

INVERTEBRATE FAUNA (COLEOPTERA, COLLEMBOLA, DIPLOPODA, ISOPODA) COLLECTED IN THE KARST AREAS OF THE ANINEI – LOCVEI MOUNTAINS

EUGEN NITZU, IONUȚ POPA, ANDREI GIURGINCA

Abstract. The authors identified 132 species of invertebrates (14 Oniscidea, 25 Diplopoda, 31 Collembola and 62 Coleoptera) recently sampled (2001–2006) from the soil and subterranean (MSS and caves) environments from the Banat Mountains. Some new, rare and endemic species are discussed. The seasonal changes of the species diversity in the superficial subterranean environments at 0.5 to 1 m in depth are for the first time presented for the Reșița – Moldova Nouă synclinorium. The characteristic and preferential species for the mesovoid shallow substratum (MSS), belonging to the analyzed taxa, are identified.

Key words: Collembola, Diplopoda, Isopoda, Coleoptera, subterranean, soil environments, MSS, species diversity, seasonal variations.

1. INTRODUCTION

Taking into consideration the modification of the local landscape in the last 50 years, the present article, comes to update the existent faunal data on the Oniscidea, Diplopoda, Collembola and Coleoptera found in the soil, the subterranean superficial environment and the caves from the Aninei and Locvei Mountains (South-Western Roumania), as most of them are obsolete. Thus, for edaphic (soil) and subterranean Coleoptera, up to present, faunal lists were published by FRIVALDSZKY (1876); KUTHY (1896); CSIKY (1904, 1909); SZÉKESSY (1938 a, b, 1939 a–d, 1940, 1943); JENO (1906). Recently, STAN (2003) published a paper on the fauna of Staphylinidae from Banat. Unlike the well known fauna of Collembola, Oniscidea and Diplopoda from caves (DANCĂU and TABACARU, 1964; NEGREA and NEGREA, 1977; GRUIA, 2003), only few data are available for the soil fauna (GRUIA and ILIE, 2001; GIURGINCA and ILIE, 2002). No data are published up to present on the occurrence of the Collembola, Oniscidea, Diplopoda and Coleoptera from MSS (mesovoid shallow substratum) from the Aninei Mountains.

The authors present new contributions on the fauna of invertebrates inhabiting the mentioned habitats, following three recent published faunal lists on Chilopoda (ILIE, 2003; ILIE *et al.*, 2003) and Araneae (NAE, 2008) from the same area of investigation. Moreover, as we mentioned in a recent paper (NITZU *et al.*, 2010), the subterranean superficial environment from the calcareous scree deposits represents the preferential habitat for a rich invertebrate fauna, including glacial relicts and endemic species, insufficiently known up to now. Another aimed aspect of the

study is that of seasonal variation in number of species in the subterranean superficial environment (also called “mesovoid shallow substratum”) of the Banat mountains and identifying of the characteristic species for this poorly known environment.

1.1. SHORT PRESENTATION OF THE INVESTIGATED AREA

The Aninei and Locvei Mountains are situated in the South-Western part of the Southern Carpathians and are characterized by their “low mountains” landscape. The investigated karst areas are included in the *Reșița – Moldova Nouă Synclinorium* – the largest and most compact carbonate zone of Roumania which extends over 800 km². The limestone is highly fractured and karstified of large extension and thickness, exhibiting high effective infiltration capacity and intensive groundwater flow (IURKIEWICZ, 2010). The vegetation is typical for the deciduous forest biotic zone (mixed forests of *Fagus sylvatica* with *Quercus ceris* and *Q. petrea*, or mixed forests of *Fagus* with *Carpinus betulus*). The climate is temperate continental with Mediterranean influences. The annual average temperature varies from 8°C at highest altitude, to 10°C at lowest altitude, while the average temperature in January varies from –4°C to –2°C. In summer, the temperature varies between 19 and 30 °C (16–20°C average annual temperature variation). The annual average quantity of precipitation is 1000–1200 mm, the average number of rainy days being 140 and that of snowing days 20 (ATLASUL GEOGRAFIC AL REPUBLICII SOCIALISTE ROMÂNIA, 1985). Supplementary information on the investigated area were published by ILIE (2003) and NAE (2008).

2. MATERIAL AND METHODS

The authors identified the material collected by Dr. VICTORIA ILIE, CIPRIAN ILIE, CRISTIAN ȚENCUȘE, ROMULUS VUIA during the preparation of doctoral thesis of V. ILIE in the period July 2001 – August 2005, by ANCA DRAGU (2005) and by RALUCA BĂNCILĂ (2006).

The soil fauna was sampled with Winkler sieve and with Barber traps. For the mesovoid shallow substratum, the Barber traps were placed at the bottom of drillings at 0.5, 0.7, 0.8 and 1 m in depth, following the methodology described by ILIE (2003, 2007), NAE (2008). The material from the traps was collected monthly.

For the MSS fauna, three sites were sampled:

1. Cheile Carașului (the Carașului Gorges), with two sectors:

1.a. Peștera Liliacilor – Carașova sector characterized by scree clogged by soil at the upper part (five Barber traps placed in drillings of 0.5 m in depth each, one of 0.7 m and other of 0.8 m).

