

## Diet of boreal owl (*Aegolius funereus*) in lowlands of north-eastern Poland

### Potrava pôtika kapcavého (*Aegolius funereus*) na nížine severovýchodného Poľska

Tomasz TUMIEL & Paweł MIRSKI

**Abstract:** Although studies on many owl species diets are common, there are only scarce data on the diet of the boreal owl from the lowlands of Eastern Europe. We have therefore studied its diet in one of the most important Polish population areas, the Knyszyńska Forest (north-eastern Poland). Pellets were gathered between February and June in 2006, 2012–2016 from tree hollows and the ground underneath. Altogether 178 pellets and six sets of pellet fragments were collected from 19 different sites. Eight mammal and eight bird species were identified among the 213 prey items found in the gathered material. Small mammals dominated, both in prey number (88.3%) and biomass (85.1%). Bank vole proved to be the main prey (over 40% of prey numbers), while *Microtus* voles (27.3%), small passerine birds (11.7%) and shrews (7.5%) were important alternative prey. Diet range proved to be similar to other sites in Europe.

**Abstrakt:** Hoci štúdií o potrave viacerých druhov sov je množstvo, tých o potrave pôtika kapcavého z nížin východnej Európy je minimum. Z tohto dôvodu sme študovali jeho potravu v jednej z najvýznamnejších poľských populácií – v Knyszyńskom lese (severovýchodné Poľsko). Vývržky boli zbierané od februára do júna v rokoch 2006, 2012 – 2016 z dutín a zo zeme pod hniezdnou dutinou. Na 19 lokalitách sa spolu zozbieralo 178 vývržkov a šesť skupín častí vývržkov. V rámci 213 kusov koristi sa identifikovalo osem druhov cicavcov a osem druhov vtákov. Drobné cicavce dominovali aj počom jedincov koristi (88,3 %) a aj biomasou (85,1 %). Hrdziak lesný bol hlavnou korisťou (viac ako 40%-ná početnosť), pričom hraboše rodu *Microtus* (27,3 %), drobné spevavce (11,7 %) a piskory (7,5 %) boli dôležitou náhradnou korisťou. Spektrum koristi pôtika tu bolo podobné ako na iných lokalitách v Európe.

**Key words:** boreal owl; diet composition; foraging ecology

**Tomasz Tumieli**, Nature Society “Dubelt”, Juskowy Gród 17, 16-050 Michałowo, Poland

**Paweł Mirski**, Institute of Biology, University of Białystok, Ciołkowskiego 1J, 15-245 Białystok, Poland. E-mail: p.mirski@uwb.edu.pl

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## Introduction

The boreal owl (*Aegolius funereus*) is a regular breeder in Poland, although its distribution is divided between the lowlands in the northern part of the country and the mountains in the south (Domaszewicz et al. 2007). It has favorable conservation status, both in this country as well as in the European Union as a whole. Recently it attracted the attention of a few conservation projects in Poland, but it has rarely been the subject of ecological studies. Although diet studies of most owl species in Poland are quite numerous, so far the boreal owl diet composition has been reported only in the Białowieża Primal Forest (Jędrzejewska & Jędrzejewski 2001). It was found to depend greatly on small mammals (75.3%) and to a lesser extent also on small passerines

(22.6%). Although that study by Jędrzejewska & Jędrzejewski (2001) was not included in the review on boreal owl diet diversity by Korpimäki & Hakkarainen (2012), the general results are to be expected, compared to those from 27 other sites in Europe included in their review. In each of those sites (with one exception) the ratio of small mammals in prey number exceeded 70%, and in a large part of the studies even 90%. However, the proportion of birds very rarely exceed 10%. It should be noticed however that the majority of the surveyed studies were carried out in Scandinavia, the Alps and the Carpathians, while the lowlands of boreal character in Eastern Europe (i.e. in the Baltic States, Poland, Belarus) were not represented at all. Since prey diversity in raptors is expected to increase inversely to

latitude (i.e. Terraube & Arroyo 2011), and probably also inversely to altitude (in accordance with the often elevation-dependent biodiversity gradient; Rahbek 1995), the boreal owl diet may show greater diversity in the lowlands of Eastern Europe. The aim of this study therefore was to fill the gap in the knowledge on boreal owl diet composition in the least-studied part of its European range.

