

THE DIPLOPODA FROM THE MIDDLE COURSE OF ARGEȘ RIVER

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Abstract. 23 species of Diplopoda are recorded from the poorly investigated region of the middle basin of the Argeș River, several species being recorded for the first time in this region while for other species like *Rumaniulus mammosus* it expands the known distribution.

Keywords: Diplopoda, Glomeridae, Polydesmidae, Mastigorophyllidae, Julidae, Argeș, Romania.

1. INTRODUCTION

The millipede fauna of Romania is generally well-known as a result of the papers published by Latzel, Daday, Verhoeff, Attems, Loksa, Ceuca and Tabacaru (TABACARU, 1979; TABACARU, GIURGINCA, VĂNOAICA, 2004; GIURGINCA, 2021).

171 species from 62 genera, 19 families and 7 orders form the Diplopod fauna of Romania. Among the orders of the Class Diplopoda recorded in Europe, the fauna of Romania does not contain the order Platydesmida, while the order Callipodida is represented only by *Callipodela fasciata* and *Dorypetalum degenerans*: in the case of both species, South-Western Romania is the northern limit of their spreading (TABACARU, GIURGINCA, VĂNOAICA, 2004; GIURGINCA, 2021).

The number of Diplopoda species found in Romania exceeds the number of species from other European countries: 51 species in Britain and Ireland (BARBER & JONES, 1996), 127 species in Switzerland (PEDROLI – CHRISTEN, 1996), 160 species in Germany (SCHUBART, 1934), 81 species in Poland (STOJALOWSKA & STAREGA, 1974), 110 species in Bulgaria (BERON, 1994), 70 species in Serbia, 59 species in Montenegro and 59 species in Macedonia (ĆURČIĆ, MAKAROV, STANKOVIĆ-JOVANOVIĆ, 2002A & B). But, the number of Diplopoda species found in France, 282 species (GEOFFROY, 1996) and in Italy, 470 species (STRASSER & MINELLI, 1984) clearly exceeds the number of species from Romania (TABACARU, GIURGINCA & VĂNOAICA, 2004; GIURGINCA, 2021).

However, the number of millipede species from Romania mentioned above is underestimated since several regions are not thoroughly investigated from a faunistic point of view (GIURGINCA, 2021). The middle course of the Argeş River represents such a region. To our knowledge, there are only two studies in the northern part of the High Plain of the town Piteşti, precisely on the contact line with the Cotmeana and Cândeşti Piedmont (GAVA, 2004, 2009).

Our aim is to investigate the millipede fauna of the riparian zones in the middle basin of the Argeş River.

2. MATERIAL AND METHODS

The sampling sites were located along small streams in the middle basin of the Argeş River (South-Eastern Romania). The sampling took place each month between May and November 2018. Three types of sites were selected for the study: forest sites (F), sites with (R) and without (I) forested riparian buffer. Sites with forested buffers were located a short distance (50–500 m) downstream of those without forested riparian buffers.

The F sites are: F1: Gura Pravăţ (Getic Subcarpathians), F4 and F5: Cândeşti (Iezer-Păpuşa Mountains). The R sites are: R1: Muşcel (Getic Subcarpathians), R2 and R3: Cândeşti (Getic Subcarpathians), R7: Miloşari (Getic Plateau), R8: Măgura (Getic Plateau) and R9: Valea Caselor (Getic Plateau). The I sites are: I1: Muşcel (Getic Subcarpathians), I2 and I3: Cândeşti (Getic Subcarpathians), I7: Miloşari, I8 and I9: Măgura, I11: Davideşti, I13: Rudeni and I14: Gura Foi are all within the Getic Plateau. The altitude of the collecting sites is presented in Table 1 and Fig.1.

