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Mammalian Remains in the Pellets of Long-eared Owls (*Asio otus*) in Diyarbakır Province

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Abstract: This study was conducted with the pellets of Long-eared Owls from 2 sites in the area of Dicle University Campus, located in the north-eastern part of Diyarbakır Province, Turkey (lat 37°55'N, long 40°12'E). Pellets were collected at monthly intervals from July 2000 to June 2001 and the remains of 310 prey items were recovered from 211 pellets.

The assemblages were composed mostly of small mammals. Eight species of mammals belonging to 2 orders (Insectivora: *Crocidura suaveolens*, and Rodentia: *Microtus guentheri*, *Microtus* sp., *Mus musculus*, *Meriones tristrami*, *Cricetus cricetus*, *Rattus rattus*, and *Nannospalax ehrenbergi*) were identified from the Long-eared Owl pellets. Rodentia were found to be dominant, which accounted for 95.48% of the identified remains. The most important part of the Owl's food consisted of mammals, especially *Microtines*. *Microtus guentheri* was of particular importance, representing 71.29% of the remains found in the pellets.

Living samples of the *Crocidura* species could not be trapped or observed in this area, but this study shows that the analysis of regurgitated pellets of Long-eared Owls is a valuable tool for inventorying small mammals.

Key Words: *Asio otus*, Rodentia, Insectivora, pellet, *Microtus*, mammals, Turkey

Diyarbakır Yöresi Kulaklı Orman Baykuşu (*Asio otus*)'nun Peletlerindeki Memeli Kalıntıları

Özet: Bu çalışma Diyarbakır'ın kuzeydoğusundaki (40° 12' D, 37° 55' K) Dicle Üniversitesi Kampüs Arazisi içinde farklı iki bölgeden toplanan kulaklı orman baykuşuna ait peletler üzerinde gerçekleştirildi. Peletler 2000-2001 yıllarında Temmuzdan Hazirana kadar aylık periyotlarla toplandı ve 211 adet pelet içinde 310 adet av hayvanı kalıntısı tespit edildi.

Pelet birikintilerinin büyük kısmını küçük memeliler oluşturmaktadır. İki ordoya ait 8 memeli türü (Insectivora: *Crocidura suaveolens*, ve Rodentia: *Microtus guentheri*, *Microtus* sp., *Mus musculus*, *Meriones tristrami*, *Cricetus cricetus*, *Rattus rattus*, *Nannospalax ehrenbergi*) *Asio otus* peletlerinde tanımlandı. Rodentia % 95,48 oranla dominant bulundu. Besinlerin büyük bir kısmını memelilerin, özellikle *Microtin*ler, oluşturduğu tespit edildi. *Microtus guentheri* peletlerde oldukça önemli yer tutmakta olup % 71,29 oranıyla en sık rastlanan türdür.

Bu bölgede *Crocidura* türlerinin canlı örnekleri yakalanamadı veya gözlemlenemedi, ancak bunların kalıntılarını peletler içerisinde rastlanması, kulaklı orman baykuşunun peletlerinin küçük memelilerin tespitinde önemli bir araç olduğunu göstermektedir.

Anahtar Sözcükler: *Asio otus*, Rodentia, Insectivora, pelet, *Microtus*, memeliler, Türkiye

Introduction

The study of small mammals by pellet analysis is a valid method used to obtain new data on the species composition of a particular area, on population features in relation to bioclimate and vegetation, and

biogeographic information (Amr et al., 1997; Obuch and Benda, 1996). Such information is essential for research and conservation purposes, and is also useful for determining the distribution of small mammals (Niethammer, 1962). The study of the food composition

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of owls may be fairly important, not only in the field of owl ecology, but also in providing new insights into the structure of animal communities (Tores and Yom-Tov, 2003).

Long-eared Owls, *Asio otus*, are medium-sized, nocturnal, woodland owls, with a broad distribution across North America, Eurasia, and northern Africa; they feed primarily on mammals. Mammalian prey includes voles, squirrels, bats, shrews, moles, and dormice. Their pellets are oval or cylindrical, greyish, and compact, with many bones, skulls, and teeth. They are regurgitated 3 to 4 h after eating (Bate, 1945; Steiner and Vauk, 1966; Obuch, 1998a, 1998b, 2001).

