

WINTER DIET OF THE LONG-EARED OWL *Asio otus* IN SLOVENIA**Zimska prehrana male uharice *Asio otus* v Sloveniji**

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Winter diet of the Long-eared Owl *Asio otus* was investigated at 15 localities across Slovenia, belonging to seven geographical regions (Fig. 1). Of 3,712 prey items found in pellets, small mammals represented more than 98%, with voles Arvicolinae being the most important (Tab. 1). The proportions of Common Vole *Microtus arvalis* were the only with a significant negative correlation with food niche-breadth (Fig 2.). Common Vole was therefore the main prey for the owl. The most important alternate prey species were: Field Vole *Microtus agrestis*, mice of the genus *Apodemus*, Common-pine Vole *Microtus subterraneus*, and Water Vole *Arvicola terrestris*. Which of them occurred in higher percentages in the diet was dependent on their geographical distribution and ecological requirements. Field Voles, for example, were present with more than 10% of all prey items only at Ljubljansko barje and Ribniško podolje. This was probably due to the high ground-water level and regular floods in these two regions, which gain some ecological advantages to Field Voles against other small mammals. In the areas with high degree of field cover, on the other hand, the community of small mammals is often dominated by mice. In such areas (Bela krajina, Dravsko podolje, Mursko podolje), the most important alternate prey species for the Long-eared Owl was Wood Mouse *Apodemus sylvaticus* (Fig. 3).

**Key words:** Long-eared Owl, *Asio otus*, winter diet, prey use

**Ključne besede:** mala uharica, *Asio otus*, zimska prehrana, izbor plena

**1. Introduction**

Most of the studies on the Long-eared Owl *Asio otus* in Slovenia deal with its diet (KRYŠTUFEK 1980, TOME 1991, TOME 1994, ŠORGO & JANŽEKovič 1996, KATALINIČ 1997). These contributions, however, are geographically very narrowly limited only to certain parts of the country. So far, there was no attempt to make a survey of the owls diet across the entire area of Slovenia. The aim of this article is to investigate the Long-eared Owl's winter diet in different geographical regions of the country, as well as to establish which are the main and which alternate prey species for the owl.

**2. Materials and methods**

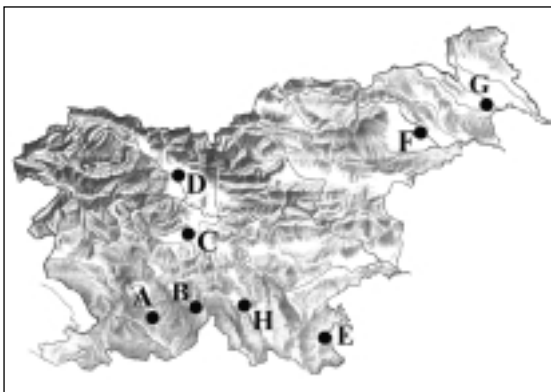
Pellets were collected in different parts of Slovenia between 1986 and 1991. Some of the samples were

obtained from my associates. For this study only samples found between November and April were taken into consideration. For the presentation of the Long-eared Owl's diet, the samples were combined according to the existing mezoregions (hereinafter referred to as "the regions"; PERKO & OROŽEN-ADAMIČ 1998). All prey species reaching 10% in the diet were considered as important for the Long-eared Owl. During the more detailed analysis of the feeding habits, the samples were not combined, and only those with more than 20 prey items were taken into consideration. For this analysis the data from Mursko polje (KATALINIČ 1997) were added to my personal results.

Food niche breadth (FNB) was estimated according to LEVINS (1968). The optimal diet theory (PYKE 1984) foresees that the food niche widens when the population of the main prey species decreases, and vice versa, which means that FNB correlates negative with the proportion of the main prey species in the diet.

