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Faunistical and Ecological Analysis of Small Mammals Species Diversity in Strandzha Natural Park

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Abstract: An ecological and faunistical analysis of local assambleges of small mammals in four major vegetation types in Strandzha Natural Park was carried out. Thirteen small mammal species, four of which from Insectivora and nine from Rodentia order, were determined. Species diversity and structure of terrestrial small mammal assemblages were characterized via indices of species diversity, dominancy and evenness. The standardized niche breadth, niche overlap, vegetation types preferrences, and avoidance of the extanted species were established. The highest diversity and evenness occur in mesic conditions with relatively diverse herb communities in the moist vegetation types. The antrophogenicaly influenced vegetation types preserve a reasonably high species diversity and stability of small mammals assemblages, which proves their 'intermediate disturbance'. The typical for Strandzha Natural Park primary mesophylic mixed deciduous forests have a low number of small mammal species because of the strongly expressed dominancy of wood mice. The carried out faunistical analysis proves the great conservational significance of Strandzha Natural Park due to its established high average species diversity.

Key words: rodents, shrews, assemblages structure, diversity indicies, Strandzha Natural Park

Introduction

The environmental factors, the landshaft's structure, and its heterogenity, as well as the the type of territory use determine the character of species diversity, structure of terrestrial small mammal's assemblages, and spatial distribution of the species' populations (Fahrig, Johnson 1998, Verboom *et al*. 1991, Knick, Rotenberry 2000).

Strandzha Mountain has specific geological, climatical, and biogeographical characteristics. It belongs to the European deciduous forest region, in Euxinian province (Takhtajan 1978). It is characterised with an ancient, mostly, mesofilous and, partly, hygrophilic deciduous forest vegetation with Euxinian floristic elements. This leads to the formation of characteristic ecosystems with a large biological diversity, in which, up till now, a considerable amount of natural and seminatural habitats have been established. This habitat's patchiness provides an opportunity to examine the effects of vegatation type on the structure of rodent's local assemblages and the response of species populations to different habitat types.

The purpose of the present investigation is to determine the level of species' diversity and to characterize the structure of small mammals' assemblages in major vegetation types (VT) in Strandzha.

Material and Methods

Study area

Nine site types (Fig.1), including four of the characteristic for Strandzha Natural Park (SNP) vegetation