Analyses of owl pellets from Turkey are not numerous, despite the wealth of information that can be derived from such studies. Steiner and Vauk (1966) reported some small mammals in pellets of the Long-eared Owl (*Asio otus*) in the Lake Beyşehir area, as did Hoppe (1986) from Samandağ, Antakya Province. Kock (1990) reported small mammals in pellets of the Tawny Owl (*Strix aluco*) from Uludağ, Bursa Province. Obuch (2001) reported small mammals in pellets collected from Turkey, Syria, Iran, and Israel. Bate (1945) identified 8 species from *Asio otus* pellets collected from Lebanon and Syria, and she suggested that in these 2 countries, the mountainous regions are the home to *Microtus socialis* and *Microtus (Chionomys) nivalis*, while *M. philistinus* and *M. guentheri* inhabit the plains and hills.

Herein, we report on the composition of 2 assemblages of Long-eared Owl (*Asio otus*) from Diyarbakır, Turkey. The study's aim was to give a more detailed faunal description of small mammals by pellet analysis of *Asio otus* in this province.

Material and Method

The study was carried out with pellets of the Long-eared Owl from 2 sites in the area of Dicle University Campus, located in the north-eastern part of Diyarbakır, Province, Turkey (lat 37°55'N, long 40°12'E). In the study area (690 m a.s.l.), pines are prevalent (*Pinus nigra*). Samples were obtained from sites minimally disturbed by human activities and surrounded by pine trees. They encompassed 2 sites and came mostly from agricultural landscapes.

Pellets were collected at monthly intervals from July 2000 to June 2001 and were found under pine trees

(*Pinus nigra*). All remains were deposited at Dicle University Science Faculty Biology Department.

Analysis of the pellets was conducted according to standard procedures (Obuch 1994, 2001; Amr et al., 1997). Each pellet was soaked in water and then teased apart using a pair of forceps and a needle. The skeletal remains and skulls were placed in separate containers for analysis. Remains of 310 prey items were recovered from 211 pellets. The identification of the prey was performed using the keys by Ellerman (1940, 1941), Ognev (1947), Vinogradov and Argiropulo (1968), Corbet (1978), and Kryštufek and Vohralik (2001).

Results and Discussion

The assemblages were composed mostly of small mammals. Generally 1 or 2 prey, though sometimes 3 prey and once 4 prey items were found in a pellet. Eight species of mammals belonging to 2 orders (Insectivora: *Crocidura suaveolens*, and Rodentia: *Microtus guentheri*, *Microtus sp.*, *Mus musculus*, *Meriones tristrami*, *Cricetus cricetus*, *Rattus rattus*, and *Nannospalax ehrenbergi*) were identified from the Long-eared Owl pellets (Table 1).

Rodentia were dominant among the collected specimens (95.48%). *Microtines* were the most important part of the owl's food and, in particular, *Microtus guentheri*, which accounted for 71.29% of the remains found in the pellets. The second most frequent species preyed on was *Mus musculus*, which represented 19.35% of the remains. Other mammals (9.36% of the identified remains) preyed on were (*Microtus sp.*, *Meriones tristrami*, *Cricetus cricetus*, *Crocidura suaveolens*, *Nannospalax ehrenbergi*, and *Rattus rattus*) were of little importance. The seasonal abundance of taxa is given in Figure 1.

Ordo: *Insectivora*

Family: *Soricidae*

Crocidura suaveolens Pallas, 1811

This species has been reported from all regions of Turkey (Kryštufek and Vohralik, 2001). A total of 14 skulls were recovered from 211 pellets. Measurements are given in Table 2. The dorsal and ventral views of skull and lower jaws are shown in Figure 2 I A, B, and C, respectively.

Table 1. The number of mammal prey items in the pellets of the Long-eared Owl.