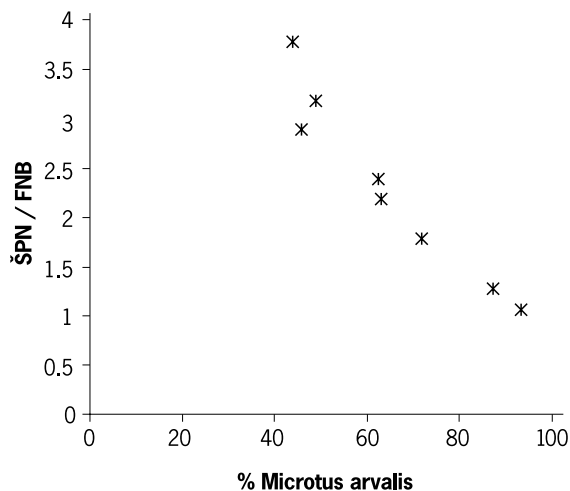
Small mammals were identified with the determination key of KRYŠTUFEK (1985), while birds and insects were not identified to lower taxonomic units. Biomasses were calculated from average masses of small mammals and birds obtained from individual skull (humerus in birds) length (TOME in print) or taken from literature (TOME 1991). The distribution of small mammals in Slovenia is derived from KRYŠTUFEK (1991).

The proportions of field areas in the open habitat were estimated in a circle of 100 m around the place where pellets were found: low proportion denotes that there were no or almost no fields in its vicinity, intermediate proportion indicates that there were fields present, while high proportion denotes that at least half of the area was covered with fields. For the pellets from Dravsko polje and Mursko polje that were not collected by me, the proportion of fields were estimated on the basis of statistical values for separate mezoregions (PERKO & OROŽEN-ADAMIČ 1998). Significance of differences in the proportion of mice in the diet with regard to the proportion of fields in a certain surrounding were calculated using ANOVA. Prior to the calculations, the data were arcsin transformed.



**Figure 1:** Study area (location and date of pellet collection in brackets)

**Slika 1:** Območje raziskave (v oklepaju lokacija in datum pobiranja izbljuvkov): A=Pivško podolje (Koritnice – 7.2.1991; Knežak – 17.3.1991); B=Notranjsko podolje (Vrhnika pri Starem trgu – 25.2.1990; 17.3.1991); C=Ljubljansko barje (Mah, Kozlarjeva gošča, Črna vas, Ljubljana, Bevke, Gričica; vsa leta od 1986 do 1991); D=Savska ravan (Predoslje – 30.1.1986; Hrastje – 15.11.1990; 25.12.1990; 1.3.1991); E=Bela krajina (Krasinec – 7.4.1991); F=Dravska ravan (Bukovci – 2.2.1986; 21.2.1987; 26.2.1989; Hajdoše – 23.4.1989); G=Murska ravan (Katalinič 1997); H=Ribniško podolje (Dolenja vas – 8.4.1989; 10.3.1990; 24.3.1991)



**Figure 2:** Change of food niche breadth (FNB) according to the proportions of Common Vole *Microtus arvalis* in the diet of the Long-eared Owl ( $r=-0.961$ ;  $p<0.001$ ;  $N=8$ )

**Slika 2:** Spreminjanje širine prehranjevalne niše (ŠPN) glede na delež poljske voluharice *Microtus arvalis* v prehrani male uharice ( $r=-0,961$ ;  $p<0,001$ ;  $N=8$ )

### 3. Results

Pellets were collected at 15 localities in seven different geographical regions (Fig. 1). 3,712 prey units belonging to 17 species of small mammals and to unidentified number of bird species were isolated from them. The most important prey species was Common Vole *Microtus arvalis* with 51% by number, followed by Field Vole *Microtus agrestis* with 17% and mice of the genus *Apodemus* with 13%, respectively. The proportion of other species was lower than 10%. The proportions by mass did not essentially differ from the proportions by number. Fifty-five birds represented a little more than 1% in the diet in view of the number of prey units as well as biomass (Tab. 1).

