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Seasonal changes in food composition of the Barn Owl (*Tyto alba*) in the northern part of the "Záhorie" region

Sezónne zmeny v potrave plamienky driemavej (*Tyto alba*) v severnej časti Záhoria

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Abstract: 33 prey species (10 296 individuals) were recovered from pellets of the Barn Owl in northern part of the "Záhorie" region (Western Slovakia) during period 2002–2006. The family Arvicolidae constituted 65.68 % of recoveries, Soricidae 17.86 %, Muridae 16.64 %, Talpidae 0.04 %, Gliridae 0.02 %, Mustelidae 0.02 %, Vespertilionidae 0.04 % and Aves 4.7 %. *Microtus arvalis* was predominantly represented by 65.2 %. For evaluation of diet data "The marked differences from the mean method" was used. The results of pellet analyses provide, besides information about owl diet, also new data about occurrence and geographical distribution of small mammalian species and importance of predators in agricultural landscape.

Abstrakt: Analýzou vývržkov bolo determinovaných v potrave plamienky driemavej v období 2002–2006 v severnej časti Záhoria 33 druhov koristi (10 296 jedincov). Výrazne dominuje čeľaď Arvicolidae 65,68 %, ďalej sú zastúpené Soricidae 17,86 %, Muridae 16,64 %, Talpidae 0,04 %, Gliridae 0,02 %, Mustelidae 0,02 %, Vespertilionidae 0,04 % a Aves 4,7 %. Dominantne je zastúpený hraboš poľný 65,2 %. Kvantitatívne údaje o počte koristi v potrave boli vyhodnotené "Metódou výrazných odchýlok od priemeru". Výsledky analýzy vývržkov prinášajú okrem informácií o potrave sov aj nové údaje o výskyte druhov drobných cicavcov a tiež dokazujú význam predátorov v poľnohospodárskej krajine.

Key words: Barn Owl, *Tyto alba*, food ecology, seasonal changes, Záhorie, Slovakia

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Introduction

Currently, more and more scientific attention is dedicated to research of food ecology of owls. The best known method for detection of representation of prey species in owl's food is a collection and analyses of pellets found on breeding places or daily shelters. Probably, this method of pellet analyses was developed in 1863 by German scientist Bernhard Altum (Mlíkovský 1998). Later, method was distributed mainly thanks to the activity of the German ornithologist Otto Uttendörfer (Uttendörfer 1939). In Slovakia and Czech Republic, several authors (Schaefer 1933, Kinský 1942, Balát 1956, Schmidt & Štollmann 1972, Šťastný 1973, Danko & Štollmann 1977, Bárta 1980, 1983, Obuch 1982, 1992a, 1992b, Vondráček & Hošek 1984, Obuch & Kürthy 1995, Noga 2004 and others) studied Barn Owl's food sources via analyses of pellets. The previous research of Barn Owl's food in the "Záhorie" region was concentrated to the southern part, mostly around the "Morava" river. This is the first report of complex data from the northern part of the "Záhorie" region.

Methods

During period 2002–2006, monitoring of Barn Owl population in the northern part of the "Záhorie" and collection of pellets on lofts of agricultural buildings were performed regularly (Latková 2007, 2008). Collected samples were pre-treated in 5% NaOH gradually. For determination, maxilla and skull of mammals, humerus and beak of birds were sorted out. The number of prey species is given from the most abundant determined part. The prey species were determined according to publication Anděra & Horáček (1982) and by using comparative samples.

The quantitative data for distribution of prey species found in pellets were evaluated using the marked differences from the mean method – MDFM (Obuch 1991, 2001). MDFM provided means for description of spatial and temporal changes in food ecology of Barn Owls. The mean was defined as sum of compared material. The method is based on comparison of real and theoretical values. In the case of limited sample sizes, the values of the marked differences from the mean give us information about parameters responsible for such heterogeneity.

The contingency table (Tab. 1) with data for frequency of species in particular localities or data for temporal periods is a base for evaluation of quantitative data. The differences between theoretical and real abundances have positive (+) or negative (-) value. The species with marked differences from the mean are considered diagnostic. Further, the rearranged table was created (Tab. 2). In this table the samples were ordered according to their similarity with diagnostic species with positive values organized in clusters. The computer database programme "Zber", version 2.72 (author Tomáš Šipöcz) was used for data analyses and archiving.

