

## IMPORTANCE OF LONG-EARED OWL (*Asio otus* L.) IN RODENT REGULATION NUMBER IN URBAN AREAS

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### Abstract

The winter trophic spectrum of two *Asio otus* colonies from Chisinau city was studied. There were collected and analysed 1432 pellets from the first colony (Ciocana district, 60 individuals) and 528 pellets from the second colony (Botanica district, 22 individuals). After the quantitative and qualitative analysis of the pellets 3567 individuals in Ciocana pellets and 1584 individuals in Botanica pellets were identified. The long-eared owl diet in both sites consists mostly of rodents - more than 90% of all identified animals, the birds constituted 4.93% and 3.35%, the shrews and the bats constituted less than 2%. The main prey of *A. otus* were the *Microtus* species, which constituted 61.9% in Ciocana pellets and 63.38% in Botanica pellets, followed by *Apodemus sylvaticus* (14.02% and 17.99%) and by the *Mus* species with 12.42% and 14.21%, respectively. Other rodent species registered less than 5%. Thus, the trophic spectrum of long-eared owl in winter period in urban area consists mostly of field vole. The proportion of synanthropic pest species *Mus* is rather high, which prove the huge importance of long-eared owl trophic activity in urban ecosystems.

**Key words:** long-eared owl, urban ecosystems, trophic spectrum, rodents, biological control.

### INTRODUCTION

The long-eared owl (*Asio otus* L., Figure 1) is a sedentary bird and one of the most widespread nocturnal predators in Europe (Birrer, 2009). In cold period of the year the density of species increases due to the migrant individuals from the northern regions and they form rather large colonies of several tens of individuals. The hunting sectors of the long-eared owl are open type biotopes, including agricultural lands, where they hunt mainly rodents and occasionally birds, shrews and bats. After the digestion process the owls regurgitate as pellets the indigestible remains of consumed animals (bones, hair, feathers, fur). The analysis of pellets can provide data on the diet of the prey bird, the fauna of small mammals in a certain area, their density, their dynamics, etc. The long-eared owl is well adapted to anthropic environment and its wintering colonies are frequently registered in urban localities (Zubcov, 1986; Romanowski, 1988; Mori & Bertolino, 2015).

Many rodent species are important pests of agricultural crops, including in urban areas. Taking into consideration the huge importance of long-eared owl trophic activity in biological control of rodent pest species, especially in

winter period, its diet was rather well studied in many regions of Europe (Goszczynski, 1977; Nilsson, 1981; Wijnandts, 1984; Tome, 1994; Galeotti & Canova, 1994; Romanowski & Zmihorscki, 2008; Birrer, 2009 etc.), as well as in the Republic of Moldova (Averin & Ganea, 1966; Anisimov, 1969; Zubcov, 1981; Nistreanu et al., 2015a; 2017). There are several studies concerning the long-eared owl's diet in urban areas (Barbu & Barbu, 1972; Barbu & Korodi Gal, 1972; Murariu et al., 1991; Laiu & Murariu, 1998; Banaru & Coroiu, 1997; Riegert et al., 2009, Sharikov et al., 2009; Sandor & Kiss, 2004; Kiat et al., 2008) and only few studies in the Republic of Moldova (Anisimov, 1969; Zubcov, 1986; Nistreanu et al., 2015b).



Figure 1. Long-eared owl (*Asio otus*) individuals from Ciocana site

The long-eared owl usually shows strong preference for *Microtus* voles, but in urban areas it hunts in open type biotopes within and outside the city, using also alternative prey (Pirovano et al, 2000; Kiat et al., 2008; Sandor & Kiss, 2008; Riegert et al., 2009).

The aim of the paper is the analysis of winter diet of two long-eared owl colonies located in opposite zones of Chisinau city and highlight the importance of trophic activity of the species in urban area.

## MATERIALS AND METHODS

The studies were performed in winter periods of 2011-2012 in Chisinau city. Chisinau is the largest city of the Republic of Moldova, with the surface of 123 km<sup>2</sup>, situated at the altitude of 82 m, coordinates 47°01' N 28°52' E. The climate is humid continental with warm summers and cool, windy winters. The winter period lasts 78-80 days. The average temperature in winter is -2.3°C and the minimum temperature during January and February can drop below -20°C.