Common Vole was the most important prey species in the Long-eared Owl's diet in all seven regions. The highest share was in the pellets from the localities in Savska ravan and Pivško podolje, the lowest at Ljubljansko barje and Bela krajina. Mice played an important part in the owl's diet in four regions, Common-pine Vole *Microtus subterraneus* and Field Vole in two, and Water Vole *Arvicola terrestris* in a single region. In two regions, Common Voles were the only important prey species for the Long-eared Owl (Tab. 1).

The most diverse diet was recorded at Ljubljansko barje and Dravska ravan, the least diverse at Savska

ravan and Pivško podolje (Tab. 1). FNB correlates negative only with changes in the proportion of the Common Vole ( $r=-0.962$ ;  $p<0.001$ ;  $N=8$ ; Fig. 2). The proportion of Wood Mouse *Apodemus sylvaticus* in the pellets changed significantly with the proportion of fields around the locations where pellets were found ( $F=10.08$ ;  $p=0.002$ ; Fig. 3).

#### 4. Discussion

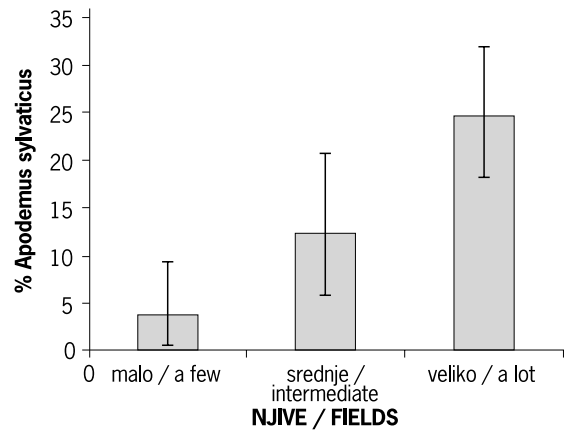
The Long-eared Owl is specialized in hunting small mammals in open countryside, among which it chooses opportunistically according to their occurrence (TOME 1991). A large proportion of small mammals in the diet, in the first place voles Arvicolinae, is thus not surprising and in accordance with the findings of other authors (KRYŠTUFEK 1980, TOME 1994, ŠORGO & JANŽEKVIČ 1996, KATALINIČ 1997).

Due to the five to fifty times greater sample from Ljubljansko barje in comparison with other regions, two to three times more prey species have been discovered. This fact, however, has no essential effect on the FNB value of this location.

The FNB correlates negative only with the proportion of Common Vole in the diet, due to which this species was regarded as the only main prey species for the owl. When Common Voles were less readily available, the owl captured more mice, Field Voles, Common Pine Voles and Water Voles. In different geographical regions these species were the most important alternate prey, respectively.

In fields, Wood Mice are often the dominant small mammal species (KRYŠTUFEK 1991). It is therefore not surprising that their proportion in the Long-eared Owl's diet depended on the area covered by fields (Fig. 3). The main difference between Field Vole and Common Vole is that the latter spends most of its life underground, where it also builds its nest, while the first makes its nest and connecting tracks above the ground as well, due to which it is less sensitive to high groundwater level (KRYŠTUFEK 1991). Height of the groundwater level together with flood frequency is thus an important ecological factor, which determines the population density of both species and their proportion in the Long-eared Owl's diet. The most frequently flooded areas dealt with in this study are Ljubljansko barje and the surroundings of Dolenja vas in Ribniško podolje, and it was only in these areas where Field Voles were found to be an important alternate prey species.

On the basis of the collected data I was unable to establish the characteristic ecological entities, due to which Common Pine Vole and Water Vole were an



**Figure 3:** Change of Wood Mouse *Apodemus sylvaticus* proportions in the diet of the Long-eared Owl, according to field cover area in a surrounding (a few – fields were non-existent or very rare; intermediate – fields were present; a lot – over half of the area was covered with fields). Bars=average, line=SD

**Slika 3:** Spreminjanje deleža navadne belonoge miši *Apodemus sylvaticus* v prehrani male uharice glede na površino, ki so jo v okolici pokrivalo njive (malo – v okolici ni bilo njiv ali so bile le posamezne; srednje – v okolici so bile njive; veliko – več kot polovica odprtih površin v okolici so bile njive). Histogram=povprečna vrednost, črte=SD

important alternate prey of the Long-eared Owl in two of the regions investigated.