Study area

The study area, where the pellets were collected, is located in Western Slovakia, in northern part of the "Záhorie" region. It is a part of geomorphologic units "Chvojnícka pahorkatina" upland, "Borská nížina" lowland (its northern part) and "Dolnomoravský úval" ravine. The area has a triangular shape and covers approximately 700 km^2. The "Morava" river creates western border of this study area, "Sudoměřický potok" brook and "Biele Karpaty" Mts northern border, "Myjava" river southern border and "Myjavská pahorkatina" upland eastern border. The study area is situated in districts Skalica and Senica and belongs to following squares of Databank of Slovak Fauna (DFS): 7168, 7169, 7268, 7269, 7270, 7367, 7368, 7369 and 7370.

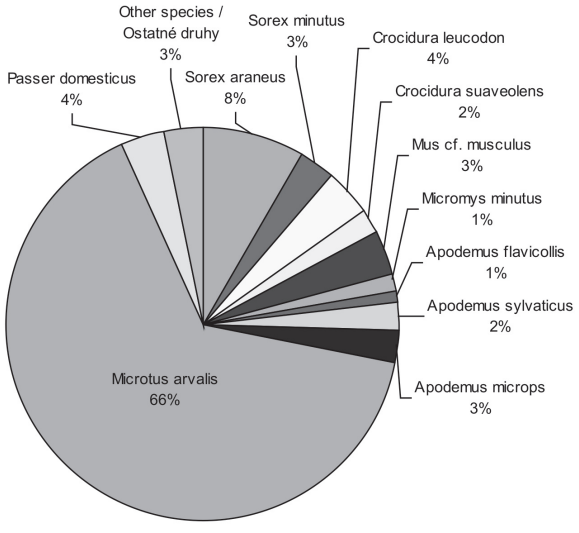

Fig. 1. Percentage proportion of prey species in food of *Tyto alba*
Obr. 1. Percentuálne zastúpenie jednotlivých druhov koristi v potrave *Tyto alba*

Results

During five years of our study, Barn Owl's pellets were collected on 37 localities (73 collections in total). 33 prey species and 10 296 individuals were identified in Barn Owl's food. Mammals (21 species) represented 95.3 % and birds 4.7 % of species detected in analyzed pellets (12 species from the order Passeriformes). Family Arvicolidae (65.68 %) was found to dominate significantly with *Microtus arvalis* represented by 65.18 %. The family Soricidae was represented by 6 species (17.86 %) – *Crocidura leucodon*, *C. suaveolens*, *Sorex araneus*, *S. minutus*, *Neomys fodiens* and *N. anomalus*. Family Muridae was represented by 16.64 % with following species being recorded: *Mus* cf. *musculus*, *Apodemus flavicolis*, *A. sylvaticus*, *A. microps*, *Rattus norvegicus* and *Micromys minutus*. Furthermore, species from the family Talpidae 0.04 % (*Talpa europaea*), Gliridae 0.02 % (*Muscardinus avellanarius*) and Mustelidae 0.02 % (*Mustela erminea*) were identified as well. The most abundant bird prey species was *Passer domesticus* with 3.7 %. The percentage of prey species is shown in Fig. 1.

The composition of Barn Owl's food in particular years 2002–2006 was also compared. Even though the number of identified prey species in particular years varied greatly, for comparison purposes we created contingency table (Tab. 1).

The rearranged table (Tab. 2) shows significant positive and negative differences from the mean. The positive species were put into the cluster for each year. In 2003 and 2004 (phase of pesimum of *Microtus arvalis* population cycle) the highest number of prey species (8 in 2003 and 9 in 2004) had positive differences from the mean and on the contrary *Microtus arvalis* had negative value. In 2006 (phase of gradation) the *Microtus arvalis* had positive value and 12 other species negative one. The results obtained by MDFM method correlate significantly with the number of breeding pairs of Barn Owl in the study area.