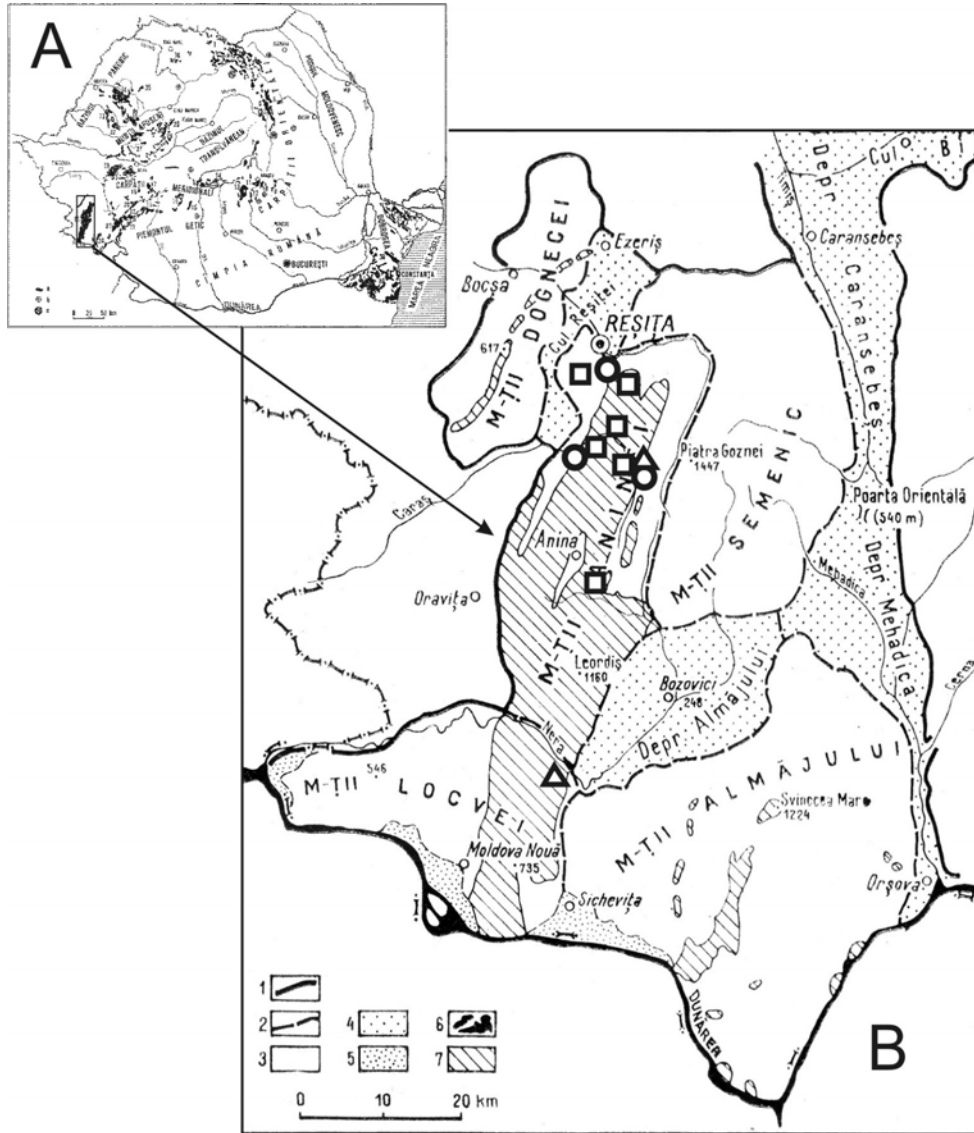


Fig. 1. A. The map of karst of Roumania; B. detail of the Reșița-Moldova Nouă synclinorium (after, SENCU, 1984, modified) showing the placement of sampling areas for MSS fauna (circles), soil fauna (squares) and cave fauna (triangles) {in the Sencu's map legend: 1 – the mountains limits; 2 – the limits of subunits; 3 – mountains; 4 – depressions; 5 – small basins; 6 – karst in cristaline dolomites (dolostones) 7 – karst in Mezozoic limestone}

1.b. The left bank of the Caraș River nearby the Peștera de după Cârșă (peștera = cave), a sector with scree covered by moss, presenting a high relative

humidity (2 pitfall traps placed in drillings of 0.8, respectively 0.7 depth and one microcave).

2. The right and left banks of Valea Comarnicului (the Comarnicului Valley) – fixed MSS in forested areas (four pitfall traps placed at 0.5, 0.5, 0.7 and 1 m depth on the left bank, and one at 1 m depth and on the right bank on the river. On the right bank, another pitfall trap was placed in a microcave following the procedure described by Nitzu (1997).

3. The Doman Valley, the left and right banks of the Doman River, characterized by fixed colluvial MSS in a forested area (one pitfall placed in a drilling of 0.5 m depth and one of 0.8 m) and sunbathed colluvial semi mobile MSS (one pitfall at 0.8 m in depth).

The placement of sampling areas for the soil, MSS and cave fauna are presented in Fig. 1.

The collected material was sorted, labelled and preserved in ethanol 70%.

3. RESULTS

The authors identified 132 species (14 Oniscidea, 25 Diplopoda, 31 Collembola and 62 Coleoptera) listed below with their collecting site, data, and environment. In square brackets, after the scientific name, the chorotypes are given. The species are listed in alphabetical order. For the mesovoid shallow substratum (subterranean superficial environment) – MSS, the depths of trapping are presented in brackets.