The data on the Long-eared Owl's diet have also enabled some conclusions (KRYŠTUFEK 1991) on the geographical distribution of small mammals in Slovenia. Field Voles found at Pivško podolje confirm the SW border of the known distribution of the species. Further south it was recorded only at Ilirska Bistrica (KARAJIČ & KRYŠTUFEK 1999). According to so far published data the species was also expected in Bela krajina, but has not been found there as yet. New zoogeographical data, however, are the records of a Common Vole at Pivško podolje, a Harvest mouse *Micromys minutus* at Notranjsko podolje, and of a Common Pine Vole at Notranjsko podolje and in Bela krajina, where it lives sympatric with Alpine Pine Vole *Microtus multiplex*.

#### 5. Conclusions

This study confirms that voles are certainly the most important prey of Long-eared Owl, with Common Voles being the main prey species. Which of the alternate prey species will have an important share in the owl's diet depends on the geographical distribution of small mammals and their ecological requirements.

**Table 1:** Proportions by number of prey species in the diet of the Long-eared Owl in Slovenia during winter (N – numerus, LB – Ljubljansko barje; BK – Bela krajina; RP – Ribniško podolje; SR – Savska ravan; NP – Notranjsko podolje; PP – Pivško podolje; DR – Dravska ravan; N% – combined proportion by number; B% – combined proportion by biomass; W – average weight of a prey; \* denotes that weight was derived from literature; FNB – food niche breadth; + < 0.1%)

**Tabela 1:** Delež posameznih vrst po številu v zimski prehrani male uharice v Sloveniji (N – velikost vzorca; LB – Ljubljansko barje; BK – Bela krajina; RP – Ribniško podolje; SR – Savska ravan; NP – Notranjsko podolje; PP – Pivško podolje; DR – Dravska ravan; N% – skupni delež po številu; B% – skupni delež po biomasi; W – povprečna teža plena; \* označuje, da je bila povprečna teža povzeta po literaturi; ŠPN – širina prehranjevalne niše; + < 0,1%)

