

DIVERSITY OF MAMMAL COMMUNITIES IN THE ECOSYSTEMS FROM THE CENTRAL ZONE OF THE REPUBLIC OF MOLDOVA

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Abstract. The studies have been accomplished in two ecosystems with different microclimatic, vegetation and landscape features: Peresecina and Trebujeni areas. On rocky woody slopes of Trebujeni the insectivores, carnivorous mammals and chiropterans are characteristic ($W_a > 5.0$), in opposite to Codru forest near Peresecina village, where the anthropogenic influence is much higher and the mentioned mammal groups are accessory. The rodents have in both stations a constant ecological significance, the population density reaching the maximum values in July. The dominant rodent species had rather high trappability index – between 28% and 32%. The common insectivore species (hedgehog and mole) are frequent and wide spread in both studied areas. The shrews (common and white toothed) are more frequent in Trebujeni area, due to the proximity of the Răut river. The carnivorous mammals have the density and the frequency much higher in Trebujeni area, due to more favorable shelter conditions, which they found in rocky slopes of the Răut banks. The artiodactyls (roes and deer) were rather rare, due to intense use of the studied forest ecosystems as recreational areas and forest management activities. The chiropteran density was also significantly higher in Trebujeni area, due to landscape peculiarities, which conditioned the existence of many caves, grottos and other formations suitable for bats prosperous existence. In both studied areas, a decrease of mammal community diversity was registered during summer period in forest ecosystems, as well as in adjacent agroecosystems. The analysis of similarity between various ecosystems revealed that the similarity index is higher for agroecosystems, while the forest mammal communities are less similar.

Keywords: ecosystems, mammals, faunistic communities, diversity, similarity.

Rezumat. Diversitatea comunităților de mamifere din ecosistemele zonei centrale ale Republicii Moldova. Cercetările în staționare au fost efectuate în două ecosisteme cu diferite condiții microclimatice, floristice și de landsaft: Peresecina și Trebujeni. Pe versanții stâncosi împăduriți ai Trebujenilor sunt caracteristice ($W_a > 5.0$) insectivorele, răpitoarele și chiropterele, spre deosebire de pădurea din zona Codrilor din preajma Peresecinei, cu o influență antropică mult mai mare, unde aceste grupe taxonomice sunt accesorii. Rozătoarele au o semnificație ecologică constantă în ambele zone, densitatea populațiilor atingând valori maxime în iulie. Speciile dominante de rozătoare atingeau valori destul de ridicate ale coeficientului de capturare, cuprinse între 28% și 32%. Speciile comune de insectivore (ariciul și cârțița) sunt frecvente și larg răspândite în ambele staționare. Chițanii (comun și de câmp) sunt mai frecvenți în zona Trebujeni, datorită proximității râului Răut. Mamiferele carnivore au o densitate și o frecvență mult mai mare în zona Trebujeni, datorită condițiilor de adăpost mult mai favorabile, pe care le găsesc în malurile stâncoase ale versanților Răutului. Copitatele au fost semnalate în ambele zone, însă cu o abundență redusă, din cauza utilizării intense a ecosistemelor forestiere și amenajărilor silvice. Densitatea chiropterelelor este semnificativ mai mare în staționarul Trebujeni, landsaftul stâncos asigurându-le acolo condiții favorabile de trai, în special adăposturi. La ambele staționare se observă o scădere a diversității comunităților de mamifere vara, atât în ecosistemele de pădure, cât și în agroecozozele adiacente. În urma analizei similarității ecosistemelor ambelor staționare, constatăm că indicele Sorensen este mai mare pentru agroecozozele, comunitățile de mamifere din păduri fiind mai puțin similare.

Cuvinte cheie: ecosisteme, mamifere, comunități faunistice, diversitate, similaritate.

INTRODUCTION

The anthropogenic transformations of the natural ecosystems represent an indispensable component of modern civilization. The development of urban areas, tourism and recreational activities of the population become important factors of wild world functioning. Vast areas of natural ecosystems located not only near settlements, but even to a greater distance suffer high recreational and anthropogenic pressures. Under such conditions significant changes in the integrity and stability of ecosystems occur, covering all biogeocoenosis components, including the animals.

