



Small mammals of the Rembertów Military Training Area based on avian predators pellets analysis

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Abstract: The aim of the research was to assess small mammal diversity in the Rembertów Military Training Area, with particular attention to species rarely detected in central Poland. The study site covers around 7,500 ha. The landscape was highly diverse but dominated by forests. Altogether, in pellets of tawny owl, long-eared owl and common buzzard, we found remnants of 559 mammals from 16 species. Voles *Microtus* spp. were the most numerous (above 53% of prey). Among the *Apodemus* genus, yellow-necked mouse dominated (13.4%). Soricomorphs were represented by four species: common shrew, pygmy shrew, water shrew, and mole, all of which constituted 9.8% of prey. Among rare species we detected: water vole (1 individual), pine vole (2 individuals) and water shrew (2 individuals).

Key words: mammals, pellets, central Poland, tawny owl diet, long-eared owl diet, common buzzard diet

INTRODUCTION

Analyses of avian predators pellets can offer an effective source of data on the diversity, abundances, and local distributions of small mammals (Yalden & Morris 1990, Clark & Bunck 1991, Moreno & Barbosa 1992, Gryz et al. 2008, Lesiński et al. 2008, Żmihorski et al. 2011). The small mammal community of Warsaw agglomeration and surrounding area was precisely described in recent decades (Gryz et al. 2008, Lesiński & Gryz 2008, 2012, Lesiński et al. 2013, Gryz et al. 2017). The exception is Rembertow Military Training Area, situated east of Warsaw. Data on small mammal diversity in this region are limited and documented some decades ago (Lesiński et al. 2016). Especially worth studying is the presence of the northern birch mouse *Sicista betulina* (Pallas, 1779). This species was detected in the area in 1997, and this is the only current information about this species from central Poland (Lesiński et al. 1998, Lesiński & Gryz 2008). The aim of the research was to assess small mammal diversity in the study area, with special attention to species rarely detected in central Poland.

STUDY AREA AND METHODS

The study was conducted on the central part of the Rembertów Military Training Area, which covers around 7500 ha. From the west, the area bordered Warsaw. From the south, it bordered Voivodship Road no. 637. Otherwise, it was surrounded by agricultural areas and scattered development. This place was established in the XIX century for artillery training. The landscape is highly diverse but dominated by forests. Most were planted on the dunes, marshes, and heathland after World War II. Only a small part of stands are older than 80 years. Forests are pine *Pinus silvestris* L. dominated with an admixture of oaks *Quercus* spp. and birches *Betula* spp. In peatland and along the watercourses, black alder *Alnus glutinosa* (L.) Gaertn. stands occur. In the central part of the study area, the valley of Długa River is located. It is a small river surrounded by sedge meadows, reeds, and willows *Salix* spp. bushes. Some areas are

permanently used by the army, where barracks, shooting ranges, military research institutes, and other infrastructure are present. Two reserves and one Natura 2000 site were established in the study area. Access to the study area is restricted, and special permission is required for entrance. According to the Atlas of Polish Mammals (www.iop.krakow.pl/ssaki), pellet collecting sites were situated within 15Ib and 15Ic squares.

Fieldwork was done in 2024. During this time, we looked for places where raptor pellets could be found. We localized five such sites in the central part of the study area. Three of them were close to a high voltage line crosscutting a forest complex from north to south. It is a treeless area dominated by grassland and heathland, growing on the 2,500 m long and 35 m wide belt which surround voltage poles. In this landscape, we found pellets of the common buzzard *Buteo buteo* (Linnaeus, 1758) and long-eared owl *Asio otus* (Linnaeus, 1758); the third site of pellet collection could not be assigned to a particular species. Mostly, we found there only bones mixed with old leaves and grasses. Other materials like hair and feathers were largely decomposed. All pellets collected on these three sites probably represented the winter diet of the avian predators. Two other places of pellet collection were localized in the vicinity of the Długa River valley close to the east border of Mosty Kaleńskie Reserve. Pellets of the common buzzard were collected near the nest; therefore, they came from the breeding season. Pellets of the tawny owl *Strix aluco* Linnaeus, 1758, were probably accumulated for a long time and represented all seasons.

The pellet analysis followed standard procedures (Raczyński & Ruprecht 1974, Yalden & Morris 1990, Gryz & Krauze 2007). Pellets were soaked in water for 12 hours and then processed by separating fractions into bones, hides, feathers, and invertebrates. The number of mammals was established by reference to the maximal number of right and left mandible bones. The number of birds reflected the skulls or sterna counted. Pelvic bones were taken into account in the case of frogs. Bone fragments of mammals were identified using the key from Pucek (1981) or more detailed studies (Ruprecht 1979). The comparative collections of the Department of Forest Zoology and Wildlife Management at Warsaw University of Life Sciences (SGGW) were also used to identify remains. If the state of preservation was too poor to allow species to be identified, the identification of remains was attempted at the lowest possible taxonomic rank. Dietary composition refers to the percentage shares accounted for by specimens of given taxa as set against the total number of all identified mammals. Data about other prey (birds, amphibians, reptiles, and insects) were also added to the table but excluded from further analysis.

