

The diet of the greater spotted eagle (*Aquila clanga*) in Belarusian Polesie

Potrava orla hrubozobého (*Aquila clanga*) v Bieloruskom Polesí

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Abstract: During 1999–2009 the food remains from the nests of 43 breeding pairs of the greater spotted eagle in Belarusian Polesie (southern Belarus) were collected. 797 prey items were determined, including mammals (40%, 15 species and *Sylvaemus* sp., 4 orders), birds (36%, 35 species and *Phylloscopus* sp., Corvidae sp., 11 orders), evertebrates (16%, Coleoptera, Odonatoptera, Gastropoda), reptiles (6%, 4 species and *Lacerta* sp.), amphibians (1%, *Rana* sp.) and fish (1%, 3 species). Small rodents from the genus *Microtus* (*M. arvalis* and *M. oeconomus*) as well as *Arvicola amphibius* were the most numerous mammal species, followed by *Erinaceus roumanicus* and *Talpa europaea*. Rallidae (mostly *Rallus aquaticus*, *Porzana porzana* and *Crex crex*), waders (mainly *Galinago gallinago*), dabbling ducks (mainly *Anas platyrhynchos* and *Anas querquedula*), Galliformes (*Lyrurus tetrix*), Ciconiiformes (*Ardea cinerea* and *Botaurus stellaris*) were the most numerous bird prey species. *Emberiza schoeniclus* was predominated prey species among Passerines. Reptiles were frequently represented by snakes (mainly *Natrix natrix*, but also *Vipera berus* and *Coronella austriaca*). Biomass predominance in diet of the greater spotted eagles is as follows: birds (67.9%), mammals (25.3%), reptiles (3.4%), fish (3.0%) and amphibians (0.3%). Prey species with a body mass of 51–200 g (41.9%) and 11–50 g (38.3%) were predominant in the food spectrum of the greater spotted eagles. In the weight category of 1–50g, mammals were dominant, but from the categories of 51–200 g and heavier, birds occupied the leading position. The prey which made the largest contribution in total biomass of the greater spotted eagle were in the prey weight category from 601 to 1200 g (34%), then from 51 to 200 g (24%), from 11 to 50 g (16.6%) and more than 1200 g (16%). The species of the genus *Microtus* were equally represented in prey set of the greater spotted eagle in habitats with different degrees of anthropogenic transformation (24% in each habitat type). The share of *Arvicola amphibius* in the diet of the greater spotted eagle decreased from 12% in natural habitats to 4% in transformed habitats; the share of birds decreased from 41% to 26% correspondingly. The share of Insectivora and Evertebrata, on the contrary, increased to 3% and 11% in natural habitats and to 6% and 27% in transformed habitats correspondingly.

Abstrakt: V rokoch 1999–2009 boli zozbierané vzorky potravy z hniezd 43 hniezdiacich párov orlov hrubozobých v Bieloruskom Polesí (južné Bielorusko). 797 identifikovaných vzoriek potravy zahŕňalo cicavce (40 %, 15 druhov a *Sylvaemus* sp., 4 rady), vtáky (36 %, 35 druhov a *Phylloscopus* sp., Corvidae sp., 11 radov), bezstavovce (16 %, Coleoptera, Odonatoptera, Gastropoda), plazy (6 %, 4 druhy a *Lacerta* sp.), obojživelníky (1 %, *Rana* sp.) a ryby (1 %, 3 druhy). Malé hlodavce rodu *Microtus* (*M. arvalis* a *M. oeconomus*) ako aj *Arvicola amphibius* boli najpočetnejšími druhmi cicavcov, nasledované druhmi *Erinaceus roumanicus* a *Talpa europaea*. Rallidae (hlavne *Rallus aquaticus*, *Porzana porzana* a *Crex crex*), bahniaky (hlavne *Galinago gallinago*), kačice (hlavne *Anas platyrhynchos* a *Anas querquedula*), Galliformes (*Lyrurus tetrix*), Ciconiiformes (*Ardea cinerea* a *Botaurus stellaris*) boli najpočetnejšími vtáčimi druhmi v potrave. Zo spevavcov bola prevládajúcou potravou *Emberiza schoeniclus*. Plazy boli dosť častou potravou prezentované druhmi *Natrix natrix*, ale taktiež *Vipera berus* a *Coronella austriaca*. Prevládajúca zložka biomasy v potrave orlov hrubozobých bola nasledovná: vtáky (67,9 %), cicavce (25,3 %), plazy (3,4 %), ryby (3,0 %) a obojživelníky (0,3 %). V potravnom spektre orlov hrubozobých boli prevládajúce druhy s hmotnosťou 51–200 g (41,9 %) a 11–50 g (38,3 %). Vo váhovej kategórii 1–50 g boli dominantné cicavce, ale už od kategórie 51–200 g a ďalej vtáky obsadili dominantné postavenie. Najväčší podiel z celkovej biomasy koristi orlov hrubozobých bol tvorený váhovou kategóriou 601–1200 g (34 %), následne 51–200 g (24 %), 11–50 g (16,6 %) a viac ako 1200 g (16 %). Druhy z rodu *Microtus* boli rovnomerne zastúpené v koristi orlov hrubozobých v habitatoch s rozdielnym stupňom antropogénnej zmeny (24 % v každom habitatovom type). Podiel *Arvicola amphibius* v potrave orlov hrubozobých poklesol z 12 % v pôvodných habitatoch na 4 % v zmenených habitatoch, podiel vtákov súbežne poklesol zo 41 % na 26 %. Podiel Insectivora a Evertebrata naopak vzrástol na 3 % a 11 % v pôvodných habitatoch a na 6 % a 27 % v zmenených habitatoch.

