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DISTRIBUTION OF THE HARVEST MOUSE (*MICROMYS MINUTUS*) IN GEORGIA BASED ON BARN OWL (*TYTO ALBA*) PELLET ANALYSIS

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Abstract

The present study investigates the distribution of the harvest mouse (*Micromys minutus*) in Georgia through the analysis of barn owl (*Tyto alba*) pellets. Historically, *Micromys minutus* has been documented in restricted areas of western Georgia, with a fragmented range that extends into north-eastern Azerbaijan. Despite being considered nationally vulnerable, its current status and distribution within Georgia remain insufficiently known. With the recent establishment of the barn owl as a breeding species in Georgia, this study explores the potential of diet analysis as an effective method for detecting elusive or poorly documented small mammal species. Pellet collection was carried out between June 2023 and January 2025 across diverse Georgian regions, including Adjara, Guria, Imereti, Kakheti, Kvemo Kartli, Mtskheta-Mtianeti, Samegrelo-Zemo Svaneti, and Shida Kartli. Nevertheless, remains of the harvest mouse were only recovered from pellets collected in Adjara, Imereti, Kakheti, Kvemo Kartli, and Samegrelo-Zemo Svaneti. All collected pellets were processed using standard osteological techniques, and prey species were identified based primarily on cranial and mandibular remains. A total of 6136 prey items were identified, among which 82 individuals (1.34%) were assigned to *Micromys minutus*. The species was most prevalent in Samegrelo-Zemo Svaneti (64 individuals, 16.45% of prey), followed by Adjara (9 individuals, 2.99%) and Imereti (5 individuals, 13.51%). In eastern Georgia, the species was recorded in significantly lower numbers, with only one specimen from Kakheti (0.03%) and three from Kvemo Kartli (0.16%), confirming its rarity in that part of the country. These findings reveal a broader and more continuous distribution of *Micromys minutus* in western Georgia, while suggesting scattered populations further east. The results support earlier hypotheses regarding importance of barn owl dietary studies in small mammal biodiversity assessment. This study provides essential baseline data for conservation efforts and long-term monitoring of this ecologically valuable but vulnerable rodent species.

Cite as

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Поширення мишки лучної (*Micromys minutus*) в Грузії на основі аналізу пелеток сипухи (*Tyto alba*)

Денис Китель, Олександр Бухнікашвілі

Резюме. Дослідження присвячено вивченню поширення мишки лучної (*Micromys minutus*) на території Грузії шляхом аналізу погадок сипухи (*Tyto alba*). Історично *Micromys minutus* була відмічена лише в окремих районах західної Грузії, а фрагментований ареал виду простягається до північно-східного Азербайджану. Попри національний статус уразливого виду, сучасні дані щодо його поширення в Грузії є обмеженими. У зв'язку з нещодавнім утворенням гніздових популяцій сипухи в Грузії розглядається потенціал аналізу її раціону як ефективного методу для виявлення рідкісних, малодосліджених або важковловимих видів дрібних ссавців. Збір пелеток здійснювали з червня 2023 р. по січень 2025 р. у різних регіонах країни, включно з Аджарією, Гурією, Імереті, Кахетією, Квемо-Картлі, Мцхета-Мтіанеті, Самегрело-Земо Сванеті та Шида Картлі. Рештки мишки лучної виявлено лише в пелетках, зібраних у п'яти регіонах: Аджарії, Імереті, Кахетії, Квемо-Картлі та Самегрело-Земо Сванеті. Зібраний матеріал обробляли за стандартною остеологічною методикою, а видову приналежність здобичі визначали переважно за ознаками краніальних решток. Усього ідентифіковано 6136 особин здобичі, з яких 82 особини (1,34 %) належали до виду *Micromys minutus*. Найбільше особин виявлено у Самегрело-Земо Сванеті (64, 16,45 %), далі йдуть Аджарія (9, 2,99 %) та Імереті (5, 13,51 %). У східній Грузії вид траплявся значно рідше — лише одна особина в пелетках з Кахетії (0,03 %) і три — з Квемо-Картлі (0,16 %), що підтверджує його обмежене поширення в цьому регіоні. Отримані результати свідчать про ширше та більш неперервне поширення *Micromys minutus* у західній Грузії, а також вказують на присутність цього виду у деяких східних районах. Результати підтверджують раніше висунуті гіпотези щодо важливості аналізу живлення сипух як дієвого інструменту дослідження дрібних ссавців у регіональному моніторингу біорізноманіття. Це дослідження надає актуальні дані, необхідні для вжиття подальших природоохоронних заходів, спрямованих на збереження цього екологічно важливого, але вразливого виду.

Ключові слова: мишка лучна, *Micromys minutus*, сипуха, совині пелетки, поширення, Грузія.