In the following list, the English translation of the Roumanian terms included in the proper name of the collecting sites are:

Peștera = cave; Valea = valley; Cheile = gorges.

Cls. Insecta

Ord. Coleoptera (det. E. NITZU)

Fam. Carabidae

1. *Abax parallelus* Duftschmid, 1812. [European] **MSS**: Cheile Carașului, 10.07.2004 (–0,5 m).
2. *Abax (Abacopercus) schueppeli* Palliardi, 1825 [E-European] **Soil**: Comarnic-Toplița at Peștera cu Gheață, 22.06.2002; 28.06.2003; 7.06.2003; 27.07.2003. **MSS**: Comarnic, 10.07.2007 (–0.7 m, –0.5 m).
3. *Bembidion (Ocydromus) incognitum* J. Müller, 1931. [European] **Soil**: Valea Minișului, 2.05.2002.
4. *Bembidion (Peryphus) tetracolum* Say, 1823. [W-Palaeartic] **Soil**: Valea Minișului, 1.05.2002.

5. *Carabus (Morphocarabus) scheidleri kollari* Palliardi, 1825. [Roumanian endemite] **Soil**: Comarnic, 28.06.2003.
6. *Carabus ullrichi* Germar, 1824. [European] **Soil**: Comarnic-Toplița at Peștera cu Gheață, 22.06.2002; 7.06.2003.
7. *Clivina collaris* (Herbst, 1784). [Palaeartic] **Soil**: Valea Minișului, 1.05.2002.
8. *Duvalius (Bihartrechus) herculis* J. Frivaldszky, 1889 [Roumanian endemite] **Caves**: Peștera de la Fagul Împreunat, 3.08.2005.
9. *Duvalius (Bihartrechus) milleri* J. (Frivaldszkyi 1862) [Roumanian endemite] **MSS**: Comarnic, 24.08.2003 (–1 m) **Caves**: Peștera Exploratorii '85, 13.08.2003.
10. *Molops piceus orthogonius* Chaudoir, 1868 [Roumanian endemite (ssp.)] **Soil**: The entrance of Drăgoina Cave, 17.10.2005.
11. *Platynus (Batenus) banaticus* I. Frivaldszky, 1865 [Roumanian endemite]. **Caves**: Peștera de la Fagul Împreunat, 3.08.2005.
12. *Platynus scrobiculatus* (Fabricius, 1801) [European] **Soil**: The entrance of Drăgoina Cave, 13.07.2002; 17.10.2005.
13. *Pterostichus (Cophosus) cylindricus* (Herbst, 1785) [Central-E. European] **Soil**: Comarnic-Toplița upstream of Peștera cu Gheață, 7.06.2003, 22.07.2003.
14. *Pterostichus (Platysma) niger* (Schaller, 1783) [Palaeartic] **MSS**: Cheile Carașului, 18.04.2004 (–0.5 m).

Fam. Staphylinidae

15. *Anotylus sculpturatus* (Gravenhorst, 1806) [Palaeartic] **Soil**: Comarnic-Toplița at Peștera cu Gheață, 7.06.2003. **MSS**: Valea Comarnicului, 11.10.2003 (–0.5 m), 11.11.2003, 24.08.2003 (–0.7 m).
16. *Anthobium melanocephalum* (Illiger, 1794) [European] **Soil**: Padina Seacă near Avenul din Padina Seacă (Av. 2241/2), 7.08.2007.
17. *Atheta (Dimetrota) europaea* Likovsky, 1984 [European] **MSS**: Cheile Carașului, 3.06.2004 (–0.5 m).
18. *Atheta revicollis* (Baudi di Selve, 1848) [European] **MSS**: Cheile Carașului, 10.07.2004 (–0.5 m).
19. *Bryaxis nodicornis* (Aubé, 1833). [European] **Soil**: Cheile Carașului at the entrance of cave Peștera de după Cârșă, 26.07.2002. **MSS**: Cheile Carașului, 2.08.2003, 16.08.2003, 26.08.2003, 3.06.2004 (–0.8 m), Comarnic 11.10.2003, 11.07.2004, (–0.5 m).
20. *Leptusa globulicollis* (Mulsant & Rey, 1853) [Alpino-Carpathian] **MSS**: Comarnic 11.10.2003 (–0.5 m).
21. *Leptusa schaschli* Ganglbauer, 1897 [S-E European?] **MSS**: Comarnic, 15.08.2004 (–0.5 m), Cheile Carașului, 10.07.2004 (–0.5 m).
22. *Lesteva longolytrata* (Goeze, 1777) [Palaeartic] **Soil**: Valea Minișului at the entrance in Ponor, 4.05.2002.
23. *Ocypus biharicus* (G. Müller, 1926) [Central-East European] **Soil**: Valea Comarnicului (in litter), 12.04.2003, 28.06.2003, Comarnic-Toplița at Peștera cu Gheață, 7.06.2003, 22.07.2003, 12.03.2005.