Tab. 1. Food composition of *Tyto alba* in period 2002–2006; contingency table
Tab. 1. Zloženie potravy *Tyto alba* v rokoch 2002–2006; kontingenčná tabuľka

Years / Roky / **Species / Druhy**	**2002**		**2003**		**2004**		**2005**		**2006**		**∑**	**%**
Talpa europaea				1		1					2	0.02
Sorex araneus	1-	375	1+	208	1+	214		26	2-	31	854	8.29
Sorex minutus		167	1+	78	1+	69	1-	5	2-	8	327	3.18
Neomys anomalus		20		3		7				8	38	0.37
Neomys fodiens		5	1+	7		3		2			17	0.17
Crocidura leucodon	1+	270		47		56	2-	1	3-	6	380	3.69
Crocidura suaveolens		122	1+	35	1+	50		5	1-	11	223	2.17
Pipistrellus pipistrellus						2					2	0.02
Pipistrellus nathusii		1									1	0.01
Plecotus austriacus		1									1	0.01
Muscardinus avellanarius		1		1							2	0.02
Mus cf. *musculus*	1-	152		41	1+	116	1+	22	1-	26	357	3.47
Micromys minutus		89	1+	25		22		4	2-	3	143	1.39
Apodemus flavicollis	1+	95		11		13			2-	3	122	1.18
Apodemus sylvaticus		127	1+	39		33		5	1-	13	217	2.11
Apodemus microps		140		33	1+	62	1+	17	1-	22	274	2.66
Apodemus sp.		3								2	5	0.05
Rattus norvegicus	2-	12	2+	33	1+	34			1-	1	80	0.78
Clethrionomys glareolus		31		5		8			1-	0	44	0.43
Arvicola terrestris	1-	0		1		5		1		1	8	0.08
Microtus arvalis		4066	1-	564	1-	723		236	1+	1124	6713	65.20
Mustela erminea		2									2	0.02
Mammalia		**5679**		**1132**		**1418**		**324**		**1259**	**9812**	**95.30**
Hirundo rustica		3		2		2			1+	6	13	0.13
Delichon urbica	1-	0		1	1+	6				2	9	0.09
Motacilla alba		1									1	0.01
Phoenicurus ochruros	1-	13	1+	9		10				3	35	0.34
Erithacus rubecula		1				2		1			4	0.04
Parus major	1-	3			1+	12				1	16	0.16
Troglodytes troglodytes		2									2	0.02
Fringilla coelebs		3									3	0.03
Carduelis carduelis										1	1	0.01
Passer domesticus	1-	161		39	2+	160	1-	3	1-	22	385	3.74
Passer montanus		1		4		2					7	0.07
Sturnus vulgaris						1					1	0.01
Passeriformes sp.		1		1		3				2	7	0.07
Aves	**1-**	**189**		**56**	**2+**	**198**	**1-**	**4**	**1-**	**37**	**484**	**4.70**
∑		**5868**		**1188**		**1616**		**328**		**1296**	**10296**	**100.00**
Diversity index / Index diverzity H'		1.36		1.90		2.01		1.14		0.72	1.50	

Discussion

Differences in proportion of *Microtus arvalis* (main prey species of Barn Owl) in owl pellets suggest its regular population cycles (Fig. 2). Phase of retrograduation (2002–2003), pesimum (2003–2004) and phase of pro-graduation (2004–2005–2006) were recorded over study period. According to our estimations, the phase of gradation started at the beginning of 2006. The population of the Barn Owl was significantly affected by above described dynamics of its main prey species population. This was

Tab. 2. Food composition of *Tyto alba* in period 2002–2006; rearranged table
Tab. 2. Zloženie potravy *Tyto alba* v rokoch 2002–2006; usporiadaná tabuľka