The vegetation in the F sites is represented by a mature, mixed forest (*Alnus glutinosa*, *Picea abies*) and a mature *Fagus sylvatica* forest, with rich leaf litter, dead-wood logs and unmanaged herbaceous groundcover. Generally, the vegetation of the R sites presents a higher diversity than in the F sites. *Alnus glutinosa* is present in each site, except R1 and R9. Other 11 tree species occur in up to four sites, among which *Salix alba*, *Cornus sanguinea* and *Crataegus monogyna* are more frequent. Leaf litter is less abundant than in the forest sites, and in some cases (e.g., R3, R8), the herbaceous groundcover is managed. Generally, in the I sites there are no or few trees (*Alnus glutinosa*, *Salix alba*, *Crataegus monogyna*, *Robinia pseudoacacia*, *Malus sylvestris* and *Rosa canina*), the leaf litter is absent, and the herbaceous groundcover is predominantly managed. Bare rocks may occur in some plots. Among the I sites, there are some matrix sites (I11, I13 and I14) placed downstream of the other sites.

A total of 18 sites were selected for the study, each stretching along a 30 m river section. On each site, nine Barber pitfall traps were placed along each river bank at three different distances from the shore (1 m, 5 m and 15 m). Round-mouthed plastic cups were used as Barber traps. Each cup had a volume of 400 ml and a top diameter of 95 mm. Antifreeze gel and ethylene glycol were used as preservatives in each trap. After the sampling, the trapped invertebrates were sorted and preserved in tubes filled with 70% concentrated alcohol.

3. RESULTS AND DISCUSSION

A total of 23 species of Diplopoda are recorded from the studied area. Four of the seven orders of Diplopoda recorded in Romania are represented (Polyxenida, Callipodida and Polyzonida are absent).

The order Julida, the best represented by 13 species, includes the families Blaniulidae and Julidae. No species from the family Nemasomatidae was found. The situation mirrors the general composition of the order Julida in Romania: the family Nemasomatidae is represented by only one species (*Nemasoma varicorne* C.L. Koch, 1847), while the Blaniulidae has 6 species, and the Julidae has 62 species (see GIURGINCA, 2021 for more details).

The order Polydesmida is the second most important order with 7 species. Two of the three families recorded in Romania (Paradoxosomatidae and Polydesmidae) are present: the former with 1 species and the latter with 5 species. The third family, Trichopolydesmidae, is absent from the studied area as its representatives are endemic species, generally restricted to a limited number of caves (three of the four species are troglobitic) or to a strictly localized area (*Napocodesmus endogeus* known only from the garden of the Institute of Zoology Cluj, see CEUCA, 1974 and GIURGINCA, 2021).

The order Chordeumatida is represented by a single species, *Mastigona transsylvanica*, from the family Mastigophorophyllidae. All the other families (Haaseidae, Anthroleucosomatidae, Brachychaeteumatidae, and Entomobielziidae) are absent, as their representatives are mostly endemic species known from relatively few locations.

Rather surprisingly, the order Glomerida is present by a single species from the family Glomeridae. The other family recorded from Romania, Trachysphaeridae, was not found. As the spreading of the *Trachysphaera* species is linked to the limestone regions, this can explain the absence of the family from the studied area (TABACARU, 1979; TABACARU, GIURGINCA, VĂNOAICA, 2004). However, this does not explain the absence of other species of *Glomeris* from this area.

The sole individual of *Glomeris connexa* was collected at Gura Pravăţ, a site located at the highest altitude (795 m) in a mixed, mature forest (*Alnus glutinosa* and *Picea abies*). As the species is distributed along the entire chain of the Romanian Carpathians (GIURGINCA, 2021), in the leaf-litter of both deciduous and coniferous forests (CRIŞAN, 1999), it is surprising it was not recorded in the other sites investigated by this study.

Strongylosoma stigmatosum was also recorded only at Căndeşti but at sites located at altitudes varying from 638 m to 730 m. It was collected from a *Fagus sylvatica* forest and from riparian forested buffer strips with *Alnus glutinosa*, *Salix alba*, *Cornus sanguinea*, *Sambucus nigra* and *Crataegus monogina*. Unmanaged grass was also present.

