STRUCTURE OF SMALL RODENT COMMUNITIES IN ORCHARDS FROM THE CENTRAL PART OF THE REPUBLIC OF MOLDOVA AND BACAU DISTRICT, ROMANIA

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Abstract. The studies were performed in the period 2008-2015 in orchards from the central part of the Republic of Moldova and Bacău County, Romania. In both areas 12 species rodent were registered, of which in central Moldova orchards the species *R. norvegicus* and *P. subterraneus* were not registered, while in Bacău orchards the species *A. uralensis*, *M. rossiaemeridionalis* and *D. nitedula* weren't recorded. In CM orchards the dominant species was *M. rossiaemeridionalis* with about 30%, followed by *A. sylvaticus* and *A. flavicollis*. In BC orchards the dominant species was *A. flavicollis* with more that 41%, followed by *A. sylvaticus* and *M. arvalis*. The analysis of demographic structure in spring period showed a high proportion of reproductive females in all species, being the highest at *M. rossiaemeridionalis* in CM orchard and in *A. flavicollis* in BC orchard. The share of young individuals constituted up to 40% depending on the species being the highest at *M. rossiaemeridionalis* in CM orchard and in *A. flavicollis* in BC orchard. A significant difference in the area of the individual sectors of *M.rossiaemeridionalis* males and females in the orchard in summer ($t = 3.46$) and autumn ($t = 3.39$) was established, as well as for *A. sylvaticus* in the spring and summer period ($t = 2.06$; 2.03), and for *A.uralensis* in spring and autumn ($t = 2.99$; 3.44).

Introduction

The rodents are the most spread group of mammals and quickly adapt to environmental changes. Therefore, they are important elements of terrestrial ecosystems, being the dominant vertebrate species in agricultural lands, such as orchards. The orchards, especially abandones ones provide favorable trophic and shelter conditions not only for field rodent, but also for forest rodent species, due to specific vegetation, formed by fruit trees, shrubs and various grass species. The monitoring of rodent communities is of high priority, because about 80% of the republic territory is occupied by agrocenoses [6, 10]. In the central part of the Republic Moldova the agricultural landscape, including orchards, of which many abandoned, occupy large surfaces. The mosaic aspect of the agricultural landscape is particular for some areas of Bacău County, Romania. In both regions important areas are covered with natural or semi-natural forests, that contribute to the rather high diversity of small rodents in adjacent agrocenoses, among which the orchards are the most favorable for the small rodent fauna. A comparative analysis of small rodent fauna of agricultural ecosystems from central part of the Republic of Moldova and from Bacău County was performed in the past years and revealed the influence of environmental conditions upon the diversity and structure of small rodent communities in several types of agrocenoses [5].

The aim of the study was to reveal the differences between the structure of small rodent communities in orchards from central part of Moldova and Bacău district, Romania.

Materials and methods

The studies were performed in the period 2008-2018 in several orchards from the central part of the Republic of Moldova (CM) and Bacău County (BC). The most of the studied orchards from CM are abandoned, surrounded by other types of agrocoenoses, by pastures and forest belts (fig. 1). In BC the studied orchards were surrounded by other types of agrocoenoses (corn, vineyard) and by natural forest. The rodents were caught with snap traps and live traps, placed in lines at 5-8 m distance. The traps were baited with small bread pieces imbued with sunflower oil.

In order to characterize the biotopic distribution of the species the following indexes were considered: trappability $Cc=100n/C$, where n – number of individuals, C – number of traps; the frequency $F= 100p/P$, where P – number of samples, p - samples where the species is present, and the species abundance $A = 100n/N$, where n – number of individuals of a species in the sample, N – total number of individuals. The ecological significance was calculated (W) using the formula $W = F \cdot A/100$, where F is frequency of a species and A – abundance index. The species with the significance lower than 1% in the studied biocenoses are considered accidental; 1.1 – 5 % - accessorial; 5.1-10% – characteristic and $W > 10\%$ - constant for the given biocenosis.

