



Small mammals of the Góra Świętej Anny Landscape Park (south-western Poland) in the diet of two owl species

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Abstract: The knowledge about small mammals of the Góra Świętej Anny Landscape Park is lacking. Here I provide data about diversity of small mammals identified from the pellets of the two owl species: the tawny owl *Strix aluco* and the barn owl *Tyto alba*. Pellets derived from 1999–2024. The material was collected at two breeding sites of the barn owl and at 5 sites of regular occurrence of tawny owl. In total, 1549 prey items have been identified: 1433 prey consumed by the barn owl, and 116 prey consumed by the tawny owl. 18 mammal species were identified: 5 species of Soricomorpha, 1 Chiroptera and 12 Rodentia. Rodents were the most important prey group for both owl species. Depending on owl species, the most numerous prey species were *Microtus arvalis* and *Mus musculus* for the barn owl, and *Apodemus flavicollis* together with *Clethrionomys glareolus* for the tawny owl. The results are the first detail data about diversity of small mammals in the the Góra Świętej Anny Landscape Park and one of the few in whole Opole Voivodeship.

Key words: Soricomorpha, Chiroptera, Rodentia, owl diet, owl pellets, Opole Region, Park Krajobrazowy Góra Św. Anny

INTRODUCTION

An analysis of the contents of owl pellets provides valuable faunal information about the distribution of prey, especially mammals (Lesiński & Gryz 2008, Żmihorski et al. 2012, Lesiński et al. 2013, Lesiński & Błachowski 2023, Lesiński & Kmiecik 2023). As long as a large amount of material is analysed (Żmihorski et al. 2011), samples collected from the pellets are a good indicator of the species composition and numerical relationships between the fauna of small mammals in a given area. The pellet method is a frequent, and sometimes even the sole, source of information about the state of local fauna of small mammals. Very frequently, a pellet analysis is used to characterise communities of small mammals, even in large areas, such as national parks (Zawadzka & Zawadzki 2007), landscape parks (Romanowski et al. 2014, Lesiński et al. 2016a, 2016b) or large forests complexes (Żmihorski & Osojca 2006).

The Góra Św. Anny Landscape Park is one of three landscape parks located in the Opole Voivodeship. Although it was established as early as in 1988, its fauna of small mammals has not been characterised to date. Apart from a list of mammals included in a monograph about the Góra Św. Anny Landscape Park (Kubok 1998), which does not provide a source of this list and record details, such as: dates, or localities, there is only minor publication about the distribution of bats (Hebda 2001).

The aim of this article is to fill the aforementioned gap in knowledge about the natural assets of the Góra Św. Anny Landscape Park and to characterise the complex of small mammals inhabiting the area based on an analysis of owl pellets.

MATERIAL AND METHODS

The Góra Św. Anny Landscape Park (Fig. 1) was established on 26 May 1988. It is one of three landscape parks in the Opole Voivodeship, alongside the Góry Opawskie and Stobrawski Landscape Parks. It spans an area of 5051 ha. A buffer zone surrounding the park has been created, which spans an additional 6275 ha.

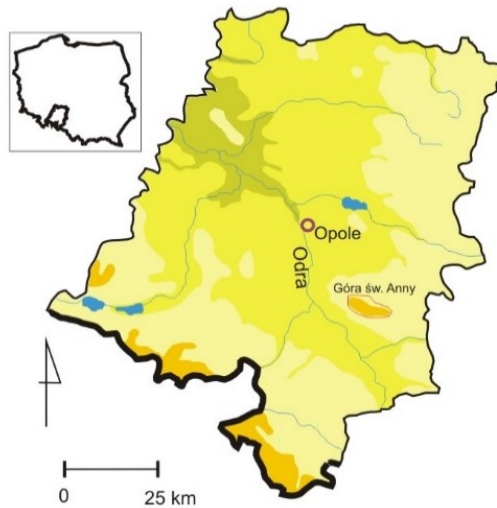


Fig. 1. Maps of the study area: top – Poland with the Opole Voivodeship; right - Opole Voivodeship with the Góra Św. Anny Landscape Park (marked with red thin line).