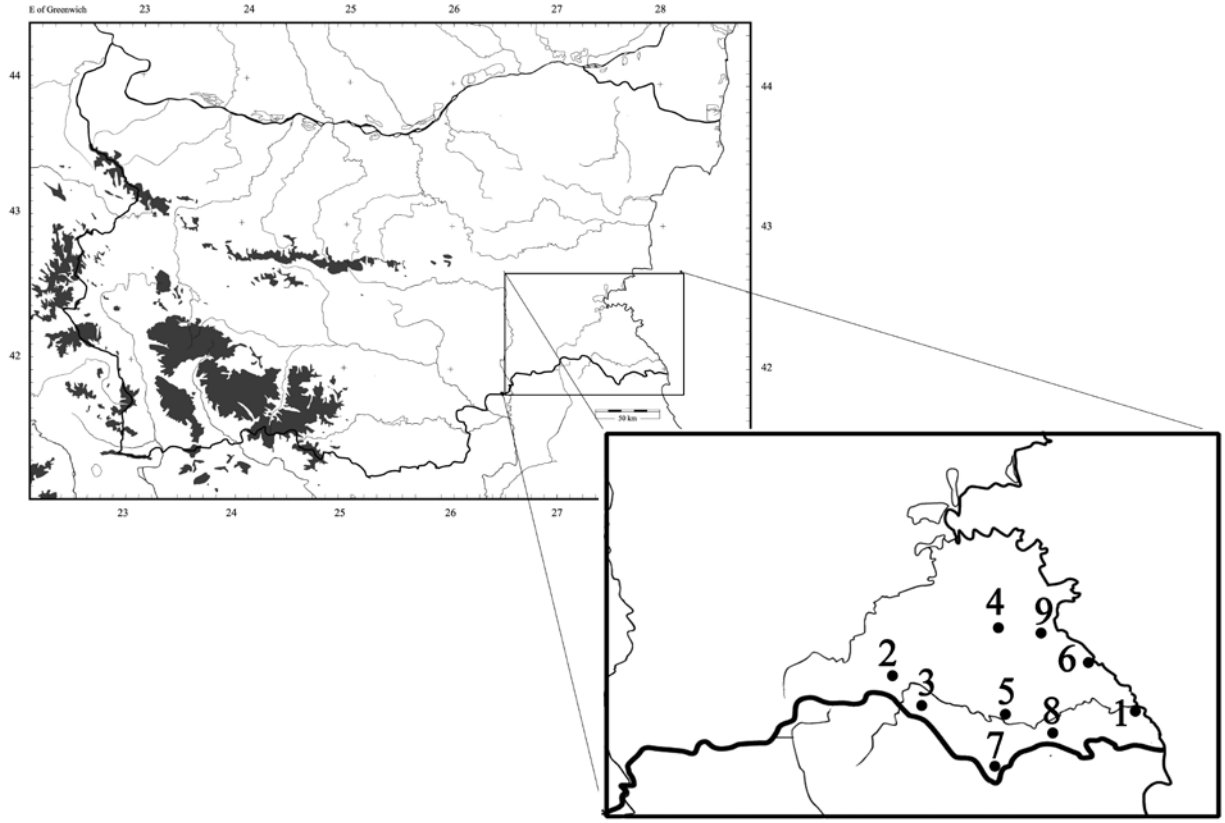

Fig. 1. Topographic location of the investigated site types:1 – outflow of the Veleka river (42° 4′ N. 27° 59′ E); 2 – Fakijska river banks near the Fakija village (42° 11′ N. 27° 5′ E); 3 – Gorno Yabalkovo village (42° 7′ N. 27° 6′ E); 4 – Novo Panicharevo village (42° 17′ N. 27° 33′ E); 5 – Gramatikovo village (42°3′ N. 27° 39′ E); 6 – Tsarevo town (42° 10′ N. 27°51′ E); 7- Malko Turnovo town (41° 59′ N. 27° 32′ E); 8 – Kosti village (42°4′ N. 27°47′ E); 9 – Pismenovo village (42° 13′ N. 27° 41′ E).

types have been investigated (Bondev 1991, Gruev, Kuzmanov 1994).

Vegetation type I – Riverside dense forests

It includes periodically overflowed riverside mixed deciduous forests, including *Querqus robur*, *Fraxinus oxycarpa, Populus alba, Populus nigra*, etc., and lianas. The herb cover has incostant content due to the periodical drying of the soil inbetween the overflows or its overmoisturizing during the overflows (Site types along Veleka and Fakijska river banks).

Vegetation type II – Open landscapes (meadow and pasture herb communities of nonzonal type, with a transitory or secondary origin and semishrub and shrub vegetation).

It consists of xerotermal herb communities, similar to steppe ones, with a larger amount of Mediterranean species, terrace-like desolate arable areas, surrounded by brushy mountain ridges, agrarian lands. (Site types: Gorno Yabalkovo, Novo Panicharevo, Gramatikovo).

Vegetation type III – **Artificial mixed forests**

It includes artificially planted mixed forests with a poor species' communities and a prevailing presence of coastal pine (*Pinus pinaster*). The herb understory in the denser and shady sites is poorly developed and consists of a small number of species. However, in the sparse and lighted sites, as well as on the periphery, the number of species drastically increases (Site types: Tsarevo, Malko Turnovo)

Vegetation type IV – Kolhid-Mediterranean type of deciduous forests.