As in the case of *Glomeris connexa*, this is a medium altitude, as both species are known from the Retezat Mountains, at an altitude of 1790 m (GIURGINCA, PLĂIAŞU, MUNTEANU, 2007).

Brachydesmus polydesmoides is a rare species in Romania: it is known from four locations, one of them being a cave, all of them located in the Banat Mountains and the westernmost part of the Southern Carpathians (GIURGINCA, 2021). Our study adds two new locations in the Getic Subcarpathians at Căndești and Gura Pravăț, at altitudes of 645 – 655 m, the highest location being at 795 m.

The species was collected in a mature, mixed forest of *Picea abies* and *Alnus glutinosa* and in riparian buffers with (*Alnus glutinosa*, *Cornus sanguinea*, *Crataegus monogyna*, *Salix alba*, *Sambucus nigra*) and without woody vegetation strips (only a few individuals of *Alnus glutinosa*). Unmanaged grass was present in all sites, except one site without riparian forested buffer.

Brachydesmus superus is also a rare species in Romania, with only a few scattered records (GIURGINCA, 2021), one of them in the close-by forests of Făget, Zăvoi and Trivale (GAVA, 2004, 2009). We have collected it in only one location, Valea Caselor, at 230 m altitude, between the Getic and Căndești Plateaus. It was collected only in a forested riparian buffer site with *Salix alba*, *Acer negundo* and unmanaged grass.

For *Polydesmus burzenlandicus* this is the second record from the Southern Carpathians, the first being at Păltiniș (1440 m altitude) (CEUCA & CRIȘAN, 1998). We recorded the species at Căndești at 720 m altitude, in the Iezer-Păpușa Mountains, in a mature forest with *Fagus sylvatica* and at Gura Pravăț at 795 m altitude in the Getic Subcarpathians in a mature, mixed forest of *Picea abies* and *Alnus glutinosa*.

Polydesmus complanatus is a widespread species in Romania, along the entire Carpathian chain. We recorded its presence in several localities from the Getic Plateau (Miloșari, Davidești and Rudeni), Getic Subcarpathians (Mușcel and Gura Pravăț) and the Iezer-Păpușa Mountains (Căndești). In this area, the lowest recorded altitude is 258 m at Miloșari, and the highest, at 795 m, is at Gura Pravăț. It was collected from all vegetation types, from mature, mixed forests to sites almost devoid of trees or only with isolated individuals of *Salix alba*. Unmanaged grass was also present in all sites, except one site without riparian forested buffer.

For *Polydesmus renschi*, this is the second record from the Getic Plateau, namely at Măgura, Miloșari and Valea Caselor, in forested riparian buffers with *Alnus glutinosa*, *Salix alba*, *Cornus sanguinea*, *Acer negundo*, *Juglans regia*, *Morus nigra*, *Prunus cerasifera*, *Sambucus nigra* or *Ulmus glabra* and in sites without forested riparian buffer (only with individuals of *Salix alba*). Unmanaged grass was present in all sites except one site without riparian forested buffer. It was collected up to an altitude of 262 m.

Polydesmus schaessburgensis is a relatively rare but broadly distributed species. It was previously collected on the contact line between the Căndești and Cotmeana plateaus (GAVA, 2004, 2009). We recorded its presence in Getic Subcarpathians (Mușcel and Căndești) and the Iezer-Păpușa Mountains (also Căndești) ranging from 560 m up to 730 m altitude and all vegetation types. Unmanaged grass was present in all the locations.