Key words: food, diet composition, dominant prey, natural habitat, transformed habitat, Belarus

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Introduction

The greater spotted eagle (*Aquila clanga*) is a rare species in Belarus with an estimated 150–200 pairs, two thirds of which inhabit the Polesie Region in southern Belarus (Dombrovski & Ivanovski 2005a). As a consequence of high species reticence, out-of-the-way nest places and similarity of appearance with the more abundant lesser spotted eagle (*Aquila pomarina*), breeding biology of the greater spotted eagle and peculiarities of diet have been poorly studied for a long time. There are only fragments of data regarding the feeding of the greater spotted eagle in the northern part of Belarus (50 prey items, only percentage ratio of mammals, birds, amphibian and reptiles; Ivanovsky 1996). The same parameters specify a small number of studies within a total species range. There are only few papers devoted to through study of the greater spotted eagle diet during their nesting period in Russia (Glotov 1959, Kuchin 1959, Priklonskiy 1960, Galushin 1962, Pukinskiy 1966), Estonia (Väli & Lõhmus 2002, Väli et al. 2005) and Poland (Maciorowski et al. 2005). It is also possible to find the original authors' information about the feeding of this species in the summary review on avifauna of large regions (Dement'ev 1951, Averin et al. 1971, Danilov 1976, Zubarovskiy 1977, Malchevskiy & Pukinskiy 1983, Karyakin 1998, Ryabtsev 2000, etc.). Our aim was to evaluate and compare the diet of the greater spotted eagle in Belarus in three habitat types with different degrees of anthropogenic transformation.

Mistakes in identification of Spotted eagles

It is necessary to remember during the quotation of "old literature" of the 19.–20. centuries, that in the sympatric zone for the greater spotted eagle and the lesser spotted eagle, there were frequent mistakes in species identification. Later these mistakes penetrated through to summary reviews on avifauna and were widely cited.

Due to this, Glutz Von Blotzheim et al. (1971) in page 599 discussed that in the paper of Likhachev (1957) of the 4–5 pairs of the lesser spotted eagle that were studied, a minimum of two pairs were erroneously identified, and these two pairs were actually greater spotted eagles. However, later on (p. 607–608) in the chapter devoted to the greater spotted eagle feeding, Glutz Von Blotzheim et al. (1971) cites the same paper as devoted to the greater spotted eagle only. In subsequent scientific literature this paper (Likhachev 1957) with reference to Glutz Von Blotzheim et al. (1971) was explicitly interpreted as devoted to feeding of the greater spotted eagle (Cramp & Simmons 1980, LeFranc & Clark 1983, Pugaciewicz 1995). However, the analysis of literature shows that the

lesser spotted eagle is still nesting in the permanent study plot of Likhachev in Tulskie Zaseki (Tula Region, Russia; Mischenko et al. 2001), and the border of the lesser spotted eagle range stretches for several hundred kilometers to the east from Tula Region (Melnikov et al. 2001).

Thus in the paper of Likhachev (1957), the most probable aggregate data on both Spotted eagle species were analyzed. It is necessary to remember this during the quotation of this paper. A similar problem was found during analysis of the papers of Portenko (1928a, b), where not only the lesser spotted eagles were described, but also the greater spotted eagles (Dombrovski & Panchenko 2009).

For detailed information about identification of Greater and lesser spotted eagles and their hybrids see also Bergmanis (1996), Väli & Lõhmus (2004), Dombrovski (2006, 2009a), Väli et al. (2010a, b).

Material and methods

The studies were carried out in Belarusian Polesie – large physiographic region located in southern part of the Republic of Belarus. This region is represented by vast swamped lowland with the predominance of turf soils. Numerous rivers have broad swamped floodplains. Fen mires and wet deciduous forests were predominant in vegetation cover before realization of large-scale drainage activities. During 1960–1980 the majority of fen mires were drained, almost all small and middle-size rivers were channeled. At present nearly all reserved large tracts of fen mires and wet deciduous forests are located in the Pripyat River Basin, which is still the habitation of the core part of the Belarus population of greater spotted eagle (*Aquila clanga*).

The feeding of the greater spotted eagle was studied in 1999–2009 based on the examination of pellets and determination of bone and feather remains in the nests of 43 breeding pairs. Mixed pairs with the lesser spotted eagle were excluded from the analysis.

Bone fragments in the pellets were used for the determination of the remnants of mammals, birds and amphibians, fishes and reptiles were determined according to scales in the pellets, insects were determined according to cephalothoraxes and elytra in the pellets (Pucek 1981, Pavlinov et al. 2002, Yalden 2003). The feathers were also used for determination of bird species in the remains of birds in the nests (Brown et al. 1989, Cieslak & Dul 1999). The following collections, apart from listed literature, were also used for identification of greater spotted eagles prey remains: collection of mammals and birds of the Zoological Museum of Belarus State University,

collection of snakes of the Institute of Zoology, Belarus National Academy of Sciences and also private collections of bird skeletons and mammal skulls.

