

First evidence for carrion–feeding of Eurasian Eagle-owl (*Bubo bubo*) in Bulgaria

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Received January 25, 2017 – Accepted May 18, 2017



Milchev, B. & Spassov, N. 2017. First evidence for carrion–feeding of Eurasian Eagle-owl (*Bubo bubo*) in Bulgaria. – Ornis Hungarica 25(1): 58–69. DOI: 10.1515/orhu-2017-0005

Abstract Three cases of carrion–feeding with remains of artiodactyls (0.3%, n=1104 samples with food remains) have been documented in a long term diet study of Eurasian Eagle-owls (*Bubo bubo*) in 53 localities at Southeastern Bulgaria. Bone pieces of a sheep/goat (*Ovis aries/Carpa hircus*), a Fallow Deer (*Dama dama*) and a Domestic Pig (*Sus scrofa dom.*) in three Eurasian Eagle-owl breeding localities (5.7%) prove extremely rare feeding on carrion. Northern White-breasted Hedgehog (*Erinaceus roumanicus*), rats (*Rattus* sp.), waterbirds and gallinaceous birds (total 59.5–72.6% by biomass) constituted the main portion of the diets with carrion remains. The comparisons between food niche breadths, diet composition, average prey biomass and values of superpredation of the annual diets in the three localities have not supported the carrion–feeding of the Eurasian Eagle-owl as a result of food shortages.

Keywords: feeding ecology, pellet analysis, dietary breadth, owl diet

Összefoglalás Az uhu (*Bubo bubo*) hosszútávú, 53 délkelet-bulgáriai költőhelyen végzett táplálkozásbiológiai vizsgálata során eddig csak három esetben találtak párosujjú patás maradványokat (1104 maradvány minta 0,3%-a). Többségében birka/kecske (*Ovis aries/Carpa hircus*), egy európai dámvad (*Dama dama*) és egy házi sertés (*Sus scrofa dom.*) csontmaradványai, három uhu költőhelyen (5,7%), bizonyítják, hogy mennyire ritkán táplálkozik ez a faj döggel. Az uhu fő táplálékforrását (59,5–72,6%) keleti sün (*Erinaceus roumanicus*), patkányfajok (*Rattus* sp.), vízimadarak és tyúkalakúak adják. A táplálkozási niche-szélesség, a fő prédaállat gyakorisága, az átlagos préda biomassza és az éves szuperpredáció értékeinek összehasonlítása alapján egyik területen sem a táplálékhiány okozza az uhu dögevését.

Kulcsszavak: táplálkozás-ökológia, bagolyköpet elemzés, táplálék összetétel

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Introduction

Carrion use is widespread among many omnivorous and animal eating birds and is a key factor in evolution of some groups as diurnal birds of prey (del Hoyo *et al.* 1994, DeVault *et al.* 2003, Selva *et al.* 2005, Selva & Fortuna 2007, Moleón *et al.* 2014, Nagy & Tökölyi 2014, Nagy *et al.* 2017). Owls are predatory birds that have adapted for hunting in the limited light at night. They rely on perfect hearing and good eyesight to locate prey, but their sense of smell is not developed (del Hoyo *et al.* 1999, Mebs & Scherzinger 2008). The latter severely limits the probability of finding a carcass at night. At the same time, numerous feeding studies are exclusively based on the analysis of owl pellets and other food remains, and direct observations are rarity (del Hoyo *et al.* 1999, Mebs & Scherzinger 2008).

Accordingly, feeding on carrion could be proved very difficult and has been reported for a few owl species (review in Allen & Taylor 2013, Mori *et al.* 2014). Carrion-feeding by owls has been interpreted mostly with food scarcity and higher energetic needs in the winter or during the breeding period (Serrano 2000, Díaz-Ruiz *et al.* 2010, Kapfer *et al.* 2011, Welch 2012, Allen & Taylor 2013, Mori *et al.* 2014).

The Eurasian Eagle-owl (*Bubo bubo*) hunts opportunistically on a wide variety of vertebrates and some large invertebrates, but prefers usually mammals and birds weighting between 200 and 1900 g (Glutz von Blotzheim & Bauer 1994). As the majority of owls, it relies on hunting mainly by keen hearing in the night (del Hoyo *et al.* 1999, Mebs & Scherzinger 2008). Despite the numerous diet studies and presumed use of carrion sometimes (Glutz von Blotzheim & Bauer 1994, Mebs & Scherzinger 2008), only single cases have been clearly identified and explained with scavenger behaviour of Eurasian Eagle-owls; Serrano (2000) reported on the consumption of Farm Chicken (*Gallus gallus dom.*) carcasses, and Díaz-Ruiz *et al.* (2010) proved eating of a Domestic Rabbit (*Oryctolagus cuniculus dom.*) carcass with an attached radiotransmitter.

Here, we present data on the use of carrion by Eurasian Eagle-owls as an exceptionally rare phenomenon in Bulgarian diets. Explanation about the established consumption of carrion is searched by comparing characteristics of the diet over the years.