24. *Ocypus nitens* Schrank, 1781 [W. Palaearctic (intr. Nearctic)] **Soil**: Valea Comarnicului (in litter), 12.04.2003.
25. *Omalius validum* Kraatz, 1858 [European] **MSS**: Valea Comarnicului 11.10.2003 (–0.7 m).
26. *Quedius (Raphirus) cincticollis carpaticola* Roubal, 1924. [Carpathian endemite] **Caves**: Avenul cel Nou from Golumbului Valley, 3.05.2002.
27. *Quedius (Microsaurus) mesomelinus* (Marsham, 1802). [European] **MSS**: Cheile Carașului, 29.09.2003 (–0.8 m), **Caves**: Peștera de la Fagul Împreunat, 3.08.2005.
28. *Quedius picipes* (Mannerheim, 1831) [European] **Caves**: Avenul din Padina Seacă (Av. 2241/2), 7.08.2007.
29. *Paederus limnophilus* Erichson, 1840. [European] **Soil**: Valea Minișului, 1.05.2002.
30. *Proteinus brachypterus* (Fabricius, 1792). [Euro-Siberian] **MSS**: Cheile Carașului, 23.05.2002, 29.09.2003 (–0.8 m).
31. *Proteinus laevigatus* Hochhuth, 1872 [European] **MSS**: Cheile Carașului 1.VI.2003 (–0.5 m).
32. *Proteinus ovalis* Stephens, 1832. [European] **MSS**: Cheile Carașului, 24.04.2002 (–0.5m).
33. *Silusa* cf. *rubiginosa* Erichson, 1837 [European] **MSS**: Comarnic, 24.08.2003 (–1 m).
34. *Tychobythinus ottonis* Ganglbauer, 1896 [Central-East European] **MSS**: Cheile Carașului (–0.7 m).
35. *Zyras (Pella) humeralis* (Gravenhorst, 1802) [European] **Soil**: Cheile Carașului at the entrance of cave Peștera de după Cârșă, 18.04.2004.

Fam. Leiodidae

36. *Catops fuliginosus* Erichson, 1837 [Euro-Caucasian] **MSS**: 29.11.2003 (–0.5).
37. *Catops neglectus* Kraatz, 1852 [Euro-Caucasian] **MSS**: Cheile Carașului, 23.05.2002 (in microcave), 1.VI.2003 (–0.5 m), 29.11.2003 (–0.8 m).
38. *Catops subfuscus* Kellner, 1846 [Euro-Caucasian] **MSS**: Valea Comarnicului, 8.07.2003 (–0.5 m), 24.08.2003 (–1m), 15.08.2004 (–0.7 m).
39. *Catops tristis* (Panzer, 1794) [European (boreo-montan)] **Soil**: Comarnic-Toplița at Peștera cu Gheață, 27.07.2003 **MSS**: Valea Comarnicului, 11.10.2003 (–0.7 m).
40. *Fissocatops westi* (Krogerus, 1931) [European] **Soil**: Comarnic-Toplița at Peștera cu Gheață, 22.07.2003.
41. *Nargus wilkini* (Spence, 1815) [European] **Soil**: Valea Minișului, 2.05.2002 **MSS**: Cheile Carașului, 23.05.2002 (–0.8 m), 18.04.2004 (–0.5 m).
42. *Nargus anisotomoides* (Spence, 1815) [European] **MSS**: Cheile Carașului, 24.04.2002 (–0.5 m).
43. *Nargus brunneus* (Sturm, 1839) [Central-South European] **MSS**: Cheile Carașului, 10.07.2004 (–0.8 m).
44. *Nemadus colonoides* (Kraatz, 1851) [Euro-Caucasian] **Caves**: Avenul de la Padina Seacă (Av. 2241/12), 7.08.2007.

45. *Ptomaphagus sericatus* (Chaudoir, 1845) [Euro-Caucasian] **Soil**: Platoul lui Cârneală, 21.05.2006, **MSS**: Cheile Caraşului, 23.05.2002 (in microcave), 26.08.2003 (–0.7 m, –0.8 m), Valea Comarnicului, 24.08.2003, 11.10.2003, 11.09.2004 (–1 m).
46. *Ptomaphagus validus* (Kraatz, 1852) [E-European] **MSS**: Cheile Caraşului, 23.05.2002 (in microcave).
47. *Sciodrepoides watsoni* (Spence, 1815): [Holarctic] **MSS**: Cheile Caraşului, 23.05.2002 (in microcave), Cheile Caraşului, 1.06.2003 (–0.5 m).

Fam. Ptinidae

48. *Ptinus fur* (Linnaeus, 1758) [Cosmopolitan] **MSS**: Cheile Caraşului, 24.04.2002 (–0.5 m).

Fam. Cryptophagidae

49. *Cryptophagus deubeli* Ganglbauer, 1897 [C-E European + Asia Minor] **MSS**: Cheile Caraşului, 24.04.2002 (–0.5, –0.7 m, –0.8 m), 23.05.2002 (–0.7 m), 11.10.2003 (–0.7 m), 29.11.2003 (–0.5 m), 3.06.2004 (–0.5 m), 18.04.2004 (–0.7 m), Valea Comarnicului, 11.09.2004 (–1 m).
50. *Cryptophagus quercinus* Kraatz, 1852 [Palaeartic] **Soil**: Cheile Caraşului, 24.04.2002 **MSS**: 24.04.2002 (–0.5 m), 27.06.2002 (–0.5 m), 11.10.2003 (–0.5 m).
51. *Cryptophagus scanicus* (Linnaeus 1758) [Holarctic] **MSS**: Cheile Caraşului, 10.07.2004 (–0.5 m).

