

Winter diet of the long-eared owl *Asio otus* in various habitats of central and north-eastern Poland

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Abstract: *Winter diet of the long-eared owl Asio otus in various habitats of central and north-eastern Poland.* Variability of the diet of the long-eared owl was studied in selected areas of central and north-eastern Poland. The sites represented three river valleys, two agricultural landscapes and a forest complex. Analysis of pellets collected in the years 1981–2013 provided data on 3,423 prey individuals. Winter food of this owl in study areas was dominated by species of the genus *Microtus* (65.3–95.7% of prey) while typically forest rodents (*Myodes glareolus*, *Apodemus flavicollis*) constituted only 3.9% of total prey. In river valleys the owls often preyed upon *Microtus oeconomus*, which was most frequent prey (87.6%) in the Biebrza river valley. Its share in the owl's diet outside river valleys varied while the dominating prey was *Microtus arvalis* there. Birds were hunted for rather infrequently, most often in the Vistula river valley. The long-eared owl is strongly associated with open areas and the share of two species dominating in its diet (*M. arvalis*, *M. oeconomus*) depends largely on moisture of habitats of these areas.

Key words: owls' diet, pellets, river valley, agricultural landscape, forest

INTRODUCTION

The long-eared owl *Asio otus* belongs to most common and numerous owl species in the country (Ruprecht and Schwagrak 1988, Grzywaczewski and Szczepaniak 2007). It lives in habitats of variable for-

est cover but avoids large, dense forests since it preys in open areas of fields and meadows. The diet of this species was analysed in various regions of Poland, in the west (Goszczyński 1981, Jurczyszyn 1990, Żmihorski et al. 2012), south (Pawłowska-Indyk et al. 1998, Zając and Zając 1998, Cichocki et al. 2008, Dziemian et al. 2012, Grzędzicka 2014), north (Hetmański et al. 2008), in the centre (Romanowski 1988, Żmihorski 2005, Romanowski and Żmihorski 2008, Gryz and Krauze-Gryz 2015, Stolarz and Lesiński 2015, Wilniewicz and Gwardjan 2015) and in the east of Poland (Ruprecht and Schwagrak 1987, Wiącek et al. 2008, Kitowski 2013, Stasiak et al. 2014). Data on the owl's diet are also available from the neighbouring countries, e.g. from Belarus (Sidorovich et al. 2003) and Lithuania (Balčiauskienė et al. 2006).

Rodents of the subfamily Arvicolinae were found to be the species most frequently preyed upon, though in various types of landscapes the proportion of various species may differ. For example, recent studies carried out in a river valley (Stolarz and Lesiński 2015) showed

a high specificity of the owl's diet compared with that from drier habitats, which was demonstrated by a high percentage share of the root vole *Microtus oeconomus*.

The aim of this study was to determine the differences in winter diet of the long-eared owl in river valleys of different characteristic. It was also aimed to check whether the owl's diet on plateau adjacent to the valley was distinctly different.

MATERIAL AND METHODS

Studies were carried out in four areas in central Poland and in two areas in north-eastern part of the country (Fig.). Fragments of three valleys of the Biebrza, Narew and Vistula rivers were selected. Moreover, the study covered forest complex of the Kampinos Forest situated near the Vistula river valley and two agricultural landscapes with small forests (Suwalszczyzna and southern edges of Płoński Plateau and Ciechanów Plateau)

