

## LAND-SNAIL DIVERSITY OF PIATRA-NEAMȚ (NEAMȚ COUNTY, ROMANIA)

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**Key words:** *land-snail, malacology, zoogeography, protected area, Piatra-Neamț, Romania*

### INTRODUCTION

Due to its geographical position (46°55'39" N - 26°22'15" E), Piatra-Neamț is located at the edge of the Cracău-Bistrița depression, exactly at the contact of the continental and alpine biogeographic regions (Fig. 1).

From a hydrological point of view, we are at the confluence of the Bistrița river with its Cujețiu tributary, in a geological, geomorphological, pedological, and climatic contact area (Apăvăloae, 2005).

Cradle of historical civilizations, this small territory hides besides Paleolithic, Neolithic, Antique and Medieval treasures, also some of unique natural sites.

No less than seven protected natural areas, four of national interest and three NATURA 2000 sites are home to hundreds of rare plant and animal species, as well as Oligocene fish fossils of world scientific importance (Bojoi & Ioniță, 1974).

In this puzzle, the presence of the land-snails, as silent witnesses of the changes that have taken place in the last millions of years, they can provide us with essential information about the past and a projection of the future (Grigore, 2019)

The purpose of this paper is to present the list of terrestrial gastropod fauna discovered on the territory of the municipality of Piatra-Neamț.

Historically, sporadic collections from four localities were made upstream on the Bistrița valley: Tarcău, Bicaz, Ceahlău and Broșteni.

The first observations are made at the end of the 19<sup>th</sup> century (Montandon, 1880) and continued later over fifteen years (Licherdopol, 1895).

Since the middle of the 20<sup>th</sup> century, research has been done especially in the lake area of the future Bicaz hydropower plant (Grossu, 1981, 1983, 1986, 1987), and Pângărați (Hușanu, 1973).

Starting with the summer of 1990, the whole area became our center of interest for thirty years, the results being detailed in this paper.

### MATERIALS AND METHODS

The area of study were hydrological delimited in five basins of the Bistrița tributaries, three left: Sărata(1), Cujețiu (2), Potocina (3), and two right: Doamna (4) and Mănăstirii (5). Also three mountain ridges were geomorphological delimited: Cozla (6), Pietricica (7), Cernegura (8) as well as one hill: Dealul Vulpilor – Boțoaia (9). We have added to these nine areas, which preserve the natural setting, the tenth: Anthropogenic Habitat (10), located in the city, such as parks, gardens, cellars and green roofs (McKinney & others, 2019).

A large part of these areas overlap totally or partially over the seven protected natural areas located on the territory studied by us (Fig. 2).

The land snail fauna studied was collected during the field exploration by two methods:

- directly from the biotope through manual collection (80 % of the material).
- secondarily through the sieving procedure, on a metallic sieve with 3 mm. meshes for soil and boscage (20 % of the material).

\*We do not use any traps. Thus, a number of 1.000 land snail shells were quantified, of which 90 % was perfectly preserved, and 10 % was juveniles or undeterminable remains. In addition, a number of 200 slug bodies have been preserved in an ethanol solution 70 %.

Taxonomic identifications were carried out using the current basic classification according to the International Union for Conservation of Nature (IUCN) as well as the classical historical and regional ones (Grossu, 1981, 1983, 1987) and (Riedel, 1988), using Bresser Erudit optical microscope and the determination keys of Alexandru V. Grossu (1993).

### RESULTS AND DISCUSSIONS

A number of forty-eight species of land-snail have been identified, belonging to fourteen families. The list of them is presented below, along with some general features (Table 1).

