

Small mammals in northern Lithuania: species diversity and abundance

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Investigations were done in 2008 during August–November in northern Lithuania: the Kamanos Strict Nature Reserve (SNR), the Žagarė Regional Park (RP) and in eight other administrative districts. Small mammals were snap-trapped using lines from 15 to 50 snap traps. In total, 1 149 small mammals of 13 species were trapped. Bank vole (*Myodes glareolus*) was the dominant species (29.3%) of the total catch, while yellow-necked mouse (*Apodemus flavicollis*) and striped field mouse (*Apodemus agrarius*) were subdominants (19.9% and 13.8%, respectively). The rarest species with a less than 2% share were as follows: water shrew (*Neomys fodiens*), house mouse (*Mus musculus*), pygmy field mouse (*Apodemus uralensis*), harvest mouse (*Micromys minutus*) and northern birch mouse (*Sicista betulina*). The forest and meadow habitats were dominated by bank vole and subdominated by yellow-necked mouse (35.7% and 19.9% of total catch in the mentioned habitats), while in agricultural habitats dominant was common vole (*Microtus arvalis / rossiaemeridionalis*) and subdominant was striped field mouse (32.4% and 24.2%). All 13 small mammal species were trapped in forest and meadow habitats, but only nine species were trapped in agricultural habitats. Pygmy field mice were recorded in the Žagarė RP and the Kamanos SNR only. Northern birch mouse was trapped in Rokiškis municipality, near the Juodupė village.

Key words: northern Lithuania, small mammals, species diversity, relatively abundance

INTRODUCTION

Communities of small mammals in northern Lithuania were studied in several districts: Mažeikiai (Juškaitis, Baranauskas, 2001), Akmenė (Kamanos SNR) (Mačiulis, 2002), Joniškis (Žagarė Botanical-Zoological Reserve (BZR)) (Maldžiūnaitė, 1980) and Zarasai (Balčiauskas, Gudaitė, 2006). We chose the northern part of Lithuania, because very few studies on small mammals have been done here in the last decade.

The area studied borders on the Latvian Republic where no root vole (*Microtus oeconomus*) has been detected (Zorenko, 2008). However, this species occurs in northern Lithuania (Balčiauskas et al., 1999; Juškaitis, Baranauskas, 2001; Mačiulis, 2002). Pygmy field mouse (*Apodemus uralensis*) in Latvia is distributed unevenly (Mitchell-Jones et al., 1999), whereas in Lithuania it is sparsely detected only in its north-western (Juškaitis et al., 2001) as well as northern (Mačiulis, 2002) and north-eastern (Balčiauskas, Gudaitė, 2006) parts. Therefore, the aim of our study was not only to investigate small

mammal species diversity and abundance, but also to collect new data on pygmy field mouse and root vole in northern Lithuania.

MATERIALS AND METHODS

For our studies, small mammals were caught in northern Lithuania's administrative districts of Plungė, Mažeikiai, Akmenė, Joniškis, Pakruojis, Biržai, Rokiškis, Zarasai, Kupiškis and Anykščiai (Fig. 1). Investigations in the districts of Joniškis and Akmenė were performed in protected areas. Catching was performed in 2008 from August to November by standard snap trapping in lines, where traps were set at a 5-m distance from each other. Slightly dried bread soaked with sunflower oil was used as a bait (Balčiauskas, 2004).

The traps in lines were held from 1 to 3 days, checking them once per 24 hours. Taking into account the specificity and size of habitats, 15 (mixed forest habitats) to 50 traps (meadow-agricultural biotopes) were set. In total, during this catching period, 58 trap-lines were set in 13 different biotopes: mixed forest (11 lines), forest ecotone (6 lines), forest