One colony of long-eared owl (*Asio otus* L.) of 60 individuals was located in a courtyard of a school from Ciocana district (47.041N, 28.883E) with several dozens of tall coniferous and deciduous trees (*Picea abies*, *Populus nigra*, *P. tremula*, *Salix alba*) suitable for long-eared owl individuals. The second colony counting 22 individuals was located in Botanica district (46.989N, 28.866E) with tree vegetation of *Thuja orientalis*, *Picea abies*, *Populus nigra*. Both locations are situated within the city limits in heavily urbanized areas.

There were collected and analysed 1268 pellets from the first colony and 528 pellets from the second colony. Each pellet was measured, weighed and unfolded. The bone fragments were cleaned and sorted into categories. Small mammal species were determined according to cranial bones and dentition (Pucek, 1981; Popescu & Murariu, 2001). The sibling species *Microtus arvalis* and *M. rossiaemeridionalis*, *Mus musculus* and *M. spicilegus* that can't be differentiated morphologically were considered as genus *Microtus* and *Mus*, respectively.

The ecological analysis of the prey species was performed using the indexes of abundance ( $A =$

$\text{no} \cdot 100/N$ , where no - number of individuals of a species, N - total number of individuals); frequency ( $F = \text{nop} \cdot 100/N$ , where nop - number of pellets with certain species, N - number of pellets); total biomass of consumed prey ( $B = \text{no} \cdot G$ , where no - number of individuals of a species, G - mean weight of one individual). The mean weight of prey individual was calculated from our own data gathered during many year studies of mammals and birds. The trophic niche breadth was estimated using the *B* Levins' index:  $B = 1/\sum p^2$ , in its standardized version *Bs*:  $Bs = (B-1)/(n-1)$ , where p is the fraction of items in the diet, and n is the number of possible food categories (Levins, 1968; Hulbert, 1978). *Bs* ranges from 0 (100% utilization of a single food category) to 1 (equal use of all categories). During the study no animal was injured or sacrificed.

## RESULTS AND DISCUSSIONS

In the first colony the pellet length varied from 1.55 cm to 8.34 cm, mean length of 4.03 cm. The pellet weight varied between 0.9 g and 7.2 g, mean - 2.71 g. The number of individuals per pellet was from 1 to 7, mean - 2.56 individuals. In the second colony the pellet length varied from 1.32 cm to 6.89 cm, mean length of 3.93 cm. The pellet weight varied between 0.9 g and 6.7 g, mean - 2.54 g. After the quantitative and qualitative analysis of the pellets 3567 individuals in Ciocana pellets and 1584 individuals in Botanica pellets were identified.

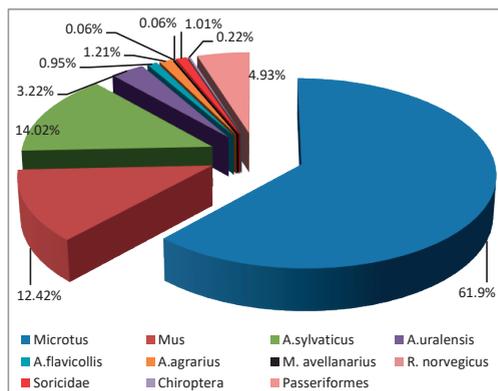


Figure 2. Trophic spectrum of long-eared owl from the first colony (Ciocana)

The trophic spectrum of long-eared owl in the first colony consisted of mammals from 3 orders (Soricomorpha, Rodentia, Chiroptera) and birds represented by Passeriformes, while in the second colony the bats have not been registered (Figures 2, 3).

In both sites *Microtus* species dominated with 61.9% and 63.38%, respectively. The wood mouse is the second species (14.02% and 17.99%), followed by the house mouse with 12.42% and 14.21%, respectively. Other *Apodemus* species constituted about 5% in the first colony and less than 1% in the second one. Other two rodent species have been registered in the first colony - the arboreal rodent *Muscardinus avellanarius* and the synanthropic species *Rattus norvegicus* with very low ratio (less than 0.1%), while in the second colony the forest species *Clethrionomys glareolus* (0.06%) and *R. norvegicus* (0.25%) were found. In both sites there were identified shrews with 1% and 0.44%, while bat species were found in the diet of the first colony only (0.2%). The birds constituted 4.93% and in 3.35%, respectively (Figures 2, 3). The diet of the first colony was more diverse, probably due to much higher number of individuals that hunted in a larger variety of ecosystems.