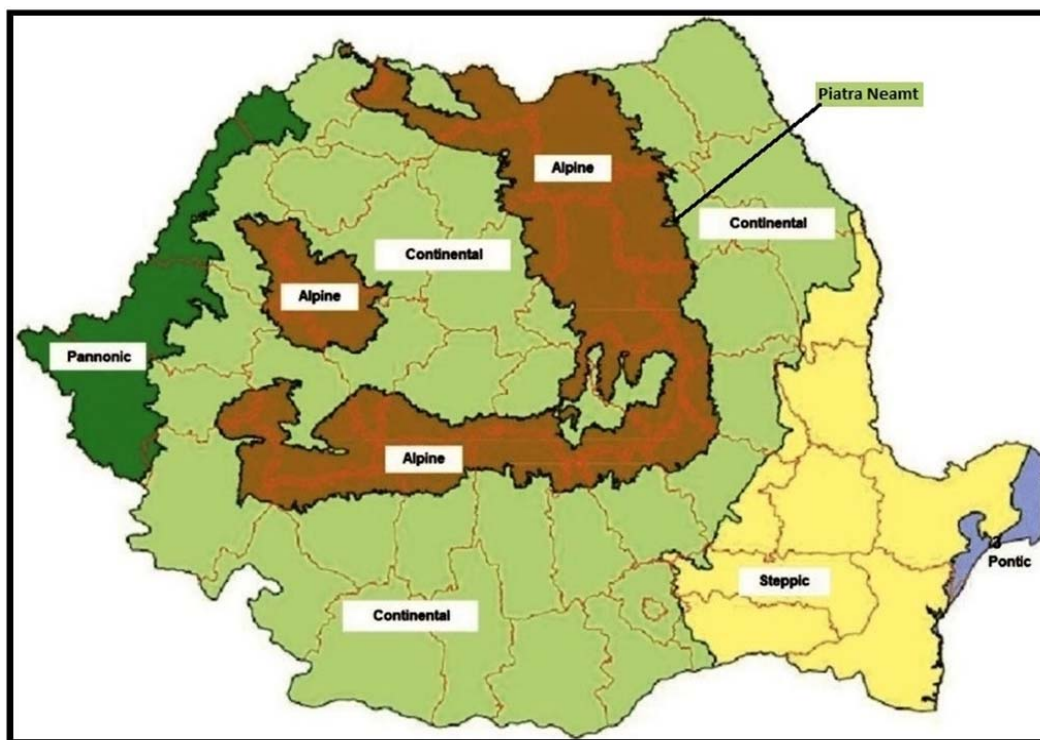


Fig. 1. The map of the European biogeographical regions of Romania

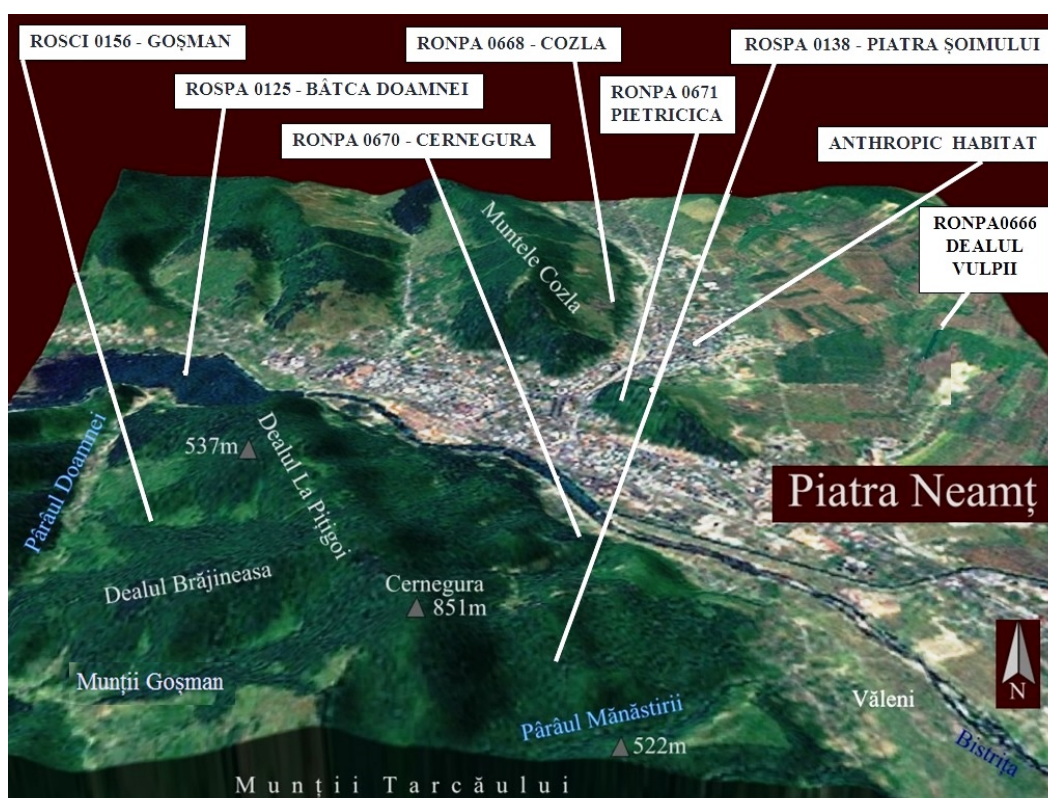


Fig. 2. The map of the most interesting observation points from the natural protected areas of Piatra-Neamț

Table 1. The list of terrestrial gastropods species identified in Piatra-Neamț with their humidity preferences (X-Xerophilous, M-Mesophilous, H-Hygrophilous) and the zoogeographic range

No	Binomial name	Humidity preferences	Zoogeographic range
1.	<i>Succinea putris</i> (LINNAEUS, 1758)	H	European-Siberian
2.	<i>Succinella oblonga</i> (DRAPARNAUD, 1801)	H	European-Siberian
3.	<i>Cochlicopa lubrica</i> (MULLER, 1774)	H	Holarctic
4.	<i>Pupilla muscorum</i> (LINNAEUS, 1758)	M	Holarctic
5.	<i>Columella edentula</i> (DRAPARNAUD, 1805)	H	Holarctic
6.	<i>Ena montana</i> (DRAPARNAUD, 1801)	M	European
7.	<i>Chondrula tridens</i> (MULLER, 1744)	X	European
8.	<i>Cochlodina laminata</i> (MONTAGU, 1803)	M	European
9.	<i>Clausilia dubia</i> (DRAPARNAUD, 1805)	M	European
10.	<i>Macrogaster plicatula</i> (DRAPARNAUD, 1801)	M	European
11.	<i>Laciniaria plicata</i> (DRAPARNAUD, 1805)	M	European
12.	<i>Pseudolinda fallax</i> (ROSSMASSLER, 1836)	M	Carpathian
13.	<i>Vestia elata</i> (ROSSMASSLER, 1836)	M	Carpathian
14.	<i>Arion vulgaris</i> (MOQUIN-TANDON, 1855)	M	European
15.	<i>Arion subfuscus</i> (DRAPARNAUD, 1805)	M	European
16.	<i>Semilimax semilimax</i> (FERUSSAC, 1802)	M	European
17.	<i>Zonitoides nitidus</i> (MULLER, 1774)	H	Holarctic
18.	<i>Vitrea diaphana</i> (STUDER, 1820)	M	East-European
19.	<i>Perpolita petronella</i> (PFEIFFER, 1853)	M	Boreal
20.	<i>Perpolita hammonis</i> (STROM, 1765)	M	Palaearctic