The Góra Św. Anny Landscape Park is located in the macroregion Silesian-Kraków Highlands within the Chełm mesoregion. The highest peak of the Chełm Range is Góra Św. Anny, at 404 m a.s.l. The surface water network is very poor, as is typical of karst areas, with only two major watercourses: Cedruń and Łącka Woda. Forests make up about 2700 ha (landscape park and buffer zone) and are very diverse in terms of forest habitats. The largest part of Park is made up of deciduous and mixed forest. Coniferous forest habitats constitute a minor part in the Park, in contrast to the buffer zone, where there are no highland habitats, while coniferous forests account for a vast majority of the habitats. The area of the park is dominated by farmland, about 70%, whereas forests cover about 20% of its area (Dubel 1998).

Owl pellets were collected at 7 localities: 2 breeding sites of the barn owl *Tyto alba* and 5 places of regular occurrence, including breeding sites of the tawny owl *Strix aluco*. General characteristics of localities is presented in Table 1. The pellets derived from 1999–2024.

Table 1. General characteristics of localities where pellets were collected in the Góra Św. Anny Landscape Park. Squares according to Polish Atlas of Mammals (PAM) (Okarma et al. 2023).

No.	Locality name [square PAM]	Geographic coordinates of pellet collection sites	General characteristics of locality; [years of study]
1.	Jasiona [09Ng]	50.465°N, 18.100°E	<i>Tyto alba</i> . Church in the village. [1999-2000]
2.	Wysoka [09Nh]	50.474°N, 18.172°E	<i>Tyto alba</i> . Church in the village. [1999]
3.	Góra Św. Anny [09Nh]	50.451°N, 18.174°E	<i>Strix aluco</i> . Nest-box in the forest, c. 60 m from its edge. [1998, 2021]
4.	Góra Św. Anny [09NG]	50.453°N, 18.160°E	<i>Strix aluco</i> . Ruins of building in the forest, c. 200 m from its edge. [1999-2000]
5.	Jasiona [09Ng]	50.455°N, 18.104°E	<i>Strix aluco</i> . Nest-box in the forest, c. 200 m from its edge. [2016, 2018]
6.	Żyrowa [09Ng]	50.452°N, 18.131°E	<i>Strix aluco</i> . Nest box in the village park. [2022]
7.	Żyrowa [09Ng]	50.443°N, 18.119°E	<i>Strix aluco</i> . Nest-box in the forest, c. 100 m from its edge. [2018, 2024]

The material was analysed according to the standard method of dry dissection. For prey identification, only characteristic skeleton elements were used: skulls and long bones (humerus of *Talpa europaea*). Identification to the species level of mammals was based on a key for mammal determination (Pucek 1984) and a reference paper for the *Sylvaemus* subgenus (Ruprecht 1979).

RESULTS

In total, 1549 prey specimen have been identified, including 1433 from *Tyto alba* pellets and 116 from *Strix aluco* pellets (Table 2). Overall, 18 mammal species were found from the orders: Soricomorpha, Chiroptera and Rodentia. Each of the 18 species were caught by *T. alba*, and 13 species by *S. aluco*. Depending on the owl species, the most hunted mammals were: *Microtus arvalis* and *Mus musculus* (47.8% and 9.4% of total prey consumed, respectively) with regard to *T. alba* prey, and *Apodemus flavicollis* and *Clethrionomys glareolus* with respect to *Strix aluco* prey (26.7% and 18.1%, respectively). Relatively more frequently hunted species, with more than a 5.0% share in the diet of each owl species, were also for *T. alba*: *Sorex araneus* (7.8%) and *Apodemus agrarius* (7.7%), and for *S. aluco*: *A. agrarius* (14.7%), *M. arvalis* (10.3%) and *Apodemus sylvaticus* (5.2%). Statistically significant differences in the share of a given species in the diet with $p < 0.001$ between the two owl species were only observed for *C. glareolus*, *M. arvalis* and *A. flavicollis*. For both owl species, rodents were the most important group of prey: 89.3% for *T. alba* and 94.0% for *S. aluco*.