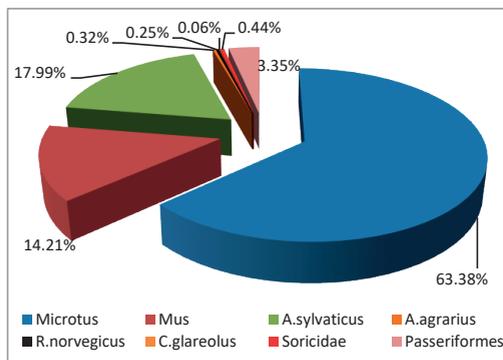


Figure 3. Trophic spectrum of long-eared owl from the second colony (Botanica)

The highest frequency in pellets from both urban areas belongs to *Microtus* species that was found in most of the pellets. The second species according to frequency was *Mus*, although it was the third after its abundance, but it was found in more pellets than *A. sylvaticus*, which also, had a rather high frequency (Table 1). The passerine birds had a

frequency of 10.75% and 7.77%, respectively, they were found in many pellets. Other *Apodemus* species had a rather high frequency in pellets from Ciocana and very low frequency in Botanica pellets. The shrews had the frequency of 2-3% in both sites, while other species had a very low frequency.

Table 1. Frequency of animal species in *Asio otus* pellets

No.	Genus/species	Ciocana		Botanica	
		No pellets	F, %	No pellets	F, %
1.	<i>Microtus</i>	917	64.04	402	76.14
2.	<i>Mus</i>	395	27.58	187	35.42
3.	<i>A. sylvaticus</i>	382	26.68	155	29.35
4.	<i>A. uralensis</i>	81	5.66	-	-
5.	<i>A. flavicollis</i>	102	7.12	-	-
6.	<i>A. agrarius</i>	41	2.86	5	0.95
7.	<i>M. avellanarius</i>	2	0.14	-	-
8.	<i>R. norvegicus</i>	2	0.14	4	0.76
9.	<i>C. glareolus</i>	-	-	1	0.19
10.	Soricomorpha	28	1.96	18	3.41
11.	Chiroptera	5	0.35	-	-
12.	Passeriformes	154	10.75	41	7.77

The total biomass of prey items constituted 139,175 g in both sites, with 93,774 g in Ciocana site and 45,401 g in Botanica site (Table 2). The highest biomass belongs to *Microtus* species, with 66,240 g and 30,120 g, respectively. In both colonies a rather high biomass was registered in *A. sylvaticus*, *Mus* species and birds (Table 2).

The trophic niche index varied between 2.19 to 2.37, the total index was 1.14. The total standardized index was 0.01 and varied from 0.137 to 0.171 and indicate that in Botanica site the prey categories had more even distribution in the diet (Table 2).

In both sites of Chisinau city the *Microtus* voles are the most important prey item in the winter diet of Long-eared owl, which was mentioned for many urban areas across Europe (Murariu et al., 1991; Laiu & Murariu, 1998; Banaru & Coroiu, 1997; Sharikov et al., 2009; Benedek & Sîrbu, 2010; Dzemian et al., 2012; Martelli & Fastelli, 2013 etc.). *Apodemus* species constitute an important trophic source for long-eared owl in urban area. Their share can vary between 3% and 66% (Romanowski, 1988; Laiu et al., 2002; Sharikov, 2006; Sharikov et al., 2009) depending on location, climatic conditions, hunting sectors and prey availability. In some urban areas the *Apodemus* species even were the most abundant prey

during winter period (Pirovano et al., 2000; Dzemian et al., 2012).

