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SHORT COMMUNICATION

Effects of a forest landscape on the prey composition of the Common Barn-owl *Tyto alba* in southern Bulgaria

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Abstract

The diet of the Common Barn-owl in a forest- and shrub-dominated hunting area in the Strandzha Mountains, southern Bulgaria, was identified from 516 prey specimens. Shrews (52.9% by number, 26.7% by biomass) and rodents (42.1% N, 71.5% B) were prevalent. Among them, White-toothed shrews, *Criocidura* sp., (45.3% N, 21.4% B) was the most numerous prey genus. Mice, *Apodemus* sp., (15.7% N, 29% B) contributed with the largest share to the food biomass due to high predation of Striped field mice, *A. agrarius*, (12.2% B). The proportions of forest species in diet (*Apodemus* sp, *Sorex* sp., and dormice Gliridae) increased with the higher proportion of forest habitats (forests and shrublands cover more than 25% of the area) in most Barn Owl hunting territories in southern Bulgaria.

Keywords

diet variations, food spectrum, opportunistic predator, pellet analysis, small mammals, Strandzha Mountains.

Introduction

Diet studies enrich our knowledge of the spatio-temporal relationships between predators and their prey and the adaptive capabilities of their populations to the increasingly changing habitats by human activities. The Common Barn-owl, *Tyto*

alba, depends heavily on buildings and other man-made structures for nesting sites and on a variety of open habitats for hunting in most of its wide range. The species typically inhabits agricultural landscapes where it hunts mostly small mammals such as rodents and shrews (Taylor 1994; Scherzinger and Mebs 2020). Local variations in diet usually correspond to the composition of small-mammal communities in a hunting territory and follow the fluctuations of availability and accessibility of prey populations (Tores et al. 2005; Miltschev and Georgiev 2009; Bernard et al. 2010; Paspali et al. 2013; Horváth et al. 2018, 2020; Milana et al. 2019; Szép et al. 2019; Romano et al. 2020). Therefore, Common Barn-owls are important regulators of populations of mammalian agricultural pests (Wood and Fee 2003; Peleg et al. 2018). The diet reliably mirrors the status of small mammal communities, even indicating the presence of populations of sparse and difficult-to-find species (Milchev 2012; Torre et al. 2015; Veselovský et al. 2017; Horváth et al. 2019; Kiamos et al. 2019; Stefke and Landler 2020).

Voles, *Microtus* sp., typical mice, *Mus* sp., and white-toothed shrews, *Crocidura* sp., were the most important prey, each with variable proportions in Common Barn-owl diets in the predominantly agricultural and suburban landscapes of southern Bulgaria (Miltschev et al. 2004; Milchev 2015). However, breeding sites and diets of Common Barn-owls were previously unknown in the forested part of that region, including the Strandzha Mountains (Golemanski 2015).

The present paper investigates Common Barn-owl diets for: i) differences attributable to the predominance of woodlands and scrublands around the breeding site in the Strandzha Mountains; and ii) comparisons with diets in other hunting territories richer in woodlands and shrublands within agricultural and suburban landscapes of southern Bulgaria.

Material and methods

Pellets were collected in an attic of a two-storey building in the village of Brodilovo (42°05'16"N; 27°51'27"E; 40 m a.s.l.), SE Bulgaria, on 8th July 2020. Common Barn-owls could fly into the attic only during the warm half of the year, when the windows on the uninhabited second floor were constantly open. A Common Barn-owl pair has bred in the eaves of the same building for at least three years (G. Lomski, pers. com.). The village is situated at the foot of the highest peak of the Strandzha Mountains (502 m a.s.l.) along the Bulgarian Black Sea coast, set among spacious deciduous forests dominated by oaks *Quercus* sp. Open habitats consist of margins up to several hundred meters wide along the Veleka River. These corridors are mainly abandoned farmlands, currently used in part for cattle grazing. The river periodically floods the riparian forests and adjacent open habitats. Natura 2000 zones SCI BG0001007 and SPA BG0002040 cover the study area.

The identification of prey and the minimum number of individuals (MNI) were based mainly on the skull, lower jaw and pelvis for mammals (Peshev et al. 2004), and

on the bones of girdles and limbs for birds. Head capsules, mandibles and ovipositors were used to identify insects and their MNI. The comparative collections of the National Museum of Natural History in Sofia were referenced to identify prey birds and insects to the species level. Collections from this study were also deposited at the National Museum. Because the identifications for the species pairs *Apodemus sylvaticus – A. flavicollis* and *Microtus arvalis – M. levis* are difficult, individuals of these species are listed as wood mice, *Apodemus* spp., and voles, *Microtus* spp., respectively. Biomass was calculated after Glutz von Blotzheim and Bauer (1994) and Peshev et al. (2004). Food niche breadth (FNB) was calculated: $FNB = 1/\Sigma\ pi^2$, where pi is the proportion of prey category i by number in the diet (Levins 1968). Wider values of food niche breadth indicate a higher dietary diversity. To obtain results comparable to those of Miltschev et al. (2004), mammals were classified to genera, while birds and insects were classified to their taxonomic class.