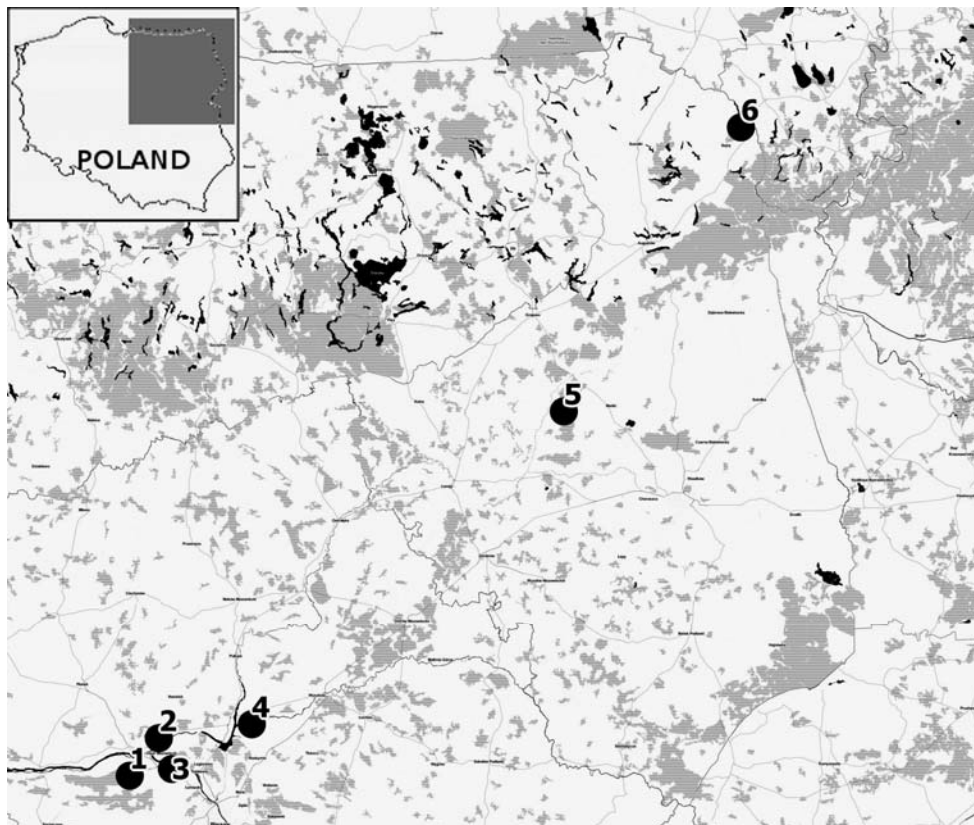


FIGURE. Distribution of study sites (circles): 1 – Kampinos Forest, 2 – Płoński and Ciechanów Plateaus, 3 – Vistula river valley, 4 – Narew river valley, 5 – Biebrza river valley, 6 – Suwalszczyzna. Forests – grey, waters – black

situated close to the river valleys under study.

The Biebrza river valley – situated in north-eastern Poland it is a boggy valley of a width of several kilometers within the study area. Swamps (alder woods and birch on bogs) and open areas overgrown mainly by sedges may be found in the valley. The area is largely flooded during spring snow melting. At the edge of plateau there are crop fields and oligotrophic pine forests.

The Narew river valley – studies were carried out in a 2–3 km wide fragment of the lower Narew river. There are small oxbow lakes in the flooded areas and open grounds are used as pastures. At the edge of plateau there are village buildings, crop fields and relatively small, mainly pine, forests.

The Vistula river valley – studies were carried out in a 3-km-wide flooded stretch of the valley downstream Warsaw. The dominating form of land use is meadows and crop fields often surrounded by willows *Salix* spp. Riparian forests, midfield woodlots and numerous oxbow lakes are present there. At the edge of the valley there are buildings of Łomianki and of other villages.

The Kampinos Forest – it is the largest forest complex in central Poland protected as the Kampinos National Park. Study area in the eastern part of the park includes forested dunes and boggy belt used by agriculture. Forest cover about 70% of the area. Coniferous forests dominated by pine *Pinus sylvestris* prevail over oak-pine forests and broad-leaved forests. Agricultural lands are

used extensively; mown meadows, crop fields and pastures are the dominating forms there.

Suwalszczyzna – a fragment of agricultural landscape close to the border with Lithuania. The area is slightly undulating with crop fields and grasslands. Rather small forest complexes are present in northern and eastern part of the area.

Płońsk Plateau and Ciechanów Plateau – they are morainic plains up to 163 m a.s.l. cut with several small rivers and the Wkra river bordering both areas. Agricultural lands are the dominating element of the landscape while forests and woodlots constitute less than 10% of the area. Forests are fragmented there but some of them show a marked share of deciduous and mixed tree stands.

In the Vistula river valley the study material was collected from five sites along the 40-km-long stretch in the years 1994–2012. One study site in the Narew river valley was selected near Kuligów (years of sampling 2010–2012). Three sites localised along the 30-km-long stretch in the Biebrza river valley were sampled in the years 1981–2005. Study material from the Kampinos Forest was collected from nine sites (years 1983–2013) while that from Suwalszczyzna was collected at one site – Sankury – in the year 2009. Six sites were selected on Płońsk Plateau and Ciechanów Plateau (sampled in the years 1982–2011) situated in relatively small area in southernmost part of both regions.

Composition of the owls' diet was estimated by the analyses of pellets

collected from under trees, where the birds had rested. Material for analyses was from the winter season (November–March). Pellets were prepared after soaking in water, and prey species were determined based mainly on skulls and mandibles, less frequently on skeleton bones (humeral bones of mole *Talpa europaea*, humeral bones and breast-bones of birds or on pelvic bones of amphibians). Mammalian species were determined based on skulls and mandibles by adopting the features given in the key edited by Pucek (1984) and those from comparative collection. The minimum number of individuals was determined based on the number of recognizable elements.

To estimate species diversity, Simpson's index was calculated ($S = 1 - \sum pi^2$, where p is a share of i species within all prey items).

RESULTS AND DISCUSSION

Study material contained remains of 3,423 prey items of the long-eared owl *Asio otus*. Prevailing number of prey animals (98.4%) were mammals; other taxa like birds or anurans were preyed upon very rarely. The number of mammalian species varied from six in the Narew river valley to twelve in the Kampinos Forest (Table).

