub-optimal habitat for this species. Even the maximum density of nests of *M. minutus* found in plot I of the overgrown clearing in Lithuania (45.6 nests/ha) was significantly lower than densities found in other studies: 93.4 nests/ha and 156.3 nests/ha in reeds mixed with grasses in Poland (Surmacki *et al*. 2005), 80–176 nests/ha in rough grasslands in Great Britain (Trout 1978), 95–225 nests/ha in different open habitats in the Khabarovsk region of Russia (Trout 1978), 66–337 nests/ha in habitats dominated by *Phragmites* and *Carex* communities in Slovakia (Kminiak 1968), and 53 breeding nests/ha in habitat dominated by *Phalaris arundinacea* in Germany (Feldmann 1975).

Among small mammals living in open habitats, *M. minutus* is distinguished by its ability to use the three-dimensional environment for feeding and nesting. For example, there was no clear pattern or trend in niche overlap between *M. minutus* and eight other small mammal species from the reed-bed habitat (Haberl and Kryštufek 2003). However, in a series of eight grassland plots of different successional stages, niche overlap was least between *M. minutus* and the wood mouse *Apodemus sylvaticus* (Churchfield *et al*. 1997). *M. minutus* avoided the mid-successional stage (10 years old), where trees and shrubs occurred, maybe because of its sparser and more open ground cover, whereas *A. sylvaticus* preferred it (Churchfield *et al*. 1997).

M. avellanarius is another woodland species able to exploit a three-dimensional environment, and competition between *M. minutus* and *M. avellanarius* may be expected when they live sympatrically. In the overgrown clearing, a negative relationship was found between *M. minutus* and *M. avellanarius* according to the localisation of their nests. Such a result was expected, because *M. minutus* and *M. avellanarius* have different requirements for nest supporting plants: *M. minutus* use tall grasses for this aim mostly, while *M. avellanarius* make nests in young trees and shrubs.

However, most nests of *M. minutus* were situated in the areas covered by woody vegetation, where tall grasses, mainly *Calamagrostis epigeios*, grew among young trees, often on the borders with the areas covered by grass vegetation. In many open areas, grasses were too low for nests of *M. minutus*, as also observed by Feldmann (1975). It seems that most open areas in the overgrown clearing were unsuitable (eg too wet) for both young woody vegetation and tall grasses. The successionary stage when woody vegetation was 4–5 years old did not choke grass vegetation yet was favourable for both sympatric living *M. minutus* and *M. avellanarius* in overgrown clearings.

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