Material and methods

Food remains (intact and disintegrated pellets, skin, feathers, etc.) were collected from and around the nest and places for day roosting in 53 Eurasian Eagle-owl breeding localities in SE Bulgaria between 1994 and 2015. This area includes mainly hilly and plane territory around 10,000 km² (see also Milchev & Georgiev 2012). The localities are not specified due to conservation considerations. The samples (n=1104) with food remains were gathered from three visiting periods annually in localities, where at least one young fledged successfully: 1) end of April – first week of May; 2) end of May – beginning of June; 3) end of August – beginning of September. The later Eurasian Eagle-owl clutches were studied additionally in late June – July, while the unsuccessful nests dropped from repeated visits.

The mammals were identified according to Görner and Hackethal (1987), Popov and Sedefchev (2003), Bowen *et al.* (2016) and the authors' comparative collections. Other taxa were determined using the comparative collections of the National Museum of Natural History in Sofia (NMNHS), where the osteological materials were deposited. The minimum number of prey individuals were based on mainly remains and fragments of crania, mandibles and pelvic of mammals, reptiles, amphibians and fish, but also limb bones and pectoral girdles of birds. The number of invertebrates was estimated mostly on head fragments, prothoraces, wingcases and legs. These estimations followed the procedures recommended by Frey (1973). The bird feathers identified to the species level were compared with the list of bone determinations from the same sample, and any species missing in the bone samples were added to the species list. The biomass was calculated after Glutz von Blotzheim and Bauer (1994), Popov and Sedefchev (2003). The proportion of predatory mammals and

birds in diet formed the value of superpredation, which corresponds positively to the level of food stress (Lourenço *et al.* 2011, 2013).

Food niche breadth (FNB) was calculated as follows:

$$FNB = \frac{1}{\sum_{i=1}^N p_i^2}$$

where p_i is the proportion of prey taxon i in the Eurasian Eagle-owl diet (Levins 1968). Larger values of this index indicate a higher dietary diversity. The means were arithmetic mean \pm standard deviation.

Results

Bones from three artiodactyls were found singly in samples with food remains (0.3%, $n=1104$ samples) in three Eurasian Eagle-owl localities (5.7%, $n=53$ localities). The diet composition in the three localities was determined based on the remains of 5893 specimens distributed among 156 identified taxa of vertebrates and 19 taxa of arthropods, with prevalence of birds (120 taxa, 68.6%) (*Appendix 1*). Northern White-breasted Hedgehog (*Erinaceus roumanicus*), rats (*Rattus* spp.), waterbirds and gallinaceous birds (total 59.5–72.6% by biomass) constituted the main portion of the diets.

A piece of axis of a subadult Sheep (*Ovis aries*) or Goat (*Capra hircus*) (No. RM 1046 in NMNHS collection) was found in one nest site on April 24th 1996. The piece has been separated from the vertebrae with something like a hatchet, according to the well-defined outlines of cutting. A detached sheep-farm about 1180 m from the Eurasian Eagle-owl nest was the most probable source of the carrion as well as of Norway Rats (*Rattus norvegicus*), which formed 8.9% by number and 19.2% by prey biomass of the same food sample. The pair bred successfully with two fledged juveniles in 1996. The Northern White-breasted Hedgehog was the most important prey (33% by biomass) followed by gallinaceous birds, waterbirds and rats (total 72.6% by biomass), (*Table 1*). The same group of prey constituted the main portion in the diets between 1994 and 1999 ($70.6 \pm 2.7\%$, range 65.9–72.6% by biomass) (*Figure 1a*). Some smaller prey such as thrushes (*Turdus* sp.), field mice (*Apodemus* spp.) and amphibians were caught more rarely in 1996 (*Table 1*). The food niche was narrower and the mean prey biomass higher in 1996 than the averages in this locality (*Table 1*). Respectively, the value of superpredation was lower than the average.

A pellet with remains of a Norway Rat contained a left semi-mandible fragment with a first molar of a juvenile Fallow Deer (*Dama dama*) about four months old ($L=15.8$ mm occl; No. RM 1045 in NMNHS collection). The pellet was taken below the rock used by the female Eurasian Eagle-owl for day roosting on April 21st 2002. The carcass of the shooting male (skeleton No 23/2002, in NMNHS collection) with severed feet explained the destruction of the nest containing eggs some weeks ago. Reintroduced Fallow Deers inhabit mainly

Table 1. Main prey (> 5%) of the Eurasian Eagle-owl (*Bubo bubo*) with a piece of axis from sheep (*Ovis aries*) or goat (*Capra hircus*) in 1996, Bakadzhitsite Hills, Southeastern Bulgaria, 1994–2015: % N – % by number; % B – % by biomass; tr. – traces (<0.1%)