Mastigona transsylvanica was collected from the Getic Plateau (Miloşari, Măgura, Davideşti, and Rudeni), the Getic Subcarpathians (Muşcel, Căndeşti and Gura Pravăţ) and the Iezer-Păpuşa Mountains (at Căndeşti), ranging from 258 m up to 795 m altitude, from a mature mixed forest (*Picea abies* and *Alnus glutinosa*) and a mature *Fagus sylvatica* forest to sites with *Alnus glutinosa*, *Salix alba*, *Crataegus monogyna*, *Morus nigra*, *Cornus sanguinea*, *Juglans regia*, *Populus nigra*, *Prunus cerasifera*, *Robinia pseudacacia*, *Sambucus nigra*, *Ulmus glabra* and even in sites without tree cover or only with individuals of *Salix alba* and *Robinia pseudacacia*. Unmanaged grass was present in all the locations.

Nopoiulus kochii is a rather rare species being known from only two edaphic and six cave locations in Romania (GIURGINCA, 2021). We found the species at other two edaphic locations in Romania: at 645 m altitude, at Căndeşti (Getic Subcarpathians) in a forested riparian area, with *Alnus glutinosa*, *Crategus monogina*, *Cornus sanguinea*, *Salix alba*, *Sambucus nigra* and at 265 m altitude, at Măgura (Getic Plateau) in a site without forested riparian buffer, with *Crategus monogina*, *Malus sylvestris*, *Rosa canina*. Unmanaged grass was present in both locations.

Allopoiulus verhoeffi is a rather rare species, known mostly from Transylvania (GIURGINCA, 2021), this being the first record from Iezer-Păpuşa Mountains (Căndeşti), Getic Plateau (Măgura and Miloşani) and Getic Subcarpathians (Căndeşti and Gura Pravăţ) ranging from 262 m up to 795 m altitude. The species was collected in a mature, mixed forest of *Picea abies* and *Alnus glutinosa* and in a mature *Fagus sylvatica* forest and in riparian buffers without woody vegetation strips, with individuals of *Crategus monogina*, *Malus sylvestris*, *Rosa canina* and *Salix alba*. Unmanaged grass was also present in all sites, except one site without riparian forested buffer.

Brachyiulus bagnalli is a rare species known from Dobrogea and just one location from the Getic Plateau (see CEUCA, 1992; GIURGINCA, 2021). We now recorded two new locations from the Getic Plateau, at 229 m altitude: Măgura, in a riparian area without woody vegetation and at 230 m altitude: Valea Caselor, in a riparian forested buffer with, *Salix alba*, and *Acer negundo*. Unmanaged grass was present in both locations.

Cylindroiulus burzenlandicus is known mainly from the Eastern and Curvature Carpathians (GIURGINCA, 2021): this is the first record from the Getic Subcarpathians at an altitude of 795 m in a mature, mixed forest of *Picea abies* and *Alnus glutinosa*.

Cylindroiulus horvathi is a rare species, patchily distributed in Romania and up to the present known only from five locations (GIURGINCA, 2021): this is the first record from the Getic Plateau, at Valea Caselor, at 230 m altitude, a location with forested riparian buffer with *Salix alba*, *Acer negundo* and unmanaged grass

Julus terrestris is another rare species, patchily distributed from Apuseni Mountains to the Danube Delta (GIURGINCA, 2021). This is the first record from the Getic Plateau, at Gura Foi, at 192 m altitude, a location with unmanaged grass and without tree cover.

Leptoiulus cibdellus also known from only a few locations scattered from Transylvania to the Danube Delta and the Romanian Plain (GIURGINCA, 2021), is recorded for the first time in the Getic Plateau, at Miloşari and Măgura, at an altitude of 262–265 m, in two riparian buffers without woody vegetation strips, with individuals of *Salix alba*, *Crataegus monogyna*, *Malus sylvestris* and *Rosa canina*. Unmanaged grass was present in only one location.

Leptoiulus trilobatus is a relatively widespread species from the northern part of the Romanian Carpathians to the Banat Mountains but was never recorded from Dobrogea (GIURGINCA, 2021). This is the first record of the species from the Getic Subcarpathians and the Iezer-Păpuşa Mountains, at Căndeşti (645 m and 730 m altitude, respectively). It was collected in a mature, *Fagus sylvatica* forest and in a forested riparian buffer with *Alnus glutinosa*, *Cornus sanguinea*, *Salix alba*, *Crataegus monogyna* and *Sambucus nigra*. Unmanaged grass was present in both locations.

