ECOLOGICAL AND EPIZOOTOLOGICAL FEATURES OF SMALL MAMMALS (MAMMALIA: SORICOMORPHA, RODENTIA) AS A RESERVOIR OF LEPTOSPIRA IN THE REPUBLIC OF MOLDOVA

BURLACU Victoria

Abstract. During 2018-2019, in various types of ecosystems from the northern, central and southern areas of the Republic of Moldova, studies were been conducted on the ecological and epizootological features of small mammals and their role in leptospirosis foci. The small mammals were represented by 17 species. The euritope species *A. agrarius*, *A. flavicollis* and *A. sylvaticus* were the most abundant in all the studied ecosystems. Positive results for leptospira were determined in the Cahul district, the southern area, for 4% of the total number of investigated small mammals. The leptospirosis epizootic process involved the species *R. norvegicus*, where specific antibodies to the serotype *L. icterohaemorrhagiae* were determined. During 2018-2019, a total of 10 cases of leptospirosis were reported. A higher number of leptospirosis cases was reported mainly in the northern districts (8 cases) and in the central area (2 cases). At the country level, the highest share of leptospirosis cases was registered among rural population (90%). The research results confirm the existence of natural outbreaks of leptospirosis, the risk for public health being influenced by the varying degree of anthropization of ecosystems, which bring natural outbreaks closer to the settlements. The updated epizootiological data are used in the substantiation of public health policies, as well as in the propagation of measures argued for the population to prevent risks associated to diseases of zoonotic origin.

Keywords: small mammals, leptospirosis, pathogen agent, biotope, rodents.

Rezumat. Unele date privind aspectele ecologice și epizootologice a comunităților mamiferelor mici (Mammalia: Soricomorpha, Rodentia) - rezervor de leptospire în ecosistemele Republicii Moldova. În perioada 2018-2019 în diverse tipuri de ecosisteme din zona de nord, centru și sud a Republicii Moldova s-au efectuat cercetări privind particularitățile ecologice și epizootologice ale mamiferelor mici și rolul lor în focarele de leptospiroză. Diversitatea faunistică a inclus 17 specii de mamifere mici; speciile *A. agrarius, A. flavicollis* și *A. sylvaticus* fiind euritope și cele mai abundente în toate ecosistemele studiate. Rezultate pozitive la leptospire s-au determinat în raionul Cahul, zona de sud la 4% din totalul de mamifere mici investigate. În procesul epizootic la leptospiroze a fost implicată specia *R. norvegicus* la care sau determinat anticorpi specifici către serotipul *L. icterohaemorrhagiae.* În perioada anilor 2018-2019 au fost raportate sumar 10 cazuri de leptospiroză. Un număr mai mare de cazuri de leptospiroză au fost raportate în raioanele din zona de nord (8 cazuri), în zona de centru - 2 cazuri. La nivel de țară cota cea mai mare a cazurilor de leptospiroză s-au înregistrat la populația rurală (90%). Rezultatele cercetărilor confirmă existența, la etapa actuală în țara noastă, a focarelor naturale de leptospiroză, riscul pentru sănătatea publică fiind influențat de gradul variat de antropizare a ecosistemelor, care apropie tot mai mult focarele naturale de localități. Datele epizootologice reactualizate sunt utilizate în fundamentarea politicelor de sănătate publică cât și în propagarea măsurilor argumentate pentru populație în prevenirea riscului asociat maladiilor de origine zoonoză.

Cuvinte cheie: mamifere mici, leptospiroză, agent patogen, biotop, rozătoare.

INTRODUCTION

Small mammals are a large and diverse group of terrestrial vertebrates, which has been studied quite well in the republic (MIHAILENKO, 1997; SAVIN & NISTREANU, 2009; BURLACU et al., 2016, 2018; NISTREANU et al., 2011, 2019). Nevertheless, their role in the spread of pathogens of natural focal diseases in a certain territory with specific landscape, climatic factors and under the conditions of anthropogenic transformation still needs to be studied. The bio-ecological characteristics of small rodents are the high rate of population renewal, the ability of intense reproduction in a short period, accompanied by mass dispersal, which can contribute to the spread of pathogens of natural focal diseases in new territories.

From an epidemiological point of view, small mammals are reservoirs of leptospires and a source of infection. The hosts of epidemiologically pathogenic leptospira populations can be divided into 3 groups: small mammals that ensure the maintenance of the causative agent in natural foci, farm animals - which keep leptospires in anthropogenic foci and man. The last host cannot ensure the circulation and maintenance of the causative agent, but can determine the appearance of diseases.

Leptospirosis is a worldwide zoonotic infection with a much greater incidence in tropical regions and has now been identified as one of the emerging infectious diseases. The epidemiology of leptospirosis has been modified by changes in animal husbandry, climate, and human behaviour (LEVETT, 2001; GHEORGHIȚA et al., 2009; BURLACU et al., 2017, 2019; CATERINCIUC et al., 2017).