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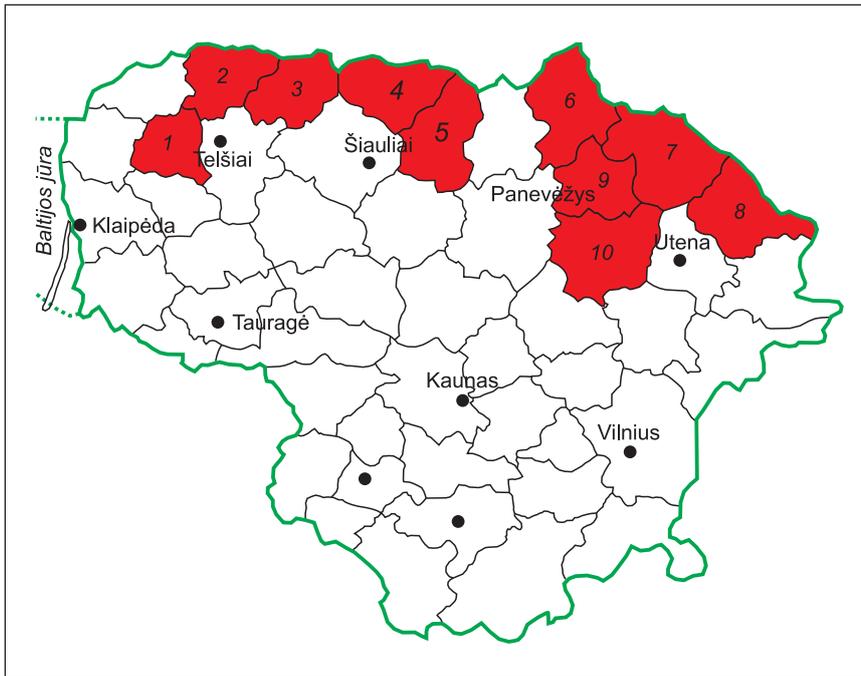


Figure. Locations of the study area in northern Lithuania: 1 – Plungė, 2 – Mažeikiai, 3 – Akmenė, 4 – Joniškis, 5 – Pakruojis, 6 – Biržai, 7 – Rokiškis, 8 – Zarasai, 9 – Kupiškis, 10 – Anykščiai districts

meadow (5 lines), forest wetland (4 lines), shrubby meadow (7 lines), natural meadow (6 lines), cultural meadow (3 lines), re-growing clear-cut (4 lines), forest culture (4 lines), abandoned homestead (4 lines) habitats, as well as inside the farm buildings (1 line), in pasture among silage (2 lines) and straw rolls (1 line).

During the catching period, 4444 trap-days were set. The relative abundance of small mammals was calculated based on the individuals caught during the first 24 hours (ind / 100 trap-days). Their species composition and diversity indices were calculated from one to three days results on the three-day results. The distribution of small mammals in the area was assessed according to their frequency of occurrence, i. e. the percentage of trap lines where individuals of a certain species were caught. The Shannon (H) index and the Simpson (c) index (Krebs 1999; Balčiauskas, Juškaitis, 1997) were used to characterise the species diversity of the small mammal communities.

The sibling species are difficult to distinguish by the classical morphological features that are used in the systematics of the genus *Microtus*. For this reason, we did not identify which vole species – *M. arvalis* or *M. rossiaemeridionalis* – were trapped. Therefore this species was not separated and was noted as *M. arvalis / rossiaemeridionalis* in the paper.

RESULTS AND DISCUSSION

Diversity of small mammal species and their biotope distribution

The catch by snap trapping during the study resulted in 1 149 small mammals belonging to 13 species: common shrew (*Sorex araneus*), pygmy shrew (*Sorex minutus*), water shrew (*Neomys fodiens*), bank vole (*Myodes glareolus*), field vole

(*Microtus agrestis*), common / sibling vole (*Microtus arvalis / rossiaemeridionalis*), root vole (*Microtus oeconomus*), harvest mouse (*Micromys minutus*), striped field mouse (*Apodemus agrarius*), yellow-necked mouse (*Apodemus flavicollis*), pygmy field mouse (*Apodemus uralensis*), house mouse (*Mus musculus*) and northern birch mouse (*Sicista betulina*).

Bank vole was the dominant species (29.3%), while yellow-necked mouse and striped field mouse were subdominants (19.9% and 13.8%, respectively). In 2008 the yellow-necked mouse in northern Lithuania was more frequent than in the earlier investigation in which, in similar habitats, they make 9.1–12.6% of all small mammal species (Maldžiūnaitė, 1980; Ulevičius et al., 2002; Juškaitis, Baranauskas, 2001; Mačiulis, 2002).