Megaphyllum projectum is widely distributed in Romania (GIURGINCA, 2021). Nevertheless, this is the species first record in the Getic Plateau (Măgura, at 265 m altitude), the Getic Subcarpathians (Căndeşti, at 638 m altitude) and in the Iezer-Păpuşa Mountains (also Căndeşti, at 720 m and 730 m altitude). It was collected from a mature *Fagus sylvatica* forest, but also from sites with and without forested riparian buffer, the following species being present: *Alnus glutinosa*, *Crataegus monogyna*, *Malus sylvestris* and *Rosa canina*. Unmanaged grass was present in all the locations.

Megaphyllum rosenauense is patchily distributed from the northern part of the Romanian Carpathians to the Romanian Plain (GIURGINCA, 2021) where it was collected near Piteşti, also on the Argeş River (GAVA, 2004, 2009).

It was collected from all the regions investigated (Getic Subcarpathians, Getic Plateau and Iezer-Păpuşa Mountains) from an altitude of 229 m up to 795 m and in all vegetation types from mature, mixed forest to sites with no leaf-litter. Unmanaged grass was also present in all sites, except two sites without riparian forested buffer.

Megaphyllum unilineatum is widely distributed in Romania, even in Bucharest (GIURGINCA, 2021). It was collected at Miloşari and Măgura (at 260 – 265 m altitude) in sites with and without forested riparian buffers, the following species being present: *Alnus glutinosa*, *Crataegus monogyna*, *Populus nigra*, *Robinia pseudoacacia*, *Ulmus glabra*, *Malus sylvestris*, *Rosa canina* and *Salix alba*. Unmanaged grass was present in all sites, except one site without riparian forested buffer.

Pachyiulus hungaricus presents a patchy distribution in Transylvania, along the Southern Carpathians to the Banat Mountains and in the Romanian Plain where it was collected near Piteşti, also on the Argeş River (GAVA, 2004, 2009; GIURGINCA, 2021). The species was collected in mature forests (a *Fagus sylvatica* forest and a mixed forest with *Alnus glutinosa* and *Picea abies*), forested riparian buffer sites (with *Alnus glutinosa*, *Cornus sanguinea*, *Juglans regia*, *Morus nigra*, *Prunus cerasifera*, *Salix alba*, *Sambucus nigra* and *Ulmus glabra*) and in a riparian area without woody vegetation. Unmanaged grass was present in all the locations.

This is the first record of the species in the Getic Plateau (Miloşari, 258 m altitude), Getic Subcarpathians (Cândeşti, at 638 – 649 m altitude and Gura Pravăţ, at 795m altitude) and Iezer-Păpuşa Mountains (Cândeşti, 720 – 730 m altitude).

By far the most interesting species collected is *Rumaniulus mammosus* Attems, 1927. Up to the present the species was known only from the type locality, Aluniş (Kecsed as ATTEMS recorded it in his publication 1927), a village located approximately 43 km northward from Cluj-Napoca, at approximately 342 m altitude.

This represents a second record of the species from Romania in two new locations: Cândeşti (730 m) and Gura Pravăţ (795 m). Both locations are in Argeş County on the southern slope of the Southern Carpathians: the first is in the Iezer-Păpuşa Mountains and the second in the Getic Subcarpathians. The distance between the location given by Attems and the new records is approximately 220 km as the crow flies. Moreover, the altitude of the new locations is twice as high as that of the original location (see Fig. 2).

ATTEMS (1926) records finding the species in the leaf-litter of a beech forest. Both our locations are in mature forests of *Fagus sylvatica* or *Alnus glutinosa* and *Picea abies*, the soil being covered by leaf-litter.