Leptospirosis was detected on the territory of the Republic of Moldova in 1948, in the southern region. In 1950 leptospirosis was observed in cattle in Tiraspol, then the disease was seen in pigs, horses and small cattle in all regions of the country. In the 80 - 90s of the 20th century, leptospirosis was registered in small rodents in all landscape-faunistic zones (GHEORGHIȚA et al., 2009; TODERAȘ et al., 2010; BURLACU et al., 2017, 2019; CATERINCIUC et al., 2017). Since then, the annual monitoring of foci of leptospirosis has been carried out throughout the republic. In this context, the organization of the epizootiological monitoring regarding the study and collection of data related to the bio-

ecological peculiarities of small mammal populations, the leptospirosis foci, etc. allow the estimation of the periods of epidemiological situation aggravation and the accomplishment of the activities of epidemiological surveillance and control of the zoonotic origin diseases.

The paper presents the results of epizootiological monitoring performed in 2018-2019 in order to study the etiological structure of leptospira, to identify the species involved in the epizootic process of leptospirosis, as well as to study the fauna and population ecology of small mammals in the leptospirosis foci.

MATERIALS AND METHODS

The data were collected during the spring, summer and autumn months during 2018 and 2019 in the northern, central and southern areas of the republic. In the northern area, epizootiological monitoring was carried out in the administrative territory of the Glodeni district, located in the northwest of the country. 23 types of biotopes of annual and multiannual evidence were studied, which were subsequently grouped as follows: summer camp located in the forest, forest, forest edge, agrocenosis and the ecotones – shelter belt-agrocenosis, shelter belt-pond, fallow ground-pond and forest-agrocenosis. 25 km to the west of the Glodeni town, in the middle sector of the Prut River, lies the "Pădurea Domnească" natural forest reserve.

In the central area studies were carried out in the administrative territory of Orhei district. Most of the territory of the Orhei district is occupied by the Codrii forest massif, which in some places is fragmented into agrocenoses and paludous biotopes. 12 types of biotopes were included in the study and grouped into forest, shelter belts, paludous, forest edge and ecotones.

The Cahul district is located in the southern part of the country on the Lower Prut Plain. The district includes the "Prutul de Jos" natural scientific reserve, where about ⅓ of the surface is occupied by Beleu Lake, the rest of the territory being represented by marsh biotopes and floodplain. The studies were conducted in 20 biotopes grouped in forest, forest belt, paludous, agrocenosis.

The material was collected in the vegetation period (April-August) and in the autumn period (September-October). Small mammals were caught with traps placed in line or randomly, 10 m away from each other, baited with food – pieces of black bread crust, soaked in unrefined sunflower oil. About 50 traps were used per biotope (CHICU et al., 2012). A total of 3366 trap-night were processed, 539 small mammals were caught and 523 individuals investigated for the presence of specific antibodies to *Leptospira* spp. in the laboratory of the National Agency for Public Health. Each small mammal was identified on the basis of morphological characteristics, except for the sibling species of the genus *Microtus* (*M. arvalis* and *M. rossiaemerdionalis*), which were considered as *Microtus* sp.

The ecological analysis of small mammal communities was performed by calculating the following indexes: trappability (Ic), abundance (A), frequency (F), dominance (Naughton-Wolf, I_d), diversity (Shannon, H', Berger-Parker, Simpson). The ecological significance (W_a) of the species in the studied biotopes was determined: species with a significance of up to 1% in the analysed biotopes were considered recedent; 1.1-5% - subdominant; 5.1-10% - dominant and over 10% – eudominant for a biotope. Statistical analysis and graphical interpretation of the results was performed using Microsoft Excel and BioDiversity Programme.

Data on leptospirosis morbidity in the Republic of Moldova for the period 2018-2019 were obtained from the Statistical Report on "Infectious and Parasitic Diseases" (CATERINCIUC et al., 2017, 2018).

RESULTS AND DISCUSSIONS

During the study period, 539 small mammals from 17 species included in two orders were collected: Soricomorpha - *Sorex minutus*, *S. araneus* and *Neomys anomalus*; Rodentia - *Myoxus glis, Dryomys nitedula, Apodemus sylvaticus*, *A. flavicollis*, *A. uralensis*, *A. agrarius*, *Mus spicilegus*, *M. musculus, Micromys minutus*, *Rattus norvegicus*, *Clethrionomys glareolus*, *Arvicola terrestris*, *Microtus* sp. and *M. subterraneus* (Table 1). Among the registered species three are listed in the Red Book of the Republic of Moldova (2015): *N. anomalus* [EN], *M. glis* [VU] and *M. minutus* [VU].

The values of the trappability index varied depending on year, season, biotope and climatic conditions. In 2018 the index constituted 22.4% in the central area and was higher in comparison to the northern area – 18.5% and southern one – 12.8%. In 2019, the index values were similar in the central and southern areas (13.3% and 12.9%, respectively) and in the northern area – 11.9%. The climatic conditions were different in the study years: the spring of 2018 was warm and short and rather high temperatures and low precipitations were recorded in autumn. The spring of 2019 was warm with isolated abundant precipitations, while unusually high temperatures were recorded in autumn, with no rains, which happened once every 20-30 years (HIDROMETEO, 2018-2019). Thus, in the northern area, during 2018-2019, the lowest capture index values were recorded in comparison to previous results from 2010-1017, which can be explained by extremely unfavourable climatic conditions (BURLACU et al., 2017, 2019; CATERINCIUC et al., 2017).