1. táblázat Az uhu (*Bubo bubo*) főbb tápláléktípusai (>5%) feltüntetve a birka (*Ovis aries*) vagy kecske (*Capra hircus*) csigolyadarabot 1996-ból, Bakadzhitsite, Délkelet-Bulgária, 1994–2015: % N – darabszám %; % B – biomassa %; tr. (traces) – nyomokban (<0.1%)

Prey	1996			1994–2015, 18 years with nesting attempts		
	Number	% N	% B	Number	% N	% B
<i>Erinaceus roumanicus</i>	31	8.7	33.0	239	5.3	23.7
<i>Lepus europaeus</i>	2	0.6	1.9	92	2.0	8.1
<i>Microtus</i> spp.	104	29.1	4.4	1020	22.6	4.1
<i>Rattus</i> spp.	32	9.0	11.4	277	6.1	9.0
<i>Apodemus</i> spp.	6	1.7	0.3	243	5.4	0.9
<i>Mus</i> spp.	43	12.0	1.2	543	12.0	1.4
Other mammals	11	3.1	1.5	198	4.4	2.6
sheep/goat (carrion)	1	0.3	0.4	1	tr.	tr.
Mammalia subtotal	230	64.4	54.1	2613	57.9	49.8
Waterbirds	24	6.7	13.8	239	5.3	13.6
Galliformes	24	6.7	14.4	284	6.3	10.7
Birds of prey	4	1.1	3.7	66	1.5	5.4
Strigiformes	8	2.2	2.5	152	3.4	5.5
Other Nonpasserines	13	3.7	5.1	178	4.0	6.3
<i>Turdus</i> sp.	4	1.1	0.4	285	6.3	2.9
Corvidae	13	3.6	5.4	110	2.4	3.8
Other Passerines	15	4.2	0.6	235	5.2	1.2
Aves subtotal	105	29.4	45.8	1549	34.3	49.5
Reptilia subtotal				7	0.2	tr.
Amphibia subtotal	2	0.6	tr.	106	2.3	0.2
Actinopterygii subtotal				7	0.2	0.4
Arthropoda subtotal	20	5.6	0.1	231	5.1	0.1
Total	357	100	100	4513	100	100
Food niche breadth	8.47			14.11±8.5, 3.72–34.04		
Average prey biomass (g)	197			178±52.9, 79–264		
Superpredation % N; % B	4.8; 7.0			5.8±3.1, 1.6–12.6; 11.7±6.7, 3.0–29.2		

specialized hunting ranges in Bulgaria. The nearest range is about 45 km far from the study locality. An illegal dump including meat waste was situated 400 m from the breeding locality. The dump was the most probable source of rats as main prey in 2002 (15.4% by prey number, 32.2% by prey biomass) (Table 2) and the piece of Fallow deer mandible. Rats dominated in the food biomass in seven diets between 1996 and 2010 (77.8%, n=9 diets), (Table 2). Waterbirds took second place (19.9% by biomass) in 2002 but were the most important prey (22.9% by biomass) in the next year (Figure 1b). The values of FNB, mean prey biomass and superpredation in 2002 were below the averages in this locality (Table 2).