Introduction

The harvest mouse (*Micromys minutus*) is distributed almost throughout the entire Palaearctic. It is not present on the Iberian Peninsula, in the south of the Balkan Peninsula, in the western part of Scandinavia except for a small refugium near the southern part of the border between Sweden and Norway, the entire north of Eurasia except for the shores of the White Sea, and the central, dry part of Asia; it reaches Japan and Yunnan Province in China [Kryštufek *et al.* 2019]. In Transcaucasia, the species is noted only in the north-east of Azerbaijan and western Georgia [Gromov & Erbajeva 1995]. The first mention of the findings of the harvest mouse in western Georgia dates back to the beginning of the 20th century [Satunin 1913] and is limited to two points: the vicinity of the city of Gagra and the village of Nizhneye Troitskoye, now Chanchkeri, and an unclear mention of either the vicinity of Sukhumi or the Sukhumi district.

On the maps of the mid-20th century the species range reached the city of Sukhumi [Shidlovskiy 1950; Bobrinsky *et al.* 1965]. In the 1940s, a new point appeared, the village of Anukhva in the Gudauta region to the east of the city of Gagra [Shidlovskiy 1950]. In the 1960s, another point appeared, the village of Natanebi, but much further south than Abkhazia, near the city of Kobuleti [Morgilevskaya 1989]. Subsequent finds date back to the 21st century and are located within the general range in western Georgia—the villages of Anaklia and Dedalauri [Bukhnikashvili *et al.* 2023], the latter point being the easternmost find of the species in Georgia. Since 2014, the harvest mouse in Georgia has a status of nationally *Vulnerable* due to its small, fragmented range of distribution [Government… 2014].

Owls in general are a good tool to investigate and monitor the fauna of small mammals as well as to localise rare or non-abundant species [Savarin & Kitel 2016; Drebet 2022]. The barn owl (*Tyto*

alba) particularly is a species used for pest control as it predominantly catches rodents [Kross *et al.* 2016]. The barn owl has only recently appeared as a breeding species in Georgia [Bukreev 2003; Malandzia & Ivanitskiy 2005] and nothing is known about its diet from this area.

As the habitats of the barn owl and the harvest mouse might overlap in Georgia, the hypothesis to this research is whether barn owl diet data might reveal the distribution range of little-studied small rodent species such as the harvest mouse.

Material and Methods

In order to collect the pellets belonging to the barn owl (*Tyto alba*), the following regions of Georgia where subsequently visited in the period between June 2023 and January 2025: Adjara, Guria, Imereti, Kakheti, Kvemo Kartli, Mtskheta-Mtianeti, Samegrelo-Zemo Svaneti, and Shida Kartli. The signs of owls were found only in Adjara, Imereti, Kakheti, Kvemo Kartli, and Samegrelo-Zemo Svaneti (Table 1). The pellets (Fig. 1) were picked up from different kinds of buildings, mainly churches and farms, where barn owls roosted or nested. All sites where the pellets were found were situated nearby to open grassland territories, often river valleys overgrown with bushes on banks.

The pellets were sterilised in an oven at 160°C for 40 min. After this process the pellets were softened with water and hard parts (bones, skulls, teeth, and insect integuments) were extracted with tweezers and other equipment following the suggested method [Mikusek 2005].

Table 1. The places in Georgia where barn owl pellets contained harvest mouse (*Micromys minutus)* remains
Таблиця 1. Місця в Грузії, де пелетки сипухи містили *Micromys minutus*

Place, region	Coordinates	Date of collection
1. Avgia, Adjara	41.589, 41.589	22 October 2023, 26 December 2024
2. Pobeda, Kvemo Kartli	41.497, 45.131	12 November 2023
3. Gremi, Kakheti	42.000, 45.656	19 November 2023
4. Etseri, Samegrelo-Zemo Svaneti	42.255, 42.219	07 January 2024
5. Tsilori, Samegrelo-Zemo Svaneti	42.156, 42.197	07 January 2024, 28 December 2024
6. Jandari, Kvemo Kartli	41.443, 41.155	14 January 2024
7. Tskhaltubo, Imereti	42.327, 42.595	04 August 2024
8. Kortskheli, Samegrelo-Zemo Svaneti	42.559, 41.951	09 August 2024
9. Poti, Samegrelo-Zemo Svaneti	42.115, 41.702	12 January 2025

* Numbers correspond to records on the map (Fig. 3).

Fig. 1. The appearance of pellets of the barn owl (*Tyto alba*) collected in Georgia. Photo by D. Kitel.

Рис. 1. Вигляд пелеток сипухи (*Tyto alba*), зібраних у Грузії. Фото Д. Китель.

The identification of mammal skull remains was carried out with microscope and keys from the literature [Pucek 1984; Kryštufek & Vohralík 2009; Voronetskiy & Kuzmenko 2013].