In the Glodeni district, 215 individuals of small mammals from 13 species were registered (tab.2) and a decrease in terms of number and diversity is seen in comparison with the previous studies (BURLACU et al., 2016, 2017). In 2018 the trappability index varied between 13.5% in woods and 24.3% in paludous areas, while in 2019 the index varied between 8.9% in summer camps located in forests and 15.1% in woods (Table 2).

Table 1. Diversity and number of small mammals collected from the ecosystems of the Republic of Moldova in the period 2018-2019.

No	Species	Glodeni, northern area		Orhei, central area		Cahul, southern area	
		August 2018	June 2019	May 2018	April 2019	October 2018	September 2019
Ord. SORICOMORPHA							
Fam. Soricidae							
1	*Sorex minutus*	1	0	0	0	0	0
2	*Sorex araneus*	1	1	1	0	0	3
3	*Neomys anomalus*	1	0	0	0	0	0
Ord. RODENTIA							
Fam. Myoxidae							
5	*Myoxus glis*	0	0	0	1	0	0
4	*Dryomys nitedula*	0	0	0	0	0	1
Fam. Muridae							
6	*Apodemus uralensis*	7	0	0	1	4	18
7	*Apodemus sylvaticus*	4	9	31	3	18	22
8	*Apodemus flavicollis*	64	28	53	43	5	15
9	*Apodemus agrarius*	44	10	15	5	13	10
10	*Mus spicilegus*	6	0	18	2	2	3
11	*Mus musculus*	2	0	0	0	0	0
12	*Micromys minutus*	1	0	0	0	2	0
13	*Rattus norvegicus*	1	0	0	0	1	0
Fam. Cricetidae							
15	*Arvicola terrestris*	0	0	0	0	2	0
14	*Clethrionomys glareolus*	18	2	7	8	1	0
16	*Microtus* sp.	15	0	3	0	2	0
17	*Microtus subterraneus*	0	0	2	0	0	0
Total individuals		165	50	134	64	52	74
Total species		13	5	9	8	11	8

The number of studied biotopes was higher in 2018 than in 2019, therefore more species and individuals were collected. In 2018 the shrew species *Sorex araneus,* S. *minutus* and *N. anomalus* were registered at the ecotones with paludous biotopes with an abundance of about 1.4%, a frequency of 20% and recedent ecological significance (Wa=0.3%). In 2019 only *S. araneus* was recorded in forest biotopes with about 4.3% abundance, 33.3% frequency and subdominant ecological significance (Wa=1.4%) (Fig. 1, Table 2). For the whole period the most widespread species was *A. flavicollis*, registered in all biotopes with a frequency of 100% and eudominant ecological significance (Wa=12%-85.7%). In 2018 its abundance was the highest in woods (85.7%; I_d=30.3%), at forest edge (A=69.2%; I_d=24.4%) and in paludous biotopes (A=22.9%), and in 2019 it was also the most abundant and dominant species in all the studied biotopes.

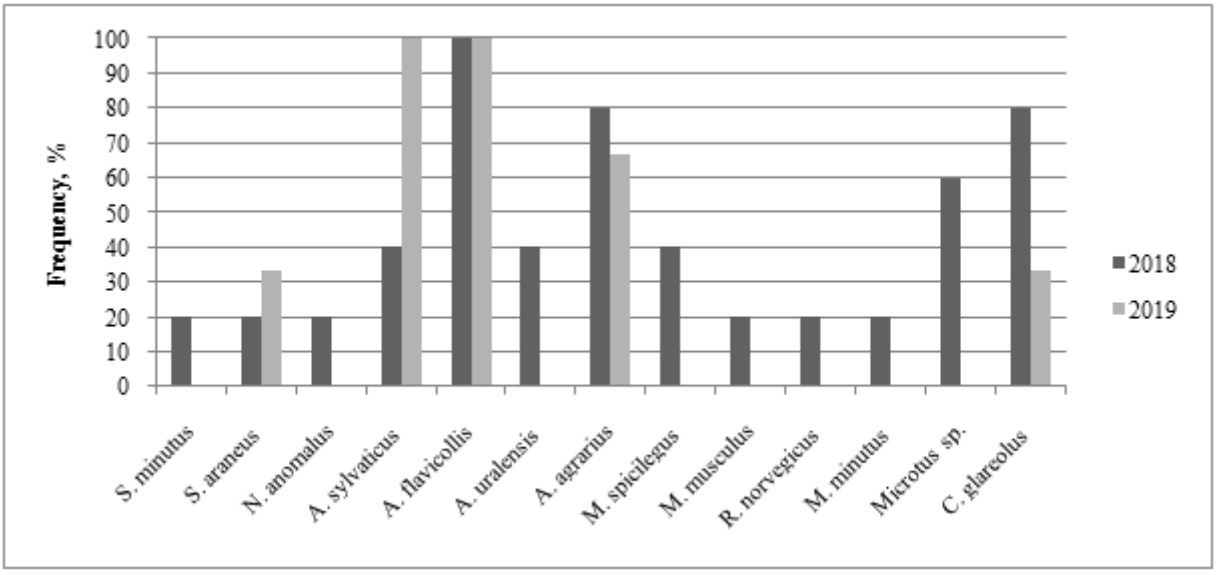

Figure 1. Frequency of small mammal species in the ecosystems of Glodeni district in 2018-2019.