Figure 1. Abandoned plum and apple orchard limited by pasture and forest belt near Bacioi village, central part of the Republic of Moldova

The spatial structure of the rodent species was studied by the capture-mark-recapture method (CMR) according to standard methodology [11]. The method involves marking a number of individuals in a natural population, returning them to that population, and subsequently recapturing some of them as a basis for estimating the size of the population, the surface of the individual sectors, the migration process. During three study weeks there were processed 1500 trap-nights and marked more than 300 individuals by the method of the phalanx amputation [12].

The area of individual sectors and groups was calculated according to standard methods [2]. The size of the individual sectors was determined for individuals captured at least 3-4 times during a 5-day study. Individuals captured more than 3 times during a census were classified as

“residents” and the rest - “migrants”. By the method of exclusion at the border, the sizes of the individual sectors and the movement distance for the “resident” individuals were determined.

Results and discussions

In both areas 12 species were registered: *Apodemus sylvaticus*, *A. flavicollis*, *A. uralensis*, *A. agrarius*, *Mus musculus*, *M. spicilegus*, *Rattus norvegicus*, *Microtus arvalis*, *M. rossiaemeridionalis*, *M. subterraneus*, *Clethrionomys glareolus* and *Dryomys nitedula*. In CM orchards the species *R. norvegicus* and *M. subterraneus* were not registered, while in BC orchards the species *A. uralensis*, *M. rossiaemeridionalis* and *D. nitedula* weren't recorded. The presence of silvicolous species *M. subterraneus* in BC orchard can be explained by the proximity of the natural forest ecosystems. The brown rat can be met in cultivated lands situated near villages [1], though the species density was very low in the studied period (only one individual). In the CM the species *M. rossiaemeridionalis* is one of the dominant species in orchards and *A. uralensis* is very spread in various types of agricultural ecosystems, especially in adjacent pasture ecosystems [4, 8]. Although the forest dormouse occurs mostly in silvicolous habitat, it was often recorded in orchards with tree and bush vegetation, where it finds favorable conditions similar to the forest biotopes [4].

The species distribution in orchards from both studied areas showed some differences (fig. 2). Thus, in CM orchards the dominant species was *M. rossiaemeridionalis* with about 30%, followed by *A. sylvaticus* and *A. flavicollis*, which constituted about 70% from the rodent community. In BC orchards the dominant species was *A. flavicollis* with more than 41%, followed by *A. sylvaticus* and *M. arvalis*, which constituted over 80% from all rodent species (fig. 2). *A. uralensis* had a rather high percent in rodent community from CM orchard (more than 10%), which confirm the data obtained in other studies [8]. The species *A. agrarius* reached almost 10% in CM orchard and only 4.4% in BC orchard. This fact is probably due to the differences in climatic conditions during the study period, especially in humidity degree, since the species prefers more humid environment. The proportion of *M. spicilegus* is rather close in both areas and usually do not overpass the abundance of 15-18% in orchards [3]. For *M. musculus* the orchard is not a very suitable habitat, because of high density of other rodent species and the proximity of localities, where it finds favorable conditions. Therefore, the species abundance was very low (0.8-1.1%) in both studied areas. The silvicolous species *C. glareolus* is much more abundant in BC (6.6%) than in CM (2.3%) orchards, which is due to the existence of adjacent forest ecosystems in Bacau area.

Figure 2. Rodent communities' structure in orchards from Central Moldova and Bacau County

The analysis of demographic structure in spring period (May-June) showed that 80.8% of *M. rossiaemeridionalis* population from orchard in CM are represented by breeding females and 22.8% of them belong to spring generation, which prove a very high reproductive potential. In the same period in BC orchard the reproductive females of *M. arvalis* constituted about half population and juvenile individuals constituted about 38.5%. In *A. sylvaticus* from CM orchard the share of females was of 47.6% and from the BC – 35.7%, which prove a lower reproductive potential that the previous species. In *A. uralensis* the males were dominant with more than 70% and the species was represented only by adult individuals. In *A. agrarius* the female constituted 16.7% in CM orchard, while in BC they constituted more than 90% of the population. The subadult and juvenile individuals constitute about 20% in CM orchard and 16.7% in BC orchard. In *A. flavicollis* the share of females was of 41.9% in CM orchard and the young individuals constituted 44.4%. In BC orchard the share of females was 42.86% and that of the subadults was about 40%. The *M. spicilegus* reproductive females had a share of 25% and the proportion of young individuals – about 30%, while in BC the species was not registered in spring period.