RESULTS

In pellets of long-eared owls, we found remnants of 141 mammals. Among them, the common vole *Microtus arvalis* was the most numerous and constituted 48.9% of all identified mammals. Other voles species, root vole *Microtus oeconomus* and short-tailed vole *Microtus agrestis*, had smaller shares, 22.0% and 5.0%, respectively. Altogether, with voles unidentified to species level, rodents from this genus constituted 91.5% of mammals found in pellets (Table 1).

In the case of the tawny owl diet (281 mammals), voles were also frequently identified, and the share of prey from this genus reached almost 40%. Tawny owls also hunted on typically forest rodents like yellow-necked mouse *Apodemus flavicollis* (23.5%) and bank vole *Myodes glareolus* (13.2%). A relatively high share (5.7%) of harvest mouse *Micromys minutus*, among tawny owl prey, should also be highlighted. Only in pellets of this species, we found bones of the water vole *Arvicola amphibius* (1 individual), pine vole *Microtus subterraneus* (2 individuals), and water shrew *Neomys fodiens* (2 individuals).

Pellets of buzzard (96 mammals) contained mainly remnants of common vole (22.9%) and mole *Talpa europaea* (18.8%).

Among material not assigned to a particular raptor, mice from the *Apodemus* genus constituted 70.7% of identified mammals (N=41).

Altogether, in pellets of at least three species of avian predators, we found remnants of 559 mammals from 16 species. Voles *Microtus* spp. were the most numerous (above 53% of prey). Among the *Apodemus* genus, yellow-necked mouse dominated (13.4%). Soricomorphs were represented by four species: common shrew *Sorex araneus*, pygmy shrew *Sorex minutus*, water shrew, and European mole, all of which constituted 9.8% of prey (Table 1).

Table 1. Diet composition of three species of avian predators inhabiting the study area

No.	Prey	<i>Asio otus</i>		<i>Strix aluco</i>		<i>Buteo buteo</i>		Unident.		Total	
		N	%	N	%	N	%	N	%	N	%
1.	<i>Microtus arvalis</i> (Pallas, 1779)	69	48.9	18	6.4	22	22.9	1	2.4	110	19.7
2.	<i>Microtus oeconomus</i> (Pallas, 1776)	31	22.0	46	16.4	9	9.4	6	14.6	92	16.5
3.	<i>Microtus agrestis</i> (Linnaeus, 1761)	7	5.0	34	12.1	1	1.0		0.0	42	7.5
4.	<i>Microtus subterraneus</i> (de Selys-Longchamps, 1836)		0.0	2	0.7		0.0		0.0	2	0.4
-.	<i>Microtus</i> spp.	22	15.6	11	3.9	19	19.8	5	12.2	57	10.2
	Σ <i>Microtus</i>	129	91.5	111	39.5	51	53.1	8	19.5	299	53.5
5.	<i>Myodes glareolus</i> (Schreber, 1870)	2	1.4	37	13.2	3	3.1		0.0	42	7.5
6.	<i>Arvicola amphibius</i> (Linnaeus, 1758)		0.0	1	0.4		0.0		0.0	1	0.2
7.	<i>Apodemus agrarius</i> (Pallas, 1771)	4	2.8	23	8.2	6	6.3	12	29.3	45	8.1
8.	<i>Apodemus flavicollis</i> (Melchior, 1834)		0.0	66	23.5	1	1.0	8	19.5	75	13.4
9.	<i>Apodemus sylvaticus</i> (Linnaeus, 1758)	1	0.7	1	0.4		0.0		0.0	2	0.4
-.	<i>Apodemus</i> spp.	2	1.4	5	1.8	6	6.3	9	22.0	22	3.9
10.	<i>Micromys minutus</i> (Pallas, 1771)		0.0	16	5.7		0.0		0.0	16	2.9
11.	<i>Sciurus vulgaris</i> Linnaeus, 1758		0.0		0.0	1	1.0		0.0	1	0.2
12.	<i>Sorex araneus</i> Linnaeus, 1758	3	2.1	9	3.2	9	9.4	4	9.8	25	4.5
13.	<i>Sorex minutus</i> Linnaeus, 1766		0.0	3	1.1	1	1.0		0.0	4	0.7
14.	<i>Neomys fodiens</i> (Pennant, 1771)		0.0	2	0.7		0.0		0.0	2	0.4
15.	<i>Talpa europaea</i> Linnaeus, 1758		0.0	6	2.1	18	18.8		0.0	24	4.3
-.	<i>Mustela</i> sp.		0.0	1	0.4		0.0		0.0	1	0.2
	Σ Mammalia	141	100.0	281	100.0	96	100.0	41	100.0	559	100.0
	Aves	1		3		4		3			
	Reptilia					1					
	Amphibia							1			
	Insecta			2				1			