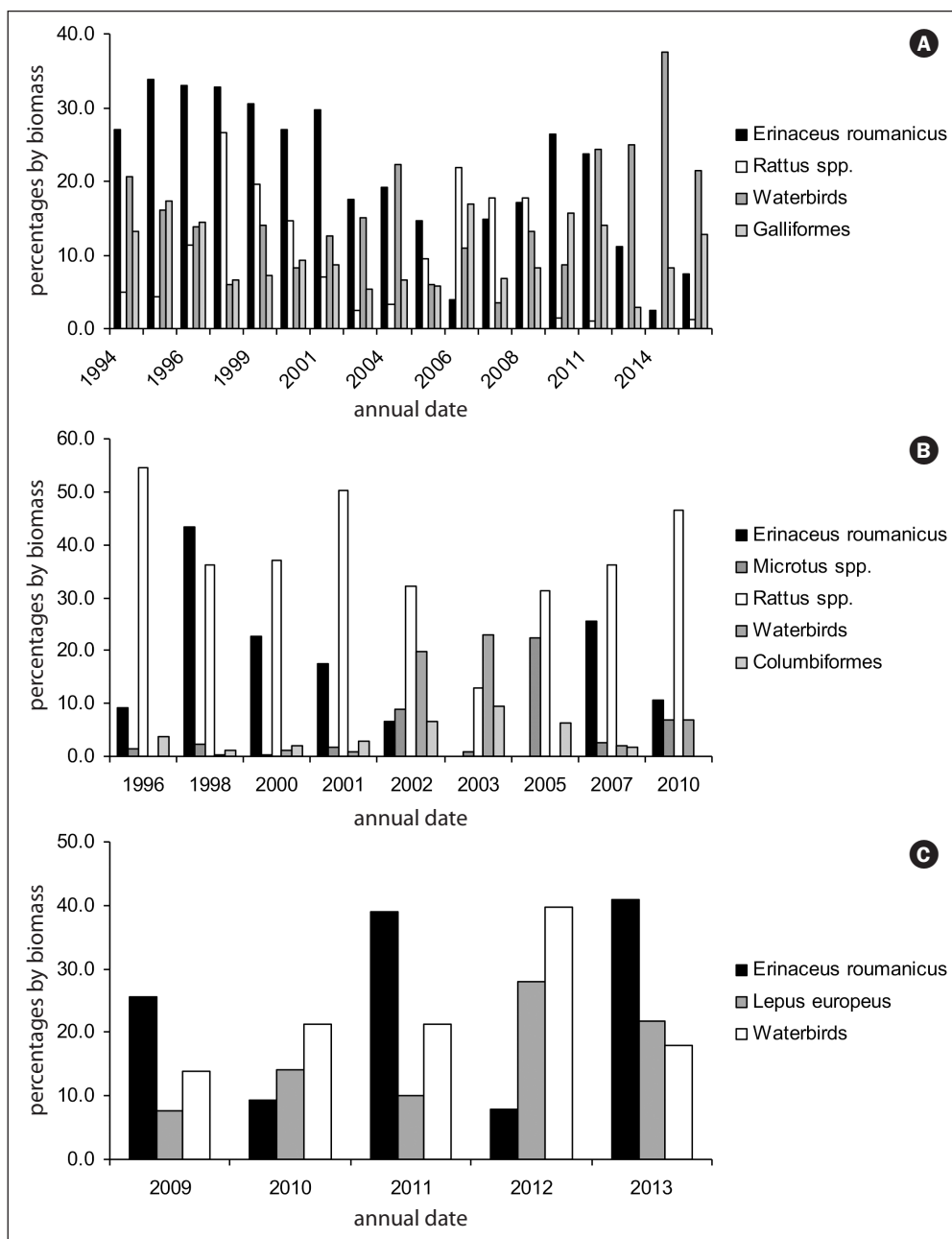


Figure 1. Prey constituted the main part of the biomass (cumulatively 70%) in three European Eagle-owl (*Bubo bubo*) diets with carrion consumption in Southeastern Bulgaria and their variation within the same localities over the years: a) Bakadzhitsite Hills, carrion-feeding in 1996; b) Hisar Hills, carrion-feeding in 2002; c) Tundza river Valley, carrion-feeding in 2011

1. ábra A biomassza fő táplálékcsoportjai (70%) az uhu három Délkelet-Bulgáriából származó táplálékmintájában (a: Bakadzhitsite hegység, b: Hisar hegyiség, c: Tundza folyó völgye). Az első területen 1996-ban, a másodikon 2002-ben, a harmadikon 2011-ben fogyasztott döögöt az uhu

Table 2. Main prey (>5%) of the Eurasian Eagle-owl (*Bubo bubo*) with a piece of mandible of a Fallow deer (*Dama dama*) in 2002, Hisar Hills, Southeastern Bulgaria, 1996–2010: % N – % by number; % B – % by biomass; tr. – traces (<0.1%)

2. táblázat Az uhu (*Bubo bubo*) főbb tápláléktípusai (> 5%) feltüntetve egy európai dámvad (*Dama dama*) álkapocs-darabját 2002-ből, Hisar, Délkelet-Bulgária, 1996–2010: % N – darabszám %; % B – biomassa %; tr. (traces) – nyomokban (<0,1%)

Prey	2002			1996–2010, 9 years with nesting attempts		
	Number	% N	% B	Number	% N	% B
<i>Erinaceus roumanicus</i>	1	1.1	6.6	65	5.1	21.0
<i>Lepus europaeus</i>	1	1.1	2.8	27	2.1	8.1
<i>Microtus</i> spp.	33	36.3	8.8	262	20.5	3.4
<i>Rattus</i> spp.	14	15.4	32.2	344	26.9	38.2
<i>Apodemus</i> spp.	3	3.3	0.8	86	6.7	1.1
<i>Mus</i> spp.	9	9.9	1.5	81	6.3	0.7
Other mammals	3	3.3	4.2	50	3.9	4.4
<i>Dama dama</i> (carrion)	1	1.1	0.9	1	0.1	0.1
Mammalia subtotal	65	71.4	57.8	916	71.7	77.0
Waterbirds	5	5.5	19.9	25	2.0	3.9
Columbiformes	3	3.3	6.7	26	2.0	2.9
Other Nonpasserines	2	2.2	3.2	67	5.3	7.8
<i>Turdus</i> sp.	6	6.6	4.0	64	5.0	2.2
Corvidae	2	2.2	6.6	29	2.3	3.6
Other Passerines	5	5.5	1.3	116	9.1	2.5
Aves subtotal	23	25.3	41.8	327	25.6	22.8
Amphibia subtotal	3	3.3	0.4	22	1.7	0.1
Arthropoda subtotal				12	0.9	tr.
Total	91	100	100	1277	100	100
Food niche breadth	5.79			7.05±4.5, 2.17–18.39		
Average prey biomass (g)	124			169±50.4, 88–231		
Superpredation % N; % B	1.1; 2.4			2.6±1.4, 0–4.8 5.2±3.3, 0–11.3		