Among the rarer species that comprised less than 2% of all small mammals caught, there were water shrews, house mice, pygmy field mice, harvest mice and northern birch mice (Table 1).

Bank voles (35.7%) and yellow-necked mice (19.9%) topped the catches in the natural (shrubby, forest, natural meadows, mixed forests, forest ecotone, re-growing clearcuts, forest culture areas, and forest wetlands) habitats. Agricultural habitats (cultural meadows, abandoned homesteads, farm buildings, silage and straw rolls) were dominated by common / sibling voles (32.4%) and striped field mice (24.2%). During the present study, all 13 species were caught in forest and meadow habitats, and 9 small mammal species were caught in agricultural landscapes.

The highest number of small mammal species was found in shrubby and forest meadow habitats (11 and 10 species were in the catch, respectively). The lowest number of species was detected in the habitats of farm buildings (3 species) and straw rolls (2 species).

Table 1. Number of small mammals trapped in different habitats in northern Lithuania in 2008 (ind.)

Species / Habitats	NM	SM	CM	AF	RC	PYF	FW	MF	FM	FE	SR	STR	FB	N	%
<i>Sorex araneus</i>	12	18	5	9	3	16	25	10	30			2		130	11.3
<i>S. minutus</i>	2	1	1	2		5	15	3	12					41	3.6
<i>Neomys fodiens</i>		1			1		3	7	1					13	0.9
<i>Myodes glareolus</i>	13	13	2	12	39	7	38	166	21	26				337	29.3
<i>Microtus agrestis</i>	4	2	2	5	7		8	6	11					45	3.9
<i>M. arvalis / rossiae-meridionalis</i>		9	4	1		1				7	16	58		96	8.4
<i>M. oeconomus</i>	29	4		6	1	7	3	1	17					68	5.9
<i>Micromys minutus</i>	2					1			1					4	0.3
<i>Apodemus agrarius</i>	42	7	7	5	3	8	2	21	5	12	42	4	1	159	13.8
<i>A. flavicollis</i>	25	13	5	36	16	17	22	62	13	12		1	7	229	19.9
<i>A. uralensis</i>	1	3				8		1	1					14	1.2
<i>Sicista betulina</i>		1												1	0.1
<i>Mus musculus</i>				1			1						10	12	1.0
Total	130	72	26	77	70	70	117	277	112	57	58	65	18	1149	100.0
Number of species	9	11	7	9	7	9	9	9	10	4	2	4	3	13	
Shannon index, H	2.51	2.91	2.59	2.39	1.85	2.8	2.53	1.76	2.79	1.83	0.84	0.64	1.23	2.88	
Simpson index, c	0.21	0.15	0.18	0.27	0.37	0.16	0.2	0.41	0.16	0.31	0.6	0.8	0.46	0.17	

NM – natural meadows, SM – shrubby meadows, CM – cultural meadows, AF – abandoned farmstead, RC – re-growing clearcut, PYF – planted young forest, FW – forest wetlands, MF – mixed forest, FM – forest meadows, FE – forest ecotone, SR – silage rolls, STR – straw rolls, FB – farm building.

In 2008, in northern Lithuania, the small mammal species diversity index H reached 2.88 and was among the highest values in all studies done in northern Lithuania. A higher species diversity index was obtained in northern Lithuania in the Mažeikiai district in 2000 (H = 2.91) (Juškaitis, Baranauskas, 2001). However, in other investigated areas of northern Lithuania, the species diversity index (H) was lower (fluctuated from H = 1.67 in the Žagarė BZR to H = 2.47 in the Žemaitija National Park (NP)) (calculated according to Maldžiūnaitė, 1980; Ulevičius et al., 2002).

For different biotopes, the highest index of species diversity was determined in shrubby (H = 2.91) and forest (H = 2.79) meadows. The diversity was lower in forest wetlands (H = 2.53) and mixed forests (H = 1.76). Such a decrease of the diversity index from meadows to forest habitats is typical; therefore, meadows are small-sized, and forest species are also trapped in such meadows.

The lowest values of this index were determined for agrarian landscape: H = 0.84 in silage rolls and H = 0.64 in straw rolls (Table 1).