Species	n	Abundance (%)
<i>Crocidura suaveolens</i>	14	4.52
<i>Microtus guentheri</i>	221	71.29
<i>Microtus</i> sp.	6	1.94
<i>Mus musculus</i>	60	19.35
<i>Meriones tristrami</i>	5	1.61
<i>Cricetus cricetus</i>	2	0.65
<i>Rattus rattus</i>	1	0.32
<i>Nannospalax ehrenbergi</i>	1	0.32
Total	310	100.0

Dental measurements are similar to those given by Harrison and Bates (1991), and Kryštůfek and Vohralík (2001).

Ordo: **Rodentia**

Family: **Cricetidae**

Cricetus cricetus L., 1758, (Hamster)

We found 2 skulls belonging to *Cricetus cricetus*. The view of the upper molars, lower molars, and mandibula are shown in Figure 2 III A, B, and C, respectively. Measurements are given in Table 2.

Family: **Microtidae**

Microtus guentheri (Danford and Alston, 1880)

Danford & Alston (1880) described *M. guentheri* from Maraş, and it was also recorded by Misonne (1957) from Urfa, and by Osborn (1962) from Hatay. A total of 199 skulls were recovered from 211 pellets. This species was the predominant prey. Some skulls were in excellent condition and allowed us to make full measurements, but some were broken. The dorsal and ventral views of the skull and mandibula are shown in Figure 2 II. The skull is large and robust, higher across the braincase and rostrum, bullae are small. M¹ with 2 lateral and 3 medial denticles, M² with 3 lateral and 2 medial denticles, and M³ with 3 lateral and 3 medial denticles. Measurements are given in Table 2.

The measurements of skulls are similar to those given by Kefelioğlu and Kryštůfek (1999), Sözen et al. (1999), and Coşkun (1991).

Microtus sp.

A total of 6 skulls were recovered from 211 pellets. Most of the skulls were broken. The dental pattern of this species was different from the dental pattern of *M. guentheri*. M¹ and M² were similar to *M. guentheri*, the difference was in M³ with 3 lateral and 4 medial denticles. The dorsal and ventral views of the skull and lower molars are shown in Figure 2 V A, B, and C, respectively. Measurements are given in Table 2.

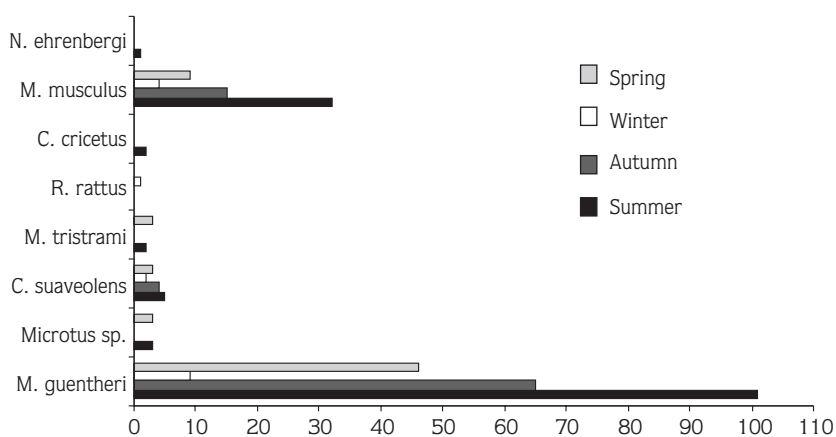


Figure 1. The seasonal abundance of taxa.