Fam. Endomychidae

52. *Hylaia rubricollis* (Germar, 1817) [E-European (S-E Roumania, Croatia, Moldova Rep.)] **MSS**: Cheile Caraşului, 2.08.2003 (–0.8 m), 26.08.2003 (–0.7 m, –0.8 m), 11.10.2003 (–0.7 m), 18.08.2004 (–0.7 m).
53. *Mycetaea subterranea* (Fabricius, 1801) [European] **Soil**: Cheile Caraşului at the entrance of cave Peştera de după Cârşă, 26.07.2002, **MSS**: Cheile Caraşului, 24.04.2002 (in microcave), 23.05.2002 (–0.7 m), 27.06.2002 (–0.5 m), 26.08.2003 (–0.8 m), 29.09.2003 (–0.8 m), 11.10.2003 (–0.7 m).

Fam. Latridiidae

54. *Dienerella ruficollis* (Marsham, 1802) [Cosmopolitan] **MSS**: Cheile Caraşului, 23.05.2002 (–0.5 m, –0.7 m), 27.06.2002 (–0.7 m, –0.5), 3.06.2004 (–0.7 m).
55. **Dienerella separanda* (Reitter, 1887) [Mediterraneo-E European] **MSS**: Valea Comarnicului, 11.07.2004 (–0.5 m), Cheile Caraşului, 27.07.2002 (–0.5 m), 26.08.2003 (–0.5 m, –0.8 m).

Fam. Corylophidae

56. *Sericoderus lateralis* (Gyllenhal, 1827) [Palaeartic] **Soil:** Cheile Carașului at the entrance of cave Peștera de după Cârșă, 26.07.2002, Cheile Carașului, 27.07.2002.

Fam. Sylvanidae

57. *Uleiota planata* (Linnaeus, 1761) [European] **Soil:** Valea Golumbu, 2.05.2002 (in litter).

Fam. Scarabaeidae

58. *Plagiogonus putridus* (Geoffroy in Fourcroy, 1785) [Palaeartic] **Soil:** Cheile Carașului, 3.06.2004.
59. *Pleurophorus caesus* (Creutzer in Panzer, 1796) [Holarctic] **Soil:** Cheile Carașului, 18.08.2004.

Fam. Geotrupidae

60. *Anoplotrupes stercorosus* (Hartmann in L.G. Scriba, 1791) [European] **Soil:** Cheile Carașului, 3.06.2004.

Fam. Curculionidae

61. *Otiorhynchus (Thalycrychnus) adonis* Apfelbeck, 1906 [East European] **Soil:** Valea Domanului, 18.04.2004, **MSS:** Valea Domanului, 18.04.2004 (–0.8 m), 3.06.2004 (–0.8 m), 10.07.2004 (–0.8 m).
62. *Otiorhynchus (Nehrodistus) populeti* Boheman, 1843 [Euro-Caucasian (In Europe only in Italy and South-Eastern Europe)] **Soil:** Cheile Carașului 10.07.2004, **MSS:** Cheile Carașului, 11.10.2003 (–0.5 m, –0.7 m), 10.07.2004 (–0.5 m), 18.08.2004 (–0.5 m, –0.7 m), Valea Comarnicului, 25.08.2003 (–1 m).

Cls. Collembola (det. I. POPA)**Ord. Poduromorpha****Fam. Neanuridae**

1. *Deutonura plena* (Stach, 1951) [Central East-European] **Soil:** Cheile Carasului, 3.06.2004, Valea Domanului, 3.06.2004.

Fam. Hypogastruridae

2. *Ceratophysella engadinensis* (Gisin, 1949) [European] **MSS :** Cheile Carasului, 23.05.2002 (–0.5 m), 23.05.2002 (microcave), 11.10.2003 (–0.5 m).
3. *Ceratophysella granulata* Stach, 1949 [Palaeartic] **Soil:** Cheile Carasului, 29.11.2003, 3.06.2004, 10.07.2004, Valea Domanului, 3.06.2004.

4. *Hypogastrura sahlbergi* (Reuter, 1895) [Cosmopolitan] **MSS**: Cheile Carasului, 3.06.2004 (–0.5, –0.7 m), 10.07.2004 (–0.7 m), 29.11.2003 (–0.5 m), 18.04.2004 (–0.5, –0.7, –0.8 m), 14.03.2004 (–0.5, –0.7 m), Valea Domanului, 3.06.2004 (–0.8 m).

Fam. Onychiuridae

5. *Kalaphorura tuberculata* (Moniez, 1890) [European] **MSS**: Cheile Carasului, 23.05.2002 (–0.5, –0.8 m), 23.05.2002 (microcave), 10.07.2004 (–0.8 m), 29.11.2003 (–0.8 m), 18.04.2004 (–0.8 m), 14.03.2004 (–0.8 m), 11.10.2003 (–0.7, –0.8 m).
 6. *Protaphorura quadriocellata* (Gisin, 1947) [European] **MSS**: Cheile Carasului, 10.07.2004 (–0.5, –0.7 m).
 7. *Tetrodontophora bielanensis* (Waga, 1842) [Central East-European] **Soil**: Cheile Carasului, 10.07.2004 ; **MSS**: Cheile Carasului 10.07.2004 (–0.7 m).