Results and Discussion

In total, 6136 prey items were extracted from the barn owl pellets; the share of harvest mouse remains among them was 1.34%, or 82 individuals. The details about the number of prey items identified and the number of harvest mouse remains within the regions in Georgia are presented in Table 2.

Within the species' distribution range, the harvest mouse consistently constitutes a minor component of the barn owl's (*Tyto alba*) diet. For example, its proportion in barn owl pellets has been reported as 0.02% in Bulgaria [Simeonov *et al.* 1981], 0.6–1.42% in Poland [Ważna *et al.* 2011; Kłys *et al.* 2022], 0.88–2.25% in Hungary [Horváth *et al.* 2023], and 0.9–2.0% in Ukraine [Kuzmenko 2021]. Similarly, in the diet of the long-eared owl (*Asio otus*), the species is not dominant, with a share of 4.3% in Lithuania [Balčiauskas & Balčiauskienė 2023] and 2.0% in Ukraine [Kuzmenko 2021]. The harvest mouse also occurs in the diet of the eagle owl (*Bubo bubo*), albeit in extremely low proportions: 0.03% in Norway, 0.07% in the Czech Republic, and 0.08% in Slovakia [Obuch 2024]. In Ukraine, it comprises 0.9% and 0.3% of the diets of the tawny owl (*Strix aluco*) and the great grey owl (*Strix nebulosa*), respectively, while a relatively higher proportion (9.0%) has been recorded in the diet of the little owl (*Athene noctua*) [Kuzmenko 2021].

The overall cranial features of harvest mouse found in Georgia in barn owl pellets are typical for the species: relatively small dimensions and short rostrum, the absence of a conspicuous notch on the inside edge of the incisors, the first upper molar (M1) has five roots, and the mental foramen lies in line with the alveolus of the first lower molar (m1) and is well seen from above (Fig. 2).

Table 2. Harvest mouse (*Micromys minutus*) in the barn owl's (*Tyto alba*) diet in different regions of Georgia
Таблиця 2. *Micromys minutus* у живленні сипухи в різних регіонах Грузії

Region	Adjara	Imereti	Kakheti	Kvemo Kartli	Samegrelo-Zemo Svaneti
Number of preys in pellets	302	37	3582	1826	389
Number of *M. minutus* in pellets	9	5	1	3	64
% of *M. minutus* of the total number of preys	2.99	13.51	0.03	0.16	16.45

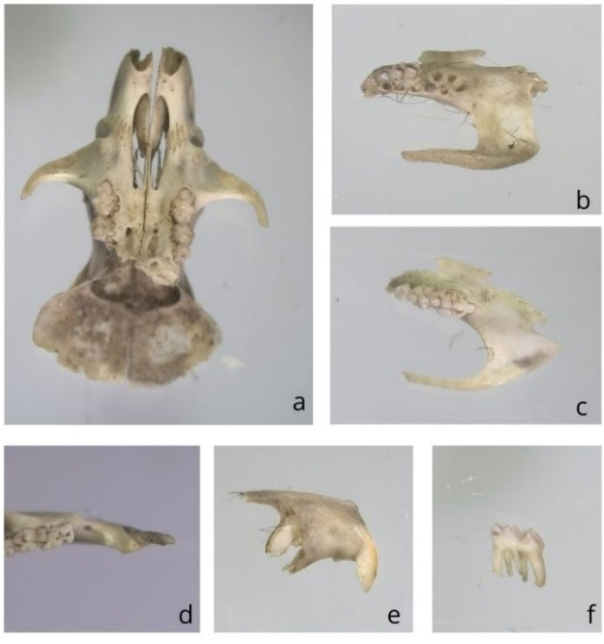

Fig. 2. Skull remains of the harvest mouse (*Micromys minutus*) from barn owl pellets (photos by D. Kitel): (*a*) shortened rostrum; (*b*) part of the upper jaw with five root holes of M1; (*c*) part of the upper jaw with all teeth present; (*d*) lower jaw showing the location of the alveolus of m1 and of the mental foramen; (*e*) upper incisor without a notch on the inside edge; (*f*) M1 with five roots. The origin of the individuals depicted on the photos: (*a*) Avgia, Adjara; (*b, e, f*) Jandari, Kvemo Kartli; (*c, d*) Pobeda, Kvemo Kartli.

Рис. 2. Рештки черепа *Micromys minutus* з пелеток сипухи (фото Д. Кітеля): (*a*) вкорочений ростральний відділ; (*b*) частина верхньої щелепи з отворами п'яти коренів M1; (*c*) частина верхньої щелепи з усіма зубами; (*d*) нижня щелепа з розташуванням альвеоли m1 відносно підборідного отвору; (*e*) верхній різець без виїмки на внутрішньому краї; (*f*) M1 з п'ятьма коренями. Походження особин зображених на фото: (*a*) Авгія, Аджарія; (*b, e, f*) Джандарі, Квемо Картлі; (*c, d*) Победа, Квемо Картлі.

