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SPATIAL DISTRIBUTION OF *APODEMUS FLAVICOLLIS* AND *A. AGRARIUS* IN A FOREST COMMUNITY *QUERCETUM-PETRAEA* ON MT. AVALA (SERBIA)

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ABSTRACT

Spatial distribution of Apodemus flavicollis and A. agrarius were studied in a forest community Quercetum-petraea at Avala mountain (Serbia). During this study (1996-1999), 381 individuals of A. flavicollis and 127 individuals of A. agrarius were marked. Our results suggest different exploitation of space within habitats. The areas most favored by A. flavicollis were those with a dense canopy of Quercus petraea. Individuals of A. agrarius inhabited the area with dense cover of Rubus hirtus. These associations with different kinds of cover indicate the spatial division of habitats shared by two studied species.

Introduction

A rodent community composed of the yellow-necked mouse *Apodemus flavicollis* (Melchior, 1834) and the stripped field mouse, *A. agrarius* (Pallas, 1771) is typical for forest habitat on Avala mountain. The yellow-necked mouse is characterized by a great mobility and is strongly dependent on the forest environment (1). The stripped field mouse is a species typical for the agricultural field-forest habitat mosaic (2).

The spatial distribution of small rodent species was analyzed by many authors (3, 4, 5). However, it is not entirely clear how individual species occupy the habitat when they co-occur, and how they interact.

Materials and Methods

The study was carried out in an oak forest (*Orno-Quercetum petraeae*) at Avala mountain (44º45' E, 18º10' N), located near Belgrade. On the study area (1 ha) the tree height was 10-20 m, with diameters ranging from 10-40 cm. Of the tree species, *Quercus petraea* predominated, accompanied by *Fraxinus ornus* and *Carpinus betulus*. The canopy cover was 70%. The middle-storey is well developed – cover 20-100% (0.5 -5 m height) composed mainly of *Acer campestre, Prunus avium* and *Tilia tomentosa*. The understorey and ground cover are variable, dominated by *Rubus hirtus* (10-100 % cover), while *Dacrylis glomerata, Lonicera caprifolium, Fragaria vesca, Galium aparine* are locally important.

Small mammals were trapped during a three year period (1996-1999). Square trapping grid of 100 points (10 x 10 m) was used, and a Longworth trap at each point. The capturing was performed every month, with a 4 days trapping period. The study was conducted by using the capture-mark-release (CMR) method. Each individual was marked by a combination of ear-punching and toe-clipping when trapped for the first time. Percentages of the trap station occupied were calculated for each trapping session. Population densities were estimated by Jolly-Seber method (6, 7).

The percentage of intra- and interspecific overlap (Ov %) in the trap use was calculated as: $Ov(\%) = \frac{Ns}{T}100$, Ns = number of traps shared by two or more individuals; T= total number of traps used (8). Distribution of captures on grid was used in extrapolating to the use of space by two studied species.

Results and Discussion

During the studied period we marked 508 individuals, (381 individuals of *A. flavicollis* and 127 individuals of *A. agrarius*). For all period, the ratio of males-to-females was 52.5% : 47.5% for *A. flavicollis* and 57.5% : 42.5% for *A. agrarius*. Total captures in a trapping session ranged from 7 to 45% of the possible capture opportunities for yellow-necked mouse and from 1 to 10% for striped field mouse.

Abundance of both species varied markedly over the period of the study. Maximal density of population of *A. flavicollis* was registered twice, in June 1997 (85 ind/ha), and in 1998 in the same period (47 ind/ha). Minimal density was registered in January 1999 (3 ind/ha). *A. agrarius* reached two peaks in April 1997 (21 ind/ha) and in September 1998 (32 ind/ha). Minimal density was registered in January 1998 (2 ind/ha). The relative abundance of these species changed considerably over the study period. From November 1996 to July 1998 the yellow necked mice predominated forming 77.4 - 90.2% of the community, but from September 1998 to January 1999 both species occurred in almost equal proportion.

The distributions of captures of *A. flavicollis* and *A. agrarius*, as a proportion of total captures, from 1996 to 1999, are illustrated in **Figure**. The individuals of yellow-necked mouse were caught at every quadrate, while the individuals of striped field mouse were not caught at 168 quadrates of the grid during the studied period.

TABLE 1

Chi-square values for frequency distribution of *A. flavicollis* (N=381) and *A. agrarius* (N=127) in four habitat subunits: A – Close canopy of mature *Quercus petraea*; B – Open canopy of mature *Quercus petraea, Fraxinus ornus* and *Carpinus betulus*; C – Very few mature trees, dense field layer of *Acer campestre, Prunus avium* and *Tilia tomentosa*; D – No mature trees, very dense *Rubus hirtus* (* P<0.001, ** P<0.01)**

	A. flavicollis	*A. agrarius*
A	96.8***	10.7
B	44.8**	13.7
C	5.2	57.3**
D	47.5	158.2***

The actual number of trapped individuals in each habitat subunit was compared with expected random distribution for studied species (**Table 1**). Statistically significant difference in distribution of *A. flavicollis* was found in areas with mature *Quercus petraea, Fraxinus ornus* and *Carpinus betulus*. The distribution of *A. agrarius* is statistically different from random distribution in habitat subunits with dense field layer and very dense *Rubus hirtus*.