Ord. Entomobryomorpha

Fam. Tomoceridae

8. *Pogonognathellus flavescens* (Tullberg, 1871) [Holarctic] **Soil**: Cheile Carasului, 14.03.2003, 14.03.2004, 24.04.2002, 18.04.2004, 23.05.2002, 3.06.2004, 10.07.2004, 18.08.2004, 26.08.2003, 11.10.2003, 2.10.2002, 29.11.2003, Valea Domanului, 24.04.2002, 3.06.2004, 10.07.2004; **MSS**: Cheile Carasului, 23.05.2002 (microcave), 14.03.2003 (–0.5 m), 14.03.2004 (–0.7 m), 24.04.2002 (–0.5, –0.7, –0.8 m), 18.04.2004 (–0.5 m), 23.05.2002 (–0.5, –0.7, –0.8 m), 3.06.2004 (–0.5, –0.7, –0.8 m), 10.07.2004 (–0.5, –0.7, –0.8 m), 18.08.2004 (–0.5, –0.7, –0.8 m), 26.08.2003 (–0.5, –0.7, –0.8 m), 11.10.2003 (–0.5, –0.7, –0.8 m), 2.10.2002 (–0.5, –0.7, –0.8 m), 29.11.2003 (–0.5, –0.8 m), Valea Domanului, 24.04.2002 (–0.5 m), 3.06.2004 (–0.8 m), 10.07.2004 (–0.8 m).
 9. *Tomocerus baudoti* Denis, 1932 [Palaeartic] **MSS**: Cheile Carasului, 29.11.2003 (–0.5, –0.8 m).
 10. *Tomocerus minor* (Lubbock, 1862) [Holarctic] **MSS**: Cheile Carasului, 23.05.2002 (–0.5, –0.7, –0.8 m), 10.07.2004 (–0.5, –0.7, –0.8 m), 18.08.2004 (–0.5, –0.7, –0.8 m), 26.08.2003 (–0.5, –0.7, –0.8 m), 11.10.2003 (–0.5, –0.7, –0.8 m), 3.06.2004 (–0.5 m), Valea Domanului, 3.06.2004 (–0.8 m), 10.07.2004 (–0.8 m).
 11. *Tomocerus vulgaris* (Tullberg, 1871) [Holarctic] **Soil**: Cheile Carasului, 3.06.2004; **MSS**: Cheile Carasului, 3.06.2004 (–0.5 m).

Fam. Isotomidae

12. *Folsomia quadrioculata* (Tullberg, 1871) [Holarctic] **Soil**: Cheile Carasului, 14.03.2003, 14.03.2004, 24.04.2002, 18.04.2004, 23.05.2002, 3.06.2004, 10.07.2004, 26.08.2003, Valea Domanului, 3.06.2004.

Fam. Entomobryidae

13. *Entomobrya atrocincta* Schoett, 1896 [Cosmopolitan] **Soil**: Valea Domanului, 3.06.2004, 10.07.2004.

14. *Entomobrya multifasciata* (Tullberg, 1871) [Cosmopolitan] **Soil:** Valea Domanului, 3.06.2004, 10.07.2004; **MSS:** Valea Domanului, 3.06.2004 (–0.8 m), 10.07.2004 (–0.8 m).
15. *Entomobrya muscorum* (Nicolet, 1841) [Palaeartic] **Soil:** Cheile Carasului, 3.06.2004, 10.07.2004, 18.08.2004, 26.08.2003, 11.10.2003, 29.11.2003, 18.04.2004, Valea Domanului, 3.06.2004, 10.07.2004.
16. *Heteromurus major* (Moniez, 1889) [Central-South European] **Soil:** Cheile Carasului, 24.04.2002.
17. *Heteromurus nitidus* (Templeton, 1835) [Holarctic] **Soil:** Cheile Carasului, 18.08.2004, 18.04.2004.
18. *Lepidocyrtus curvicollis* (Bourlet, 1839) [Holarctic] **MSS:** Cheile Carasului, 14.03.2003 (–0.5 m), 24.04.2002 (–0.5, –0.7, –0.8 m), 18.04.2004 (–0.5 m), 23.05.2002 (–0.5 m), 3.06.2004 (–0.5, –0.7, –0.8 m), 10.07.2004 (–0.5, –0.7, –0.8 m), 18.08.2004 (–0.5, –0.7, –0.8 m), 2.10.2002 (–0.5, –0.7, –0.8 m), 29.11.2003 (–0.5, –0.8 m), Valea Domanului, 10.07.2004 (–0.8 m).
19. *Lepidocyrtus cyaneus* Tullberg, 1871 [Cosmopolitan] **MSS:** Cheile Carasului, 10.07.2004 (–0.7 m), 29.11.2003 (–0.8 m), 18.08.2004 (–0.8 m), 18.04.2004 (–0.7 m), 14.03.2004 (–0.5 m), Valea Domanului, 4.01.2003 (–0.5 m), 16.02.2003 (–0.8 m).
20. *Lepidocyrtus lignorum* (Fabricius, 1775) [Holarctic] **Soil:** Cheile Carasului, 14.03.2003, 14.03.2004, 24.04.2002, 18.04.2004, 23.05.2002, 3.06.2004, 10.07.2004, 18.08.2004, 26.08.2003, 11.10.2003, 29.11.2003, Valea Domanului, 24.04.2002, 10.07.2004; **MSS:** Cheile Carasului, 14.03.2003 (–0.5 m), 14.03.2004 (–0.7 m), 24.04.2002 (–0.5, –0.7, –0.8 m), 18.04.2004 (–0.5 m), 23.05.2002 (–0.5, –0.7, –0.8 m), 3.06.2004 (–0.5, –0.7, –0.8 m), 10.07.2004 (–0.5, –0.7, –0.8 m), 18.08.2004 (–0.5, –0.7, –0.8 m), 26.08.2003 (–0.5, –0.7, –0.8 m), 11.10.2003 (–0.5, –0.7, –0.8 m), 2.10.2002 (–0.5, –0.7, –0.8 m), 29.11.2003 (–0.5, –0.8 m), Valea Domanului, 24.04.2002 (–0.5 m), 10.07.2004 (–0.8 m).
21. *Lepidocyrtus paradoxus* Uzel, 1891 [Holarctic] **Soil:** Cheile Carasului, 14.03.2003, 14.03.2004, 24.04.2002, 18.04.2004, 23.05.2002, 3.06.2004, 10.07.2004, 18.08.2004, 26.08.2003, 11.10.2003, 2.10.2002, 29.11.2003, Valea Domanului, 24.04.2002, 3.06.2004, 10.07.2004; **MSS:** Cheile Carasului, 23.05.2002 (microcave), 14.03.2003 (–0.5 m), 14.03.2004 (–0.7 m), 24.04.2002 (–0.5, –0.7, –0.8 m), 18.04.2004 (–0.5 m), 23.05.2002 (–0.5, –0.7, –0.8 m), 3.06.2004 (–0.5, –0.7, –0.8 m), 10.07.2004 (–0.5, –0.7, –0.8 m), 18.08.2004 (–0.5, –0.7, –0.8 m), 26.08.2003 (–0.5, –0.7, –0.8 m), 11.10.2003 (–0.5, –0.7, –0.8 m), 2.10.2002 (–0.5, –0.7, –0.8 m), 29.11.2003 (–0.5, –0.8 m), Valea Domanului, 24.04.2002 (–0.5 m), 3.06.2004 (–0.8 m).
22. *Orchesella multifasciata* (Tullberg, 1871) [European] **Soil:** Valea Domanului, 10.07.2004.