21.	<i>Aegopinella minor</i> (STABILE, 1864)	M	East-European
22.	<i>Aegopinella pura</i> (ALDER, 1830)	M	European
23.	<i>Oxychilus depressus</i> (STERKI, 1880)	M	Central-European
24.	<i>Cellariopsis deubeli</i> (CLESSIN, 1887)	M	Carpathian
25.	<i>Carpathica calophana</i> (WESTERLUND, 1881)	M	Carpathian
26.	<i>Limax maximus</i> (LINNAEUS, 1758)	M	European
27.	<i>Limax cinereoniger</i> (WOLF, 1803)	M	European
28.	<i>Bielzia coerulans</i> (BIELZ, 1851)	M	Central-European
29.	<i>Deroceras moldavicum</i> (GROSSU&LUPU, 1961)	M	Carpathian
30.	<i>Deroceras reticulatum</i> (MULLER, 1774)	M	European
31.	<i>Euconulus fulvus</i> (MULLER, 1774)	H	Holarctic
32.	<i>Fruticicola fruticum</i> (MULLER, 1774)	H	European-Siberian
33.	<i>Xerolenta obvia</i> (MENKE, 1828)	X	Central-European
34.	<i>Helicopsis striata</i> (MULLER, 1774)	X	European
35.	<i>Monacha carthusiana</i> (MULLER, 1774)	X	European
36.	<i>Perforatella bidentata</i> (GMELIN, 1788)	H	East-European
37.	<i>Perforatella dibothrion</i> (KIMAKOWICZ, 1890)	M	Carpathian
38.	<i>Monachoides vicinus</i> (ROSSMASSLER, 1842)	H	Carpathian
39.	<i>Monachoides incarnatus</i> (MULLER, 1774)	M	European
40.	<i>Euomphalia strigella</i> (DRAPARNAUD, 1801)	M	Central-European
41.	<i>Trochulus hispidus</i> (MULLER, 1774)	M	European
42.	<i>Trochulus sericeus</i> (DRAPARNAUD, 1801)	H	Alpine
43.	<i>Isognomostoma isognomostomos</i> (GMELIN, 1788)	M	Alpine
44.	<i>Faustina faustina</i> (ROSSMASSLER, 1835)	M	Carpathian
45.	<i>Cepaea vindobonensis</i> (FERUSSAC, 1821)	X	East-European
46.	<i>Helix pomatia</i> (LINNAEUS, 1758)	M	Central-European
47.	<i>Helix lucorum</i> (LINNAEUS, 1758)	M	East-European
48.	<i>Helix lutescens</i> (ROSSMASSLER, 1837)	M	Carpathian