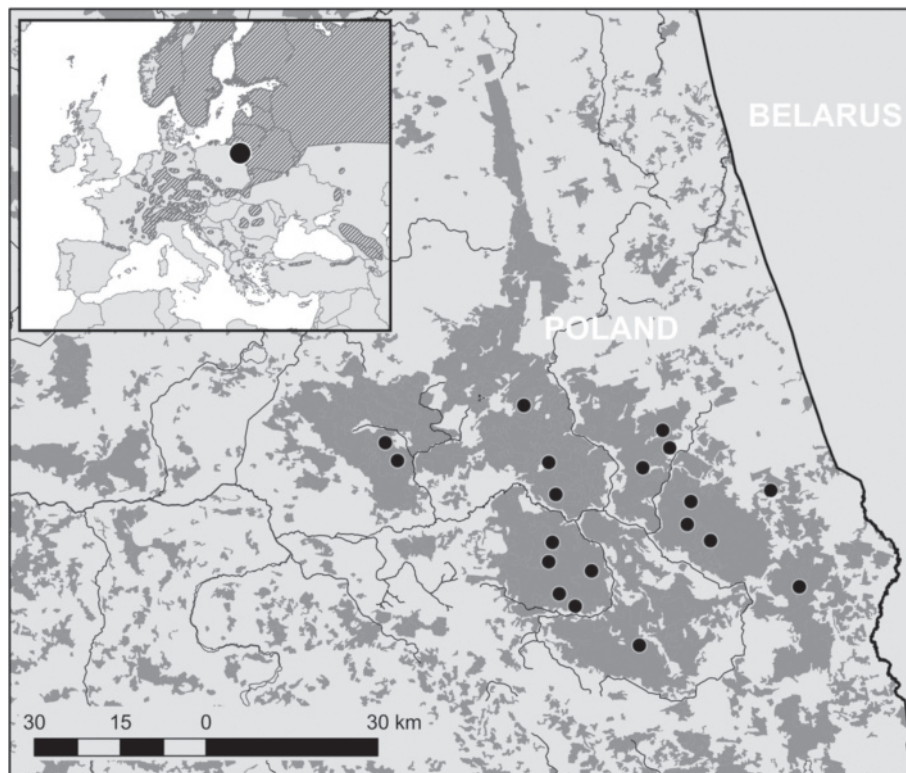
### Material and methods

The study was carried out in the Knyszynska Forest in north-eastern Poland (53.21 N, 23.46 E; Fig. 1). This large forest complex (839 km<sup>2</sup>) is of sub-boreal character and composed mostly of coniferous, mixed and swampy woodland, less frequently deciduous woodland, and also meadows and arable lands of anthropogenic origin. Except for just over 20 protected areas, the greater part of it is managed for timber. The boreal owl population in the Knyszynska Forest was estimated at 100–140 pairs (Tumiel et al. 2013) and can be considered country-important, as Poland is estimated to hold 1200–2400 pairs of this species (Chodkiewicz et al. 2015).

The boreal owl diet was investigated based on examination of pellets collected from tree hollows (by climbing) and underneath, after the hollows were cleaned by other bird species (mostly black woodpecker (*Dryocopus martius*)). Fragmented pellets were also collected, but in this case the whole set from each site was treated as one pellet in order to avoid replication. Material was collected in 2006 and between 2012 and 2016, from February till June. The prey found inside therefore reflects the diet of the winter and spring period. Pellets were collected from tree hollows used as roosts. Breeding was not confirmed in any of them. In most cases the sites were not repeated between study seasons. The habitats around the sites where the pellets were collected consisted in each case of a mature (>100 years old) coniferous stand dominated by pine with admixture of spruce, oak and birch.

We gathered from 6 to 62 pellets per study year and from 4 to 32 pellets per single site.

Pellets were disintegrated in order to extract all the solid material: teeth, bones and beaks. The ones containing only fur were discarded. Prey was identified using keys for the identification of mammals (Pucek 1984)



**Fig. 1.** Boreal owl diet study sites in the Knyszynska Forest (black dots in the larger frame) and the overall location of the study area in the species range (according to IUCN; hatched area in the smaller frame).

**Obr. 1.** Lokality pre štúdium potravy pôtika kapcavého v Knyszynskom lese (čierne body v hlavnej mape) a umiestnenie územia v rámci areálu druhu (podľa IUCN; šrafované v malej mape).

and birds (Brown et al. 1987, Jenni & Winkler 1994). Mammals were identified by teeth and bones, birds by bones, beaks and feathers. Prey was identified to species whenever possible, otherwise it was identified to the highest possible taxon (genus, order). Bone fragments and teeth found in different pellets were treated as separate prey. Biomass was calculated according to data from the forest complex located close by (Jędrzejewska & Jędrzejewski 2001). When it was impossible to identify the prey item to species, the weighted average biomass of items identified within this taxon was used to estimate the biomass for this prey category. A diet range index was calculated (according to Levins 1968) in order to compare our obtained results with other studies on the boreal owl diet gathered in the survey by Korpimäki & Hakkarainen (2012).