The greater spotted eagle was taken into account as prey only in the case of eating of large semi-feathered chicks by parents during prolonged bad weather periods. Since many pellets contained large amount of fur with rather small bone remnants, the share of murine rodents in the diet of greater spotted eagles was evidently underestimated in our studies. Similarly, the share of amphibians is likely to be understated due to poor preservation of their remains in pellets (Väli & Lõhmus 2002, Dravecký et al. 2008).

All food samples were divided into three groups depending on the degree of habitat anthropogenic transformation in the circle within a 3 km radius around the studied nests of the greater spotted eagle.

1. Natural habitats (Figs 1–4) (15 breeding pairs) – the lack of agricultural fields or drained areas in the circle within a 3 km radius around the nests. Natural habitats (fen mires – 93% of plots and river floodplains – 7% of plots) are predominant.
2. Transformed habitats (Figs 5–8) (11 breeding pairs) – in the circle within a 3 km radius around the nests are predominantly habitats of anthropogenic origin (drained fen mires, hayfields, pastures, arable lands, peat excavation areas, fish-farms etc.).
3. Mixed habitats (17 breeding pairs) – in the circle within a 3 km radius around the nests the habitats are represented by natural and transformed areas in different rates. Natural habitats are represented by fen mires (53% of plots) and swamped river floodplain (47% of plots).

The prey species of the greater spotted eagle were divided into five weight categories for analysis of biomass:

1. 1–10 g (Soricidae sp., *Micromys minutus*);
2. 11–50 g (majority of small rodents, small passerines, amphibians and reptiles);
3. 51–200 g (*Arvicola amphibius*, *Talpa europea*, Rallidae sp., *Gallinago gallinago*, some other birds, snakes);
4. 201–600 g (*Fulica atra*, *Anas querquedula*, *A. crecca*, some wader species, the majority of Corvidae sp., *Columba* sp.);
5. 601–1200 g (*Botaurus stellaris*, *Anas platyrhynchos*, *Lyrurus tetrix*, *Ondatra zibethicus*, *Erinaceus roumanicus*);
6. more than 1200 g (*Ardea cinerea*, *A. alba*, *Grus grus*, *Lepus* sp.).

We did not consider invertebrates during analysis of biomass, since their input in total biomass is insignificant.

For comparative analysis of the greater spotted eagle diet in Tab. 2–3 the method of marked differences from the mean (MDFM) (Obuch 2001) was used. The symbol “+” and “-” means significantly higher and lower abundance respectively than the mean value of species in the evaluating file. Samples are sorted according to their similarity. Diversity index was calculated according to formula of Shannon & Weaver (1949).

The data obtained with the similar method in different parts of the greater spotted eagle range are shown in Tab. 3: «Oka» – floodplain habitats of Okski natural reserve, the center of European part of Russia, 1954–1957, (Galushin 1962); «Ural» – floodplain habitats of Ural Region and adjacent areas, 1990–1997, (Karyakin 1998).

The species with occurrence more than 0.5% are shown in Tab. 3 below the dotted line.

Hunting styles and habitat. Greater spotted eagles hunt their prey mostly on the ground, inspecting the hunting area during gliding flight in diurnal time or perching in trees in the morning and evening time as well as during rainy weather. If hayfields or other types of agricultural lands are present in hunting area, *A. clanga* sometimes look out for the prey and take the prey directly on the ground. In natural habitats the above hunting style is impossible because of high vegetation and high water levels. The preferable hunting grounds of *A. clanga* in Belarus are natural fen mires (Figs 1–4). A positive correlation between *A. clanga* breeding density and the share of fen mires and a negative correlation between the share of agricultural land and dry forests were found in the study plots (Dombrovski & Ivanovski 2005a, b). *A. clanga* also hunt in drained fen mires, if such areas are used for sowing of permanent grasses or cattle grazing. Breeding density in transformed habitats is almost three times less than in natural habitats (from $4,4 \pm 0,95$ pairs/100 km² to $1,6 \pm 0,38$ pairs/100 km²; Dombrovski & Ivanovski 2005a,b).

Results

797 food items were identified. They are represented by seven animal classes, among them – 62 species or genera of vertebrates (Tab. 1, Figs 9–14). The highest species richness of prey species was found among birds (37 species or genera, 11 orders) and mammals (16 species or genera, 4 orders). The occurrence in the diet of the greater spotted eagle is as follows: mammals (40.4%) and birds (36.0%) are in the majority, while other species are less frequent: invertebrates, mostly Coleoptera (15.8%), reptiles (5.7%), amphibians (1.3%) and fish (0.9%; Fig. 15).



V. Dombrovski

Fig. 1. Natural habitat, fen mire near the Veluta lake, Brestskaa Region, Lunineckij district, 19 August 2005.

Obr. 1. Pôvodný habitat, močiare pri jazere Veluta, Brestovská oblasť, Luninetský rajón, 19. august 2005.



V. Dombrovski

Fig. 2. Natural habitat, the Olmany marshes, 3 September 2006.

Obr. 2. Pôvodný habitat, Olmanské močiare, 3. september 2006.



V. Dombrovski

Fig. 3. Natural habitat, Sluch River floodplains, 23 August 2005.

Obr. 3. Pôvodné habitaty záplavovej oblasti rieky Sluch, 23.



O. Ostrovski

Fig. 4. Natural habitat, Olmany marshes, author's monitoring in *A. clanga* breeding and hunting habitat, 20 August 2005.

Obr. 4. Pôvodný habitat, Olmanské močiare, monitoring autora v hniezdnom a lovnom prostredí *A. clanga*, 20. august 2005.