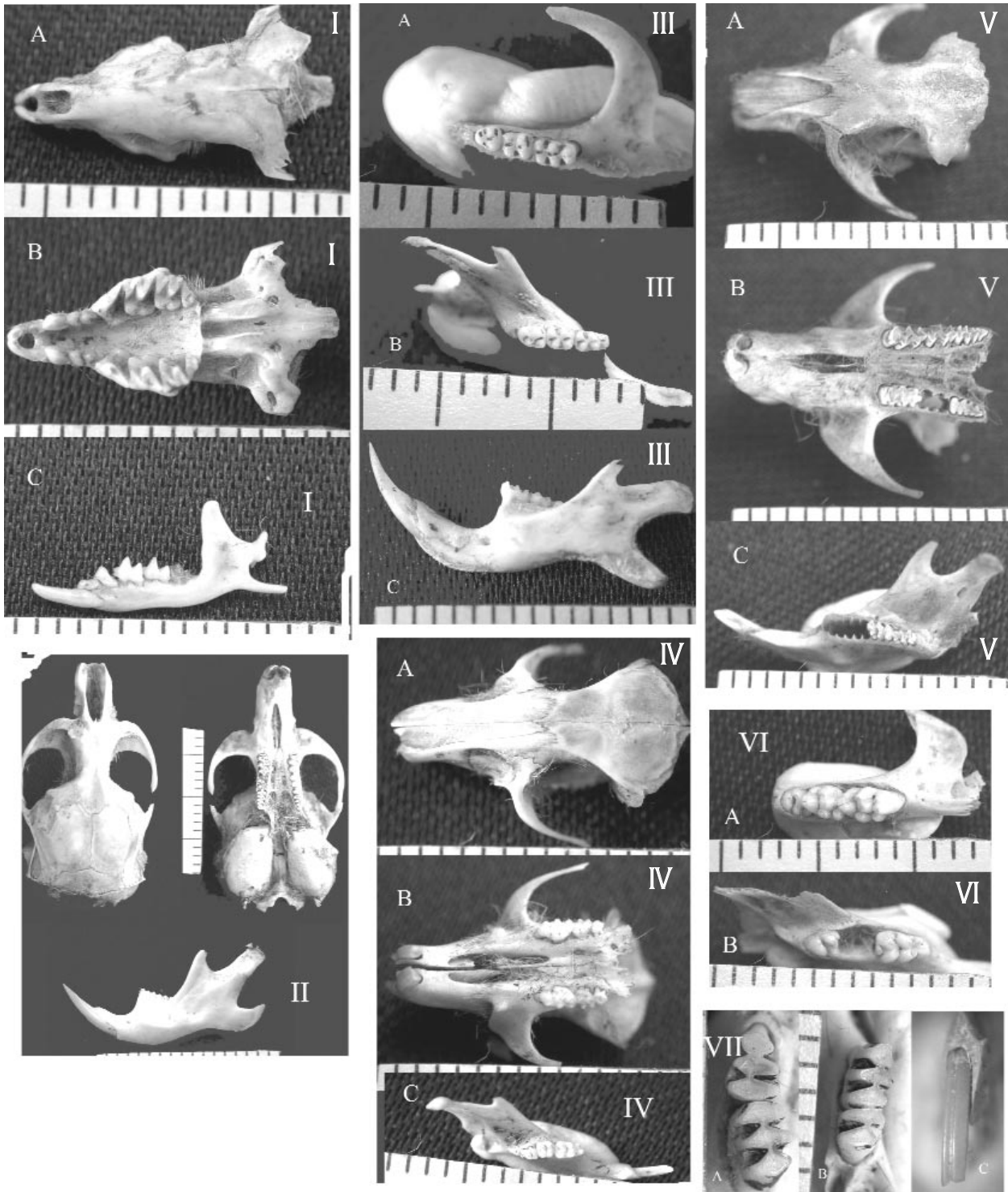


Figure 2. Remains of species.
 I- *Crocidura suaveolens*, II- *Microtus guentheri*, III- *Cricetus cricetus*, IV- *Mus musculus*, V- *Microtus* sp., VI- *Rattus rattus*, VII- *Meriones tristrami*

Table 2. The measurements of species (n: sample size; R: range; X: average; \pm SD: standard deviation).