The anthropogenic changes such as the increase of population density, the intense use of natural ecosystems, and the urbanization of new territories provoke deep modifications and in many cases even profound degradation of these areas. These modifications along with climate changes, registered in the last years in the country lead to the structure modifications of faunistic communities and to the generation of new adaptation strategies of animal species toward new life conditions.

In anthropogenic faunistic communities, the degradation and biomass variability increasing occur (ALIMOV, 1998). At the same time, neither the evolution theory nor the empiric data do not provide eloquent proves that species diversity and ecosystem functioning are in stable dependence and influence (GRIME, 1997), but species structure and diversity of animal communities depend a lot on ecosystem type, landscape heterogeneity (MUNTEANU et al., 1998), state and functional capacity of the ecosystem.

MATERIAL AND METHODS

The field studies were accomplished in two stations with different microclimatic, vegetation and landscape conditions. The landscape complex of Peresecina includes the old forest of “Codri”, a mosaic agroecosystem with use

degree of about 50%, pastures, an orchard of apples and nuts overgrown with herbaceous vegetation placed between the forest and the pasture. The landscape complex of Trebujeni is characterized by the presence of the insular forest on eastern slopes the Raut river, poorly used mosaic agroecosystem, rocky sites and the Raut meadow.

The determination of the terrestrial vertebrate species composition and of the population density was carried out by the methods of animal number relative assessment – trap-nights (NOVIKOV, 1953; IORGENSEN, 1974), counts on the route, sample plots, after the traces and trophic activity (RAVKIN & CHELINTSEV, 1990). The area of experimental plots was constant (10 ha), the length of routes ranging from 1-10 km, depending on the total area of the studied biotope (NAUMOV, 1965). The following parameters were registered at the caught animals: species, sex, age, morphological and physiological indexes, physiological and reproductive state. To characterize the biotopic distribution of the species the following indexes were used: the frequency (BALOGH, 1958) $F = \frac{100p}{P}$, where P – number of samples, p – samples where

the species is present, and the species abundance $A_i = \frac{100n_i}{N}$, where n_i – number of individuals of the species i in the

sample, N – total individual number. Both indexes are expressed in percents. The comparative characteristics of the ecosystems were accomplished by using the index of coenotic affinity (Q_s), calculated by Sorensen coefficient $Q_s = \frac{2c}{A+B}$, where A and B – number of recorded species in the compared coenoses, and c – number of species common for both coenoses.

To emphasize certain species or taxonomic group position in biocoenosis, the ecological significance was calculated (W_A) using the formula $W_A = F_a \cdot A_a / 100$, where F_a is frequency of group and A_a – abundance index. The species or taxonomic groups with the significance lower than 1% in the studied biocoenosis are considered incidental; between 1.1 – 5% – accessorial; between 5.1-10% – characteristic and when $W > 10\%$ the species is constant for the studied biocoenosis.

The statistical analysis of the material was accomplished after LAKIN (1980), ROKITSKII (1973), MAYR (1971) with use of Excel and Statistica for Windows 98 programs.

RESULTS AND DISCUSSIONS

The structure of mammalian communities studied areas is determined mostly by the landscape – vegetation complex. On rocky wooded slopes of Trebujeni area the insectivores, carnivorous mammals and chiropterans are characteristic ($W_a > 5.0$) (Table 1), unlike the Codru forest in surroundings of Peresecina village with greater anthropogenic influence, where these taxonomic groups are incidental. Rodents have in both studied stations a constant ecological significance, the population density reaching maximum values in July, especially in Peresecina area, where *Apodemus flavicollis* and *Clethrionomys glareolus*, as background species, reached the density of 32% and 28% of trappability at 100 snap traps, accordingly. Here *C. glareolus* was registered even in the fields near the wood up to the distance of 200 m. At Trebujeni station, this species had much lower ecological significance. Due to much higher diversity and abundance of mammalian predators in Trebujeni area, the density of rodent populations in September is three times lower than in faunistic complex of Peresecina. In both studies areas and in the agrocoenosis of Central Moldova as a whole, there was registered a brusque decreasing of *Apodemus uralensis* species abundance and the increasing of *Mus spicilegus* dominance. On abandoned fields, the mounds of the harvest mouse reached 40-45 individuals on 1 ha. The species *Apodemus agrarius* was most abundant in Trebujeni area due to the existence of acacia forest stands in the area, toward which this species has greater predilection.