In the orchard from CM on a surface of one hectare during May-June and in September there were performed capture-mark-release studies in order to reveal the spatial structure of rodent community and its dynamics during the reproduction period. In May the dominant species was *M. rossiaemeridionalis* (50.6%) of which individuals were dispersed on the whole surface. The recapture rate constituted 20.5% and the migrant individuals – 79.5%. The individuals of the species *A. flavicollis* with a share of 20.1% formed 4 intrapopulation groups. The difference in the area of the individual sectors of adult overwintered males ($169.4 \pm 49.5 \text{ m}^2$) and those of the spring generation ($97 \pm 10.4 \text{ m}^2$) was significant ($t=2.5$, $p \leq 0.05$). For females belonging to these generations, no significant difference in the area of the individual sectors was established ($t = 1.5$, $p \leq 1.4$). 54.8% of the individuals were recaptured and the share of migrants was 45.2%, of which 58.1% were males. In *A. sylvaticus* 3 intrapopulation groups were re-

corded, the species population was formed by several unstructured groups and the individual sectors were little highlighted. *A. uralensis* individuals were marginalized in the upper part of the sector, being closer in the pasture. *A. agrarius* individuals formed two groups. In general, the surface of individual sectors was larger in males than in female, which was established in other studies [4, 7, 9].

In June, the abundance of *M. rossiaemeridionalis* increased by 4.2% compared to May. 75.9% were breeding females, and 42.1% of individuals belong to the summer generation. The recapture rate of the individuals was of 43% and the migrants constituted 57%, which was by 22.5% less than in the previous month of study. The share of *A. flavicollis* increased by 1.5 times and the individuals formed 5 intrapopulation groups. There was a significant reduction in the area of the individual sectors of adult males, their activity decreasing significantly ($t = 2.07$). The recapture rate of the individuals was of 68.9% and the share of migrants of 31.1%. The individuals of *A. sylvaticus* formed four intrapopulation groups.

In the autumn period, a decrease in the abundance of *M. rossiaemeridionalis* species was established in the mark sector (21.4%). The population of this species was formed entirely of young individuals, as well as the population of *M. arvalis* in BC orchard. In both study zones the dominant species was *A. flavicollis* with about 50% in CM orchard and with 53.85% in BC orchard. Its abundance increased about 2.3 times compared to the previous study period. The *A. uralensis* population had a 3.7 time increase in abundance and an overwhelming share of young individuals (95%). The share of marked and recaptured individuals from the previous period was of 28.6%.

A significant difference in the area of the individual sectors of *M. rossiaemeridionalis* males and females in the orchard in summer ($t = 3.46$) and autumn ($t = 3.39$) was established, as well as for *A. sylvaticus* in the spring and summer period ($t = 2.06$; 2.03), and for *A. uralensis* in spring and autumn ($t = 2.99$; 3.44). In the orchard the reproductive groups appeared in late spring. The groups in *A. sylvaticus* are more numerous than in *A. uralensis*. In autumn these groups are more numerous than in spring and consisted of 5.2 – 8.3 individuals. In *A. uralensis* in spring-autumn period the males dominated (69-80%), demonstrating the importance of this habitat as a refuge, especially for migrant males.

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Conclusions

In both areas 12 species were registered: *Apodemus sylvaticus*, *A. flavicollis*, *A. uralensis*, *A. agrarius*, *Mus musculus*, *M. spicilegus*, *Rattus norvegicus*, *Microtus arvalis*, *M. rossiaemeridionalis*, *M. subterraneus*, *Clethrionomys glareolus* and *Dryomys nitedula*. In CM orchards the species *R. norvegicus* and *M. subterraneus* were not registered, while in BC orchards the species *A. uralensis*, *M. rossiaemeridionalis* and *D. nitedula* weren't recorded.