The feeding spectrum is characterized by high level of species diversity ($H' = 3.4$), but the occurrence was higher than 1% for only 14 vertebrate species.

Small rodents from the genus *Microtus* (*M. arvalis* and *M. oeconomus*) as well as *Arvicola amphibius* were the most numerous species, followed by *Erinaceus roumanicus* and *Talpa europaea*. Rallidae (mostly *Rallus aquaticus*, *Porzana porzana* and *Crex crex*), waders (mainly *Galinago gallinago*), dabbling ducks (mainly *Anas platyrhynchos* and *Anas querquedula*), Galliformes

(*Lyrurus tetrix*), Ciconiiformes (*Ardea cinerea* and *Botaurus stellaris*) were the most numerous bird prey species. *Emberiza schoeniclus* was predominated prey species among passerines. Reptiles were frequently represented by snakes (mainly *Natrix natrix*, but also *Vipera berus* and *Coronella austriaca*).

Completely feathered young birds or molting adults were the predominant prey among birds. It also relates to the largest bird prey – grey heron, western great egret and cranes. Bone remnants of these species corresponded



M. Dravecký

Fig. 5. Transformed habitat, drained hyfield in Pripât floodplain, Brestskaâ Region, Stolinskij district, 7 July 2008.

Obr. 5. Premenený habitat, vysušené lúky v zaplavovaných oblastiach rieky Pripjať, Brestovská oblasť, Stolinský rajón, 7. júla 2008.



V. Dombrovski

Fig. 6. Transformed habitat, drained fen mire, Gomeľskaâ Region, Žitkovičskij district, 26 July 2005.

Obr. 6. Premenený habitat, vysušované močiare, Gomeľská oblasť, Žitovičský rajón, 26. júl 2005.



V. Dombrovski

Fig. 7. Transformed habitat, drained fen mire, Brestskaâ Region, Berezovskij district, 10 July 2005.

Obr. 7. Premenený habitat, vysušené močiare v Brestovskom regióne, Berezovský rajón, 10. júl 2005.



V. Dombrovski

Fig. 8. Transformed habitat, drained and abandoned fen mire, Gomeľ Region, Žitkovičskij district, 26 June 2006.

Obr. 8. Premenený habitat, vysušené a následne zarastené močiare, Gomeľská oblasť, Žitovičský rajón, 26. jún 2005.

to the size of adult birds. Downy chicks (only Rallidae) were found in single cases, probably because of poor preservation of their remnants.

The comparison of the greater spotted eagle food spectrum in different habitats revealed that each habitat type was characterized by a specific set of prey species. Thus, the diet of the greater spotted eagles from natural “swamped” habitats significantly differed from diet of birds in other habitats by the relatively high occurrence of Rallidae species and *Gallinago gallinago*, the

greater spotted eagles from transformed habitats caught Insectivora species (*Erinaceus roumanicus* and *Talpa europaea*) as well as insects (Coleoptera) significantly more frequently. The greater spotted eagles from mixed habitats hunted waterfowl, mainly *Anas platyrhynchos* and *Anas querquedula* (Tab. 2). The species of the genus *Microtus* were equally represented in the prey set of the greater spotted eagle in habitats with different degrees of anthropogenic transformation (24% in each habitat type). The share of *Arvicola amphibius* in the diet of the greater

Tab. 1. Food composition of *A. clanga* in different habitats of Belarusian Polesie in 1999–2009**Tab. 1.** Zloženie potravy *A. clanga* v rozdielnych habitatoch v Bieloruskom Polesí v rokoch 1999–2009

species / druh	habitat type / typ habitatu			Σ	%
	natural / pôvodný	mixed / zmiešaný	transformed / zmenený		
Mammalia	128	103	91	322	40.4
<i>Erinaceus roumanicus</i>	1	2	6	9	1.1
<i>Sorex araneus</i>	1	1	0	2	0.3
<i>Neomys fodiens</i>	6	0	1	7	0.9
<i>Sorex</i> sp.	1	0	2	3	0.4
<i>Talpa europaea</i>	1	1	6	8	1.0
<i>Mustela nivalis</i>	2	1	2	5	0.6
<i>Mustela vison</i> / <i>lutreola</i>	0	1	0	1	0.1
<i>Mustela</i> sp.		1	1	2	0.3
<i>Micromys minutus</i>	1	1	0	2	0.3
<i>Sylvaemus</i> sp.	0	0	1	1	0.1
<i>Apodemus agrarius</i>	0	5	0	5	0.6
<i>Arvicola amphibius</i>	37	24	10	71	8.9
<i>Ondatra zibethicus</i>	2	3	2	7	0.9
<i>Myodes glareolus</i>	0	1	2	3	0.4
<i>Microtus oeconomus</i>	10	12	5	27	3.4
<i>Microtus agrestis</i>	6	0	0	6	0.8
<i>Microtus arvalis</i> / <i>rossiameridionalis</i>	11	19	17	47	5.9
<i>Microtus</i> sp.	47	29	34	110	13.8
<i>Lepus</i> sp.	0	0	2	2	0.3
medium sized mammalian sp.	0	1	0	1	0.1
carrion	2	1	0	3	0.4
Aves	127	98	62	287	36.0
<i>Botaurus stellaris</i>	6	1	0	7	0.9
<i>Ardea cinerea</i>	0	5	3	8	1.0
<i>Ardea alba</i>	1	0	0	1	0.1
<i>Anas platyrhynchos</i>	6	13	7	26	3.3
<i>Anas querquedula</i>	0	1	1	2	0.3
<i>Anas</i> sp.	3	5	3	11	1.4
<i>Circus aeruginosus</i>	1	0	0	1	0.1
<i>Aquila clanga</i>	1	1	1	3	0.4
<i>Lyrurus tetrix</i>	9	2	1	12	1.5
<i>Coturnix coturnix</i>	1	2	0	3	0.4
<i>Perdix perdix</i>	0	0	1	1	0.1
<i>Crex crex</i>	6	9	3	18	2.3
<i>Rallus aquaticus</i>	20	4	1	25	3.1
<i>Porzana porzana</i>	14	3	4	21	2.6
<i>Rallidae</i> sp.	3	1	1	5	0.6
<i>Fulica atra</i>	0	0	2	2	0.3
<i>Grus grus</i>	1	0	0	1	0.1
<i>Vanellus vanellus</i>	1	2	1	4	0.5
<i>Gallinago gallinago</i>	21	9	3	33	4.1
<i>Scolopax rusticola</i>	1	0	0	1	0.1
<i>Chroicocephalus ridibundus</i>	0	1	1	2	0.3
<i>Chlidonias leucopterus</i>	0	1	0	1	0.1