Xestoiulus laeticollis is known from only four locations in Romania, having a patchy distribution in Transylvania and in Bărăgan Plain (GIURGINCA, 2021). This is the first record of the species in the Getic Subcarpathians, at Cândeşti, at an altitude of 645 m in a forested riparian buffer with *Alnus glutinosa*, *Cornus sanguinea*, *Crategus monogina*, *Salix alba*, *Sambucus nigra* and unmanaged grass and in a mature *Fagus sylvatica* forest in the Iezer-Păpuşa Mountains at an altitude of 720 m (also at Cândeşti).

As this study clearly points out, our knowledge on the distribution of numerous species of millipedes from Romania is still relatively patchy, despite the fact that the fauna of Romanian Diplopoda is generally well-known. In our view, this outlines the need for more thorough faunistic studies in the near future.

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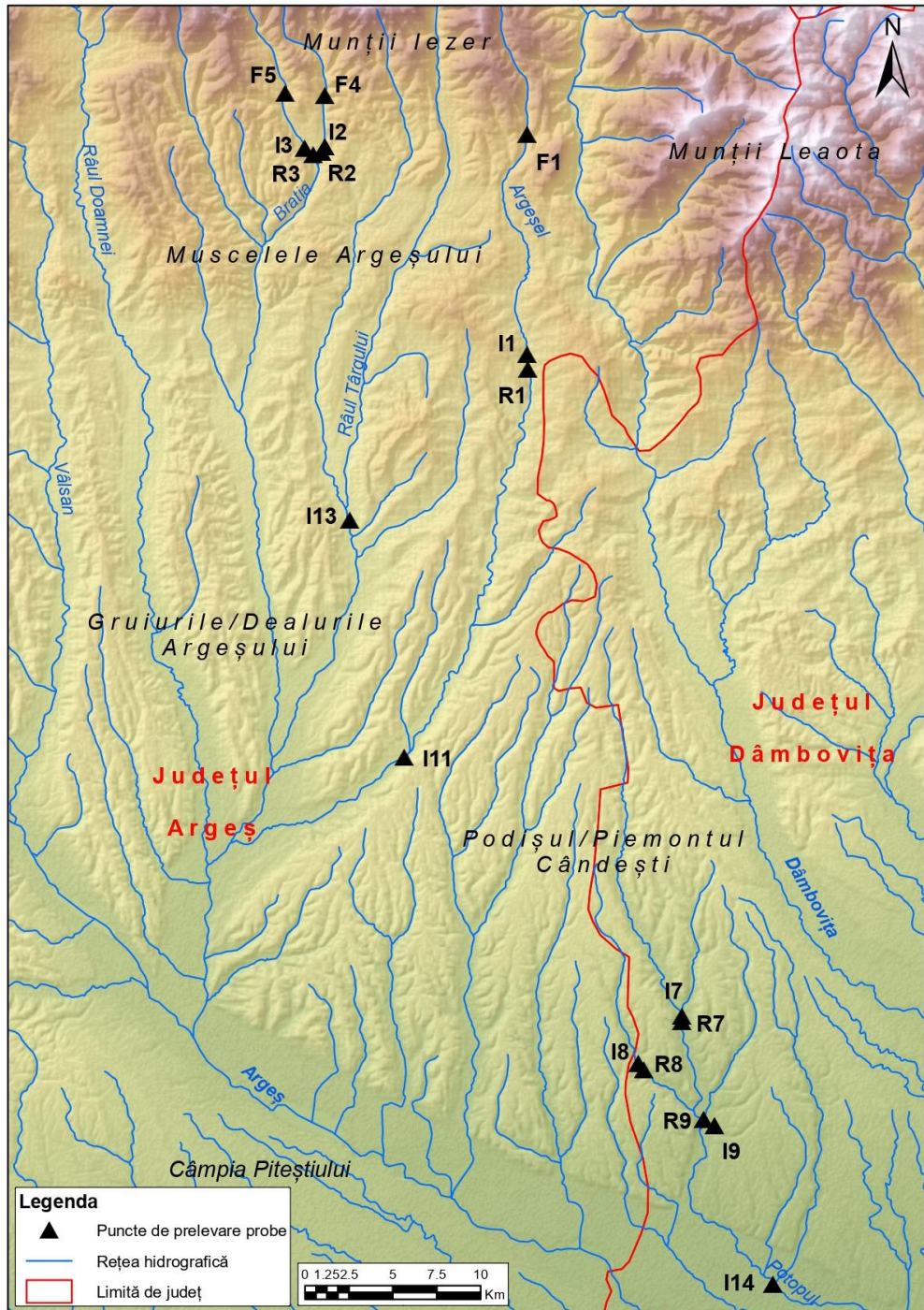


