

THE MALACOFAUNA OF THE GREENEST CITY OF ROMANIA – BRAȘOV

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ABSTRACT

The terrestrial malacofauna of Brașov, considered the greenest city in Romania, was investigated in 2025. Three habitat categories were selected: landscaped urban parks, central forested areas and recreational forests at the edge of the urban area. 36 species of land snails and slugs were found. The lowest diversity and abundance was recorded in landscaped urban parks, the species here being mostly opportunistic (*Helix pomatia*) or allochthonous (*Arion vulgaris*, *Cepaea hortensis*). The remaining forest habitats,

both those in the urban space and those bordering it, shelter a much more diverse malacofauna, which, however, differs greatly depending on the characteristics of the habitat (degree of vegetation cover, slope, substrate, etc.) as well as those of the microhabitat, such as the presence of shelters and a water source. Despite the large forested area that Brașov enjoys, the nature of the green areas and their reduced surface area mean that the diversity of the mollusk fauna remains low.

REZUMAT: Malacofauna celui mai verde oraș din România - Brașovul

Malacofauna terestră a orașului Brașov, considerat cel mai verde oraș din România a fost investigată în 2025. Au fost selectate trei categorii de habitate: parcuri urbane amenajate, zone împădurite centrale și păduri de agrement de la limita zonei urbane. Au fost identificate 36 de specii de moluște terestre. Cea mai mică diversitate și abundență a fost înregistrată în parcurile urbane amenajate, speciile de aici fiind în mare parte oportuniste (*Helix pomatia*) sau alohtone (*Arion vulgaris*, *Cepaea hortensis*). Habitatele forestiere remnante, atât cele din

spațiul urban cât și cele limitrofe, adăpostesc o malacofaună mult mai diversă, care se diferențiază însă foarte mult în funcție de caracteristicile habitatului (gradul de acoperire cu vegetație, panta, substratul, etc), precum și cele de microhabitat cum ar fi prezența adăposturilor și a unei surse de apă. În pofida suprafeței împădurite mari de care se bucură Brașovul, natura zonelor verzi și suprafața redusă a acestora, fac ca diversitatea faunei de moluște să rămână redusă.

RÉSUMÉ: La malacofaune de la ville la plus verte de Roumanie - Brașov

La malacofaune terrestre de Brașov, considérée comme la ville la plus verte de Roumanie, a été étudiée en 2025. Trois catégories d'habitats ont été sélectionnées : les parcs urbains aménagés, les zones forestières centrales et les forêts récréatives en périphérie de la ville. Trente-six espèces de mollusques terrestres ont été recensées. La plus faible diversité et la plus faible abondance ont été observées dans les parcs urbains aménagés, les espèces y étant principalement opportunistes (*Helix pomatia*) ou allochtones (*Arion vulgaris*,

Cepaea hortensis). Les autres habitats forestiers, tant en milieu urbain qu'en périphérie, abritent une malacofaune beaucoup plus diversifiée, qui varie cependant considérablement selon les caractéristiques de l'habitat (degré de couverture végétale, pente, substrat, etc.) et du microhabitat, comme la présence d'abris et d'un source d'eau. Malgré l'étendue des surfaces forestières de Brașov, la nature des espaces verts et leur superficie réduite expliquent la faible diversité de la faune de mollusques.

INTRODUCTION

The loss and fragmentation of habitats brought on by human pressures on natural ecosystems is the main cause of the worldwide reduction in biodiversity. Probably the most harmful, enduring, and quickly growing type of anthropogenic pressure is urbanization (McKinney, 2002, Miller and Hobbs, 2002).

Over half of the world's population now resides in large urban areas. By 2050, this number is expected to rise to 68% (United Nations, 2018).

Many scientists believe that the impact of urban development on wildlife is not confined to the city itself but can also extend to nearby regions, affecting species and ecological processes in surrounding areas (Bissonette, 2002, Yeoman and MacNally, 2005). In recent years, however, researchers have found that cities can also help protect and manage certain fragile ecosystems and support high levels of biodiversity. Studies have shown that specific urban habitats play a crucial role in helping species spread and survive (Angold et al., 2006). Additionally, urban green

spaces can improve people's quality of life by offering opportunities for recreation and encouraging community participation and environmental education (Carrus et al., 2015, Barbato et al., 2017) through activities like community participation and environmental education (Beumer and Martens, 2015).