Ord. Neelipleona**Fam. Neelidae**

23. *Neelus murinus* Folsom, 1896 [Cosmopolitan] **MSS**: Cheile Carasului, 3.06.2004 (–0.7 m), 10.07.2004 (–0.7, –0.8 m), 29.11.2003 (–0.5, –0.8 m), 18.04.2004 (–0.8 m).

Ord. Symphypleona**Fam. Katiannidae**

24. *Sminthurinus aureus* (Lubbock, 1862) [Palaeartic] **Soil**: Cheile Carasului, 3.06.2004, 10.07.2004, Valea Domanului, 3.06.2004.
 25. *Sminthurinus elegans* (Fitch, 1863) [Holarctic] **Soil**: Cheile Carasului, 10.07.2004.

Fam. Arrhopalitidae

26. *Pygmarrhopalites ornatus* (Stach, 1945) [European] **MSS**: Cheile Carasului, 03.06.2004 (–0.7 m), 10.07.2004 (–0.7 m), 29.11.2003 (–0.5 m).
 27. *Pygmarrhopalites pygmaeus* (Wankel, 1860) [Holarctic] **MSS**: Cheile Carasului, 23.05.2002 (microcave), 23.05.2002 (–0.7 m), 3.06.2004 (–0.5, –0.7 m), 10.07.2004 (–0.7 m), 11.10.2003 (–0.5 m), Valea Domanului, 24.04.2002 (–0.5 m).
 28. *Pygmarrhopalites sericus* (Gisin, 1947) [Euro-mediterranean] **MSS**: Cheile Carasului, 18.08.2004 (–0.8 m).
 29. *Pygmarrhopalites terricola* (Gisin, 1958) [European] **MSS**: Cheile Carasului, 18.04.2004 (–0.8 m), Valea Domanului, 3.06.2004 (–0.8 m).

Fam. Sminthuridae

30. *Caprainea marginata* (Schott, 1893) [Euro-mediterranean] **MSS**: Cheile Carasului, 3.06.2004 (–0.5, –0.7 m), 10.07.2004 (–0.5, –0.7 m), 26.08.2003 (–0.7 m), 29.11.2003 (–0.8 m), 18.08.2004 (–0.8 m).
 31. *Ptenothrix atra* (Linnaeus, 1758) [European] **Soil**: Cheile Carasului, 10.07.2004, 18.08.2004.

Cls. Diplopoda (det. A. GIURGINCA)**Fam. Polyxenidae**

1. *Polyxenus lagurus* (Linnaeus, 1758) [Holarctic] **Soil**: Dealul Gol, 07.10.2003, Valea Săliștei, 21.08.2004, Valea Cernei-Cascada Vânturătoarea, 20.08.2006, **MSS**: Cheile Carașului, 29.11.2003 (–0.5 m).

Fam. Trachysphaeridae

2. *Trachysphaera costata* (Waga, 1857) [Central-East European] **Soil:** Cheile Comarnicului, 12.10.2003, Valea Stârnice, 15.10.2003, Valea Săliștei, 21.08.2004, Platoul Cârneală, Ogașul Roșu, 20.08.2006, **Caves:** Peștera Exploratorii '85, 13.08.2003, Peștera Ponorul Pecinișcăi, 21.08.2004.
3. *Trachysphaera schmidtii* Heller, 1858 [Central-East Europe] **Soil:** Cheile Comarnicului, 10.08.2004, Văliug, 17.10.2004, **MSS:** Cheile Carașului, 2.10.2002 (−0.7 m), 19.04.2004 (−0.5 m).