The interspecific overlap in the trap use was generally low (**Table 2**). The highest values were observed in July (2%) and during the winter (November – January). Intraspecific overlap in trap use for *A. flavicollis* reached maximum in July (4.5%) and minimum in November (0.3%). The highest percentages were observed in the summer. During the studied period intraspecific overlap in the trap use for *A. agrarius* was smaller.

A. flavicollis and *A. agrarius* coexist within an *Orno-Quercetum petraeae* community on Avala mountain. The mature deciduous woodland is the favored habitat of *A. flavicollis*. This species as a seed specialist could be restricted to areas where sufficient species diversity occurs to ensure an adequate food supply each year (1). Striped field mice are commonly found in grassy fields, cultivated areas, rice paddies,

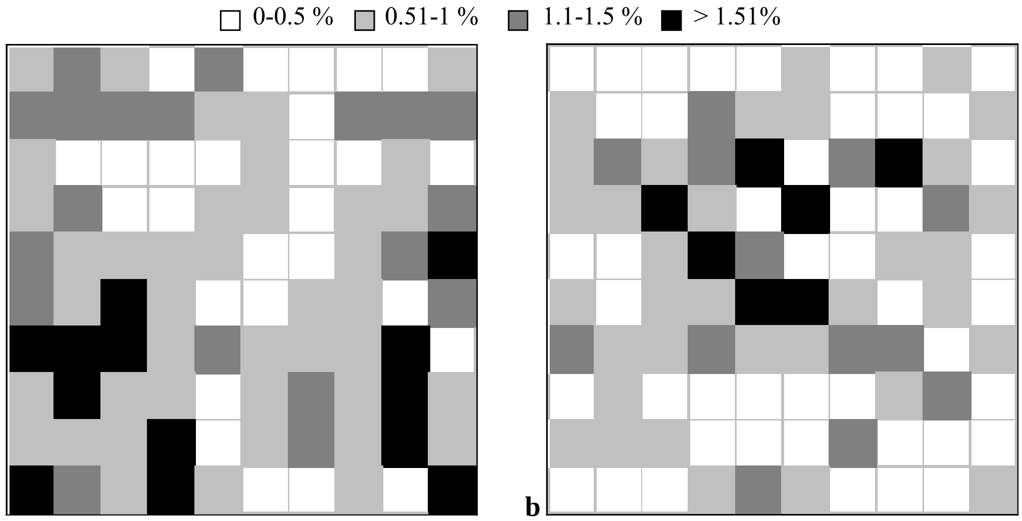

Figure. Proportion of total captures of *A. flavicollis* (a) and *A. agrarius* (b) at each trap point of the grid.

TABLE 2

Percentage of intra- and interspecific overlap in trap use among *A. flavicollis* (N=381) and *A. agrarius* (N=127)

Month	Inter-specific overlap	Intraspecific overlap for *A. flavicollis*	Intraspecific overlap for *A. agrarius*
I	1.7±0.92	1.3±0.72	0.3±0.20
II	0.3±0.17	1.2±0.85	0
III	0.3±0.26	0.5±0.26	0
IV	0	1.3±0.56	0.3±017
V	1.3±0.61	1.5±0.87	0
VI	1.0±0.40	3.3±1.05	0
VII	2.0±0.66	4.5±1.95	0.5±0.30
VIII	1.1±0.46	3.3±1.49	0.3±0.26
IX	1.0±0.36	3.3±0.96	0
X	0.3±0.20	1.4±0.60	0
XI	1.7±0.26	0.3±0.26	0
XII	1.8±0.78	1.8±0.85	0

woodlands and forests (9). Gliwicz (10) pointed out that *A. agrarius* holds an inferior position in the community and the other rodents strongly affect its population processes. The trophic niches of both studied species are very similar. They are granivorous and the seed and fruits of trees are their predominant food resource. Both species supplement their diet with invertebrates – animal food forming up to 20% of the whole food consumed in *A. flavicollis* and about 40% in *A. agrarius* (11, 12).

The analysis of spatial relationships was performed in order to discover whether both species inhabited the same patches of habitat. The percentage of interspecific overlap in the trap use among individuals of two studied species was generally low. Intraspecific overlap in the trap use is much bigger for *A. flavicollis* than for *A. agrarius*, and that could be explained by its higher density on the studied area. Our results indicate different exploitation of space within habitats. The areas most favored by *A. flavicollis* were those with a dense canopy of *Quercus petraea*. Individuals of *A. agrarius* inhabited area with dense cover of *Rubus hirtus*. These associations with different kinds of cover point out the spatial division of habitats shared by two studied species.

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