A. agrarius was rather abundant in agrocenosis and various types of ecotones (24.0%-40.9%), with a frequency of 80% in 2018 and 66.7% in 2019 and eudominat ecological significance in all biotopes, except the forest, where it had

dominant significance. The wood mouse had a low abundance in 2018 and represented up to 20% in 2019 with a frequency of 22% and 100% respectively (Fig. 1, Table 2).

C. glareolus had a higher abundance in forest ecosystems, while *Microtus* species – in the agricultural ones, with a frequency of 80% and 60%, respectively, in 2018. In 2019 the field vole was not registered and the bank vole was only found in forest biotopes. Other rodent species had a low abundance and frequency, with subdominant or recedent ecological significance. The obtained results confirm the previous data about the wide spreading of *Apodemus* species, of *C. glareolus* in forest biotopes and of *Microtus* species in open type biotopes (Fig. 1, Table 2).

The diversity and biotopic preferences of the species are different among the studied biotopes. The diversity after Shannon was the highest at forest edge, in forest camp and in paludous biotopes (0.737-0.96) and the lowest (0,462) in forest (Table 2). The highest diversity at forest edge and paludous biotopes is due to the presence of shrew species and of species with specific requirements (*M. minutus*, *R. norvegicus*). The diversity after Simpson was the highest in agrocenosis (5.49) and paludous biotopes (4.88), where most species were found.

The individuals were examined for the presence of specific antibodies for leptospira and no positive results were found in the period 2018-2019. Nevertheless, the previous studies performed in 2010-2017 showed the presence of 4 leptospire serogroups: *Icterohaemorrhagiae, Pomona, Grippotyphosa* and *Canicola*. Furthermore, one individual can be reservoir for several *Leptospira* spp. Thus, in *A. agrarius* 3 serogroups were found – *Leptospira icterohaemorrhagiae, L. pomona* and *L. canicola*, and in *R. norvegicus* 2 serogroups – *L. icterohaemorrhagiae* and *L. pomona.* The results of laboratory investigations proved the intense circulation of leptospira in the norther area of the republic, in 2017 being found specific antibodies in 17.6% small mammals from the Glodeni district and 6.7% in the Ocnița district (BURLACU et al., 2017; CATERINCIUC et al., 2017, 2018).

Table 2. Ecological analysis of small mammals in the ecosystems of Glodeni district.

No.	Species	Glodeni, August 2018										Glodeni, June 2019					
		Forest		Agrocenosis		Paludous		Forest edge		Shelter belt		Forest		Forest edge		Summer camp	
		A	Wa	A	Wa	A	Wa	A	Wa	A	Wa	A	Wa	A	Wa	A	Wa
1.	*S. minutus*	-	-	-	-	1.4	0.3	-	-	-	-	-	-	-	-		
2.	*S. araneus*	-	-	-	-	1.4	0.3	-	-	-	-	4.3	1.4	-	-	-	-
3.	*N. anomalus*	-	-	-	-	1.4	0.3	-	-	-	-	-	-	-	-	-	-
4.	*A. sylvaticus*	-	-	-	-	2.9	1.1	15.4	6.2			21.7	21.7	9.1	9.1	40.0	40.0
5.	*A. flavicollis*	85.7	85.7	12.0	12.0	22.9	22.9	69.2	69.2	55.8	55.8	65.2	65.2	50.0	50.0	40.0	40.0
6.	*A. uralensis*	-	-	24.0	9.6	1.4	0.6	-	-	-	-	-	-	-	-	-	-
7.	*A. agrarius*	7.1	5.7	24.0	19.2	31.4	25.1			34.9	27.9			40.9	27.3	20.0	
8.	*M. spicilegus*	-	-	20.0	8.0	-	-	-	-	2.3	0.9	-	-	-	-	-	-
9.	*M. musculus*	-	-	8.0	1.6	-	-	-	-	-	-	-	-	-	-	-	-
10.	*R. norvegicus*	-	-			1.4	0.3	-	-	-	-	-	-	-	-	-	-
11.	*M. minutus*	-	-			1.4	0.3	-	-	-	-	-	-	-	-	-	-
12.	*Microtus* sp.	-	-	12.0	7.2	15.7	9.4			2.3	1.4	-	-	-	-	-	
13.	*C. glareolus*	7.1	5.7			18.6	14.9	15.4	12.3	4.7	3.7	8.7	2.9	-	-	-	-
Capture index, %		13.46		16.03		24.31		13.83		17.62		15.13		10.38		8.93	
Shannon index		0.462		0.959		0.737		0.756		0.628		0.691		0.847		0.96	
Simpson index		1.345		5.488		4.884		1.918		2.322		2.095		2.382		2.829	