Fig.1. Map of the sampling sites (for the name of the sites, see text).

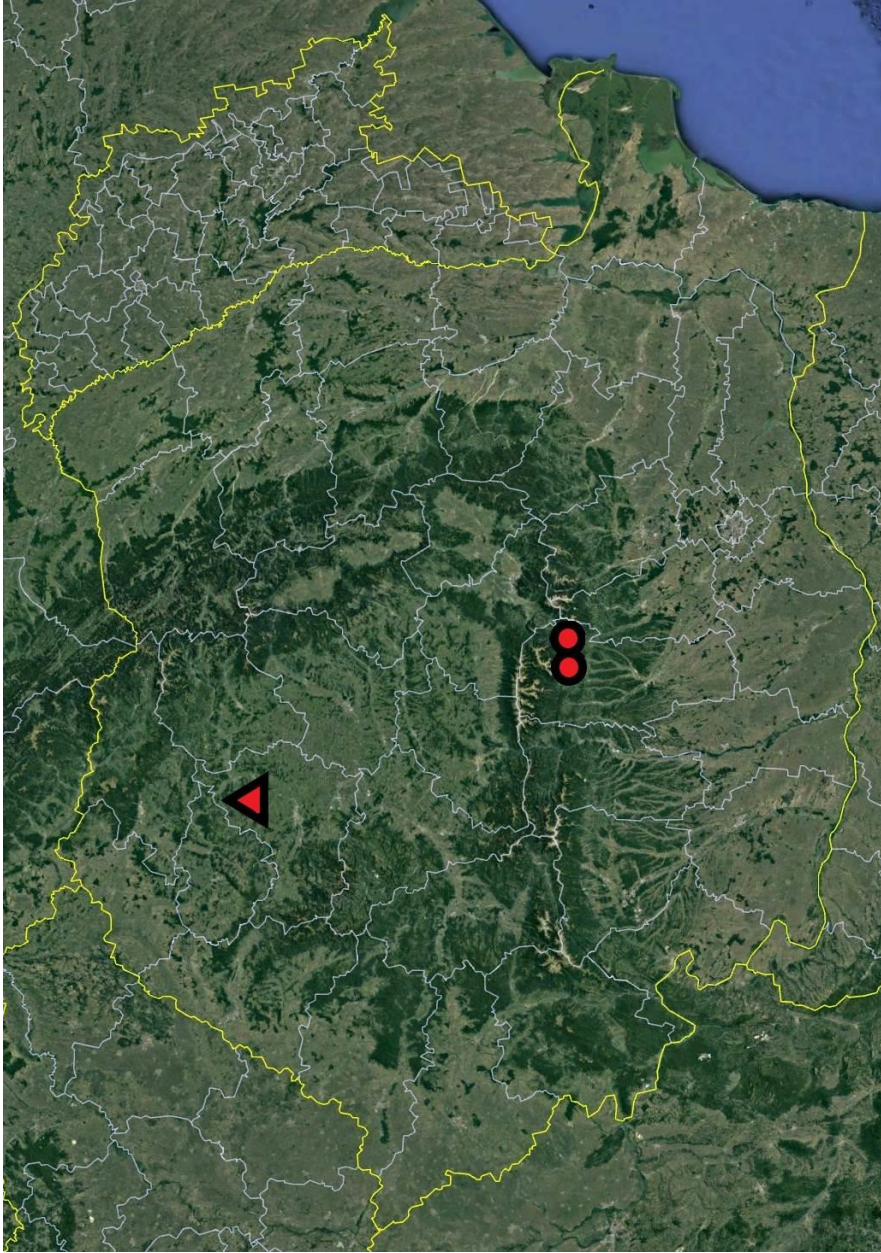


Fig. 2. Distribution of *Rumaniulus mammosus*: triangle: Aluniș (after ATTEMS, 1927); circles: Cândești, Gura Pravăț, the new locations (map by dr. N. Cruceru).

Table 1. Species distribution according to altitude: F1–Gura Pravăț, F4, F5, R2, R3, I2, I3–Cândești, R1, I1–Muscel, R7, I7–Miloșani, R8, R9, I8, I9–Măgura, I11–Davidești, I13–Rudeni, I14–Gura Foi. Locality Altitude (m-a.s.l.)

	I14	I9	R9	R7	R8	I7	I8	I11	I13	R1	I1	R3	R2	I3	I2	F4	F5	F1	
Order Glomerida Brandt, 1833																			
Family Glomeridae Leach, 1815																			
1 <i>Glomeris connexa</i> C.L.Koch, 1847																			X
Order Polydesmida Pocock, 1887																			
Family Paradoxosomatidae Daday, 1889																			
2 <i>Strongylosoma stigmatosum</i> Eichwald, 1830												X	X						X
Family Polydesmidae Leach, 1815																			
3 <i>Brachydesmus polydesmoides</i> Verhoeff, 1895			X			X							X	X	X				X
4 <i>Brachydesmus superus</i> Latzel, 1884																			
5 <i>Polydesmus burzenlandicus</i> Verhoeff, 1925																			X
6 <i>Polydesmus complanatus</i> (Linnaeus, 1761)				X		X	X	X				X	X	X					X
7 <i>Polydesmus renschi</i> Schubart, 1934		X	X	X		X													
8 <i>Polydesmus schaefferburgensis</i> Verhoeff, 1898								X				X	X						X