The diet studied here was compared with Common Barn-owl diets in four breeding sites (Miltschev et al. 2004, Milchev 2015) known to have more than 25% woodland and shrublands within a 1-km radius from an owl nest as the main owl's hunting territory (Taylor 1994). Small mammal species with preferences for woodland and shrublands, and wetland habitats (Peshev et al. 2004; Chassovnikarova et al. 2005) were classified into two functional prey groups, respectively. The correlation between the habitat characteristics of the hunting territories and the proportions of abundant prey and functional prey groups in the diets and the characteristics of the hunting territories were calculated using the Pearson product-moment correlation coefficient with arcsine-transformed data. The significance level was $P < 0.05$.

Results

Shrews (52.9% by number (N), 26.7% by biomass (B)) and rodents (42.1% N, 71.5% B) were the main prey of Common Barn-owls in studied site (Table 1). Out of them, the Lesser white-toothed shrew, *Crocidura suaveolens*, (39.7% N, 17% B) was the most frequently caught prey. No other prey species among the other 27 prey taxa exceeded 9% by total prey number. Bats, passerines and grasshoppers formed a negligible part on diet (5.0% N, 1.8% B). Heavier prey such as voles, *Microtus* spp., (17.8% B), wood mice (16.8% B) and Striped field mice, *Apodemus agrarius*, (12.2% B) contributed considerably to the food biomass. The two species of typical mice, *Mus* sp., (9.3% N, 12.2% B) were not among the most important prey, with their shares comparable to wetland inhabitants (*Neomys anomalus*, *Micromys minutus* and *Arvicola amphibius*) which collectively totaled 12.2% N, 9.3% B.

Woodland and shrubland habitats amid the more heavily forested hunting territories in southern Bulgaria had significantly high proportions of their main inhabitants (*Apodemus* sp, *Sorex* sp. and dormice Gliridae) in Common Barn-owl diets ($r = 0.918$, $t = 4.009$, $df = 3$, $P < 0.05$; Table 2). Species characteristic of hunting

Table 1. Prey of Common Barn-owls *Tyto alba* in the Strandzha Mountains, SE Bulgaria: N – number of specimens; % N - % by number; % B - % by biomass.

Prey	N	%N	%B
Sorex minutus	3	0.6	0.2
Neomys anomalus	35	6.8	5.1
Crocidura leucodon	29	5.6	4.4
Crocidura suaveolens	205	39.7	17.0
Suncus etruscus	1	0.2	0.02
Myotis emarginatus	1	0.2	0.2
Plecotus austriacus	1	0.2	0.1
Pipistrellus pipistrellus/pygmaeus	1	0.2	0.1
Dryomis nitedula	1	0.2	0.4
Glis glis	1	0.2	0.9
Micromys minutus	29	5.6	3.3
Apodemus agrarius	37	7.2	12.2
Apodemus spp.	44	8.5	16.8
Rattus rattus	1	0.2	1.1
Mus musculus	35	6.8	8.9
Mus macedonicus	7	1.4	1.8
Mus musculus/macedonicus	6	1.2	1.5
Arvicola amphibius	1	0.2	0.9
Microtus spp.	45	8.7	17.8
Microtus hartingi	7	1.4	4.6
Microtus subterraneus	3	0.6	1.2
Mammalia subtotal	493	95.5	98.5
Curruca nisoria	1	0.2	0.3
Curruca sp.	1	0.2	0.2
Emberiza cirlus	1	0.2	0.3
Passeriformes indeterminate	1	0.2	0.3
Aves subtotal	4	0.8	1.1
Decticus albifrons	14	2.7	0.4
Platycleis cf. *escalerai*	2	0.4	0.01
Platycleis affinis	2	0.4	0.01
Gryllus campestris	1	0.2	0.01
Insecta subtotal	19	3.7	0.4
Total number of prey items or total biomass (g)	516		7583.1

Table 2. Habitat and diet characteristics (% by number) of breeding Common Barn-owls in five hunting territories richer in woodland and scrubland in South Bulgaria.