In the Orhei district, the epizootiological monitoring was performed in various types of natural and anthropized ecosystems. In total, 198 small mammals from 10 species were collected: *S. araneus*, *M. glis*, *A. sylvaticus*, *A. flavicollis*, *A. uralensis*, *A. agrarius*, *M. spicilegus*, *C. glareolus*, *Microtus* sp., and *M. subterraneus* (Table 3). Although the climatic conditions were rather unfavourable, the number and diversity of collected species was higher in comparison to the previous years of study 2016-2017 (CATERINCIUC et al., 2017; BURLACU, 2019). In 2018 the highest trappbility index was registered at forest edge and in woods (29.0% and 23.5%) and it was the lowest in ecotone fallow ground-ponds – 14.6%. In 2019, the index at forest edge and in the woods varied between 15% and 16.7% and was the lowest in shelter belt – 8.9% (Table 3).

In 2018 the species *A. flavicollis* and *A. sylvaticus* were found in all the studied biotopes with a frequency of 100% and eudominant ecological significance. The common shrew *S. araneus* was registered at forest edge with 25% frequency and recedent ecological significance (Fig. 2, Table 3). The species *A. agrarius* and *M. spicielgus* were wide spread in open type biotopes with a frequency of 75%, while the bank vole and the field vole had 50% frequency in forest and agricultural biotopes. In 2019 *A. flavicollis* and *C. glareolus* were registered in all biotopes (100% frequency) with eudominant significance for yellow-necked mouse (Wa= 22.7%-87.5%) and dominant or eudominant significance for the bank vole. The rare species *M. glis* was recorded only in forest stands with a frequency of 33,3% and recedent ecological significance (Fig. 2; Table 3).

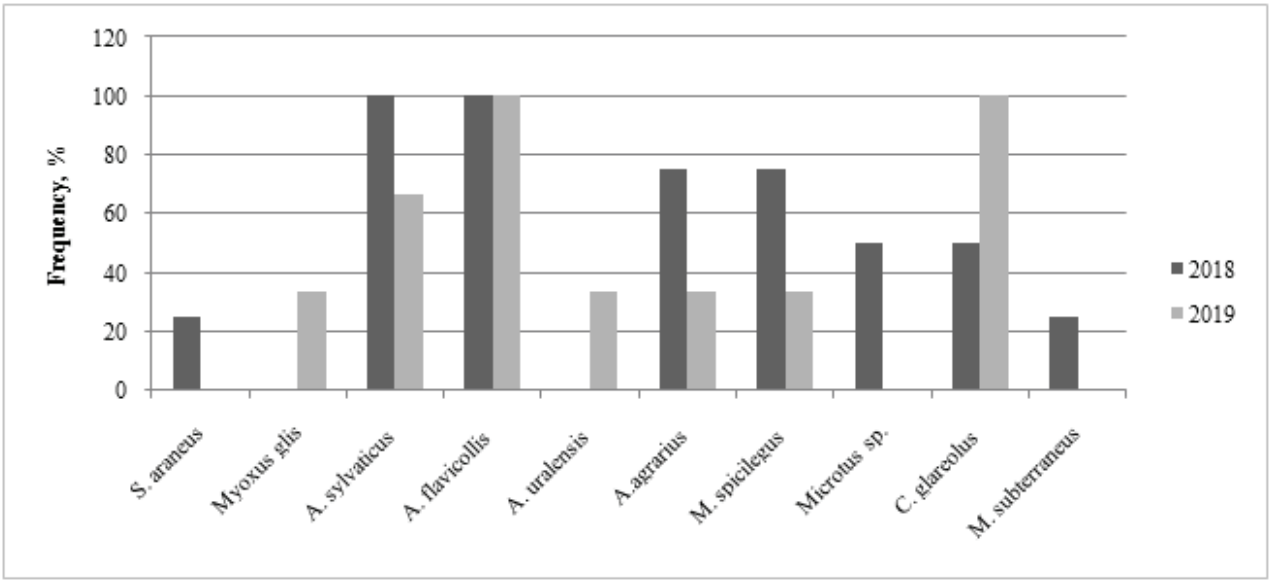

Figure 2. Frequency of small mammal species in the ecosystems of Orhei district in 2018-2019.

In 2018 *A. flavicollis* is the most abundant and dominant in forest (A=54.2%; I_d=51%) and at forest edge (A=55.2%; I_d=47%). At the ecotone of wet biotopes *A. agrarius* was the most abundant and dominant (A=53.8%; I_d=22.4%). The rare species *S. araneus* and *M. subterraneus* had the lowest abundance (A=3.4%-4.2%) in woods and at the forest edge (tab. 3). In 2019 the most abundant was *A. flavicollis* (A=87.7%-29.4%), being dominant (about 30%) in all studied biotopes. Rather abundant in forest belts are *A. agrarius*, *M. spicilegus* and *C. glareolus* (10.4%-29.4%), while the rare species *M. glis* (A=3.1%) was recorded only in woods (Table 3). The diversity index showed the highest diversity at forest edge and at shelter belt ecotones (H'=0.783-0,952) and the lowest in woods in middle spring (0,407). The Simpson diversity proved to be higher in shelter belts (3.58-4.61) in both study periods.