Table 2. Individual number and biomass (g) of prey species in studied sites

Species	Site	Ciocana	Botanica	Total
<i>Microtus</i>	No	2208	1004	3212
	BM	66240	30120	96360
<i>Mus</i>	No	443	225	688
	BM	6645	3375	10020
<i>A. sylvaticus</i>	No	500	285	785
	BM	12500	7125	19625
<i>A. uralensis</i>	No	115	-	115
	BM	2300	-	2300
<i>A. flavicollis</i>	No	34	-	34
	BM	1190	-	1190
<i>A. agrarius</i>	No	43	5	48
	BM	1075	125	1200
<i>R. norvegicus</i>	No	2	4	6
	BM	200	600	800
<i>M. avellanarius</i>	No	2	-	2
	BM	40	-	40
<i>C. glareolus</i>	No	-	1	1
	BM	-	25	25
Soricidae	No	36	7	43
	BM	288	56	344
Chiroptera	No	8	-	8
	BM	96	-	96
Passeriformes	No	176	53	229
	BM	3200	3975	7175
<b>Total ind.</b>	<b>No</b>	<b>3567</b>	<b>1584</b>	<b>5151</b>
<b>Total biomass, g</b>	<b>BM</b>	<b>93774</b>	<b>45401</b>	<b>139175</b>
<b>BTN</b>		<b>2.369</b>	<b>2.198</b>	<b>1.139</b>
<b>BTNs</b>		<b>0.137</b>	<b>0.171</b>	<b>0.01</b>

No - number of individuals

BM - biomass

BTN - breadth of trophic niche

BTNs - breadth of trophic niche standardized

The abundance and biomass of *Mus* species is very high, which can be explained by the surface and structure of Chisinau city - there are many tall buildings and a massive production of waste. Data on high ratio of *Mus* species (up to 10%) in winter diet of the long-eared owl was noted for other large cities (Murariu et al., 1991; Bencova et al., 2006; Escala et al., 2009; Sharikov et al., 2009; Martelli & Fastelli, 2013).

Among other rodent species the brown rat was found in pellets with very low ratio, similar to other studies, where *R. norvegicus* registered up to 5% (Murariu et al., 1991; Laiu & Murariu, 1998; Romanowski, 1988; Sandor & Kiss, 2004), but in some large cities the species is one of the main prey, reaching about 20% and 60-70% biomass (Pirovano et al., 2000).

The representatives of shrews and bats have been registered in very low percent. The shrews represent an alternative prey type for *A. otus* and are usually hunted when the abundance of *Microtus* species is low (Korpimäki &

Norrdahl, 1989). The presence of bats in *A. otus* pellets is usually accidental and constitutes less than 0.5% (Obuch, 1998).

The passerine birds constituted about 3-5% in long-eared owl diet, as well as in other urban studies, where their share varied between 1% and 10% (Romanowski, 1988; Bencova et al., 2006; Sharikov et al., 2009; Dzemian et al., 2012; Tulis et al., 2019).

The long-eared owl is a feeding specialist predator and hunt individuals that weight between 15 g and 50 g, therefore, the ratio of preferred prey - *Microtus* voles remain high in spite of the availability of other prey types (Goszczynski, 1977; Birrer, 2009). As adaptations to urban environment, may be considered the hunting of synanthropic rodent species (*Mus musculus*, *Rattus norvegicus*), the highest ratio of bird species as well as the use of many prey types (Wijnandts, 1984; Banaru & Coroiu, 1997; Pirovano et al., 2000; Sandor & Kiss, 2008; Kiat et al., 2008; Mori & Bertolino, 2015).

The low values of trophic niche breadth prove the high hunting specialization of the long-eared owl for *Microtus* voles, which are one of the most important rodent pests, and highlight its importance in rodent regulation in urban areas and surroundings.

## CONCLUSIONS

The trophic spectrum of long-eared owl in Chisinau city is rather diverse and consists of mammals and birds, the rodents being the dominant trophic source with more than 90%. The *Microtus* species were the main prey in both sites and constituted more than 60%.

The proportion of synanthropic pest species from genus *Mus* was rather high, which prove the huge importance of long-eared owl trophic activity in urban ecosystems.

The total biomass of prey items constituted 139,175 g, among which the highest belongs to *Microtus* species with 93,360 g.

The low total value of trophic niche breadth (BTNs = 0.01) prove the high hunting specialization of the long-eared owl for *Microtus* voles, and highlight its importance in rodent regulation in urban areas and surroundings.

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