The common insectivore species (hedgehog and mole) are frequent and wide spread in both studied areas. The most spread shrew species (*Sorex araneus* and *Crocidura leucodon*) were registered in both areas, but they are more frequent in Trebujeni area (Table 1), due to the proximity of the Răut river, which provide favorable humidity conditions.

The martens (*Martes martes* and *M. foina*) were present in both studied zones. *M. martes* was more frequent near Peresecina, where the forest area is much greater, while the stone marten was very rare in Peresecina and rather frequent in Trebujeni, because of the rocky landscape with many places for shelter. The fox and the badger were also registered in both areas, but they were much frequent in Trebujeni area, due to favorable shelter conditions. The fox was active even during the day, because of its high density and trophic necessities.

The artiodactyls (roes and deer) were rather rare, due to intense use of the studied forest ecosystems as recreational areas and forest management activities. The chiropteran species were recorded in the studied areas, but their density was significantly higher in Trebujeni area, due to landscape peculiarities, which conditioned the existence of many caves, grottos and other formations suitable for bats prosperous existence (Table 1).

Table 1. Ecological significance (W_a) of different mammal taxonomic groups in the ecosystems of Central zone.
Tabel 1. Semnificația ecologică (W_a) a diferitor grupe taxonomice de mamifere în ecosistemele staționarelor din zona Centrală.

Ecosystem		Insectivores	Rodents	Carnivorous	Artiodactyls	Chiropterans
Peresecina	Forest	1.05	16.00	3.20	1.10	1.80
	Agrocoenosis	0.60	24.00	1.20	0.1	0.50
Trebujeni	Forest	5.40	11.00	6.80	0.40	5.7
	Agrocoenosis	0.95	13.00	2.30	-	1.1

In both stations a decreasing of mammal community diversity (Shannon-Wiener, Simpson) was registered in summer (Table 2, Fig. 1) in forest ecosystems, as well as in adjacent agrocoenosis. This decreasing is more obvious in forest ecosystems. The highest diversity was registered in forest ecosystems of both stations in spring period and in woods and agrocoenosis of Trebujeni area in autumn period. The dominance is higher in summer period at Trebujeni and in autumn at Peresecina, caused by high densities of rodent species.

Table 2. Seasonal dynamics of mammal community diversity in the studied areas of Central zone.
Tabel 2. Dinamica sezonieră a diversității comunităților de mamifere la staționarele zonei Centrale.

Ecological parameter	May				July				September			
	Peresecina		Trebujeni		Peresecina		Trebujeni		Peresecina		Trebujeni	
	For.	Agrocen.	For.	Agrocen.	For.	Agrocen.	For.	Agrocen.	For.	Agrocen.	For.	Agrocen.
Simpson Diversity	5.94	5.19	4.64	3.52	2.82	5.04	3.45	2.69	3.41	5.72	8.74	5.29
Simpson Dominance	0.09	0.09	0.10	0.13	0.10	0.10	0.29	0.30	0.32	0.17	0.21	0.10

The diversity of mammal communities during the year proved to be more stable in the fields near Peresecina forest. Here, in summer and autumn, the diversity is higher than in forest ecosystems, in opposite to Trebujeni area, because many forest species can be observed in the fields.