Table 3. Ecological analysis of small mammals in the ecosystems from the Orhei district.

No.	Species	Orhei, May 2018								Orhei, April 2019					
		Forest		Forest edge		Shelter belt		Paludous		Forest		Forest edge		Shelter belt	
		A	Wa	A	Wa	A	Wa	A	Wa	A	Wa	A	Wa	A	Wa
1.	*S. araneus*	-	-	3.4	0.9	-	-	-	-	-	-	-	-	-	-
2.	*M. glis*	-	-	-	-	-	-	-	-	3.1	1.0	-	-	-	-
3.	*A.sylvaticus*	25.0	25.0	31,0	31.0	20.5	20.5	7.7	7.7	-	-	13.3	8.9	5.9	3.9
4.	*A.flavicollis*	54.2	54.2	55.2	55.2	22.7	22.7	7.7	7.7	87.5	87.5	66.7	66.7	29.4	29.4
5.	*A.uralensis*	-	-	-	-	-	-	-	-	-	-	-	-	5.9	2.0
6.	*A.agrarius*			3.4	2.6	15.9	11.9	53.8	40.4	-	-	-	-	29.4	9.8
7.	*M.spicilegus*	6.3	4.7	3.4	2.6	40.9	30.7	-	-	-	-	-	-	17.6	5.9
8.	*Microtus* sp.	-	-	3.4	1.7	-	-	15.4	7.7	-	-	-	-	-	-
9.	*C.glareolus*	10.4	5.2	-	-	-	-	15.4	7.7	9.4	9.4	20.0	20.0	11.8	11.8
10.	*M.subterranus*	4.2	1.0	-	-	-	-	-	-	-	-	-	-	-	-
Capture index, %		23.53		29.00		21.40		14.60		16.67		15.00		8.95	
Shannon index		0.759		0.643		0.952		0.811		0.407		0.783		0.9	
Simpson index		2.734		2.493		3.585		2.923		1.293		2.01		4.61	

The individuals collected in Orhei district were examined for the presence of specific antibodies for leptospira and no positive results were found in the period 2018-2019. However, specific antibodies to *L. grippotyphosa* and *L. icterohaemorrhagiae* were determined in the species *A. agrarius, M. musculus* and *Sorex araneus*, collected in the same period in the neighbouring district Ialoveni. The epizootiological monitoring of this territory was performed in autumn period of 2018-2019 according to epidemiological indications due to the registration of leptospirosis cases among local population.

In the Cahul district, the epizootiological monitoring was performed in the following types of biotopes: forest, agrocenosis, paludous, shelter belt and their ecotones. 126 individuals from 12 species were collected: *Sorex araneus*, *D. nitedila, A. sylvaticus*, *A. flavicollis*, *A. uralensis*, *A. agrarius*, *M. spicilegus*, *M. minutus, R. norvegicus, C. glareolus*, *Microtus* sp. and *A. terrestris* (Table 4).

In 2018 the highest capture index was registered in forest biotopes 26.92%, followed by paludous and shelter belts with 12.2%. In 2019 this index was the highest in the paludous biotope – 14.14% (Table 4). The number of individuals was very low for the autumn period, due to unfavourable climatic conditions of the year (high temperatures, low precipitation quantity) that had a negative impact on the reproductive activity of the species.

Table 4. Ecological analysis of small mammals in the ecosystems from the Cahul district.

No.	Species	Cahul, October 2018						Cahul, September 2019					
		Forest		Paludous		Shelter belt		Forest		Paludous		Shelter belt	
		A	Wa	A	Wa	A	Wa	A	Wa	A	Wa	A	Wa
1.	*S. araneus*	-	-	-	-	-	-	-	-	7.3	4.88	-	-
2.	*D. nitedula*	-	-	-	-	-	-	11.1	3,7	-	-	-	-
3.	*A. sylvaticus*	7.1	7.1	35.5	35.5	85.7	85.7	11.1	11,1	43.9	43.9	12.5	12.5
4.	*A. flavicollis*	14.3	9.5	9.7	6.5	-	-	77.8	51,9	-	-	33.3	22.2
5.	*A.uralensis*	-	-	12.9	4.3	-	-	-	-	31.7	21.1	20.8	13.9
6.	*A. agrarius*	71.4	47.6	9.7	6.5	-	-	-	-	14.6	9.8	16.7	11.1
7.	*M.spicilegus*	-	-	9.7	6.5	14.3	9.5			2.4	1.6	16.7	11.1
8.	*R. norvegicus*	-	-	3.2	1.1	-	-	-	-	-	-	-	-
9.	*M. minutus*	-	-	6.5	2.2	-	-	-	-	-	-	-	-
10.	*Microtus* sp.	-	-	6.5	2.2	-	-	-	-	-	-	-	-
11.	*C.glareolus*	7.1	2.4			-	-	-	-	-	-	-	-
12.	*A. terrestris*	-	-	6.5	2.2	-	-	-	-	-	-	-	-
Capture index, %		26.92		12.20		7.00		13.43		14.14		11.11	
Shannon index		0.645		0.888		0.592		0.622		0.8		0.976	
Simpson index		1.863		5.694		1.329		1.597		3.183		4.855	