As land snails are highly vulnerable to anthropogenic activity, they are excellent subjects for researching the effects of urbanization (Ström et al. 2009, Hodges and McKinney 2018). Due to their significant reliance on microhabitats and extremely restricted movement and dispersal, microsnails (less than 5 mm in diameter) are particularly susceptible to disturbance (Baur and Baur 1988).

In Romania, there is only one study addressing urban malacofauna, the one that analyzes terrestrial mollusk assemblages in Sibiu (Gheoca, 2012). The current paper focuses on land malacofauna from different urban habitats in one of the greenest city of Romania, the city of Brasov, completing the image of this current topic.

MATERIAL AND METHODS

In 2025, sampling was conducted in the urban and peri-urban areas of Braşov, located in central Romania (45.657974 N, 25.601198 E). Seven locations were selected and categorized into three types of habitats (Fig. 1): central/ultra-central parks featuring bike/running tracks, playgrounds, and areas with grass and ornamental trees and shrubs (Gheorghe Dima Park, Nicolae Titulescu Park, and Tractorului Park); central forested areas experiencing high human activity (Streaja Hill and Livada Poştei Park); and recreational forests situated at the urban boundary. In the latter category, sampling was performed in areas designated for recreation, adjacent to the urban

environment. Mollusks were visually searched by two individuals for one hour at each site, covering all suitable microhabitats.

Additionally, for smaller species, litter and soil samples were collected from three quadrats of 0.0625 m² at each site (Clergeau et al., 2011). The identification of land snails and slugs was based on the works of Grossu (1981, 1983, 1987), Welter Schultes (2012), and comparative collections. The nomenclature checklist was compiled in accordance with MolluscaBase (<http://www.molluscabase.org>).

The collected specimens were incorporated into the author's personal collection.