Order Chordeumatida Pocock, 1894																			
Family Mastigophorophyllidae Verhoeff, 1899																			
9 <i>Mastigona transsylvanica</i> Verhoeff, 1897			X	X			X			X	X	X	X	X	X	X	X	X	X
Order Julida Brandt, 1833																			
Family Biantulidae C.L. Koch, 1847																			
10 <i>Nopoiulus kochii</i> Gervais, 1847													X						
Family Julidae Leach, 1814																			
11 <i>Alloporotulus verhoeffi</i> (Jawłowski, 1931)						X	X							X		X			X
12 <i>Brachyulus bagnalli</i> (Brolemann, 1924)		X	X																
13 <i>Cylindrotulus burzenlandicus</i> Verhoeff, 1907																			X
14 <i>Cylindrotulus horvathi</i> (Verhoeff, 1897)			X																
15 <i>Julus terrestris</i> Linnaeus, 1758		X																	
16 <i>Leptoiulus cibellus</i> (Chamberlin, 1821)						X	X												
17 <i>Leptoiulus trilobatus</i> (Verhoeff, 1894)													X						X
18 <i>Megaphyllum projectum</i> Verhoeff, 1894							X									X	X		
19 <i>Megaphyllum roseauense</i> (Verhoeff, 1897)		X	X	X	X	X	X	X	X			X	X		X	X			X
20 <i>Megaphyllum unilineatum</i> (C.L. Koch, 1838)				X	X	X	X												
21 <i>Pachyulus hungaricus</i> (Karsch, 1881)				X								X							X
22 <i>Rumanitulus mammosus</i> Attems, 1926																			X
23 <i>Xestoiulus laeticollis</i> (Porat, 1889)													X						X