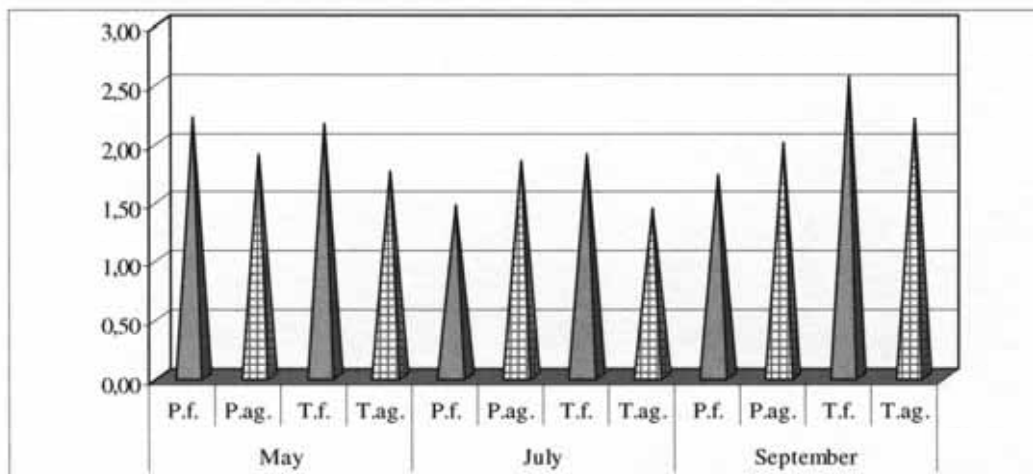


Figure 1. Seasonal dynamics of mammal communities' diversity (Shannon) in the studied stations of Central zone Peresecina (P.), Trebujeni (T.) in forest biotope (f.) and argocoenosis (ag.).

Figura 1. Dinamica sezonieră a diversității (Shannon) comunităților de mamifere la staționarele zonei Centrale Peresecina (P.), Trebujeni (T.) pentru biocenoză de pădure (f.) și agrocoenoză (ag.).

After analyzing the ecosystem similarity of both stations (Table 3), it can be seen that Sorensen index is higher (0.89) for agrocoenosis. The mammal communities of forest ecosystems from both studied areas are rather similar too (0.82). The similarity between mammal communities in forest ecosystems and agrocoenosis is higher at Trebujeni (0.54) by comparing with Peresecina (0.48).

Table 3. Similarity after Sorensen index between the ecosystems of the Central zone.
Tabel 3. Similaritatea după indicele Sorensen pentru ecosistemele staționarelor zonei Centrale.

Ecosystems		Peresecina		Trebujeni	
		Forest	Agrocoenosis	Forest	Agrocoenosis
Peresecina	Forest	1	0.48	0.82	0.56
	Agrocoenosis	0.48	1	0.51	0.89
Trebujeni	Forest	0.82	0.51	1	0.54
	Agrocoenosis	0.56	0.89	0.54	1

The analysis of mammal communities diversity emphasized that the functionality of Trebujeni faunistic complex is ensured by higher ecological significance of insectivores, carnivorous mammals and chiropterans ($W_a = 3.9$, 5.1 and 4.7 accordingly), unlike Peresecina area with much higher anthropogenic influence, where the insectivores are incidental ($W_a = 0.8$), while the chiropterans and carnivorous mammals are accessorial ($W_a = 1.3$ and 2.1 accordingly).

The seasonal dynamics of diversity and the structure of mammal communities are largely determined by the diversity and density of carnivorous species and by the trophic relations between predator and prey. The ecosystems with lower diversity of mammal communities show higher seasonal fluctuations. Therefore, the ecosystems with higher species diversity are more stable during the year.

CONCLUSIONS

By analyzing the diversity of mammal communities it can be seen that the functionality of Trebujeni faunistic complex is ensured by a higher ecological significance of insectivores, carnivorous mammals and chiropterans ($W_a = 3.9, 5.1, 4.7$ accordingly), unlike Peresecina complex with much higher anthropogenic influence, where the insectivores are incidental ($W_a = 0.8$) and the chiropterans and carnivorous mammals are accessorial ($W_a = 1.3$ and 2.1 accordingly).

The seasonal dynamics of diversity and structure of mammal communities are largely determined by the diversity and density of carnivorous species and by the trophic relations between predator and prey. The ecosystems with lower diversity of mammal communities show higher seasonal fluctuations.