Roky / Years / **Druhy / Species**	**2002**		**2003**		**2004**		**2005**		**2006**		**∑**	**%**
Crocidura leucodon	1+	270		47		56	2-	1	3-	6	380	3.69
Apodemus flavicollis	1+	95		11		13			2-	3	122	1.18
Micromys minutus		89	1+	25		22		4	2-	3	143	1.39
Apodemus sylvaticus		127	1+	39		33		5	1-	13	217	2.11
Phoenicurus ochruros	1-	13	1+	9		10				3	35	0.34
Neomys fodiens		5	1+	7		3		2			17	0.17
Sorex araneus	1-	375	1+	208	1+	214		26	2-	31	854	8.29
Sorex minutus		167	1+	78	1+	69	1-	5	2-	8	327	3.18
Crocidura suaveolens		122	1+	35	1+	50		5	1-	11	223	2.17
Rattus norvegicus	2-	12	2+	33	1+	34			1-	1	80	0.78
Passer domesticus	1-	161		39	2+	160	1-	3	1-	22	385	3.74
Parus major	1-	3			1+	12				1	16	0.16
Delichon urbica	1-	0		1	1+	6				2	9	0.09
Mus cf. *musculus*	1-	152		41	1+	116	1+	22	1-	26	357	3.47
Apodemus microps		140		33	1+	62	1+	17	1-	22	274	2.66
Microtus arvalis		4066	1-	564	1-	723		236	1+	1124	6713	65.20
Hirundo rustica		3		2		2			1+	6	13	0.13
Clethrionomys glareolus		31		5		8			1-	0	44	0.43
Arvicola terrestris	1-	0		1		5		1		1	8	0.08
Neomys anomalus		20		3		7				8	38	0.37
Passer montanus		1		4		2					7	0.07
Mammalia		**5679**		**1132**		**1418**		**324**		**1259**	**9812**	**95.30**
Aves	**1-**	**189**		**56**	**2+**	**198**	**1-**	**4**	**1-**	**37**	**484**	**4.70**
∑		**5868**		**1188**		**1616**		**328**		**1296**	**10296**	**100.00**
diversity index / Index diverzity H'		1.36		1.9		2.01		1.14		0.72	1.5	

manifested by: (1) variability in food composition – in the phase of *Microtus arvalis* pesimum, the Barn Owl hunts other prey species, (2) the number of breeding pairs, which was changing in correlation with abundance of *Microtus arvalis* population. In 2004, in the phase of *Microtus arvalis* pesimum, only one nesting was recorded. On the contrary, in 2006 the highest representation of *Microtus arvalis* in food (86.7 %) and the highest number of recorded nesting pairs (n=7) suggest the population increase (graduation). Based on above mentioned findings we estimate the duration of one population cycle of *Microtus arvalis* in northern part of the "Záhorie" region to be 5–6 years.

Up to now, research of Barn Owl´s food was focused mostly on southern part of "Záhorie" region. In two localities near "Morava" river Obuch & Kürthy (1995) determined 2 734 individuals of prey, from which 21 were mammalian species, 28 species of birds, 6 species of lower vertebrates and 4 taxons of invertebrates. According to their results the Barn Owl hunts predominantly *Microtus arvalis* and species from the family Soricidae. In contrast to our results, authors recorded 1 ex. *Pelobates fuscus* and *Pitymys subterraneus*. Noga (2004) collected pellets (and in some cases also lining material from nest boxes) on 11 localities in the "Záhorie" region and determined 9 769 individuals in total. The representation of particular prey species in their study corresponded with our results. Additionally, Noga (2004) detected also two orders of frogs (0.06 %), *Nyctalus leisleri* and *Microtus agrestis*. During the period of our study in the northern part of the "Záhorie" region we did not find any frog species (Anura) in Barn Owl's food. Previously published data showed that frogs are rarely detected in Barn Owl diet. Uttendörfer (1939) found 0.5% of frogs in diet of Barn Owls in Germany. In "Záhorie" region before mentioned authors confirmed following species: *Rana arvalis*, *R.* cf. *esculenta*, *Pelobates fuscus* and *Hyla arborea*. In area of "Turiec", "Moldava" and "Pálava", Obuch (1992a) assigned 11 diagnostic species. *Neomys fodiens*, *Sorex minutus* and *Crocidura leucodon* had two positive values.