Characters		<i>Crocidura suaveolens</i>	<i>Cricetus cricetus</i>	<i>Microtus guentheri</i>	<i>Microtus sp.</i>	<i>Meriones tristrami</i>	<i>Mus musculus</i>	<i>Rattus rattus</i>
Occipitonasal length	n	–	–	7	–	–	–	–
	R	–	–	23.9 – 27.9	–	–	–	–
	X	–	–	25.93	–	–	–	–
	\pm SD	–	–	1.26	–	–	–	–
Condylobasal length	n	–	–	7	–	–	–	–
	R	–	–	24.5 – 28.5	–	–	–	–
	X	–	–	26.5	–	–	–	–
	\pm SD	–	–	1.36	–	–	–	–
Zygomatic breadth	n	–	–	72	2	–	3	–
	R	–	–	14.0 – 16.8	14.5 – 15.7	–	11.0 – 11.0	–
	X	–	–	15.58	15.1	–	11	–
	\pm SD	–	–	0.59	0.85	–	–	–
Interorbital constriction	n	–	1	167	4	–	17	–
	R	–	3.9	3.4 – 4.1	3.5 – 3.8	–	3.4 – 3.8	–
	X	–	3.9	3.75	3.64	–	3.56	–
	\pm SD	–	–	0.14	0.11	–	0.12	–
Nasal length	n	10	–	142	1	–	9	–
	R	4.7 – 6.2	–	5.6 – 7.9	5.7	–	5.4 – 8.7	–
	X	5.56	–	7.07	5.7	–	7.63	–
	\pm SD	0.43	–	0.47	–	–	1.12	–
Foramen incisivum	n	–	1	176	4	–	23	–
	R	–	5.3	3.9 – 6.1	4.0 – 4.8	–	4.6 – 5.6	–
	X	–	5.3	4.91	4.58	–	5.04	–
	\pm SD	–	–	0.35	0.39	–	0.3	–
Palatal length	n	10	1	171	4	–	18	–
	R	6.6 – 7.6	12.1	11.6 – 15.1	12.0 – 14.4	–	9.5 – 11.7	–
	X	7.09	12.1	13.48	13.2	–	10.26	–
	\pm SD	0.31	–	0.68	1.01	–	0.56	–
Diastema	n	–	1	176	4	–	23	–
	R	–	7.8	6.5 – 8.9	6.9 – 8.1	–	5.5 – 6.6	–
	X	–	7.8	7.79	7.38	–	6	–
	\pm SD	–	–	0.48	0.51	–	0.31	–
Mandibula	n	14	1	184	6	2	42	–
	R	7.4 – 8.6	15.4	11.1 – 17.5	14.0 – 15.6	15.8 – 19.1	8.8 – 12.8	–
	X	8.01	15.4	15.14	15.07	17.45	11.17	–
	\pm SD	0.45	–	1.13	0.58	2.33	0.91	–
Maxillary tooth row	n	10	1	179	4	2	33	1
	R	4.2 – 4.6	4.2	5.8 – 7.2	6.1 – 6.9	6.0 – 6.2	3.4 – 4.8	6.8
	X	4.39	4.2	6.47	6.45	6.1	3.87	6.8
	\pm SD	0.14	–	0.3	0.34	0.14	0.3	–
Mandibular tooth row	n	14	1	177	6	3	55	1
	R	3.1 – 3.9	4.2	5.5 – 7.3	6.2 – 7.1	6.2 – 6.7	3.2 – 4.1	6.7
	X	3.59	4.2	6.49	6.52	6.4	3.61	6.7
	\pm SD	0.19	–	0.33	0.36	0.26	0.15	–

All measurements are given in mm.

Family: *Spalacidae*

Nannospalax ehrenbergi (Nehring, 1898)

We analyzed only one scapula and clavicle of *Nannospalax ehrenbergi* in the pellets.

Family: *Gerbillidae*

Meriones tristrami (Thomas, 1892)

A total of 4 skulls were recovered. All were broken. The view of the upper and lower molars and groove of the incisors are shown in Figure 2 VII A, B, and C, respectively. Measurements are given in Table 2.

The measurements of skulls were similar to those given by Coşkun (1991), but bigger than Nadachowski et al. (1990) and Harrison and Bates (1991).

Family: *Muridae*

Mus musculus L., 1758

The House Mouse is common in almost all populated areas of Turkey. A total of 60 skulls were recovered from 211 pellets. The dorsal and ventral views of the skull and lower molars are shown in Figure 2 V A, B, and C, respectively. Measurements are given in Table 2.

The measurements of skulls were similar to those given by Coşkun (1991), Vinogradov and Argiropulo (1941), Corbet (1966), and Harrison and Bates (1991). The dental peculiarities were similar to those given by Coşkun (1991) and Harrison and Bates (1991).