The percentage distribution after their humidity preferences are shown in Fig.3.

This distribution is in perfect accordance with the local climatic conditions (Apăvăloae, 2005), but also with the geomorphological ones (Bojoi & Ioniță, 1974).

A similar distribution can be noticed in the north of Prahova County, with the preservation in an excessively continental climate of some hygrophilous or xerophilous forms, retreated today further south, especially in the Balkan Peninsula (Grossu & Stoicescu, 1972).

The fauna belongs from a zoogeographical point of view to eight major categories (Fig. 4).

The European elements are predominant, which are 35,4 % follow by Central-East-European elements with 20,8 % and Carpathian elements with 18,7 %, which amounts to 75 % of the total.

The best represented families are Helicidae family with sixteen species, followed by Clausiliidae family with six species which amounts to 50 % of the total. It is remarkable the the population similarity of land-snail from north of Apostolache - Cricovul Sărat (Prahova County), with those discovered by us on the Doamna valley – Piatra-Neamț, for the malacological biocenosis of deciduous forests located also in an area of continental – alpine biogeographical interference (Stoicescu & Grigore, 1976).

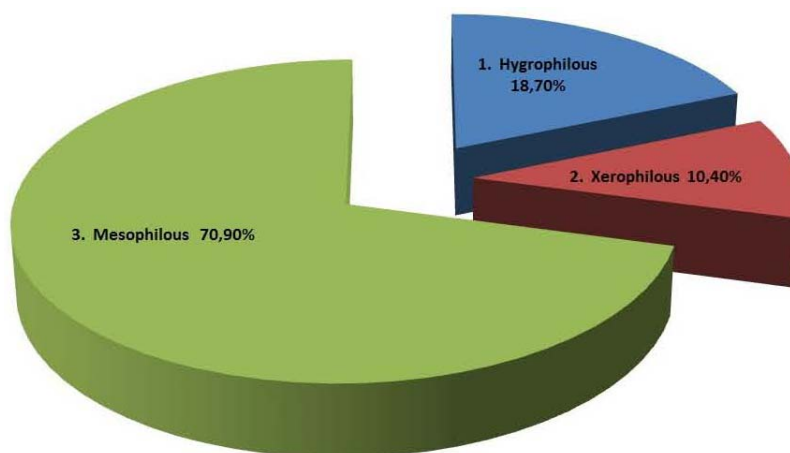


Fig. 3. The humidity preferences spectrum of the terrestrial gastropods fauna from Piatra-Neamț