Humerus with a length of 5 cm from the right forelimb of a suckling pig *Sus scrofa* (No. RM 1044 in MNMHS collection) was identified in food remains, which have been accumulated by an Eurasian Eagle-owl family in the period of May 23rd – July 23rd 2011. The breeding locality was situated in a mostly open landscape between two villages spaced respectively 2200 and 2300 m of it. The owls preyed upon waterbirds, which accounted for about a fifth of the food (Table 3), in a reservoir with a detached retail holding at distance of about 1650 m. The last place and the two villages were possible sources of the carcass of suckling. The Eurasian Eagle-owl pair bred later with one fledgling in 2011. Northern White-breasted Hedgehogs were the most important prey (39.0% by biomass) and together with waterbirds and European Hares (*Lepus europaeus*) comprised the main share of the diet in 2011. The same prey group in different proportions formed 75.8% and 80.5% by diet biomass in the next two years (Figure 1c). FNB and the mean prey biomass in 2011

Table 3. Main prey (>5%) of the Eurasian Eagle-owl (*Bubo bubo*) including a suckling pig (*Sus scrofa* dom.) in 2011, Tundza river Valley near the town of Elhovo, Southeastern Bulgaria, 2009–2013: % N – % by number; % B – % by biomass; tr. – traces (<0.1%)

3. táblázat Az uhu (*Bubo bubo*) főbb tápláléktípusai (> 5%) feltüntetve egy házi sertés (*Sus scrofa* dom.) maradványát 2011-ből, Tundza-völgy, Elhovo közelében, Délkelet-Bulgária, 2009–2013: % N – darabszám %; % B – biomassza %; tr. (traces) – nyomokban (<0,1%)

Prey	2011			2009–2013, 5 years with nesting attempts		
	Number	% N	% B	Number	% N	% B
<i>Erinaceus roumanicus</i>	19	16.5	39.0	49	9.1	21.1
<i>Lepus europaeus</i>	4	3.5	10.0	43	8.0	18.0
<i>Microtus</i> spp.	7	6.1	0.6	49	9.1	0.8
<i>Mus</i> spp.	14	12.2	0.7	28	5.2	0.3
Other small mammals	13	11.3	5.4	53	9.8	3.3
Carnivora	1	0.9	6.8	11	2.0	13.1
<i>Sus scrofa</i> dom. (carrion)	1	0.9	1.4	1	0.2	0.2
Mammalia subtotal	59	51.3	63.8	234	43.5	56.9
Waterbirds	25	21.7	21.3	103	19.1	21.0
Galliformes	7	6.1	4.9	36	6.7	6.5
Strigiformes	5	4.3	3.8	33	6.1	4.7
Other birds	14	7.9	6.1	78	14.6	10.5
Aves subtotal	51	44.3	36.0	250	46.5	42.6
Reptilia subtotal				3	0.6	0.1
Amphibia subtotal	4	3.5	0.2	42	7.8	0.4
Arthropoda subtotal	1	0.9	tr.	9	1.7	tr.
Total	115	100	100	538	100	100
Food niche breadth	14.8			14.32±4.0, 8.33–19.26		
Average prey biomass (g)	318			324±5.2, 318–331		
Superpredation % N; % B	7.0; 13.3			10.3±2.5, 7.0–13.5; 20.9±10.3, 8.4–34.8		

were close to the averages, while the level of superpredation was one of the lowest for this locality (Table 3).

Discussion

Remains of three artiodactyls were the only evidence of eating carrion by Eurasian Eagle-owls in Bulgaria. They have been taken as a food accidentally according to their paltry frequency of occurrence in diets and in breeding localities. The Eurasian Eagle-owls in the three localities were not re-feeding on carrion in this long term study of their diets in contrast to the use of farm chicken carcasses by a Spanish local population (Serrano 2000).

Scavenging might relate mostly with higher energy requirements during the breeding period and use of carrion as profitable food source when it is available to the Eurasian Eagle-owl (Serrano 2000, Díaz-Ruiz *et al.* 2010). The present study corresponds with this assumption

but does not support the carrion-feeding by the Eurasian Eagle-owl as consequence of a food shortage. The diets including carrion did not distinguish from others in the respective localities with very low average prey biomass or sharply expanding food niche, which indicate unfavorable food supply (Glutz von Blotzheim & Bauer 1994, Penteriani *et al.* 2005). The level of superpredation as a measure of food stress (Lourenço *et al.* 2011) in years with carrion consumption was lower than the average in the relevant locality.