Tab. 1. continuation
Tab. 1. pokračovanie

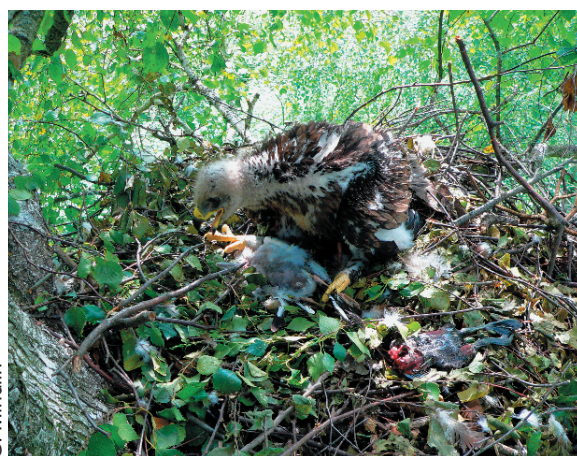
species / druh	habitat type / typ habitatu			Σ	%
	natural / pôvodný	mixed / zmiešaný	transformed / zmenený		
<i>Chlidonias</i> sp.	0	1	0	1	0.1
<i>Columba livia</i>	0	0	2	2	0.3
<i>Columba palumbus</i>	0	0	1	1	0.1
<i>Columba</i> sp.	0	1	0	1	0.1
<i>Cuculus canorus</i>	2	1	0	3	0.4
<i>Asio otus</i>	0	1	0	1	0.1
<i>Dendrocopos major</i>	1	0	0	1	0.1
<i>Dryocopus martius</i>	1	0	0	1	0.1
<i>Anthus trivialis</i>	0	1	0	1	0.1
<i>Anthus</i> sp.	2	0	1	3	0.4
<i>Saxicola rubetra</i>	1	0	0	1	0.1
<i>Luscinia luscinia</i>	0	2	0	2	0.3
<i>Turdus philomelos</i>	2	1	0	3	0.4
<i>Turdus merula</i>	3	1	1	5	0.6
<i>Turdus</i> sp.	0	1	1	2	0.3
<i>Phylloscopus</i> sp.	0	1	1	2	0.3
<i>Sylvia nisoria</i>	0	0	1	1	0.1
<i>Garrulus glandarius</i>	0	2	3	5	0.6
<i>Corvidae</i> sp.	0	0	1	1	0.1
<i>Sturnus vulgaris</i>	0	2	0	2	0.3
<i>Emberiza schoeniclus</i>	4	5	2	11	1.4
small passeriformes sp.	9	8	6	23	2.9
<i>Aves</i> sp.	7	10	9	26	3.3
Reptilia	17	17	11	45	5.7
<i>Anguis fragilis</i>	0	2	0	2	0.3
<i>Lacerta</i> sp.	1	4	0	5	0.6
<i>Natrix natrix</i>	10	2	6	18	2.3
<i>Vipera berus</i>	1	3	3	7	0.9
<i>Coronella austriaca</i>	3	0	0	3	0.4
<i>Serpentes</i> sp.	2	6	2	10	1.3
Amphibia	2	3	5	10	1.3
<i>Rana</i> sp.	1	1	1	3	0.4
<i>Anura</i> sp.	1	2	4	7	0.9
Pisces	1	1	5	7	0.9
<i>Carassius carassius</i>	1	0	0	1	0.1
<i>Cyprinus carpio</i>	0	1	0	1	0.1
<i>Cypriniformes</i> sp.	0	0	1	1	0.1
<i>Esox lucius</i>	0	0	2	2	0.3
<i>Pisces</i> sp.	0	0	2	2	0.3
Vertebrata	35	28	63	126	15.8
Coleoptera sp.	33	24	62	119	14.9
Odonatoptera sp.	2	0	0	2	0.3
Gastropoda sp.	0	4	1	5	0.6
Σ	310	250	237	797	100.0
H' diversity index	3.2	3.4	3	3.4	



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Fig. 9. The most frequently preyed birds – *Rallus aquaticus* and 2 *Porzana porzana* near the nest of *A. clanga* (Lelčickij district, Gomeľskaâ Region, 2 August 2005).