Although the number of preys from pellets in the western regions is seven times lower than in the eastern part of the country (728 and 5405 prey items, respectively), the number of harvest mice identified is higher in the west with 78 individuals compared to the four individuals found at tree localities in Kakheti and Kvemo Kartli. This disproportion can be explained by the wide distribution of the harvest mouse in the western regions and its extremely rare status and isolated presence in the east. It is impossible to localise the exact place where harvest mice were caught by barn owls, the assumption, however, is that the distance between roosting/nesting and foraging sites is just few, often not more than 2 km, according to published date from other countries [Cain *et al.* 2023].

All sites in Georgia do not exceed 473 m above sea level, although in the North Caucasus the harvest mouse rises to 2200 m above sea level. The species prefers reed beds and shrubs located there, enters floodplain and lowland forests, it can live along the edges of roads and in fields with strong anthropogenic pressure, but everywhere with high grass and near water [Gromov & Erbaeva 1995; Spitzenberger 1999; Haberl & Kryštufek 2003; Kryštufek & Vohralik 2009].

Based on these data, it can be assumed that the harvest mouse can occur throughout Transcaucasia, most likely in fairly small numbers, with no significant barriers. Moreover, in particular publications the range of the harvest mouse was already extrapolated over the whole of Georgia connecting the western lowland with the population in Azerbaijan [Aulagnier *et al.* 2009].

The current map of distribution of the harvest mouse in Georgia based on the published sources and our data from barn owl pellets collected in 2023–2025 is presented in Fig. 3. The record localities in the eastern regions, Kakheti and Kvemo Kartli, have not been known before, although there were reports from locals living in eastern Georgia that a mouse described as the harvest mouse inhabits the Iori Plateau.

Underlaying the results, we suggest that the hypothesis of this research is true, and the analyses of barn owl pellets help to clarify the range of distribution of the harvest mouse in Georgia.

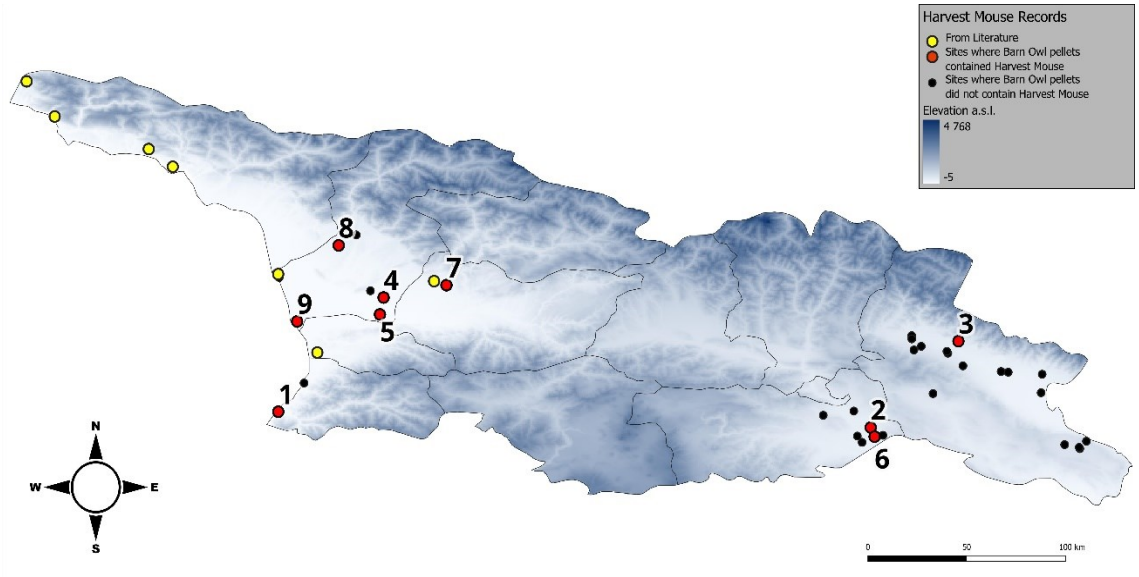

Fig. 3. A map of Georgia with records of the harvest mouse (*Micromys minutus*): yellow marks—data from published papers; red marks—data from barn owl pellets collected in 2023–2024; black marks—sites where pellets were collected but with no evidence of harvest mouse presence.

Рис. 3. Мапа Грузії зі знахідками мишки лучної (*Micromys minutus*): жовті позначки — дані з опублікованих праць; червоні мітки — дані з пелеток сипухи, зібраних у 2023–2024 роках; чорні позначки — місця, де були зібрані пелетки без ознак присутності мишки лучної.

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Declarations

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