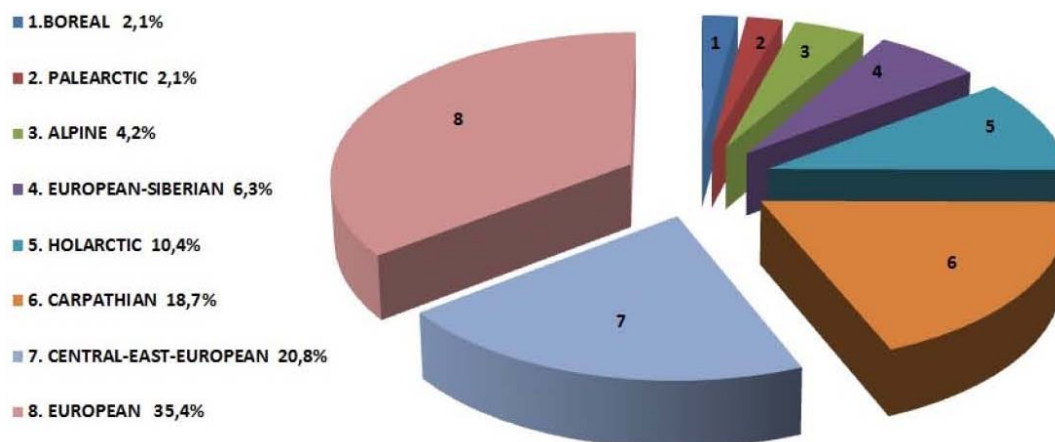


Fig. 4. The zoogeographical spectrum of the terrestrial gastropods fauna from Piatra-Neamț

## CONCLUSIONS

The land-snail diversity of Piatra-Neamț, studied for the first time, belongs to five main habitats:

steppe, forest, grassland, riparian and anthropic.

The most representative areas together their standard species are the following:

1. Steppe - Dealul Vulpilor-Botoaia (*Chondrula tridens*, *Xerolenta obvia*, *Helicopsis striata*, *Monacha carthusiana*, *Cepaea vindobonensis*, *Helix pomatia*)
2. Forest - Padurea Cernegura (*Cochlodina laminata*, *Clausilia dubia*, *Laciniaria plicata*, *Oxychilus depressus*, *Isognomostoma isognomostoma*, *Helix lucorum*)
3. Grassland - Poiana Ciresului ( *Pupilla muscorum*, *Aegopinella minor*, *Euconulus fulvus*, *Euomphalia strigella*, *Faustina faustina*, *Helix lutescens*)

4. Riparian - Valea Doamnei (*Succinea putris*, *Succinea oblonga*, *Cochlicopa lubrica*, *Columella edentula*, *Zonitoides nitidus*, *Trochulus sericeus*)

5. Anthropogenic - Cartier Darmanesti (*Arion vulgaris*, *Limax maximus*, *Deroceras reticulatum*, *Xerolenta obvia*, *Cepaea vindobonensis*, *Helix lucorum*)

We emphasize that the invasive *Arion vulgaris*, is the first records for Moldova region and it causes significant damage in vegetable gardens every year.

We notice the presence of the Helicidae family in all habitats of Piatra-Neamț and the presence of Clausiliidae family only in the forest habitat (Sulikowska-Drozdz, 2005).

We note the special ecological role of the riparian habitat for all the other habitats present and their species (Fischer, 1938), (Patterson, 1971), (Forsyth, 2004).

At Piatra-Neamț we have another confirmation of the specificity of the contact habitats, noticed since a century ago (Berry, 1922), as well as the interference of the different biogeographical areas, as beneficial for the diversity of land-snail fauna (Backer, 1939).

We aim to present detailed each habitat of Piatra-Neamț in future papers.

### ABSTRACT

This paper presents the list of land-snail to be found within the administrative territory of Piatra-Neamț (Romania). The material of study, which encompasses more than 1.200 samples, is the result of thirty years of observation and collecting, spanning between 1990 and 2020. We have identified 48 species of land-snail, belonging to 14 families.

The area of study includes seven natural protected areas, of which four are of national interest and three are NATURA 2000 sites. The list of land-snail presented (the first on this territory), predominantly comprises continental elements, plus alpine forms, as well as a rare and isolated steppe biocoenosis.

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