Obr. 9. Najčastejšie lovené vtáky – *Rallus aquaticus* a 2 *Porzana porzana* pri hniezde *A. clanga* (Lelčický rajón, Gomeľská oblasť, 2. august 2005).



G. Mindlin

Fig. 10. Prey *Chroicocephalus ridibundus* and *Fulica atra* (Žitkovičskij district, Gomeľskaâ Region, 25 July 2005, 1 pull. 35-day).

Obr. 10. Korisť *Chroicocephalus ridibundus* a *Fulica atra* (Žitkovičský rajón, Gomeľská oblasť, 25. júl 2005, 1 pull. 35-dní).

spotted eagle decreased from 12% in natural habitats to 4% in transformed habitats, the share of birds decreased from 41% to 26% correspondingly.

Biomass predominance in diet of the greater spotted eagles is as follows: birds (68.0%), mammals (25.3%), reptiles (3.4%), fish (3.0%) and amphibians 0.3% (Fig. 15). Prey species with body mass 51–200 g (41.9%) and 11–50 g (38.3%) was predominant in the food spectrum of the greater spotted eagles (Fig. 16). In the first and second weight categories (1–50 g), mammals were predominant, but from the third category birds occupied the leading position (Fig. 16). The largest contribution in total biomass of the greater spotted eagle prey was made by the weight category from 601 to 1200 g (34%), then from 51 to 200 g (24%), from 11 to 50 g (16.6%) and more that 1200 g (16%).

Discussion

Our data confirms the general opinion about the polyphagy of the greater spotted eagle (Dement'ev 1951, Priklonskiy 1960, Glutz Von Blotzheim et al. 1971, Cramp & Simmons 1980). The spectrum of prey species included the set of various animals from the insects and small shrews to large Ciconiiformes species and *Grus grus*. *Botaurus stellaris* and *Ardea alba* were not presented in the lists of prey species for the greater spotted eagle in all papers accessible for us, and *Ardea cinerea* was recorded by only two authors: in Tulske Zaseki (Tula

Region, Russia) (Likhachev 1957) and in Voronezhskij natural reserve (Voronezh Region, Russia) (Sapelnikov & Sapelnikova 2007). The preying on *A. cinerea* chicks in breeding colonies was described in both cases. Our data demonstrates that the greater spotted eagle is able to hunt and transport adult herons and egrets, or at least flying full-grown birds to the nest. Especially demonstrative of this case is the following: bone remnants (almost a complete skeleton) and feathers of adult *A. alba* were found in the nest of the greater spotted eagle in centre of large forest-mire tract (Olmanskij bolota Reserve). This place was remote from any great egret colonies in this region. The most probable explanation would be that the greater spotted eagles successfully hunted egret that occasionally visited their nesting area, since western great egrets were not recorded earlier in Olmanskij bolota Reserve.

Adult cranes seem to be very large prey for the greater spotted eagle, and most probably, it was the case of feeding on carrion. However, there are observations of unsuccessful attacks of the greater spotted eagle on sitting on the ground female of the demoiselle crane (*Anthropoides virgo*) in literature (Smetanin 1985, cit. by Sapelnikov & Sapelnikova 2007). Also the greater spotted eagle is considered as potential predator for crane in wintering grounds in Israel (Levy 2000).

Apart from polyphagy, almost all authors in the 20th century state that the greater spotted eagle demonstrated a specialization to middle-size rodents during the years of



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Fig. 11. *Microtus* sp., *Ondatra zibeticus* and *Esox lucius* in *A. clanga* nest ("Middle Pripât floodplain", 18 July 2007).

Obr. 11. *Microtus* sp., *Ondatra zibeticus* a *Esox lucius* v hniezde *A. clanga* ("Stredná Pripjat'", 18. júl 2007).



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Fig. 12. Unusual *A. clanga* prey – *Columba livia* f. *domestica* (Soligorskij district, Minskaâ Region, 21 July 2006).

Obr. 12. Nezvyčajná korisť *A. clanga* – *Columba livia* f. *domestica* (Soligorský rajón, Minská oblasť, 21. júl 2006).



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Fig. 13. Remains of *Erinaceus roumanicus* and egg of *Porzana porzana* (Soligorskij district, Minskaâ Region, 16 July 2007, 1 pull. 45-day and 1 egg of *A. clanga*).

Obr. 13. Zostatky *Erinaceus roumanicus* a vajce *Porzana porzana* (Soligorský rajón, Minská oblasť, 16. júl 2007, 1 pull. 45-dní a 1 vajce *A. clanga*).



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Fig. 14. *Ardea alba* feathers at the nest of *A. clanga* ("Olmanske Marshes", 30 July 2009, 1 pull. 2 month).

Obr. 14. Perá *Ardea alba* na hniezde *A. clanga* ("Olmanské močiare", 30. júl 2009, 1 pull. 2 mesiace).