Table 2. The number of prey caught by *Tyto alba* and *Strix aluco* at seven localities in the Góra Św. Anny Landscape Park; statistical significance of the difference in the share of a given mammal species in the diet of two owl species tested with the chi-squared test: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

No.	Species	<i>Tyto alba</i>			<i>Strix aluco</i>					Statistical significance	
		1	2	%	3	4	5	6	7		%
1.	<i>Talpa europaea</i> Linnaeus, 1758	1	1	0.1		1					0.9
2.	<i>Sorex minutus</i> Linnaeus, 1766	25		1.7							0.0
3.	<i>Sorex araneus</i> Linnaeus, 1758	105	7	7.8	2		1		1		3.4
4.	<i>Neomys fodiens</i> (Pennant, 1771)	6		0.4							0.0
5.	<i>Crocidura suaveolens</i> (Pallas, 1811)	8		0.6	1			1			1.7
	Σ Soricomorpha	145	8	10.7	3	1	1	1	1	1	6.0
6.	<i>Eptesicus serotinus</i> (Schreber, 1774)	1		0.1							0.0
	Σ Chiroptera	1	0	0.1	0	0	0	0	0	0	0.0
7.	<i>Clethrionomys glareolus</i> (Schreber, 1860)	24		1.7	2	4	7		8		18.1
8.	<i>Arvicola amphibius</i> (Linnaeus, 1758)	34	1	2.4							0.0
9.	<i>Microtus arvalis</i> (Pallas, 1779)	482	203	47.8	3	6			3		10.3
10.	<i>Microtus agrestis</i> (Linnaeus, 1758)	30	1	2.2				1	1		1.7
11.	<i>Microtus subterraneus</i> (de Selys-Longchamps, 1836)	19	1	1.4	2	1					2.6
	- <i>Microtus sp.</i>	52	11	4.4							0.0
12.	<i>Rattus norvegicus</i> (Berkenhout, 1769)	22	1	1.6							0.0
13.	<i>Mus musculus</i> Linnaeus, 1758	123	12	9.4	3	1			1		4.3
14.	<i>Apodemus agrarius</i> (Pallas, 1771)	92	19	7.7	5	5	2	3	2		14.7
15.	<i>Apodemus flavicollis</i> (Melchior, 1834)	57	3	4.2	4	7	6	2	12		26.7
16.	<i>Apodemus sylvaticus</i> (Linnaeus, 1758)	44	2	3.2		1	1		4		5.2
	- <i>Apodemus sp.</i>	26	14	2.8		4			4		6.9
17.	<i>Micromys minutus</i> (Pallas, 1771)	3		0.2		1			1		1.7
18.	<i>Muscardinus avellanarius</i> (Linnaeus, 1758)	3		0.2		2					1.7
	Σ Rodentia	1011	268	89.3	19	32	16	6	36	94.0	
	Mammalia total	1157	276	100.0	22	33	17	7	37	100.0	

DISCUSSION

Tyto alba and *Strix aluco* differed in main prey consumed. *T. alba* preyed mostly on mammal species inhabiting farmland, close to developed areas: *M. arvalis*, *M. musculus*, *A. agrarius*, and *S. araneus* more commonly in woods. *Strix aluco* hunted mostly forest dwelling species, such as *A. flavicollis*, *C. glareolus*, but also, although less frequently, *M. arvalis* and *A. agrarius*. This indicates that these two owl species forage largely in different habitats: *T. alba* in farmland, *S. aluco* in forests and in farmland, likely at the forest edge. Such a difference in the diet of two species is common (Goszczyński 1981, Źmihorski et al. 2012, Lesiński et al. 2016b). In contrast to other studies (Goszczyński 1981, Źmihorski et al. 2012, Lesiński et al. 2016b, Lesiński & Kmieciak 2023), the diet of *Tyto alba* was more diverse in terms of prey species (18 species vs 13 for *Strix aluco*); on the other hand, the number of identified *T. alba* prey was approximately 10 times greater.

The results of the pellet analysis indicated 18 species of micromammalia that live in the Góra Św. Anny Landscape Park: 5 species of Soricomorpha, 12 Rodentia and 1 Chiroptera. Taking into consideration that this landscape park is one of the smallest in Poland, by simply comparing the fauna of Soricomorpha and Rodentia (17 in total) with other landscape or national parks, this number is revealed to be considerable: Szczeciński Landscape Park – 12 species (Michalonek & Kościów 2005), Chojnowski LP – 12 (Romanowski et al. 2014), Wigierski National Park – 13 (Zawadzka & Zawadzki 2007), Bolimowski LP – 15 (Lesiński et al. 2016a), Mazowiecki LP – 19 (Lesiński et al. 2016b).