Relative abundance of small mammals and their frequency of occurrence

The average abundance of small mammals reached 25.9 ind. / 100 trap-days and was lower than that in northern Lithuania (Žagarė BZR) in the earlier study in which the average abundance of small mammals was 56 ind. / 100 trap-days (Maldžiūnaitė, 1980), but it is higher than in the Žemaitija NP in 1997 (18.2 ind. / 100 trap-days) (calculated according to Ulevičius et al., 2002). A very similar average abundance of small mammals was found in Mažeikiai district in 2000 (25.1 ind. / 100 trap-days) (calculated according to Juškaitis, Baranauskas, 2001).

In different habitats, the mean relative abundance index for small mammals ranged from 10.6 (cultural meadows) to 47.9 (mixed forests) ind. / 100 trap-days.

The highest relative abundance of small mammals was determined in forest wetlands (up to 68 ind. / 100 trap-days), while the lowest abundance was obtained in cultural meadows (3.8 ind./100 trap-days.) (Table 2).

The relative abundance of small mammals in northern Lithuania in 2008 was higher than in eastern Latvia (Teiči Nature Reserve (NR)) where the average values in meadows and forests reached, respectively, 24.4 and 16.6 ind. / 100 trap-days in September (Pupila, Bergmanis, 2006).

Among three insectivore species, the most abundant were common shrews; their relative abundance in natural meadows reached 26.7 ind. / 100 trap-days. Pygmy shrews were most abundant in forest wetlands, while water shrews were more numerous in mixed forests. Common shrews were caught in more than a half of trap lines (51.7%); the frequency of occurrence of pygmy and water shrews was lower (Table 3).

Among the mice caught, the yellow-necked mouse showed the highest frequency of occurrence (caught in 48 trap lines from the total of 58). This was the second most abundant species of small mammals in northern Lithuania in 2008. Their highest relative abundance was detected in shrubby meadows and abandoned homesteads, where it reached 20.8 ind. / 100 trap-days. The highest relative abundance of yellow-necked mouse was similar in Mažeikiai district in 2000 (Juškaitis, Baranauskas, 2000). However, the highest relative abundance of yellow-necked mouse could be very different in other years (Ulevičius et al., 2002).

Striped field mouse was distinguished by a high frequency of occurrence that made up 48.3% (caught in 28 trap lines),

Table 2. Relative abundance of small mammals in different habitats of northern Lithuania in 2008

Habitats	Number of trap-lines (N)	Mean \pm SE	min-max
Mixed forest	11	47.9 \pm 4.24	20.0–60.0
Forest ecotone	6	18.7 \pm 4.34	8.0–32.0
Forest wetlands	4	37.0 \pm 13.71	4.0–68.0
Planted young forest	4	36.5 \pm 12.59	12.0–65.0
Re-growing clearcut	4	31.5 \pm 3.33	24.0–40.1
Forest meadows	5	33.9 \pm 3.78	22.5–40.0
Natural meadows	6	31.6 \pm 7.84	12.0–62.5
Shrubby meadows	7	22.0 \pm 5.55	4.0–37.5
Cultural meadows	3	10.6 \pm 4.85	3.80–20.0
Abandoned farmstead	4	22.8 \pm 5.06	15.0–37.5
Silage rolls	2	22.5 \pm 7.50	15.0–30.0
Straw rolls	1	30.0	–
Farm buildings	1	12.0	–

Table 3. Maximum relative abundance of small mammals and their frequency of occurrence in northern Lithuania in 2008

Species	Habitats (with maximum relative abundance (ind / 100 trap-days))	Frequency of occurrence (%)
<i>Sorex araneus</i>	Natural meadow (26.7)	51.7
<i>S. minutus</i>	Forest wetland (12)	25.9
<i>Neomys fodiens</i>	Mixed forest (5)	17.2
<i>Myodes glareolus</i>	Mixed forest (55)	79.3
<i>Microtus agrestis</i>	Forest ecotone, re-growing clearcut, forest wetland, forest meadow (12)	32.8
<i>M. arvalis / rossiaemeridionalis</i>	Silage rolls (22)	20.7
<i>M. oeconomus</i>	Natural meadow (15.4)	32.8
<i>Micromys minutus</i>	Natural meadow (2.5)	5.2
<i>Apodemus agrarius</i>	Natural meadow (55)	48.3
<i>A flavicollis</i>	Shrubby meadow, abandoned farmstead (20.8)	82.3
<i>A uralensis</i>	Planted young forest (10)	10.3
<i>Sicista betulina*</i>	Shrubby meadows (–)	1.7
<i>Mus musculus</i>	Farm building (8)	5.2

* This single individual was not caught during the first 24 hours.

while its relative abundance in natural meadows reached 55 ind. / 100 trap-days (Table 3).