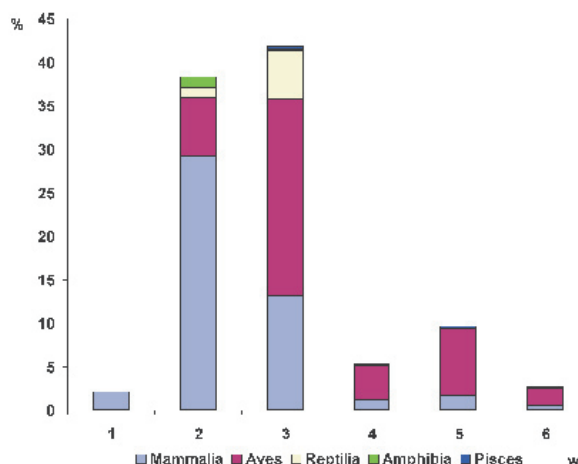
their large population numbers: genus *Spermophilus* and *Cricetus cricetus* in steppe zone (Somov 1897, Kolesnikov 1960 (cit. by Zubarovskiy 1977), Riabtsev 1997) and *Arvicola amphibius* in central part of Europe and western Siberia (Glotov 1959, Galushin 1962, Pukinskiy 1966, Danilov 1976, Malchevskiy & Pukinskiy 1983). According to data of these authors *A. amphibius* constituted 28% to 96% of records in the diet of the greater spotted eagle during different years. According to our data, the occur-

rence of *A. amphibius* in diet of the greater spotted eagle in Belarus was only 8.9% during 1999–2009 (Tab. 1). Few contemporary publications on feeding of the greater spotted eagle in western part of the range also state low occurrence of *A. amphibius* in the diet of this species (Maciorowski et al. 2005, Väli et al. 2005). This is connected with a deep depression in numbers of *A. amphibius* in vast areas exposed to drainage activities during 1960, especially in Polesie Region (Mikholap & Mikhailovs-

Tab. 2. Comparisons of *A. clanga* diet composition from three habitat types of Belarusian Polesie**Tab. 2.** Porovnanie zloženia potravy *A. clanga* z troch rozdielnych habitatov v Bieloruskom Polesí

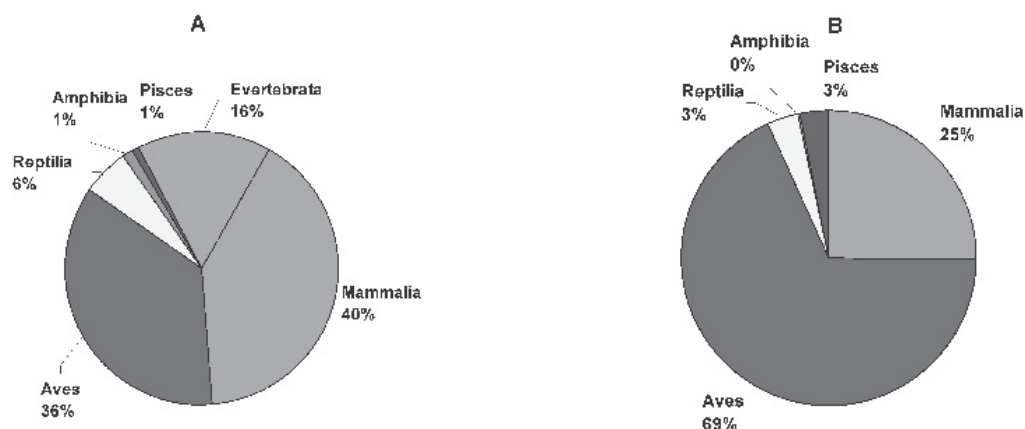
species / druh habitat type / typ habitatu	natural / pôvodný	mixed / zmiešaný	transformed / zmenený	Σ
<i>Rallus aquaticus</i>	1+ 20	4	1- 1	25
<i>Porzana porzana</i>	1+ 14	3	4	21
<i>Gallinago gallinago</i>	1+ 21	9	1- 3	32
Anseriformes	1- 9	1+ 19	11	39
Insectivora	10	1- 4	1+ 15	28
Coleoptera	1- 33	1- 24	1+ 62	119
<i>Arvicola amphibius</i>	37	24	1- 10	71
<i>Microtus arvalis</i>	1- 11	19	17	47

Mammalia	128	103	91	322
Aves	127	98	1- 62	287
Reptilia	17	17	11	45
Amphibia	2	3	5	10
Pisces	1	1	5	7
Evertebrata	1- 35	1- 28	1+ 63	126
Σ	310	250	237	797

**Fig. 16.** Different weight categories of prey species in the diet of *A. clanga* in Belarusian Polesie.**Obr. 16.** Rozdielne hmotnostné kategórie koristi v potrave *A. clanga* v Bieloruskom Polesí.

w – weight categories / hmotnostné kategórie:

1. 1–10 g (*Soricidae* sp., *Micromys minutus*); 2. 11–50 g (majority of small rodents, small passerines, amphibians and reptiles) / (väčšina malých hlodavcov, malé spevavce, obojživelníky a plazy); 3. 51–200 g (*Arvicola amphibius*, *Talpa europea*, *Rallidae* sp., *Gallinago gallinago*, some other birds, snakes) / (*Arvicola amphibius*, *Talpa europea*, *Rallidae* sp., *Gallinago gallinago*, niekoľko ďalších vtákov, hady); 4. 201–600 g (*Fulica atra*, *Anas querquedula*, *A. crecca*, some wader species, the majority of *Corvidae* sp., *Columba* sp.) / (*Fulica atra*, *Anas querquedula*, *A. crecca*, niektoré bahniaky, väčšina *Corvidae* sp., *Columba* sp.); 5. 601–1200 g (*Botaurus stellaris*, *Anas platyrhynchos*, *Lyrurus tetrix*, *Ondatra zibethicus*, *Erinaceus roumanicus*); 6. >1200 g (*Ardea cinerea*, *Ardea alba*, *Grus grus*, *Lepus* sp.).