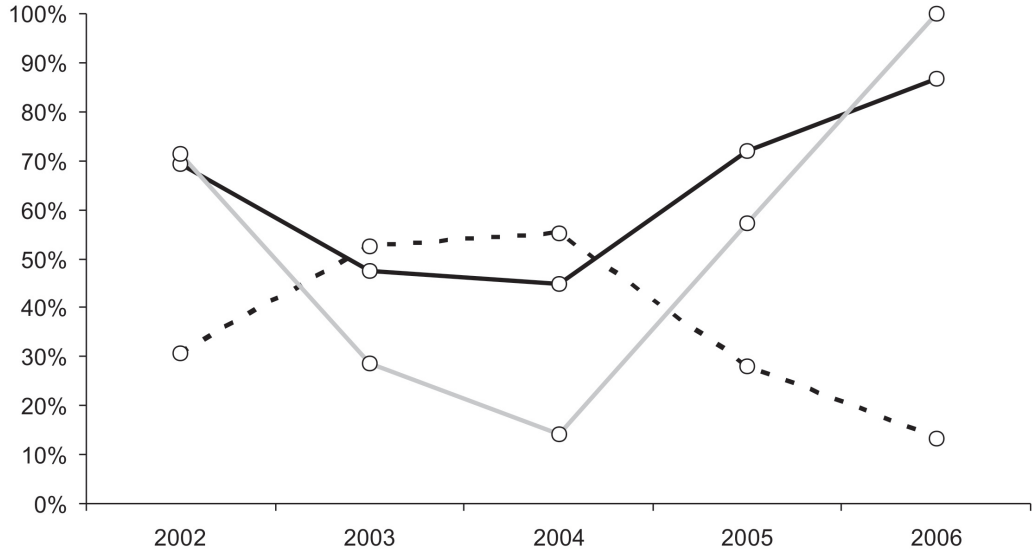

Fig. 2. Comparison of proportion of *Microtus arvalis* and other prey species in food of *Tyto alba* and connection between the number of breeding pairs (black line – *Microtus arvalis*, dash line – other prey, gray line – number of breeding pairs).
Obr. 2. Porovnanie zastúpenia hraboša poľného a ostatných druhov v potrave *Tyto alba* v súvislosti s počtom dohľadaných hniezdiacich párov (čierna línia – *Microtus arvalis*, čiarkovaná línia – ostatné druhy, sivá línia – počet hniezdnych párov)

The higher number of diagnostic species as well as species with two positive values in Barn Owl's food from the "Záhorie" region is most probably associated with higher amount of determined prey species.

Previously, many authors observed the highest representation of the family Soricidae in Barn Owl's food. In our study this family was second most abundant (17.9 %). Uttendörfer (1939) detected 25 % of family Soricidae (from total amount of 36 548 individuals). Fehér & Fehér (2004) recorded significant dominance of Soricidae in the area of Balaton in Hungary where this family made up 76 % of food (from total amount of 1 296 individuals). Same authors found that the proportion of Soricidae decreased from February to July during study period whereas the *Microtus arvalis* had the highest abundance in the second half of May. These findings support hypothesis that food composition in Barn Owl's diet in particular seasons depends on food availability.

The lower portion of *Microtus arvalis* in diet in comparison with current findings is probably related to changes in management in exploited landscape. Decrease in animal production on farms has significant impact on availability of Barn Owl's food resources. As a consequence, number of synantropic species (*Mus* cf. *musculus*, *Rattus norvegicus* and *Passer domesticus*) which are an important part of Owl's diet decreased (Obuch in litt.).

For quantitative evaluation of data obtained from pellet analyses we used marked differences from the mean method (Obuch 1991, 2001) because it allows comparison of big amount of material from big number of collections. Additionally, it also takes into regards mean values and provides information about species which abundance generates heterogeneity. The standard evaluation of abundance, dominance or biomass of prey species has only informative character and show only differences in particular indicators. Consequently, they may not depict fundamentals of differences in proportional representation of prey species in owl's food.

In the case of evaluation of food composition in 2002 it is necessary to mention that it had the biggest sample size (5 868 individuals) which significantly affected the mean value. We can assume that in 2002 we collected also pellets from previous seasons (before beginning of regular monitoring and collections of pellets). This is the reason why only two species with positive value are presented in owl's food and the representation of *Microtus arvalis* is close to the mean.

Conclusion

33 prey species and 10 296 individuals were detected in Barn Owl's pellets from localities in the northern part of the "Záhorie" region. The family Arvicolidae significantly

dominated (65.68 %) with other families represented as follows: Soricidae 17.86 %, Muridae 16.64 %, Talpidae 0.04 %, Gliridae 0.02 %, Mustelidae 0.02 %, Vespertilionidae 0.04 % and Aves 4.7 %. *Microtus arvalis* was predominantly represented with 65.2 %. The representation of particular prey species correlated significantly with the number of breeding pairs of the Barn Owl in study area. Similarly to other authors, results of our analyses confirmed that Barn Owl hunts in synathropic biotopes of agricultural landscape. The results of pellet analysis could be used for understanding of food ecology as well as to obtain faunistic data about occurrence and distribution of small mammals in particular localities (oftentimes, the analyses of owl's food can provide more information than classical catching method).

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