The lowest frequency of occurrence was observed for house mouse and harvest mouse. Individuals of these species were caught only in three trap lines (only 5.2% each). However, the maximum relative abundance of house mouse was higher and reached 8 ind./100 trap-days. Similarly as in other areas of Lithuania, the house mouse in northern Lithuania was more abundant in human-dwelling environments (the relative density was highest in buildings), but they are rare in natural habitats (Ulevičius et al., 2002; Ulevičius, Juškaitis, 2003).

The maximum relative abundance of harvest mouse in natural meadows reached 2.5 ind. / 100 trap-days. A similar abundance of this species had been detected in other areas of Lithuania: 4 ind. / 100 trap-days in Kuršių Nerija NP (Juškaitis, Ulevičius, 2002) and only 2 ind. / 100 trap-days (to 8 ind. / 100 trap-days during their peak years) in Viešvilė SNR (Juškaitis, Uselis, 2005).

Bank vole is usually a dominating small mammal species in forests (Prūsaitė et al., 1988). Small mammal studies in

northern Lithuania were mainly performed in forest or near-forest habitats; therefore, this species was dominant among small mammals in the present study. The frequency of bank vole occurrence reached 79.3% (caught in 46 trap lines from the total of 58); according to this indicator, the bank vole succumbs only to the yellow-necked mouse. The highest relative abundance of bank vole was registered in mixed forests and reached 55 ind. / 100 trap-days.

Voles of other species – field and common / sibling vole – were rarer if compared to the bank vole. The frequency of occurrence of field and common vole in northern Lithuania reached, respectively, 32.8% and 20.7%. The maximum relative abundance of field vole was observed in four habitats: forest–field ecotone, re-growing clearcut, wetlands and forest meadows (12 ind. / 100 trap-days). Most individuals of common / sibling voles were caught in the anthropogenic environment – silage rolls (22 ind./100 trap-days (Table 3). Earlier studies had shown that the abundance of field and common vole differed with the study site. The field vole was more abundant than the common vole in the Žagarė BZR and the Žemaitija NP (Maldžiūnaitė, 1980; Ulevičius et al., 2002). The common vole in Mažeikiai

district and in the Kamanos SNR was more abundant than the field vole (Juškaitis, Baranauskas, 2001; Mačiulis, 2002). On the other hand, these differences depend also on the year.

New sites of root vole, pygmy field mouse and northern birch mouse in northern Lithuania

In 2008, 68 root voles (5.9% of total catch) were caught in northern Lithuania (Table 1). The majority of root voles were caught in the Žagarė RP (39 ind.) and in the Kamanos SNR (28 ind.) in natural non-hayed meadows, where their relative abundance reached 15.4 ind. / 100 trap-days. Earlier, no root voles had been caught in the Žagarė BZR (Maldžiūnaitė, 1980), while in the Kamanos SNR they made up only 0.5% of all small mammals (among 222 individuals caught, there were only 1 root vole) (Mačiulis, 2002). The abundance of root vole in northern Lithuania was high in 2008, but it could be lower in other years.

The root vole frequency of occurrence was 32.8% (Table 3), i. e. it was higher than in the Žemaitija NP in 1997 (14.3%) (Ulevičius et al., 2002).

The previous investigations had shown that the root vole was very rare in the northern part of Lithuania. Their relative abundance in the Žemaitija NP was about 4 ind. / 100 trap-days (Ulevičius et al., 2002). Root voles made up only 0.1% in Mažeikiai district (Juškaitis, Baranauskas, 2001) and 0.2% in Zarasai district (Balčiauskas, Gudaitė, 2006) among all small mammals caught.

Rodents of this species can be caught in the northern part of Lithuania close to the border with the Latvian Republic, but they are not detected in the latter area (Zorenko, 2008). Therefore, additional investigations to be performed seem to reveal root voles in Latvia, especially in its southern part.