Three to five prey groups constituted the main part of the biomass (cumulatively 70%) in the three diets including carcasses and the Northern White-breasted Hedgehog dominated in the two of them. The high share of Northern White-breasted Hedgehog in food biomass as one of the most important prey is common in diets on Balkan Peninsula (Papageorgiou *et al.* 1993, Simeonov *et al.* 1998, Mihelič 2002, Sándor & Ionescu 2009, Milchev & Gruychev 2015, Milchev 2016) as in Central Europe as well (Glutz von Blotzheim & Bauer 1994). The larger catch of Northern White-breasted Hedgehogs and other prey from the preferred weight group as European Hares, rats, waterbirds and gallinaceous birds connects with good food supply. The opposite is usually true for higher consumption of small passerine birds and amphibians, which indicate poor food supply (Glutz von Blotzheim & Bauer 1994).

Rats were important for prey biomass in two of the diets with carrion. The Eurasian Eagle-owl apparently prefers hunting upon rats in many parts of its range (del Hoyo *et al.* 1999, Mebs & Scherzinger 2008) including Balkan Peninsula (Simeonov *et al.* 1998, Mihelič 2002, Sándor & Ionescu 2009, Milchev & Gruychev 2016). Rats are numerous near dumps, livestock farms, etc., but hunting them by Eurasian Eagle-owl is not bound to correlate with the regular occurrence of carcass in owl diets in Bulgaria.

Mebs and Scherzinger (2008) warn that the Eurasian Eagle-owls accustomed to eating carrion are at increased risk of death due to ingestion of sharp objects. The Eurasian Eagle-owl is an “endangered species” according to the national Red Data Book (Golemanski 2015) but such potential threat is not significant because of extremely rare carrion-feeding by the local population.

Acknowledgements

We express our deep gratitude to V. Georgiev, A. Kovachev, U. Georgieva, P. Arsov, M. Chelebiev, G. Gruychev and D. Emin for their assistance in the field. We thank J. Menzel for the identification of the bird feathers to species, Z. Boev and H. Frey for determination of bird's bones in some samples from 1994–1996, V. Popov for identification of some bats, N. Tzankov for identification of reptiles, B. Marinov, Y. Sivkov and A. Apostolus for identification of fishes and D. Chobanov, B. Georgiev, O. Iliev and N. Kodzhabashev for determination of invertebrates. We would like to thank the anonymous reviewers for their valuable comments. The study has been done with the financial support of J. Menzel, H. Schmid and H. Frey. Investigations were carried out under grant B–302/1993 of the National Fund for Scientific Research (1994–1996). This study complies with national legislation.

Appendix 1.

Prey	Bakadzhitsite Hills *, 1994–2015			Hisar Hills **, 1996–2010			near the town of Elhovo ***, 2009–2013		
	N	%N	%B	N	%N	%B	N	%N	%B
<i>Erinaceus roumanicus</i>	239	5.9	23.7	65	5.1	21.0	49	9.1	21.1
<i>Lepus europaeus</i>	92	2.3	8.1	27	2.1	8.1	43	8.0	18.0
<i>Spermophilus citellus</i>	3	0.1	0.1	19	1.5	2.2	8	1.5	1.2
<i>Apodemus flavicollis/sylvaticus</i>	240	5.9	0.9	86	6.7	1.1	19	3.5	0.3
<i>Mus musculus/macedonicus</i>	543	13.3	1.4	81	6.3	0.7	28	5.2	0.3
<i>Rattus norvegicus</i>	211	5.2	7.2	329	25.8	36.9	6	1.1	0.9
<i>Rattus rattus</i>	66	1.6	1.7	15	1.2	1.3	2	0.4	0.2
<i>Arvicola amphibius</i>	86	2.1	1.1	1	0.1	tr.	10	1.9	0.6
<i>Microtus arvalis/levis</i>	1009	24.7	4.0	262	20.5	3.4	49	9.1	0.8
<i>Vulpes vulpes</i>	1	tr.	0.3	1	0.1	1.1	9	1.7	12.9
Mammalia subtotal	2614	64.2	49.8	916	71.7	77.0	234	43.5	57.0
<i>Coturnix coturnix</i>	124	3.0	1.6	16	1.3	0.7	8	1.5	0.4
<i>Perdix perdix</i>	143	3.5	7.1	14	1.1	2.3	28	5.2	6.0
<i>Anas platyrhynchos</i>	25	0.6	2.8	2	0.2	0.9	4	0.7	2.5
<i>Tachybaptus ruficollis</i>	24	0.6	0.6	1	0.1	0.1	19	3.5	2.2
<i>Columba livia</i> f. dom.	52	1.3	2.3	10	0.8	1.4	6	1.1	1.1
<i>Columba palumbus</i>	27	0.7	1.7	2	0.2	0.4	4	0.7	1.1
<i>Gallinula chloropus</i>	68	1.7	2.5	14	1.1	1.7	41	7.6	6.6
<i>Fulica atra</i>	28	0.7	2.9	1	0.1	0.3	16	3.0	7.2
<i>Ixobrychus minutus</i>	13	0.3	0.2	2	0.2	0.1	10	1.9	0.8
<i>Nycticorax nycticorax</i>	7	0.2	0.6	1	0.1	0.3	3	0.6	1.2
<i>Burhinus oedicednemus</i>	5	0.1	0.3	2	0.2	0.4	5	0.9	1.2
<i>Tyto alba</i>	43	1.1	1.7	3	0.2	0.4	6	1.1	1.0
<i>Asio otus</i>	54	1.3	1.9	10	0.8	1.2	15	2.8	2.3
<i>Buteo buteo</i>	38	0.9	4.0	1	0.1	0.3	7	1.3	3.2
<i>Garrulus glandarius</i>	55	1.3	1.1	7	0.5	0.5	3	0.6	0.3
<i>Pica pica</i>	24	0.6	0.7	11	0.9	1.0	3	0.6	0.4
<i>Corvus corone</i>	30	0.7	2.0	5	0.4	1.1	2	0.4	0.6
<i>Alauda arvensis</i>	40	1.0	0.2	4	0.3	0.1	1	0.2	tr.
<i>Turdus merula</i>	125	3.1	1.4	24	1.9	0.9	11	2.0	0.5
<i>Turdus philomelos</i>	126	3.1	1.1	23	1.8	0.7	9	1.7	0.3
Aves subtotal	1215	29.8	49.5	327	25.6	22.8	250	46.5	42.6
Reptilia subtotal	4	0.1	tr.				3	0.6	0.1
<i>Pelobates syriacus</i>	87	2.1	0.2	22	1.7	0.1	41	7.6	0.4
Amphibia subtotal	106	2.6	0.2	22	1.7	0.1	42	7.8	0.4
Actinopterygii subtotal	7	0.2	0.4						
Arthropoda subtotal	132	3.2	0.1	12	0.9	tr.	9	1.7	tr.
Total	4078	100	100	1277	100	100	538	100	100