It consists of mesophilous forest communities of *Fagus orientalis*, *Quercus frainetto* and *Quercus pubescens* with an evergreen Kolhidian understory of *Rhododendron ponticum*, *Laurocerasus officinalis*, *Daphne pontica*. (Site types: Kosti, Pismenovo).

Sampling and Trapping methods

All trapping occurred during each June for the five years of the study (2002 to 2006). The samples of local small mammal assemblages were taken by pitfall traps. They were placed in locations that had

a good probability of capture (e.g. beside logs, under stumps, along trails). The traplines (about 15 pitfall) were sampled using the same site types and methods each year.

Material

One thousand two hundred and seven (1207) individuals of thirteen species of small mammals from Insectivora (148) and Rodentia (1059) orders have been caught. The individuals were determined by speices and sex exept these of the sibling species (*Sylvaemus sylvaticus/Sylvaemus flavicolis* and *Microtus arvalis/Microtus rosiameridionalis*), which were determined only by genus due to the incapability to determine the species based on the external traits.

Data analysis

Small mammal capture data is expressed as relative abundance which is the number of individuals captured per 100 Pitfall Nights (PN). The dominance gradation scale (Kuziakin 1964) was used.

Small mammal diversity was assessed for vegetation types using Shannon-Wiener diversity index as a measure of predictability in a system or community (Krebs, 1989). The Simpson's index of dominancy (Simpson 1949), and Pielou's (1966) evenness index were used to compare the diversity of different vegetation types. Cluster analysis (agglomerative hierarchical) (SPSS 1993) was used to compare small mammal assemblages among vegetation types. Small mammal vegetation type preferences were interpreted using an electivity index (Ivlev 1961 in Krebs 1989).

Results

In the four investigated vegetation types, 13 small mammals species were established: four of Insectivora order – *Talpa levantis, Neomys anomalus, Crocidura suaveolens,* and *Crocidura leucodon*, nine of Rodentia order – *Sylvaemus* sp*., Apodemus agrarius, Mus macedonicus, Rattus rattus, Rattus norvegicus, Microtus* sp*., Microtus guentheri, Microtus subterraneus,* and *Dryomys nitedula.*

The wood mice (*Sylvaemus* sp.) compose 72.2% of the total number of animals caught in the whole region during the period of investigation. The Guenther's vole and the field mouse were, respectively, 7.2% and 6.5% of the total catch. Of Insectivora order, the species *Neomys anomalus* constituted the highest percentage out of the total catch of small mammals – 5.0%.

Relative abundance and diversity of small mammals varied considerably among the investigated vegetation types (Table1). The data analysis showed that, in VT I, the most species (9) were established, whereas, in VT IV, the number of established species was only three. This determines the low level of diversity (0.36) for this type of vegetation associations, but it is accompanied by a high relative abundance of the species distributed there and the highest, for all VT investigated, dominancy index (0.36). The highest diversity indecies have the VT I and VT III, while VT IV has lower evenness values because of the extreme dominance of one or two species (*Sylvaemus* sp.).

Small mammal habitat preferences for the different vegetation types are based on Ivlev's (1961) electivity index (Table 2). The electivity index measures preference and avoidance. The VT I is preferred by most species *Neomys anomalus*, *Apodemus agrarius*, *Rattus novegicus* and *Microtus subterraneus*, while the VT IV is preferred only by 2 species. The species *Neomys anomalus* and *Microtus subterraneus* inhabit only VT I. *Microtus guentheri* is adhered only to the VT II, while *Talpa levantis* occurs only in VT III. The wood mice use high the forest vegetation types and use low the open and moiser landscapes. Only one species (*Crocidura leucodon*) avoided one of the investigated vegetation types – VT I.