Family: *Muridae*

Rattus rattus (L., 1758)

One specimen was recovered and it was a juvenile. M¹ without cingulum and M² with anterolateral cusp, as Osborn and Helmy (1980) reported. The upper and lower molars are shown in Figure 2 VI A and B, respectively. Measurements are given in Table 2. The measurements of the skull were similar to those given by Coşkun (1991).

In all seasons, the dominant species was *M. guentheri*. This species increased in number in autumn and spring. In winter, the ratio of this species decreased. *M. musculus* was mostly found in summer. *C. suaveolens* was found in the same numbers in all seasons. *M. tristrami* and *Microtus* sp. were found in spring and summer. *N.*

ehrenbergi and *Cricetus cricetus* were only found in summer. Only one sample of *R. rattus* was found in winter (Figure 1).

Several studies indicate that large numbers of *Microtus* and *Mus* are among the preferred prey consumed by *Asio otus* (Dor, 1947; Jedrzejewski and Jedrzejewska, 1993).

Bate (1945) collected pellets from Syria and Lebanon, and 1 or 2 remains each of *M. tristrami* and *M. guentheri* were identified in each pellet. In our study, generally, 2-3 specimens of small mammal remains were found in each pellet. Hoppe (1986) gives the dimensions of the pellets as 3.5 cm in length and 2.5 cm in width; in the present study, the mean measurements of the pellets were 3-7 cm in length and 2-3 cm in width.

Hoppe (1986) reported that several studies indicate large numbers of *M. guentheri* and *M. musculus* are among the preferred prey items consumed by *Tyto alba*. Kahila and Tchernov (1991) reported that 93%-99% of the diet of the Barn Owl consisted of rodents, particularly voles, and each owl can consume thousands of voles annually. This indicates the importance of owls in controlling agricultural pests. Rifai et al. (1998) reported that previous analyses showed that the Barn Owl is an extremely opportunistic feeder; whereas *Mus musculus/abbotti* is the most frequent food item at 3 locations in Turkey and in Iraq. These examples show that owls rely largely on food that is more or less available, and is thus apparently largely dependent on habitat and season.

For the Eagle Owl, *Bubo bubo*, Bates and Harrison (1989) found cranial remains of the East European Hedgehog (*Erinaceus concolor*) and the Long-eared Hedgehog (*Hemiechinus auritus*) in pellets obtained from Jordan. We did not find hedgehogs in our collection.

Amr et al. (1997) reported that the Eagle Owl is an agile hunter. The number of prey items per pellet ranged from 1-7. Analysis of each pellet separately showed that *M. musculus* and *C. suaveolens* were its main diet. A maximum of 6 skulls of *C. suaveolens* and one skull of *M. musculus* were found in one pellet. This large number of shrews per pellet may indicate their abundance in the area or their preference as a prey item. Our results showed a maximum of 4 prey items in 1 pellet.

Obuch (2001) and Obuch and Kristin (2004) collected pellets in Turkey, Syria, Egypt, Iran, and Israel, and

identified 7 species of dormice, and the species of the genera *Mus*, *Rattus*, and *Crocidura*. Kock (1990) collected pellets from north-west Turkey, and identified *Sorex caucasicus* and dormouse, *Glis glis orientalis*. *Gliridae* species were found in pellets from the Middle East, but there were no remains of *Gliridae* species in our collection.

Pellet analysis showed that *Chiroptera* species were taken by owls (Rifai et. al., 1998; Bates and Harrison 1989; Obuch 1998a); however, there were no *Chiroptera* remains in the pellets we collected.

The data confirm the role of small mammals, especially *Microtinae*, as the main prey of the Long-eared

Owl. This shows that the Long-eared Owl specializes in *Microtinae* and chooses *Muridae* of the same size, like *Mus. M. guentheri*, which was the dominant species in pellet remains. The high frequency of *Microtus guentheri* in the pellets might be due to the fact that *Asio otus* hunt mainly in open areas. The Long-eared Owl thus proved to be an important natural enemy of several field pests, including voles and other rodents.

Living samples of *Crocidura* species could not be trapped or observed in this area, but this study shows that the analysis of regurgitated pellets of Long-eared Owls is a valuable tool for inventorying small mammals.

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