¹ Mammals: *Talpa europaea* * - 21, ** - 6, *** - 2; *Talpa* sp. * - 1, ** - 1; *Sorex araneus* * - 1; *Crocidura leucodon* * - 26, ** - 5, *** - 4; *Crocidura suaveolens* * - 9, ** - 4, *** - 1; *Myotis blythii* ** - 1; *Nyctalus noctula* * - 1; Vespertilionidae gen. * - 3; *Glis glis* * - 20; *Dryomys nitedula* * - 4, *** - 1; *Nannospalax leucodon* * - 6, ** - 7; *Apodemus agrarius* * - 3; *Microtus hartingi* * - 11; *Sus scrofa* dom. (carrion) *** - 1; *Dama dama* (carrion) ** - 1; *Ovis aries* / *Capra hircus* (carrion) * - 1; *Mustela nivalis* * - 17, ** - 4, *** - 2;

Birds: *Alectoris chukar* * - 7, ** - 2; *Phasianus colchicus* * - 8; *Gallus gallus* dom. * - 2, ** - 1; *Anser anser* dom. * - 1; *Anser albifrons* * - 1; *Tadorna tadorna* * - 1; *Netta rufina* * - 1; *Aythya nyroca* * - 4; *Anas acuta* * - 1; *Anas crecca* * - 2; *Spatula clypeata* * - 1; *Spatula querquedula* * - 10, ** - 1; *Anas* sp. * - 3; *Podiceps cristatus* * - 3; *Streptopelia turtur* * - 20, ** - 6; *Streptopelia decaocto* * - 13, ** - 8; *Apus apus* *** - 1; *Cuculus canorus* * - 7; *Rallus aquaticus* * - 13, ** - 2, *** - 1; *Porzana porzana* * - 8; *Zapornia parva* *** - 5; *Zapornia pusilla/parva* * - 1; *Crex crex* * - 28, ** - 2, *** - 1; *Microcarbo pygmeus* * - 5; *Himantopus himantopus* * - 2; *Pluvialis apricaria* * - 4; *Vanellus vanellus* * - 3, ** - 1, *** - 1; Charadriidae gen. * - 1; *Calidris pugnax* * - 5; *Calidris alpina* * - 1; *Calidris minuta* *** - 1; *Scolopax rusticola* * - 7, *** - 1; *Gallinago media* * - 1; *Actitis hypoleucos* * - 1; *Tringa ochropus* * - 1; *Tringa totanus* * - 1; *Tringa* sp. * - 1; Scolopacidae gen. * - 1; *Chlidonias niger* *** - 1; *Chlidonias* sp. * - 1; *Otus scops* * - 18, ** - 4, *** - 5; *Bubo bubo* (juv.) * - 2; *Athene noctua* * - 18, ** - 5, *** - 4; *Strix aluco* * - 2; *Asio flammeus* * - 15, ** - 1, *** - 3; *Circus aeruginosus* * - 1; *Circus cyaneus* * - 3, *** - 1; *Circus macrorurus* * - 1; *Circus pygargus* * - 11; *Accipiter nisus* * - 4, ** - 1, *** - 5; *Accipiter gentilis* * - 1; *Buteo rufinus* * - 1; *Upupa epops* *** - 1; *Merops apiaster* ** - 1; *Coracias garrulus* * - 1; *Jynx torquilla* * - 2; *Picus viridis* * - 5; *Dendrocopos syriacus* * - 1; *Dendrocopos major* * - 2; *Dendrocopos major/syriacus* * - 1; *Falco tinnunculus* * - 5, ** - 2; *Falco columbarius* * - 1; *Falco cherrug* ** - 1; *Lanius minor* * - 1; *Lanius collurio* * - 20, ** - 10, *** - 1; *Lanius senator* * - 2, ** - 2; *Oriolus oriolus* * - 2, ** - 2; *Corvus monedula* * - 1, ** - 5; *Corvus corax* ** - 1; *Parus cf. palustris* * - 1; *Hirundo rustica* * - 3, *** - 1; *Melanocorypha calandra* * - 2; *Calandrella brachydactyla* * - 8, ** - 3, *** - 1; *Calandrella* sp. * - 1, ** - 1; *Galerida cristata* * - 