Discusion

Floristically Strandzha Mt. is not a uniform area but instead of a highly diverse assemblage of habitats with different degrees of vegetation cover. Among landscape variables, percentage cover was the most important variable accounting for variation in small mammal distribution's rates and provides a measure of a landscape's capacity (Vos et al. 2001). The small mammal assemblages responded to habitat patchiness related to vegetation type in SNP. It is possible that a few additional mammal species may be found in each VT by more extended trapping but the great differences in rainfall, cover and plant diversity seem to be reaected mainly in the proportions of the terrestrial mammal fauna. However, trapping success and

Table. 1. Relative abundance. diversity. dominancy and evenness for 13 small mammal species in investigated vegetation types (VT) from 2002 to 2006 in Strandzha NP

Species	VT I	VT II	VT III	VT IV	All VT	Percent of catch
Talpa levantis	0.00	0.00	0.42	0.00	0.42	0.24 [4]
Neomys anomalus	8.59	0.00	0.00	0.00	8.59	4.95 [3]
Crocidura suaveolens	0.41	0.00	0.63	0.00	1.04	0.60 [4]
Crocidura leucodon	0.27	0.00	0.42	2.86	3.55	2.04 [3]
Dryomys nitedula	0.27	1.25	0.00	0.00	1.52	0.88 [4]
Apodemus agrarius	6.09	3.75	1.46	0.00	11.3	6.51 [3]
Apodemus sp.	25.51	42.5	11.67	45.7	125.38	72.22 [1]
Mus macedonicus	0.00	1.25	0.21	0.00	1.46	0.84 [4]
Rattus rattus	0.00	1.25	0.21	2.86	4.32	2.49 [3]
Rattus norvegicus	0.14	0.00	0.00	0.00	0.14	0.08 [5]
Microtus sp.	0.07	0.00	0.21	0.00	0.28	0.16 [5]
Microtus guentheri	0.00	12.5	0.00	0.00	12.5	7.20 [3]
Microtus subterraneus	2.84	0.00	0.00	0.00	2.84	1.48 [3]
Total	44.19	62.5	15.23	51.42	173.34	
Diversity index Shannon – Wiener	0.81	0.60	0.73	0.36	0.50	
Index of Dominancy Simpson	0.14	0.21	0.24	0.36		
Evenness Index Pielou	0.81	0.77	0.81	0.75		

Notes:
[1] – ≤ 30 % of the total catch (dominant. mass species)
[2]- from 10. 0 % to 29. 9 % of the total catch (codominant. numerous species)
[3]-from 1. 0 % to 9. 9 % of the total catch (subdominant. common species)
[4]-from 0. 2 % to 0. 9 % of the total catch (secondary. minor. rare species)
[5]-under 0. 2% of the total catch (third-rate. very rare species)

Table 2. Small mammal vegetation type preferences based on electivity indices (Ivlev. 1961) for investigated vegetation types in Strandzha NP (◆ – preferred vegetation type (Ei ≥ 0.30);✶ – avoided vegetation type (Ei ≤ – 0.30); ■ – high use vegetation type (Ei = 0 – 0.29); ● – low use vegetation type (Ei = -0.29 – 0); Blank – vegetation type with no small mammals captured (Ei = -1.0).

Species	Ei vegetation type I	Ei vegetation type II	Ei vegetation type III	Ei vegetation type IV
Talpa levantis			◆	
Neomys anomalus	◆			
Crocidura suaveolens	■		◆	
Crocidura leucodon	✶		■	◆
Dryomys nitedula	●	◆		
Apodemus agrarius	◆	●	■	
Sylvaemus sp.	●	●	■	■
Mus macedonicus		◆	■	
Rattus rattus			●	◆
Rattus norvegicus	◆			
Microtus sp.	●		◆	
Microtus guentheri		◆		
Microtus subterraneus	◆			