N	2659	68	414	253	119	54	145	3712		
vrsta/species	LB	BK	RP	SR	NP	PP	DR	N%	B%	W
<i>M. agrestis</i>	20.2	2.9	19.3	-	6.7	3.7	4.8	17.2	19.2	27.3
<i>M. arvalis</i>	43.7	45.6	62.8	93.3	62.2	87.0	49.0	50.7	53.9	25.9
<i>M. subterraneus</i>	9.0	2.9	14.7	-	4.2	-	17.9	9.0	6.0	16.4
<i>M. multiplex</i>	-	1.5	-	-	-	-	-	+	+	*18
<i>M. spp</i>	0.1	1.5	1.2	-	1.7	-	-	0.3	0.2	*16
<i>C. glareolus</i>	3.0	-	-	-	-	-	2.8	2.3	2.0	21.3
<i>A. terrestris</i>	1.2	-	0.2	-	11.8	-	0.7	1.3	2.9	55.5
<b>Arvicolinae</b>	<b>77.3</b>	<b>54.4</b>	<b>98.3</b>	<b>93.3</b>	<b>86.6</b>	<b>90.7</b>	<b>75.2</b>	<b>80.7</b>	<b>84.3</b>	
<i>A. flavicollis</i>	1.0	-	0.5	1.2	4.2	-	0.7	1.0	1.5	35.5
<i>A. sylvaticus</i>	9.1	10.3	-	2.4	3.4	3.7	11.7	7.5	6.3	20.6
<i>Apodemus spp</i>	5.1	25.0	-	2.0	0.8	1.9	9.0	4.7	4.4	22.8
<i>M. minutus</i>	3.5	2.9	-	-	1.7	1.9	1.4	2.7	0.8	7.0
<b>Murinae</b>	<b>18.7</b>	<b>38.2</b>	<b>0.5</b>	<b>5.5</b>	<b>10.1</b>	<b>7.4</b>	<b>22.8</b>	<b>15.8</b>	<b>12.9</b>	
<i>S. araneus</i>	0.8	-	-	-	-	-	-	0.6	0.2	*9
<i>S. minutus</i>	-	-	-	-	0.8	-	-	+	+	*6
<i>Sorex spp</i>	+	-	-	-	-	-	-	+	+	*8
<i>C. leucodon</i>	0.5	-	0.7	0.4	-	1.9	-	0.5	0.2	*11
<i>C. suaveolens</i>	0.3	-	-	-	-	-	-	0.2	0.1	*9
<i>Crocidura spp</i>	+	-	-	-	-	-	-	+	+	*10
<i>N. anomalus</i>	+	-	-	-	-	-	-	+	+	*13
<i>N. fodiens</i>	+	-	-	-	-	-	-	+	+	*13
<b>Soricidae</b>	<b>1.7</b>	<b>0.0</b>	<b>0.7</b>	<b>0.4</b>	<b>0.8</b>	<b>1.9</b>	<b>0.0</b>	<b>1.4</b>	<b>0.6</b>	
<i>T. europaea</i>	0.3	-	-	-	-	-	-	0.2	1.0	*100
<i>M. avellanarius</i>	0.2	-	-	-	-	-	-	0.1	0.1	*27
Aves	1.5	7.4	0.5	0.8	1.7	-	2.1	1.5	1.1	18.3
Insecta	0.3	-	-	-	0.8	-	-	0.2	+	*1
ŠPN/FNB	3.8	2.9	2.2	1.1	2.4	1.3	3.2			

In places with numerous fields this probably will be the Wood Mouse, while in places with frequent floods the alternate prey most likely will be the Field Vole, which can reach even greater proportions in the diet as Common Voles (KRYŠTUFEK 1981, TOME 1991, ŠORGO & JANŽEKVIČ 1996). However, it still remains to be discovered, which ecological factors have an impact on the proportion of Common Pine Vole and Water Vole in the diet of the Long-eared Owls.

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## 6. Povzetek

Avtor članka je raziskoval zimsko prehrano male uharice na petnajstih lokacijah v sedmih mezoregijah Slovenije (sl. 1). Od 3.712 enot plena, najdenih v

izbljuvkih, jih je dobrih 98% pripadalo malim sesalcem, med katerimi so bile najpomembnejše voluharice Arvicolinae (tab.1). Glavna lovna vrsta je bila poljska voluharica *Microtus arvalis*, najpomembnejše nadomestne lovne vrste plena pa travniška voluharica *Microtus agrestis*, miši iz rodu *Apodemus*, vrtna voluharica *Microtus subterraneus* in veliki voluhar *Arvicola terrestris*. Delež nadomestnih vrst v prehrani je bil odvisen od geografske razširjenosti malih sesalcev in njihovih ekoloških zahtev. Travniška voluharica, na primer, je bila zastopana z več kot 10% vseh enot plena samo na Ljubljanskem barju in Ribniškem podolju. Razlog za to je verjetno v visoki talni vodi in rednih poplavih v teh dveh območjih, ki jim je travniška voluharica med obravnavanimi malimi sesalci najbolj prilagojena. V območjih kjer je veliko njiv, v združbi malih sesalcev prevladujejo belonoge miši. V takšnih območjih (Bela krajina, Dravsko podolje, Mursko podolje) je bila najpomembnejša nadomestna lovna vrsta male uharice navadna belonoga miš *Apodemus sylvaticus* (sl.3).

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