DISCUSSION

Our study revealed only 16 mammal species in the surveyed area. This result is not high compared to other places in central Poland (Gryz et al. 2008, Lesiński et al. 2013, 2016). First, we found no bat remnants in the collected pellets. This has a strong impact on the total number of detected species. For example, research based on the same methodology revealed nine bat species in Kampinos National Park (Lesiński et al. 2013) and four in Warsaw (Gryz et al. 2008). Previously conducted pellet analysis collected in our study area documented the presence of four bat species (Lesiński et al. 2016). The absence of bats in our results should be related to the fact that most of the owl pellets came from the winter period. This case can also make it impossible to detect Northern birch mouse and hazel dormouse *Muscardinus avellanarius* (Linnaeus, 1758), as these species hibernate from autumn to spring. The presence of the last species was confirmed in Mazovian Landscape Park (Lesiński et al. 2016), around 20 km south of our pellets collecting sites. Our study area was heavily deforested in the XIX century. As a result, this typically forest rodent is probably not present in the Rembertów Military Training Area. The lack of synanthropic rodents: *Rattus norvegicus* (Berkenhout, 1769) and *Mus musculus* Linnaeus, 1758, results from the fact that we found pellets in areas located far from human settlements and other

buildings. Our results revealed the presence of water shrew, water vole, and pine vole, species rarely detected in this part of Mazovia (Gryz et al. 2008, Lesiński et al. 2013, Gryz et al. 2017). The last two species were not previously reported in the study area (Lesiński et al. 2016). We documented a high percentage share of voles *Microtus* spp., which is not typical for big forest complexes. Most of the common voles were probably captured outside the study area on nearby arable lands. In the case of the root vole, optimal habitats for this species constitute vast open meadows and sedgeland located along the Długa River. Our study area turned out to be an important refuge for the short-tailed voles. The share of this rodent exceeded 7% among all detected mammals. Forest complexes disturbed by army activity and clearcut logging may pose a high-quality environment for this species. Apart from man-made open spaces in the forest, there are also many natural or semi-natural open habitats like heathlands and swamps.

The previous studies in the study area documented the domination of bank voles and *Apodemus* mice in small mammal communities (Lesiński et al. 2016). In contrast, our study revealed the domination of *Microtus* spp. It is difficult to compare our data directly with the previous one. The current study is based on pellets of at least three different species of avian predators, while the previous focused only on tawny owl food composition. Pellets were also collected in different places within the study area, mostly during different seasons than our study.

To conclude, Rembertów Military Training Area has a diverse small mammal community with a reflected landscape structure. For several species (e.g., water shrew, water vole, pine vole, short-tailed vole), this site constitutes an important refuge in the highly transformed landscape of the Warsaw vicinity. This forest complex deserves protection and further detailed faunistic studies. The nature of this area is threatened by the dropping water level, dynamic urbanization in its vicinity, and highway and other road infrastructure construction plans.

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STRESZCZENIE

[Drobne ssaki Poligonu Rembertowskiego na podstawie analizy wypluwek ptaków drapieżnych]

Badania prowadzono na terenie poligonu wojskowego, obejmującego kompleks leśny o powierzchni około 7500 ha. Celem badań była inwentaryzacja jakościowa zgrupowania drobnych ssaków. Prace oparto o standardowe procedury polegające na analizie wypluwek drapieżnych ptaków. Zebrano wypluwki puszczyka, uszatki i myszołowa. Na podstawie wyizolowanych szczątków kostnych oznaczono 582 osobniki należące do 16 gatunków. Dominowały gryzonie z rodzaju *Microtus* stanowiące łącznie ponad 50% zidentyfikowanych ssaków. Istotny udział miała również mysz leśna (12,9%), mysz polna (7,7%) oraz nornica ruda (7,2%). Wykryto również szereg gatunków rzadko spotykanych w środkowej Polsce: rzęsorek rzeczek, karczownik ziemnowodny, darniówka. Teren badań okazał się również istotną ostoją nornika burego. Nie wykryto obecności smużki, notowanej na tym terenie w latach 90-tych XX wieku, ani orzesznicy. W skali regionalnej poligon rembertowski stanowi istotną ostoję dla wielu gatunków drobnych ssaków i zasługuje na objęcie ochroną np. w formie parku krajobrazowego.

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