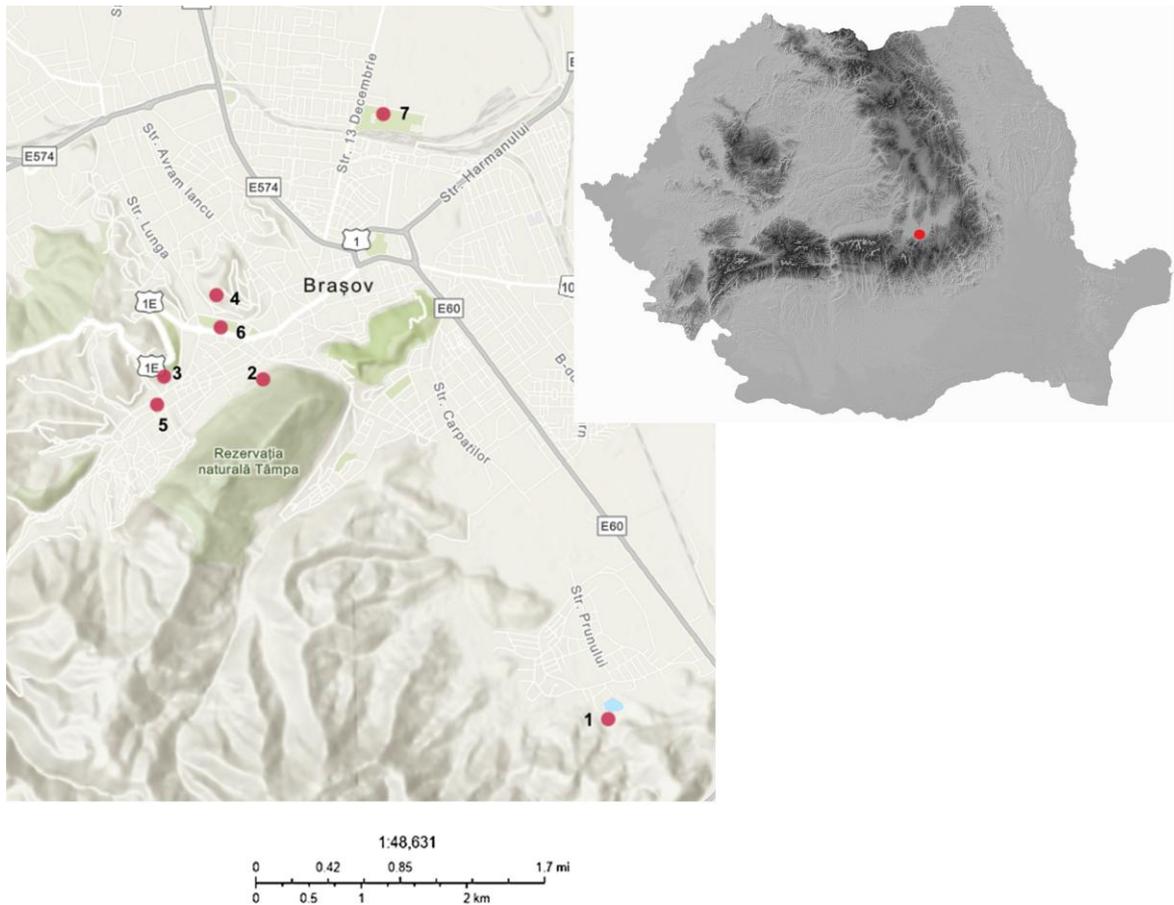


Figure 1: Location of the sampling sites: The codification of sampling areas: 1 – Lacul Noua Park; 2 – Livada Poştei Park; 3 – Tâmpa promenade; 4 – Streaa Hill; 5 – Gheorghe Dima Park; 6 – Nicolae Titulescu Park; 7 – Tractorul Park. (<https://www.arcgis.com/apps/mapviewer>).

RESULTS AND DISCUSSION

A total of 36 land mollusk species were identified in the samples (Tab. 1). Communities were dominated by *Helix pomatia* and *Laciniaria plicata*, which were found in seven and six out of seven sites, respectively, while 14 species were found at a single location. As sampling was carried out at sites with different characteristics, the occurrence of species at a single location could be related to the limited number of

sampling sites and the particular conditions needed by some species, including their response to human pressure. Some species, such as *D. banatica*, are expected to be found only in undisturbed sites in wet environments, as in the case of the area of Lacul Noua Park, while *Mastus venerabilis* and *Zebrina detrita* were only found in locations with limestone rocks.

Table 1. List of mollusc species recorded in the city of Braşov. The codification of sampling areas as represented in fig. 1: 1 – Lacul Noua Park; 2 – Tâmpa promenade; 3 – Livada Poştei Park; 4 – Streaja Hill; 5 – Gheorghe Dima Park; 6 – Nicolae Titulescu Park; 7 – Tractorul Park.

Site	1	2	3	4	5	6	7
Species							
<i>Carychium tridentatum</i> (Risso, 1826)			+				
<i>Succinea putris</i> (Linnaeus, 1758)	+						