Rodents of the genus *Microtus* clearly dominated constituting from 65.3% (the Narew river valley) to 95.7% (the Biebrza river valley) of prey. Two most frequent species: *M. arvalis* and *M. oeconomus* contributed to this domi-

nation (Table). Their share in the owl's diet varied. *M. arvalis* was less frequent than *M. oeconomus* in the Biebrza river valley while the reverse proportions were found at remaining sites, with relatively slight differences in the Kampinos Forest. The highest differences in proportion of these two voles were noted between the Biebrza river valley (6.0 and 87.6%, respectively) and Płońsk and Ciechanów Plateaus (51.2 and 6.1%, respectively) – Table.

Rodents associated with forested areas (*Myodes glareolus*, *Apodemus flavicollis*) were found less frequently (3.9% of prey on average) but relatively more often in Suwalszczyzna (7.1%). From among species of the genus *Apodemus* most frequently preyed upon was *A. agrarius* (4.3% on average, and 9.8% in the Vistula river valley). Among river valleys only in the Biebrza river valley the diet of the long-eared owl included *Arvicola amphibius*. *Micromys minutus* was the prey of owls in most study areas, and relatively high share of this species (7.9%) was noted in the Kampinos Forest. Birds rarely were the prey of owls; their relative share was highest in the Vistula river valley. Species diversity of owls' prey was very similar at most sites (S values between 0.61 and 0.76), with exception of the Biebrza river valley where it was much lower (Table).

Mikkola (1983) summarizing the results of studies on the long-eared owl's diet in various countries found that small mammals constituted 85–98% of all prey, which was confirmed in our study. Our results show also that species of the

TABLE. Species composition and percentage of the long-eared owls' prey in study areas

Specification	Biebrza river valley	Narew river valley	Vistula river valley	Kampinos Forest	Płońsk and Ciechanów Plateaus	Suwałszczyzna	Total
<i>Talpa europaea</i>	2 (0.5)*	0	2 (0.7)	0	1 (0.5)	0	5 (0.1)
<i>Sorex araneus</i>	3 (0.7)	0	1 (0.4)	4 (0.4)	0	2 (0.2)	10 (0.3)
<i>S. minutus</i>	2 (0.5)	0	0	9 (0.8)	0	0	11 (0.3)
<i>Arvicola amphibius</i>	7 (1.7)	0	0	2 (0.2)	0	1 (0.1)	10 (0.3)
<i>Myodes glareolus</i>	0	5 (1.1)	7 (2.5)	33 (3.0)	7 (3.3)	46 (4.8)	98 (2.9)
<i>Microtus subterraneus</i>	0	0	0	0	6 (2.8)	0	6 (0.2)
<i>M. arvalis</i>	25 (6.0)	242 (53.9)	121 (42.5)	427 (38.5)	109 (51.2)	408 (43.0)	1 332 (38.9)
<i>M. agrestis</i>	9 (2.2)	0	0	8 (0.7)	0	45 (4.7)	62 (1.8)
<i>M. oeconomus</i>	366 (87.6)	143 (31.8)	54 (18.9)	376 (33.9)	13 (6.1)	64 (6.7)	1 016 (30.0)
<i>Microtus</i> sp.	0	14 (3.1)	11 (3.9)	42 (3.8)	16 (7.5)	295 (31.1)	378 (11.0)
<i>Mus musculus</i>	1 (0.2)	0	4 (1.4)	2 (0.2)	6 (2.8)	0	13 (0.4)
<i>Rattus norvegicus</i>	2 (0.5)	0	0	0	0	0	2 (0.1)
<i>Apodemus agrarius</i>	0	8 (1.8)	28 (9.8)	64 (5.8)	6 (2.8)	41 (4.3)	147 (4.3)
<i>A. sylvaticus</i>	0	9 (2.0)	1 (0.4)	2 (0.2)	27 (12.7)	1 (0.1)	40 (1.2)
<i>A. flavicollis</i>	0		2 (0.7)	10 (0.9)	0	22 (2.3)	34 (1.0)
<i>Apodemus</i> sp.	0	11 (2.4)	8 (2.8)	26 (2.3)	14 (6.6)	23 (2.4)	82 (2.4)
<i>Micromys minutus</i>	1 (0.2)	16 (3.6)	4 (1.4)	88 (7.9)	2 (0.9)	0	111 (3.2)
Aves	0	1 (0.2)	35 (12.3)	16 (1.4)	6 (2.8)	1 (0.1)	59 (1.7)
Amphibia (Anura)	0	0	7 (2.5)	0	0	0	7 (0.2)
Total	418 (100.0)	449 (100.0)	285 (100.0)	1 109 (100.0)	213 (100.0)	949 (100.0)	3 423 (100.0)
S	0.23	0.61	0.76	0.72	0.70	0.71	–