4, ** - 1; *Lullula arborea* * - 16, ** - 4, *** - 2; *Eremophila alpestris* ** - 2; *Acrocephalus arundinaceus* * - 1, *** - 1; *Acrocephalus* sp. * - 1; *Sylvia atricapilla* * - 1, ** - 1; *Sylvia nisoria* * - 2, ** - 1; *Sylvia* sp. ** - 1, *** - 1; Sylviidae gen. * - 6, ** - 1; *Sturnus vulgaris* * - 29, ** - 7, *** - 4; *Sturnus roseus* ** - 40; *Turdus pilaris* * - 6, ** - 2; *Turdus iliacus* * - 2, ** - 2; *Turdus viscivorus* * - 2, ** - 3; *Turdus* sp. * - 24, ** - 10, *** - 2; *Luscinia megarhynchos* * - 3; *Luscinia* sp. ** - 1; *Oenanthe oenanthe* * - 1, ** - 2, *** - 1; *Oenanthe* sp. * - 1, ** - 3, *** - 1; Muscipapidae gen. * - 1, ** - 4; *Passer domesticus* * - 8, ** - 3; *Passer montanus* * - 1; *Motacilla flava* *** - 1; *Fringilla coelebs* * - 2; *Chloris chloris* * - 3; *Carduelis carduelis* * - 6; *Coccothraustes coccothraustes* * - 12, ** - 3; *Emberiza calandra* * - 19, ** - 9, *** - 1; *Emberiza citrinella* * - 2, ** - 3; *Emberiza melanocephala* * - 5, *** - 1; *Emberiza* sp. * - 10, ** - 4; Passeriformes indet. * - 21, ** - 4; Aves indet. * - 3, ** - 1;

Reptiles: *Testudo graeca* *** - 1; *Lacerta trilineata* * - 1; *Lacerta viridis* * - 1; *Lacerta trilineata/viridis* * - 3; *Dolichophis caspius* *** - 2; *Natrix natrix* * - 1;

Amphibians: *Pelophylax ridibundus* * - 19, *** - 1;

Fishes: *Carassius gibelio* * – 4; *Cyprinus carpio* * – 2; Cyprinidae indet. * – 1;
 Arthropods: *Potamon ibericum* * – 98; *Scolopendra* sp. * – 1, *** – 1; *Decticus albifrons* * – 5, ** – 3, *** – 4; *Decticus* sp. * – 20; *Bradyporus macrogaster* * – 8, *** – 2; *Anacridium aegyptium* * – 1; *Tettigonia caudata/viridissima* * – 10; *Platypleis escaleraei* * – 1; *Platypleis* sp. ** – 1, *** – 1; *Grylotalpa* sp. * – 6, ** – 1; *Mantis religiosa* * – 1; *Copris lunaris* * – 2, ** – 2; *Copris hispanus* * – 13; *Copris* sp. * – 4, ** – 1; *Cetonia aurata* * – 1; *Oryctes nasicornis* * – 5, ** – 1, *** – 1; Scarabaeidae gen. * – 1; Tenebrionidae gen. * – 4; Carabidae gen. * – 1, ** – 3; Cerambycidae gen. * – 6; *Lucanus cervus* * – 42; Coleoptera indet. * – 1.

Appendix 1. Diet of Eurasian Eagle-owls (*Bubo bubo*) in three localities with carrion consumption in SE Bulgaria, 1994–2015: %N – % by number; %B – % by biomass; tr. – traces (<0.1%); ¹prey in one or two localities and <1%N or <1%B: * – **, *** – number of specimens

Függelék 1. Az uhu (*Bubo bubo*) főbb táplálékának listája, mely tartalmazza azt a három területet, ahol dögfogyasztást jegyeztek fel Délkelet-Bulgáriában, 1994–2015: %N – darabszám %; %B – biomassa %; tr. (traces) – nyomokban (<0.1%); ¹ olyan préda, amely csak egy vagy két területről került elő, és számban vagy biomasszában <1%: * – **, *** – egyedek száma

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