In 2018, the species *A. sylvaticus* was found in all studied biotopes with a frequency of 100% and dominant or eudominant ecological significance. The species *A. uralensis*, *M. minutus, R. norvegicus, C. glareolus, Microtus* and *A. terrestris* registered in forest and paludous biotopes had the frequency of 33.3% and subdominant or recedent ecological significance. In 2019, *A. sylvaticus* was the most spread species with a frequency of 100% and eudominant or dominant ecological significance (11.1%-43.9%). The lowest frequency (33.3%) and subdominant ecological significance was found in *S. araneus* and *D. nitedula* (Table 4, Fig. 3).

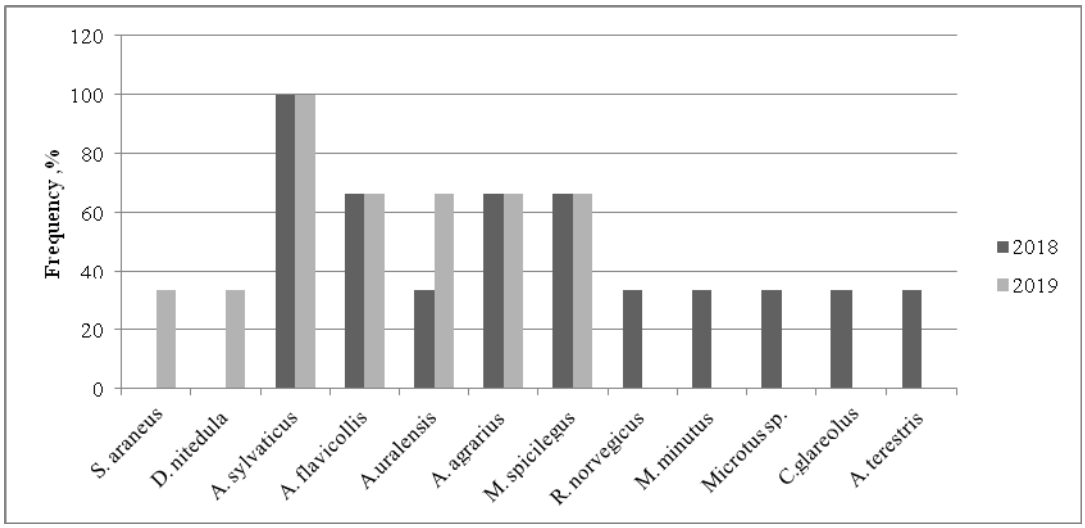

Figure 3. Frequency of small mammal species in the ecosystems of the Cahul district in 2018-2019.

In both study periods the species of gen. *Apodemus* are the most abundant and dominant in the studied biotopes. In 2018 *A. sylvaticus* had a highest abundance and dominance in shelter belts and in paludous habitats (A=35.5%; I_d=21.7%), while *A. agrarius* was the most abundant and dominant in forest (A=71.4%; I_d=24.3%). In 2019 the *A. sylvaticus* had the highest abundance and dominance in paludous biotopes (A=43,9; I_d=28.2%) and *A. flavicollis* in forest and shelter belts (77.8%). The common shrew had an abundance of 7.3% in paludous biotopes and *D. nitedula* – 11.1% in woods (Table 4). In both years the highest diversity was found in shelter belts.

The presence of leptospira was detected in 4% of small mammals. In *R. norvegicus* collected from wet biotopes located near the agrocenosis, the *L. icterohaemorrhagiae* serotype was found. In the summer – autumn period people can get

infected by leptospira, namely in these types of biotopes through agricultural or leisure activities. It must be mentioned that in September 2008 in the same area, the serotypes *L. grippotyphosa* and *L. pomona* were detected in *A. agrarius* and *A. uralensis*. Thus, after a decade of monitoring, an activation of the anthropogenic leptospirosis outbreak was established, with the substitution of the leptospire serotype (CATERINCIUC et al., 2017; BURLACU, 2019;).

During 2018-2019, a total of 10 cases of leptospirosis were reported in the Republic of Moldova. A higher number of leptospirosis cases was reported mainly in the northern districts (8 cases) and in the central area - 2 cases. At the country level, the highest share of leptospirosis cases was registered in the rural population (90%). Multiannual leptospirosis morbidity highlights a seasonal summer-autumn character, similar to the countries in temperate regions. This disease is mostly seen in July-September. Most cases were recorded in July and August (70%), compared to September-October (30%) (Fig. 4). This is due to the fact that the epidemic process is intensely stimulated by habitual and seasonal professional and leisure activities. Infection in humans correlates with occupational and recreational exposure. Occupational exposure is a significant factor in contracting leptospirosis, some groups of people being exposed to a higher risk of infection related to the type of activity (GHEORGHIȚA et al., 2009; TODERAȘ et al., 2010; CATERINCIUC et al., 2017; BURLACU 2019;).