* Share of each prey category (%).

genus *Microtus*, especially *M. arvalis* and *M. oeconomus*, dominate in the owl's diet in Poland. Similarly high share of these rodents was noted, for example in Wielkopolska (Goszczyński 1981),

Silesia (Pawłowska-Indyk et al. 1998), Małopolska (Grzędzicka 2014), or in the Pilica river valley (Stolarz and Lesiński 2015). Results of most of these studies indicate significant prevalence of

M. arvalis – at some sites its share exceeded 80% of all prey (Goszczyński 1981, Pawłowska-Indyk et al. 1998, Dziemian et al. 2012, Grzędzicka 2014, Gryz and Krauze-Gryz 2015, Wilniewicz and Gwardjan 2015). This was caused by the fact that studies were usually carried out in areas of a small share of wetlands. In the Pilica river valley, however, *M. oeconomus* predominated over *M. arvalis* in the proportion of 55.3–30.7% (Stolarz and Lesiński 2015), which was confirmed by our data from the Biebrza river valley. In the latter valley covered by large wetland areas the domination of *M. oeconomus* in the diet of the long-eared owl was the highest ever noted in Poland (87.6%). In other river valleys (Narew, Vistula) the share of this species was also high (18.9–31.8%) exceeding those demonstrated at other sites of the country. Domination of two *Microtus* species confirms, that the main hunting grounds of the long-eared owl are open habitats of different moisture from crop fields to meadows and pastures to sedge wetlands.

Common and numerous, typically forest rodents (*M. glareolus*, and particularly *A. flavicollis*) belonged to rare prey species of the long-eared owl (about 4% – Table), which is characteristic for the diet of this owl: about 7% reported by Ruprecht and Szwagrak (1988), about 5% by Goszczyński (1981), about 3% by Cichocki et al. (2008), about 1% by Dziemian et al. (2012). Small shares of birds, soricomorphs and synanthropic rodents (*Mus musculus*, *Rattus norvegicus*): less than 2% of each group of the

prey (Table) confirm results of the studies published so far. For example, in the winter diet of the long-eared owl from Rzeszów (Dziemian et al. 2012) and from Śląska Lowland (Cichocki et al. 2008) birds constituted 0.2 and 1% of prey, respectively, soricomorphs 0.2 and 1.3%, and synanthropic rodents 0.1 and 0.8% of prey, respectively.

CONCLUSIONS

Data on the winter diet of the long-eared owl in central and north-eastern Poland lead to the conclusion that the species selects open areas as hunting grounds in river valleys, agricultural landscapes and a forest complex. However, in particular areas the share of prey, especially of the species being the main components of the owl's diet (*M. arvalis*, *M. oeconomus*), may differ. The factor mostly differentiating the structure of potential prey species can be the moisture of open habitats.

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Streszczenie: Zimowa dieta uszatki *Asio otus* w różnych środowiskach środkowej i północno-wschodniej Polski. Zbadano zmienność diety uszatki na wybranych terenach środkowej i północno-wschodniej Polski, które reprezentowały trzy doliny dużych rzek, dwa krajobrazy rolnicze oraz kompleks leśny. Analiza wypluwek zebranych w latach 1981–2013 dostarczyła danych na temat 3423 osobników ofiar. Zimowy pokarm tej sowy na objętych badaniem terenach był zdominowany przez gatunki z rodzaju *Microtus* (65,3–95,7% ofiar), podczas gdy typowo leśne gryzonie (*Myodes glareolus*, *Apodemus flavicollis*) stanowiły łącznie tylko 3,9% ofiar. W dolinach rzecznych stosunkowo często sowy polowały na *Microtus oeconomus*, który w dolinie Biebrzy był najczęstszą ofiarą (87,6%). Poza dolinami rzecznyimi jego udział w diecie uszatki był zróżnicowany, a liczebnie zdecydowanie dominował *Microtus arvalis*. *Apodemus agrarius* był łowiony rzadko (średnio 4,3% ofiar). *Micromys minutus* był stosunkowo częstą ofiarą tylko w Puszczy Kampinoskiej (7,9%). W dolinie Biebrzy, na Suwalszczyźnie i w Puszczy Kampinoskiej w diecie uszatki wystąpił *Arvicola amphibius*. Ptaki łowione były rzadko, stosunkowo najczęściej w dolinie Wisły. Uszatka poluje

głównie na łowiskach zlokalizowanych na terenach otwartych, gdzie udział w jej diecie dwóch głównych ofiar (*M. arvalis*, *M. oeconomus*) zależy w dużej mierze od wilgotności habitatów tych obszarów.

Słowa kluczowe: dieta sów, wypluwki, dolina rzeczna, krajobraz rolniczy, las

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