<i>Cochlicopa lubrica</i> (O. F. Müller, 1774)	+						
<i>Mastus venerabilis</i> (L. Pfeiffer, 1853)		+					
<i>Zebrina detrita</i> (O. F. Müller, 1774)			+				
<i>Merdigera obscura</i> (O. F. Müller, 1774)			+				
<i>Vitrina pellucida</i> (O. F. Müller, 1774)				+			
<i>Vitrea diaphana</i> (S. Studer, 1820)		+					
<i>Aegopinella epipedostoma</i> (Fagot, 1879)		+	+	+	+		
<i>Morlina glabra</i> (Rossmässler, 1835)			+	+			
<i>Oxychilus draparnaudi</i> (H. Beck, 1837)		+					
<i>Zonitoides nitidus</i> (O. F. Müller, 1774)	+				+		
<i>Cochlodina laminata</i> (Montagu, 1803)		+					
<i>Laciniaria plicata</i> (Draparnaud, 1801)	+	+	+	+	+	+	
<i>Pseudalinda fallax</i> (Rossmässler, 1836)	+						
<i>Balea stabilis</i> (L. Pfeiffer, 1847)	+						
<i>Bulgarica cana</i> (Held, 1836)		+	+	+			
<i>Alinda biplicata</i> (Montagu, 1803)			+				
<i>Arion vulgaris</i> Moquin-Tandon, 1855	+				+		+
<i>Arion circumscriptus</i> G. Johnston, 1828		+		+			
<i>Arion hortensis</i> A. Férussac, 1819	+	+					
<i>Deroceras reticulatum</i> (O. F. Müller, 1774)	+			+	+		
<i>Lehmania marginata</i> (O. F. Müller, 1774)	+	+			+		
<i>Limax maximus</i> Linnaeus, 1758	+			+	+		
<i>Bradybaena fruticum</i> (O. F. Müller, 1774)	+						
<i>Monachoides vicinus</i> (Rossmässler, 1842)	+	+					
<i>Lozekia transsylvanica</i> (Westerlund, 1876)	+			+			
<i>Lozekia deubeli</i> (M. Kimakowicz, 1890)				+			
<i>Trochulus hispidus</i> (Linnaeus, 1758)					+		
<i>Euomphalia strigella</i> (Draparnaud, 1801)			+	+	+		
<i>Faustina faustina</i> (Rossmässler, 1835)		+					
<i>Drobacia banatica</i> (Rossmässler, 1838)	+						
<i>Caucasotachea vindobonensis</i> (C. Pfeiffer, 1828)			+	+			
<i>Cepaea hortensis</i> (O. F. Müller, 1774)						+	
<i>Helix lucorum</i> Linnaeus, 1758							+
<i>Helix pomatia</i> Linnaeus, 1758	+	+	+	+	+	+	+
Number of species	15	12	12	12	9	3	3

Two alien species were found: the invasive *Arion vulgaris* and *Cepaea hortensis*. *A. vulgaris* was found in three areas, including the agreement forest from Noua Lake and two landscaped urban parks. The slug was first recorded in Romania in 2014 (Păpureanu et al., 2014), and since then, it has been found almost all over the country, especially in and around large cities or transportation routes (Adam et al., 2021). *A. vulgaris* has probably been introduced into new habitats via plant matter, packaging, and waste materials (Kozłowski, 2007, Peltanová et al., 2011, Zajac et al., 2017). It

is a major defoliator of plants and causes severe damage to orchards and gardens, as well as serious crop losses. In Romania, *A. vulgaris* is considered the main threat among all alien and invasive species to plants and other invertebrates (Adam et al., 2021). The second alien species found in Braşov was *Cepaea hortensis* (Fig. 2). *C. hortensis* has been mentioned in the early 20th century from only two locations. One of the records was from Felix Baths near the Hungarian border (Csiki, 1918), which was unconfirmed by later records (Grossu, 1983; Gheoca, unpublished data). The second was

from Sibiu (central Romania), where it was introduced into a garden in the first decade

of the 20th century (Gheoca et al. 2019).



Figure 2: *Cepaea hortensis* in N. Titulescu Park, Braşov

Table 2. Species richness, abundance and dominant taxa in central parks

	Tractorul	N. Titulescu	Gh. Dima
Habitat type	Urban park with scattered ornamental trees and shrubs	Central Park with grass, flowerbeds, junipers, and scattered ornamental trees	Small urban park with old plane trees.
Species No	3	3	9
Abundance	28	48	57
Dominant species (≥5%)	<i>H. lucorum</i> <i>H. pomatia</i> <i>A. vulgaris</i>	<i>C. hortensis</i> <i>L. plicata</i> <i>H. pomatia</i>	<i>Ae. epipedostoma</i> <i>H. pomatia</i> <i>L. marginata</i> <i>L. maximus</i> <i>E. strigella</i>