## Results and discussion

We collected 178 pellets from 19 different sites and 6 sets of pellet fragments. Each pellet consisted on average of 1.13 prey items, while pellet fragments consisted of 1.83 items. Altogether 213 prey items were found, representing approximately over 4 kg of biomass (Tab.

1). Sixteen different prey taxa were identified at least to genus. Out of this number eight were mammals and another eight were birds. Small mammals dominated in the diet, both in prey number (88.3%) and biomass (85.1%). Small mammals were quite variable, but the most important prey was definitely the bank vole (*Myodes glareolus*). The birds were not numerous, but tits were clearly most often taken. Levins' Index of diet range reached a value of 2.7.

Diet examination of the boreal owl in the Knyszyńska Forest showed that the species forages mostly for small mammals, but the proportion of small birds is also significant, especially in terms of biomass. Since there are no comparable data from other lowland areas in Eastern Europe, this study could be closely compared with the only other dietary study from Poland. The study carried out by Jędrzejewska & Jędrzejewski (2001) in the Białowieża Primal Forest is especially convenient because it was carried out on a similar sample size and only about 60 km south-east from our study site. Their study showed that boreal owls took considerably more birds than in our study. This might be caused by the different habitat characteristics of those

**Tab. 1.** Diet composition of the boreal owl in the Knyszyńska Forest (north-eastern Poland).

**Tab. 1.** Zloženie potravy pŕtka kapcavého v Knyszyńskom lese (severovýchodné Poľsko).

species / druh	No. of individuals / n jedincov	prey number / početnosť koristi (%)	biomass / biomasa (%)
<i>Myodes glareolus</i>	96	45.1	41.6
<i>Microtus agrestis</i>	20	9.4	11.7
<i>Microtus arvalis</i>	11	5.2	5.3
<i>Microtus</i> unidentified / neurčené	27	12.7	14.5
<i>Apodemus flavicollis</i>	2	0.9	1.6
<i>Apodemus sylvaticus</i>	1	0.5	0.5
<i>Sicista betulina</i>	1	0.5	0.2
Rodentia unidentified / neurčené	8	3.8	3.6
<i>Sorex araneus</i>	15	7.0	3.1
<i>Neomys fodiens</i>	1	0.5	0.4
unidentified small mammals / neurčené drobné cicavce	6.0	2.8	2.6
Σ mammals / cicavce	188	88.3	85.1
<i>Parus major</i>	8	3.8	3.7
<i>Cyanistes caeruleus</i>	3	1.4	0.8
<i>Periparus ater</i>	1	0.5	0.3
<i>Fringilla coelebs</i>	2	0.9	1.3
<i>Carduelis spinus</i>	1	0.5	0.4
<i>Sturnus vulgaris</i>	1	0.5	2.0
<i>Troglodytes troglodytes</i>	1	0.5	0.2
<i>Dendrocopos</i> sp.	1	0.5	2.0
unidentified small birds / neurčené drobné vtáky	7	3.3	4.2
Σ birds / vtáky	25	11.7	14.9
Σ	213	100%	4174 g

two study sites: the Knyszyńska Forest is more coniferous, while the woodstands of the Białowieża Primal Forest are more mature and largely deciduous. This difference in stand age and forest type can facilitate larger numbers of birds inhabiting the latter place (Pugacewicz 1997). However in both places the boreal owl prefers pine stands, so the specific local habitat is ultimately more similar than the general character. Another possible explanation is that the two datasets do not cover the same phenological period. The proportion of small bird prey is known to be higher in the winter and in later breeding stages, during late spring and early summer (Korpimäki & Hakkarainen 2012). Our study covered the winter and early spring period, while the one from the Białowieża Primeval Forest covered the spring and summer period, and especially in the latter it is easy to catch the abundant juveniles of various bird species.

The main prey of boreal owls in our study was the bank vole. This fact corresponds to the results of studies from the Białowieża Primal Forest as well as a few Finnish, Swedish and recent Serbian studies (e.g. Sulkava & Sulkava 1971, Rajković 2018). However, in many other sites across Europe the field vole (*Microtus agrestis*) was the main prey, while in this study it was the second most important species. Other important alternative prey was the common shrew (*Sorex araneus*) as well as small birds, mostly tits. Mice *Apodemus* were rarely found in the diet, which could reflect their low incidence rather than avoidance (Zárybnická et al. 2013). Other small mammals were of exceptional occurrence. Overall, diet range fits the lower end of the range of values obtained from other parts of Europe (Korpimäki & Hakkarainen 2012). However, since the sample sizes in the studies reviewed by Korpimäki and Hakkarainen (2012) varied greatly, the data are very hard to compare. Number of prey species is certainly biased in some cases by small sample size, and therefore such comparisons would be more reliable if based on the same number of samples randomly drawn from each compared dataset.

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