This work provided original, new faunistic records on small mammals from a poorly studied, in this respect, part of Poland. The last, unfortunately relatively old paper, providing a list of mammals in the Góra Św. Anny Landscape Park (Kubok 1998) mentioned 3 species of Soricomorpha (*T. europaea*, *S. araneus*, *Sorex minutus*) and 11 species of Rodentia that could be the potential prey of owls: *Sciurus vulgaris*, *C. glareolus*, *Arvicola amphibius*, *M. arvalis*, *M. musculus*, *Micromys minutus*, *A. agrarius*, *A. flavicollis*, *A. sylvaticus* and *Glis glis* (L.) (I excluded from this list *Spermophilus citellus* (L.) and *Ondatra zibethicus* (L.)). From this list, only *S. vulgaris* and *G. glis* have not been confirmed in this material. *S. vulgaris* is only sporadically the prey of *S. aluco* (Gryz et al. 2008, Lesiński et al. 2016b). A lack of *G. glis* in the diet of *S. aluco* is surprising, as this Gliridae representative has been reported in this area as early as the beginning of the 20th century (Bau 1935). Furthermore, the species is regularly seen at present exactly at the collection sites of *S. aluco* pellets near the village of Góra Św. Anny. A possible explanation is that the small quantity of *S. aluco* pellets collected (only about 50 prey identified from Góra Św. Anny). Among the species listed in the diet of *T. alba* and *S. aluco* in the Góra Św. Anny Landscape Park, six species are new to the fauna of this area: *Neomys fodiens*, *Crociodura suaveolens*, *Microtus agrestis*, *Microtus subterraneus*, *Rattus norvegicus* and *Muscardinus avellanarius*. Except for *M. avellanarius*, all species are common in south-western Poland. *M. avellanarius* is much more sparsely distributed throughout the southern and eastern regions of Poland (Pucek & Raczyński 1983, Okarma et al. 2023).

The described fauna of small mammals discovered in owl pellets in the Góra Św. Anny Landscape Park is similar to that identified in the pellets in the Oder Valley (Hebda 2024), adjoining the Park's border from the south-west. The list of Soricomorpha and Rodentia of both areas is identical, except for one species: *S. minutus*, which has not been found in the pellets in the Oder Valley. However, this species was reported from this area in previous studies (Sałata-Piłacińska 1994).

Lastly, a question always appears when studying pellets or small mammal communities: 'What species one may find here next?'. Unfortunately, not much can be done when collecting just the list of small mammals species of this park (again, except bats). *Apodemus uralensis* is the only reasonable example of the species that may be discovered here, judging by its current distribution in Poland (Cichocki et al. 2011; Okarma et al. 2023).

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STRESZCZENIE

[Drobne ssaki Parku Krajobrazowego „Góra Świętej Anny” (południowo-zachodnia Polska) w pokarmie dwóch gatunków sów]

Z obszaru Parku Krajobrazowego Góra Świętej Anny brak jest jakichkolwiek danych dotyczących występowania drobnych ssaków, za wyjątkiem prowizorycznej listy gatunków umieszczonej w pierwszej monografii przyrodniczej Parku z roku 1998. By wypełnić tę lukę, w pracy zaprezentowano dane o drobnych ssakach tego obszaru na podstawie analizy wypluwek

dwóch gatunków sów: puszczyka *Strix aluco* i płomykówki *Tyto alba*. Wypluwki pochodziły z okresu 1999–2024, zbierane były z dwóch stanowisk lęgowych płomykówki oraz pięciu miejsc regularnego przebywania, w tym lęgów puszczyka (Table 1). Łącznie zidentyfikowano 1549 ofiar, 1433 płomykówki, 116 puszczyka. W wypluwkach stwierdzono 18 gatunków drobnych ssaków z pięciu rzędów: 5 gatunków Soricomorpha, 1 Chiroptera i 12 Rodentia. Gryzonie stanowiły najliczniejszą grupę ofiar. W zależności od gatunku sowy, najliczniej upolowanymi gatunkami był nornik polny *Microtus arvalis* i mysz domowa *Mus musculus* w przypadku ofiar płomykówki, oraz myszarka leśna *Apodemus flavicollis* i nornica ruda *Clethrionomys glareolus* w przypadku ofiar puszczyka (Tab. 2). Uzyskane wyniki są pierwszymi informacjami dotyczącymi różnorodności gatunkowej drobnych ssaków Parku Krajobrazowego Góry Świętej Anny i jednymi z bardzo nielicznych w województwie opolskim.

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