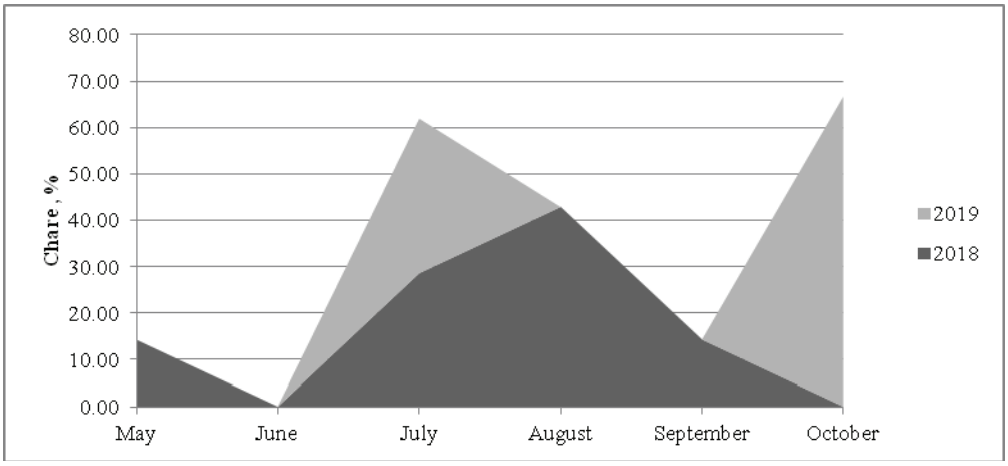

Figure 4. Seasonality of leptospiroses in the Republic of Moldova in 2018-2019.

The analysis of the peculiarities of the epidemic process shows that the main source of infection in these years is represented by rodents, and human infection occurs both during bathing, mowing, using water from unauthorized sources and after using food contaminated by rodents.

Data from the literature indicate that in the northern area the frequency of human diseases is higher compared to the central and southern areas. The presence of leptospirosis in small mammal populations and the regular activation of leptospirosis outbreaks may aggravate the epidemiological situation. These results suggest the necessity to monitor leptospirosis outbreaks all over the territory of the republic in order to obtain updated data related to the current state of natural outbreaks, reservoir communities, leptospira circulation, etc. in order to prevent the diseases of zoonotic origin (LEVETT, 2001; GHEORGHIȚA et al., 2009; TODERAȘ et al., 2010; BURLACU et al., 2016; CATERINCIUC et al., 2017; BURLACU, 2019).

CONCLUSIONS

In the ecosystems of the Glodeni district 215 small mammals of 13 species were collected, and the lowest average capture indexes were recorded in June 2019. In the ecosystems of the Orhei district in the central area 198 small mammals of 10 species were collected, the lowest average capture indexes were recorded in April 2019. In the ecosystems of the Cahul district in the southern area 126 small mammals of 12 species were collected, the average capture indexes were similar for both study years.

In the northern and central areas the most widespread are the species *A. flavicollis* and *A. sylvaticus*, in the southern area - *A. sylvaticus* and *A. agrarius* reported in most types of studied ecosystems, with a frequency of 66.7% - 100% and with high values of the abundance and dominance index.

The diversity and biotopic preferences of the species differ from one biotope to another. In the northern area the highest diversity index was recorded in agrocenosis and wet biotopes; in the centre and south – in the shelter belt and paludous habitats.

In the southern area, Cahul, the natural outbreak of leptospirosis was registered in September 2018. The species *R. norvegicus* was involved in the epizootic process, where specific antibodies to the serotype *L. icterohaemorrhagiae* were determined. The results of the research confirm the existence in our country of natural outbreaks of leptospirosis that are maintained and activated by small mammal communities – reservoirs and sources of

infection, and the varying degree of ecosystem anthropization brings these natural outbreaks closer to localities. The monitoring of leptospira circulation in small mammal communities allows the prediction of the epizootiological situation and the risk of spreading this disease in the human population.

The scientific evidence obtained in the studies serves to argue public health policies as well as to spread the measures for populations in preventing the risk associated with diseases of zoonotic origin.

Acknowledgements. The author is grateful to dr. Victoria Nistreanu for her valuable comments and suggestions, and for improving the English text of the paper. The study was performed within the doctoral project, State Program project 20.80009.7007.02 and within the collaboration contract between the Institute of Zoology and the National Agency for Public Health.

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Burlacu Victoria
National Agency for Public Health
Institute of Zoology, Academiei str.1, MD – 2028, Chisinau, Republic of Moldova.
E-mail: burlacu.ivictoria@gmail.com

Received: March 19, 2020
Accepted: July 8, 2020