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The analysis of demographic structure in spring period showed a high proportion of reproductive females in all species, being the highest at *M. rossiaemeridionalis* in CM orchard and in *A. flavicollis* in BC orchard. The share of young individuals constituted up to 40% depending on the species being the highest at *M. rossiaemeridionalis* in CM orchard and in *A. flavicollis* in BC orchard.

The recapture rate in the dominant species *M. rossiaemeridionalis* constituted 20.5% and the migrant individuals – 79.5%. The differences between the area of individual sectors of males and females is significant in autumn period and have similar values in spring. The difference in the area of the individual sectors of overwintered males and those of the spring generation in the species *A. flavicollis* in May is significant, while in June there was a considerable reduction in the area of the individual sectors of adult males.

A significant difference in the area of the individual sectors of *M. rossiaemeridionalis* males and females in the orchard in summer ($t = 3.46$) and autumn ($t = 3.39$) was established, as well as for *A. sylvaticus* in the spring and summer period ($t = 2.06$; 2.03), and for *A. uralensis* in spring and autumn ($t = 2.99$; 3.44).

Bibliography

1. Burlacu, V., Nisteanu, V., Larion A. Caterinciuc, N. Structura comunităților de mamifere mici (Rodentia, Soricomorpha) în agroceenozele zonei de nord a Republicii Moldova. Buletinul Academiei de Științe a Moldovei. Științele vieții. 2018, No 1(334), p. 126-133.
2. Metzgar L. H., Sheldon A. L. An index of home range size. J. Wildlife Monog., 1974, V. 38, No 3, p. 546 - 551.
3. Munteanu A., Larion A., Savin A., Sîtnic V., Nisteanu V. Distribuția biotopică și raportul speciilor *Mus spicilegus* și *Mus musculus* în agroceenoze. Sustainable use and protection of animal world diversity. International symposium dedicated to 75th anniversary of Professor Andrei Munteanu. Chișinău, 2014, 71-73.
4. Munteanu A., Savin A., Sîtnic V., Larion A., Nisteanu V. Ecologia rozătoarelor mici. Chișinău, Tip. „Căpățînă Print”, 236 p.
5. Nisteanu V., Paraschiv D., Savin A., Larion A., Sîtnic V. Comparative analysis of small rodent fauna in agroceenoses from central part of the Republic of Moldova and middle basin of Siret river, Bacău district, Romania. Studii și Comunicări. Complexul Muzeal „Ion Borcea”, Bacău, România, 2017, vol. 25, p. 98-102.
6. Nisteanu V., Savin A., Larion A., Sîtnic V., Chihai O. Ecological aspects of rodent communities in agrarian ecosystems of Moldova. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Volume 68, issue 1, 2011. p. 272-276.
7. Paraschiv D. Establishing the individual territory for some rodent populations in a hayfield from the Berești-Tazlău village, Bacău county. Studii și Comunicări. Complexul Muzeal „Ion Borcea”, Bacău, România, 2017, vol. 25, p. 119-121.
8. Savin A. Distribuția speciilor genului *Apodemus* (Rodentia, Muridae) în cenozele Republicii Moldova. Buletinul AȘM. Științe Biologice, Chimice și Agricole, 2004, 4, p. 46-51.
9. Savin A. Structura și dinamica grupărilor de *Apodemus sylvaticus* și *Apodemus microps* în

- populațiile din biotopurile natural. În: Diversitatea și ecologia lumii animale în ecosisteme naturale și antropizate. Chișinău, 1997, p. 24-26.
10. Savin A., Nisteanu V. Structural – functional transformations of rodent communities in ecosystems of Moldova against a background of anthropogenic and climatic changes. *Oltenia Journal for Studies in natural Sciences*, 2009, Tom. 25, No. 2, p. 275-280.
 11. Stenseth N. C., Hagen A., Ostbye E., Skar H. J. A method for calculating the size of the trapping area in capture-recapture studies on small rodents. *Norw. J. Zool.*, 1974, V. 22, no 4, P. 253 - 271.
 12. Наумов Н. П. Мечение млекопитающих и изучение их внутривидовых связей. *Зоологический журнал*. Москва, 1956, Т.35, В.1, с. 3 -15.