Characteristics		Two territories (Miltschev et al. 2004)		Two territories (Milchev 2015)		Present study
Habitat cover (%) around the owl's nest	Wood-shrub	25.8	29.1	27.4	39.3	50.2
	Open	24.5	66.7	66.4	35.8	36.7
	Urban	29.1	2.5	5.3	10.5	10.5
	Wetland	20.6	1.7	0.9	14.5	2.6
Abundant prey taxa	*Crocidura* sp.	22.5	55.8	25.2	58.9	45.3
	Microtus sp.	35.1	21.6	46.3	18.0	10.7
	Mus sp.	16.3	10.7	13.8	6.9	9.3
	Apodemus sp.	6.8	6.1	8.9	9.6	15.7
Inhabitants of mainly forest and shrubs	*Apodemus* sp., *Sorex* sp. and Gliridae	6.9	6.4	9.0	9.7	16.7
Wetland inhabitants	*Neomys*, *Micromys* and *Arvicola*	14.9	2.7	3.0	4.5	12.6
Total prey number		1675	1489	2942	1930	516
Food niche breath		4.68	2.67	3.31	2.57	3.85

territories in other habitat were insignificant in their share of respective different prey categories.

Discussion

The prevalence of woodland and shrublands around the breeding site of a nesting pair of Common Barn-owls in the Strandzha Mountains has, as expected, affected its diet. The list of prey species is in accordance with the previous Barn Owl diet studies in southern Bulgaria (Simeonov et al. 1981; Miltschev et al. 2004). The food niche is wide, but falls within the known values (FNB 3.14 ± 0.79, range 2.1 – 5.81, n = 20 localities, Miltschev et al. 2004). However, the diet composition for woodland/shrubland habitat shows several specific features. For the first time, the mice, *Apodemus* sp., was the second-most numerous prey and had the largest contribution to the food biomass of the Common Barn-owl diet in southern Bulgaria. This result is mainly due to the high predation on Striped field mice in comparison with previous studies (Miltschev et al. 2004; Milchev 2015). The spotty distribution of this rodent in the Bulgarian lowlands is associated with humid habitats with sparse trees and shrubs, where its populations are usually quite numerous (Peshev et al. 2004). Chassovnikarova et al. (2005) reported the Striped field mouse as the second most abundant small mammal after the wood mice in the humid riverine forest and shrubs near the mouth of the

Veleka River, about 10 km from the present study site. However, the species avoided the abandoned arable land around the riparian forests there (Chassovnikarova et al. 2005). Common Barn-owl avoids dense forests and shrublands for hunting (Taylor 1994; Scherzinger and Mebs 2020), but it appears that the ecotonic zone transitioning to open habitats was more intensively used.

Only four other Common Barn-owl diets in hunting territories with more than 25% forest area have been studied in southern Bulgaria, but they were situated in agricultural and suburban landscapes (Miltschev et al. 2004; Milchev 2015). The proportions of the other major habitats in these hunting territories varied greatly without corresponding significant differences in the diet structure. However, the area of forests and shrublands in these localities positively correlates with the dietary share of small mammals inhabiting them (*Apodemus* sp, *Sorex* sp. and dormice Gliridae) in owl diets. Common Barn-owl hunts in a variety of open areas (Taylor 1994; Scherzinger and Mebs 2020) and the smaller forest stands in the hunting territory did not significantly affect dietary structure of Common Barn-owls in previous studies (Miltschev et al. 2004; Milchev 2015).

A larger share of wetlands in the hunting territories significantly determines Common Barn-owl diets in southern Bulgaria as evidenced by increased predation on wetland inhabitants (*Neomys anomalus*, *Micromys minutus* and *Arvicola amphibius*) and resulting widening of the food niche (Miltschev et al. 2004; Milchev 2015). The Common Barn-owl diet presented here is an exception to this pattern due to the relatively small area of permanent wetlands and the disproportionately high hunting of wetland inhabitants. This finding could be an indication of large populations of wetland inhabitants, but also that owls hunted more intensively in wetlands as the area of normally preferred open habitats was limited. The lack of data on the populations of small mammals in the area and in its diverse microhabitats did not permit assessing how selectively the owls hunted. The study suggested the plastic hunting strategy of Common Barn-owl as an opportunistic generalist (Bernard et al. 2010; Veselovský et al. 2017; Saufi et al. 2020), allowing it to inhabit a remarkable variety of different habitats combinations in southern Bulgaria.

Conclusion

The dominance of forest and shrub habitats in the main hunting territory of Common Barn-owls has mostly affected the dominance structure of the owl diet. Wood mice and Striped field mice dominated with the largest contribution to food biomass. These mostly forest inhabitants displaced voles *Microtus* sp., typical mice and white-toothed shrews, which normally dominated food biomass in localities among the open agricultural and suburban landscape. The share of forest habitats in most Barn Owl hunting territories in southern Bulgaria where forests and shrublands cover more than 25% of their area corresponded positively with the proportions of mostly forest species (*Apodemus* sp, *Sorex* sp. and dormice Gliridae) in owl diets.

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