The diversity of mammal communities is more stable during the year on cultivated fields near Peresecina forest. In summer and autumn here the diversity is higher than in forest ecosystems, in opposite to Trebujeni area, where species diversity in the forest is higher during the whole year.

The similarity of mammal communities expressed by Sorensen index in agrarian ecosystems is higher (0.89) and the forest mammal communities are less similar (0.82). The similarity between forest and agrocoenosis mammal communities is higher at Trebujeni (0.54) by comparing with Peresecina (0.48).

REFERENCES

- ALIMOV A. F. 1998. *Bioraznoobrazie kck kharakteristika struktury soobshchestva*. Izvestia Rossiiskoi Akademii Nauk. Saratov. **4**: 434-439. (In Russian).
- BALOGH F. 1958. *Lebensgemeinschaften der Landtiere*. Akademie-Verlag-Budapest-Berlin: 67-83.
- GRIME J. P. 1997. *Biodiversity and ecosystem function: The debate dupens*. Science. **277**(5330): 1260-1261.
- KUCHERUK V. V., TUPIKOVA N. V., EVSEVA V. S., ZAKLINSKAIA V. A. 1963. *Opyt kriticheskogo analiza metodiki colichestvennogo ucheta gryzunov i nasekomojadnyh pri pomishchi lovushko-linii*. Organizatsia i metody ucheta ptits i vrednyh gryzunov. Moskva: 218-227. (In Russian).
- JORGENSEN, C. D., & H. D. SMITH. 1974. *Mini-grids and small mammal estimates*. Proceedings of Utah Academy of Sciences, Arts, and Letters. **51**: 12-18.
- LAKIN G. F. 1980. *Biometria*. Vysshiaia shkola. Moskva. 291 pp. (In Russian).
- MAYR E. 1971. *Printsipy zoologicheskoi sistematiki*. Moskva: Mir. 454 pp. (In Russian).
- MUNTEANU A., ZUBCOV N., SAVIN A. 1998. *Indicele eterogenității landșaftului în studiu diversității comunităților de vertebrate terestre*. Materialele Conferinței corpului didactic-științific. a U.S.M. pe anii 1996-1997. Chișinău. 185 pp.
- MUNTEANU A., SAVIN A., CORCIMARU N., NISTREANU VICTORIA. 2007. *Rolul structurii ecosistemelor în menținerea diversității grupărilor taxonomice de mamifere*. Materialele Conferinței a VI-a a Zoologilor din Moldova. Problemele actuale ale protecției și valorificării durabile a diversității lumii animale. Chișinău: 38-39.
- NAUMOV N. P. 1965. *Prostranstvennye osobennosti i mekhanizmy dinamiki chislennosti nazemnyh pozvonochnyh*. Zhurnal Obchshei Biologii. **26**(6): 625-633. (In Russian).
- NOVIKOV G. A. 1953. *Poleviye issledovaniya po ekologii nazemnyh pozvonochnyh*. Moskva: Sovetskaia Nauka. 502 pp. (In Russian).
- RAVKIN E. S. & CHELINTZEV N. G. 1990. *Metodicheskie rekomendatsii po kompleksnomu marshrutnomu uchetu ptits i mlekopitaiyushchih*. Moskva. 33 pp. (in Russian).
- ROKITSKII P. F. 1973. *Biologicheskai statistica*. Minsk. 319 pp. (In Russian).
- SAVIN A. 2005. *Structura soobshchestv mlekopitaiushchih drevesno-custarnicovyh i skalnyh biotsenozov agrolandshafta Respubliki Moldova*. Materialy Mejdunarodnoi konferentsii posv. 140-letiyu osnovaniya Odesskogo Universiteta i 120 Godovshiny Puzanova. Odessa: 262-266. (In Russian).
- SHANNON K. 1963. *Paboty po teorii informatsii i kibertetiei*. Izd-vo inostr. lit. Moskva. 829 pp. (In Russian).
- SIMPSON E. H. 1949. *Measurement of diversity*. Nature. **163**(4148): 668 pp.

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