Table 3. Species richness, abundance and dominant taxa in forested areas

	Livada Poştei	Cetăţuia	Lacul Noua Park	Tâmpa Promenade Park
Habitat type	Forested area in the city	Forested area in the city	Recreation forest at the limit of the city	Recreation forest at the limit of the city
Species No	12	11	15	12
Abundance	82	87	88	189
Dominant species (≥5%)	<i>L. plicata</i> <i>H. pomatia</i> <i>B. cana</i> <i>Ae. epipedostoma</i> <i>C. vindobonensis</i>	<i>H. pomatia</i> <i>E. strigella</i> <i>O. glaber</i> <i>B. cana</i> <i>L. plicata</i>	<i>M. vicinus</i> <i>H. pomatia</i> <i>B. stabilis</i> <i>F. fruticum</i>	<i>M. venerabilis</i> <i>L. plicata</i> <i>C. laminata</i> <i>B. cana</i> <i>Ae. epipeostoma</i> <i>M. vicinus</i> <i>A. hortensis</i> <i>F. Faustina</i> <i>H. pomatia</i>

				<i>L. marginata</i>
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In addition to the metapopulation from Sibiu, which seems to thrive in a widespread manner around the city, the species has also been identified in recent decades, as was *C. nemoralis*, in various locations, generally linked to the ornamental plant trade (Gheoca, unpublished data, Adam et al., 2021). The colony found in the central park of Braşov appears to have been established here, as empty shells in various stages of degradation were found. The small diversity in shell color, represented only by yellow unbanded (about 80%) and yellow banded specimens, suggests a single introduction (Fig. 2).

As expected, both diversity and abundance were lower in urban parks (Tab. 2) than in the forested areas (Tab. 3). The lowest values were recorded at Tractorul Park, where only 28 specimens belonging to three species (*Helix lucorum*, *H. pomatia*, and *A. vulgaris*) were found. *H. lucorum*, although an autochthonous species, is here outside its natural range. The snail commonly inhabits the southeastern part of the country, mainly southern Dobrogea, with several records outside its range previously reported only from towns located in eastern and southern Romania (Iaşi, Ploieşti, Craiova), as well as in more central areas such as Târgu Ocna (Grossu, 1983) and Piatra Neamţ (Gheoca, unpublished data). Its presence in Braşov in the vicinity of the

CONCLUSIONS

Despite Braşov's reputation as the greenest city in Romania, attributed to its geographical location and surrounding forests, the mollusk communities exhibit reduced diversity. Significant variations exist among the sampled locations, contingent upon the characteristics of the natural habitat from which the preserved fragment originates and the extent of human impact. Landscaped green spaces are the least conducive to supporting terrestrial mollusk species. Their open nature,

railroad suggests this pathway for the introduction of specimens in Braşov.

The presence of the old plane trees and the vicinity of old buildings surrounded by gardens explain the largest diversity and abundance of Gh. Dima Park, of all parks, however, the values remain much lower than in forested areas. The latter harbor communities of terrestrial molluscs that are probably much closer to those of natural habitats.

Previous studies by authors such as Proschwitz (1988), Slezák et al. (2025) have demonstrated that the composition of terrestrial species in urban settings is influenced by two main factors: 1. the limited capacity of native species to withstand ongoing human impact, and 2. the high ability of non-native species to spread. Although the limited number of samples does not allow us to draw definitive conclusions regarding the resilience of specific snail species to anthropogenic pressures, observations suggest that Clausiliidae species such as *B. stabilis*, *B. cana*, *C. laminata*, and *P. fallax* are confined to forest remnants. In contrast, *L. plicata* and synanthropic species like *L. maximus* and *D. reticulatum* appear capable of surviving in highly modified habitats. Similar findings concerning the impact of urbanization on land snails have been reported in Sibiu (Gheoca 2012).

characterized by predominantly decorative vegetation that fails to provide adequate shelter and the absence of a water source, constitutes the primary limiting factors. The land malacofauna of forest remnants is significantly influenced by the former natural habitat and the remnant mollusk species. We can conclude that a subset of the local pool of native species, along with a collection of unintentionally or purposefully introduced species, contributes to the species richness of urban areas.

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