**Fig. 15.** Comparison of percentage proportion of prey numbers (A) and prey mass (B) in the diet of *A. clanga* in Belarusian Polesie.**Obr. 15.** Porovnanie percentuálneho vyjadrenia početnosti (A) a hmotnosti koristi (B) v potrave *A. clanga* v Bieloruskom Polesí.

Tab. 3. Comparison of *A. clanga* diet from different part of its breeding area in eastern Europe
Tab. 3. Porovnanie potravy *A. clanga* z rozdielnych častí hniezdneho rozšírenia vo východnej Európe

species / druh regions / oblasti	Ural		Oka		Belarus		Σ	%
<i>Rana</i> sp.	1+	21	1-	1	1-	3	25	1.6
<i>Bufo</i> sp.	1+	8		0		0	8	0.5
Soricidae	1+	19	2-	0		12	31	2
<i>Sciurus vulgaris</i>	1+	7		0		0	7	0.5
<i>Rattus norvegicus</i>	1+	10		0	1-	0	10	0.6
<i>Cricetus cricetus</i>	1+	20	1-	0	2-	0	20	1.3
<i>Sylvaemus</i> sp.	1+	9		1		1	11	0.7
<i>Arvicola amphibius</i>	1+	156	1+	120	1-	71	347	22.2
<i>Myodes glareolus</i>		5	1+	19	1-	3	27	1.7
<i>Anas querquedula</i>		0	1+	11		2	13	0.8
<i>Anas crecca</i>		0	1+	6		0	6	0.4
<i>Anas</i> sp.	1-	3	1+	32	1-	7	42	2.7
<i>Chlidonias leucopterus</i>		0	1+	9		1	10	0.6
<i>Chlidonias nigra</i>		0	1+	8		0	8	0.5
Ciconiiformes	1-	0	1-	0	1+	16	16	1
<i>Lyrurus tetrix</i>		1		1	1+	12	14	0.9
<i>Rallus aquaticus</i>	1-	0	1-	0	1+	25	25	1.6
<i>Porzana porzana</i>	2-	0		10	1+	21	31	2
<i>Gallinago gallinago</i>	2-	0	1-	3	1+	33	36	2.3
Serpentes	1-	3	2-	1	1+	37	41	2.6
Carnivora		8	1-	0		8	16	1
<i>Microtus</i> sp.		106	1-	70		189	365	23.3
<i>Anas platyrhynchos</i>	1-	12		35		30	77	4.9
<i>Crex crex</i>	1-	1		13		18	32	2
Passeriformes	1-	21		31		61	113	7.2
<i>Talpa europaea</i>		3		9		8	20	1.3
<i>Vanellus vanellus</i>		8		1		4	13	0.8
<i>Erinaceus</i> sp.		1		0		9	10	0.6
<i>Ondatra zibethicus</i>		3		0		7	10	0.6

kaya 1973, Savitskiy et al. 2005). Comparison of the contemporary the greater spotted eagle diet in Belarus with the diet of this species in optimal foraging conditions – in floodplain of the Oka River (the center of European part of Russia) in the middle of the 20th century and in Ural Region shows that the feeding spectrum in Belarus has shifted to middle and large size waterfowl, as well as snakes, as opposed to low occurrence of *A. amphibius* (Tab. 3). An unusually high rate of large Ardeidae species in the feeding spectrum has probably been caused by a progressing depression in numbers of dabbling ducks, especially *Anas querquedula*, in Belarusian Polesie during past ten years (Natykanets, in press).

A high occurrence of snakes in diet of the greater spotted eagle unquestionably reflects their high density in the

hunting areas of birds. This was shown around the mouth of the Belaya River (Russia), where in 1958 the snakes represented 23% of prey animals (Priklonskiy 1960).

Thus in Belarus, due to the lack of the main feeding object (*A. amphibius*) the greater spotted eagles have changed their diet with the help of hunting on substituting prey: the birds of similar or largest size, snakes and voles. Similar data was obtained in Poland, where the main part of the greater spotted eagle diet in the Biebrza River floodplain in 1996–2003 was represented by birds (47% of prey) (Maciorowski et al. 2005). In the Okski natural reserve, the percentage of birds in the diet of the greater spotted eagle increased to 56% during years with a depression in numbers of *A. amphibius*, and decreased to 32% during years with high numbers of *A. amphibius* (Galushin 1962).

In Hingan Natural Reserve (Far East, Russia) the birds composed more than 80% of the greater spotted eagle prey during depression in numbers of voles (Ryabtsev 2000).

Drainage of mires negatively impacted *A. amphibius*, and also led to a harsh decrease in numbers of middle- and large-size waterfowl in nesting areas of the greater spotted eagle (Dombrovski 2009). Our data also demonstrates statistically a significant decrease in the occurrence of birds and *A. amphibius* in transformed habitats (Tab. 2). It is probable that apart from the voles (*Microtus* sp.) and large insectivore animals (*E. roumanicus* and *T. europaea*), amphibians are also important prey for the greater spotted eagle. It was partly confirmed by our visual observations of bringing of food to the nests. The lack of statistically significant increase in occurrence of amphibians in transformed habitats in comparison with natural habitats can be explained by insufficient sample size, as well as artificial understating of occurrence of these animals because of bad preservation of amphibian remnants in pellets (Väli & Lõhmus 2002, Dravecký et al. 2008).

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