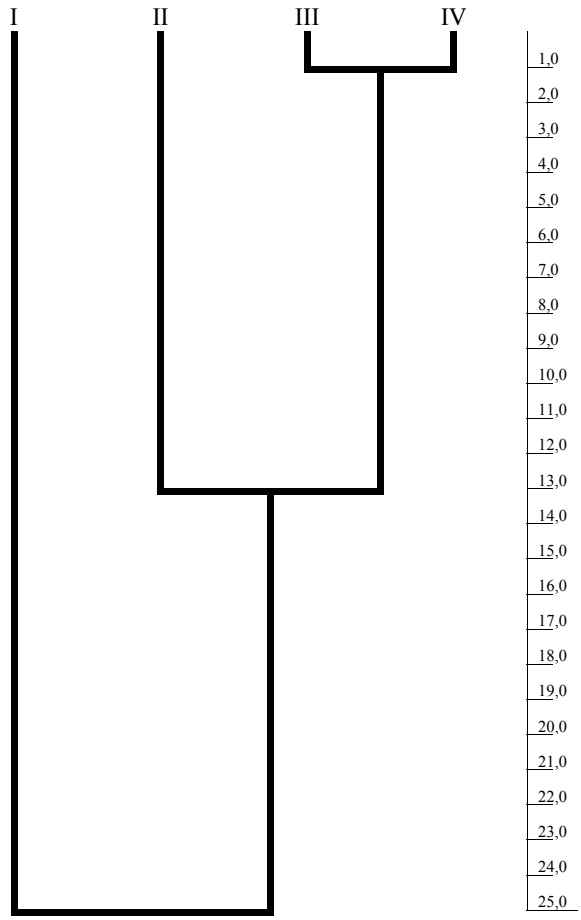

Fig. 2. Cluster analysis of the investigated vegetation types on the basis of small mammal assambleges in Strandzha Mountain (I – Riverside dense forests; II – Open landscapes; III – Extrazonal artificial mixed forests; IV – Kolhid-Mediterranean type of deciduous forests)

number of species were much lower in the primary forest (VT IV – 3 species) than in the humid dense forests (VT I – 9 species), whereas the sacred groves in the open landscapes have relative high number of species (VT II – 6 species) (Table 1).

All investigated typical for Standzha NP vegetation types were dominated by wood mice and field mouse. This is determined by high ecological flexibility and eurytopness, characteristic of these species. The dominance of these species is not an unusual result in studies from the region of Strandzha Mt. because of their broad ecological niche, which defines them as generalist species (Paspalev, Markov 1961, Markov *et al*. 2000, Popov *et al*. 2005).

In the region of the artificial forests of *Pinus pinaster* (near Tsarevo), the presence of *T. levantis* was established (2 individuals). This confirms the presence of the species, based only on data, gained after a pelets analysis (Popov, Miltchev 2001), in the most southestern parts of the country with a low above sea-level altitutde (Peshev *et al*. 2004). *N. anomalus* was established only in the moist dense forests along the rivers Veleka and Fakijska, however the species is a subdominant (5% of the total catch). This confirms the species' characteristic as common in wet habitats and its strong adherence to moust mixed beech forests (Peshev, Angelova 1962, Popov *et al*. 2005).

Small mammal assemblages seem to be not only influenced by the density of the vegetation but also by anthropogenic influences. The VT II might be an example of a patchy habitat where some degree of 'intermediate disturbance' has led to relatively low level of small mammal diversity and species evenness. It can be concluded that the modification of habitat structure by land use practices, which results in reduced microhabitat diversity, may induce a low declines in diversity and evenness of the small mammal assemlages.

Cluster analysis of the four vegetation types (Fig. 2) is based on small mammal assemblages composition where relative abundance was standardized to de-emphasize the role of the two most abundant and ubiquitous species. Less common species therefore play a greater role in defining assemblages. The small mammal assemblages in VT III and VT IV, forest vegetation types, are most simmilar. These have the greatest dominancy indecies with most of the captures for *Apodemus* sp.

The carried out faunistical analysis proves the great conservation priority of the Strandzha NP due to its established high level of average species diversity (0.50). This type of studies not only broaden the level of fauna investigation, but also predetermine, to a large degree, the ecological measures for the preservation of the biodiversity in the protected areas.

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