During the investigations, pygmy field mice were also caught, since this species of small mammals is typical of northern and western Lithuania (Juškaitis, 2003; Juškaitis, Baranauskas, 2001; Juškaitis et al., 2001). All in all, 14 pygmy field mouse individuals were caught (1.2% of all individuals caught) (Table 1). Individuals of this species were caught in each one of 10 trap lines (the frequency of occurrence was 10.3%) (Table 3). Pygmy field mice were caught only in the Žagarė RP (12 ind.) and in the Kamanos SNR (2 ind.). Their highest relative abundance in the Žagarė RP was in the forest culture areas (up to 10 ind./100 trap-days). The Žagarė RP is a new locality of pygmy field mouse in Lithuania. Individuals of this species in the Kamanos SNR made 1.4% of all small mammals caught, and they were rarer here in 2008 than during the earlier observations (in 1999–2001 they made 6.8% of the total small mammals caught) (Mačiulis, 2002). Although 44 individuals of *A. uralensis* had been caught in Mažeikiai district in 2000 (Juškaitis, Baranauskas, 2001), in our study this rodent species was not detected, possibly because in Mažeikiai district small mammals were caught in not typical habitats of pygmy field mouse (deep in the forest).

In 2008, pygmy field mice were caught in five different habitats: forest culture areas, natural meadows, forest mead-

ows, shrubby meadows and mixed forests. It should be noted that all these habitats are close to a forest edge. A similar distribution of pygmy field mice was observed in other areas of Lithuania in which investigations of this species were carried out. This is an 'ecotone' rodent species, since it is rarely caught deep in a forest or far away from the forest edge (Juškaitis et al., 2001).

In Latvia, pygmy field mouse is found nearly in all areas of the republic (Mitchell-Jones et al., 1999), but it is rare. Mice of this species in Teiči NR (eastern Latvia) were caught mostly in mixed forests (Pupila, Bergmanis, 2006).

A northern birch mouse also ran into a trap once. A mature male of this protected species of small mammals was caught in Rokiškis district at the settlement of Juodupė in a shrubby meadow on 5 September 2008. This species is included into the Lithuanian Red Data Book (Rašomavičius et al., 2007).

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SMULKIEJI ŽINDUOLIAI ŠIAURĖS LIETUVOJE: RŪŠINĖ ĮVAIROVĖ IR GAUSUMAS

Santrauka

Smulkieji žinduoliai buvo gaudomi mušamaisiais spąsteliais 2008 m. rugpjūtį–lapkritį. Tyrimai atlikti Šiaurės Lietuvoje – Žagarės regioniniame parke (RP), Kamanų gamtiniame rezervate (GR) bei aštuoniuose administraciniuose rajonuose. Iš viso sugauti 1 149 individai, priklausantys 13 rūšių. Vyraujanti rūšis buvo rudieji pelėnai – sudarė 29,3 % visų sugautų smulkiųjų žinduolių. Subdominantinės rūšys – geltonkaklės ir dirvinės pelės (sudarė atitinkamai 19,9 ir 13,8 %). Rečiausiai aptinkamos rūšys (mažiau nei 2 % visų sugautų individų) buvo vandeniniai kirstukai, naminės pelės, mažosios miškinės pelės, pelės mažylės ir beržinės sicistos. Miškų ir pievų buveinėse vyravo rudieji pelėnai (35,7 %) bei geltonkaklės pelės (19,9 %), o agrokultūrinėse buveinėse – paprastieji pelėnai / pelėnai dvyniai (32,4 %) ir dirvinės pelės (24,2 %). Miškų ir pievų buveinėse į spąstelius įkliuvo visos tyrimo metu registruotos 13 rūšių. Agrarinėse buveinėse buvo sugauti 9 rūšių smulkieji žinduoliai. Tik Žagarės RP ir Kamanų GR buvo sugautos mažosios miškinės pelės. Vienas beržinės sicistos individas buvo sugautas Rokiškio rajone, netoli Juodupės miestelio.

Raktažodžiai: Šiaurės Lietuva, smulkieji žinduoliai, rūšinė įvairovė, santykinis gausumas