Fam. Glomeridae

4. *Glomeris guttata* Risso, 1826 [Roumania, Austria, Hungary] **Soil:** Valea Minișului, 02.05.2002, **MSS:** Cheile Carașului, 24.04.2002 (−0.5 m), 27.06.2002 (−0.8 m).
5. *Glomeris hexasticha* Brandt, 1833 [Central-East European] **Soil:** embankment, Comarnic, upstream Peștera cu Gheață, 12.07.2003, Cheile Comarnicului, 10.08.2004, **MSS:** Cheile Carașului, 23.05.2002 (−0.5 m), 27.06.2002 (−0.8 m), 22.08.2002 (−0.5 m), 24.10.2002 (−0.8 m), 4.01.2003 (−0.8 m), 22.04.2003 (−0.8 m), 11.10.2003 (−0.7 m), 18.04.2004 (−0.8 m), 3.06.2004 (−0.7 m), 10.07.2004 (−0.5 m, −0.8 m), Cheile Comarnicului, 15.08.2004 (−0.7 m).

Fam. Polyzoniidae

6. *Polyzonium germanicum* Brandt, 1837 [European] **Soil:** Valea Minișului, 04.05.2002, Cheile Comarnicului, 12.10.2003, Stârnicele de Jos, 15.10.2003, Valea Golumbu, 21.04.2004, Râul Alb, 21.04.2004, near Avenul Renegate, 21.04.2004, Cheile Comarnicului, 10.08.2004, Valea Cernei-Cascada Vânturătoarea, 20.08.2006, **MSS:** Valea Domanului, 23.05.2002 (−0.8 m).

Fam. Julidae

7. *Allajulus boleti* (C.L. Koch, 1847) [Balkano-Central European] **Soil:** embankment, Comarnic, 19.08.2003, Dealul Cârnipolia, sinkhole, 20.08.2003, near Peștera Cioploaia, 09.10.2003, Cheile Comarnicului, 12.10.2003, Valea Golumbu, 21.04.2004, Valea Stârnice, 16.10.2003, **MSS:** Cheile Comarnicului, 11.07.2004 (−0.5 m).
8. *Allopoiulus verhoeffi* (Jawłowski, 1931) [Roumanian endemite] **Soil:** embankment, downstream Peștera Comarnic, 19.08.2003, Valea Topliței, 20.08.2003, Valea Săliștei, 21.08.2004.
9. *Cylindroiulus luridus* (C.L. Koch, 1847) [Central-East European] **Soil:** Valea Comarnicului, 25.08.2003, Platoul Cârneală, Ogașul Roșu, 25.07.2001, 20.08.2006.

10. *Leptoiulus trilobatus* (Verhoeff, 1894) [Central-East European] **Soil:** embankment, Comarnic, upstream Peștera cu Gheață, 14.06.2003, embankment, Comarnic, downstream Peștera cu Gheață, 19.08.2003, near Peștera lui Nermet, 15.10.2003, Platoul Cârneală, 16.08.2006.
11. *Megaphyllum platyurum* (Latzel, 1884) [Roumania, Serbia] **Soil:** Valea Minișului, 03.05.2002, embankment, Comarnic, upstream Peștera cu Gheață, 07.06.2003.
12. *Megaphyllum projectum* Verhoeff, 1894 [Central-East European] **Soil:** embankment, Comarnic, upstream Peștera cu Gheață, 14.06.2003, Dealul Colțan, 14.10.2003.
13. *Megaphyllum transsylvanicum* (Verhoeff, 1897) [South-East European] **Soil:** Dealul Gol, 07.10.2003, **MSS:** Cheile Carașului, 24.10.2002 (–0.5 m).
14. *Pachyiulus hungaricus* (Karsch, 1881) [Balkano-Carpathian] **Soil:** Carașova, 25.07.2001, embankment, Comarnic, upstream Peștera cu Gheață, 14.06.2003, 03.08.2003.
15. *Unciger foetidus* (C.L. Koch, 1838) [European] **Soil:** Valea Minișului, 02.05.2002, Dealul Colțan, 14.10.2003, Valea Stârnice, 16.10.2003, **MSS:** Cheile Comarnicului, 29.11.2003 (–1 m).
16. *Typhloiulus strictus* (Latzel, 1882) [Carpatho-Balkan] **Soil:** near Peștera de după Cârșă, 09.10.2003, Valea Cernei-Cascada Vânturătoarea, 20.08.2006, **MSS:** Cheile Carașului, 23.05.2002 (–0.5 m, –0.7 m), 02.10.2002 (–0.5 m), 22.08.2002 (–0.5 m), 04.01.2003 (–0.5 m), Cheile Comarnicului, 11.07.2004 (–1 m), 15.08.2004 (–0.7 m), Valea Domanului, 23.05.2002 (–0.8 m).
17. *Xestoiulus imbecillus* (Latzel, 1884) [Central-South-East European] **Soil:** embankment, Comarnic, 16.08.2003, 19.08.2003, embankment, downstream Peștera Comarnic, 19.08.2003, Navesul Mare, 09.09.2003, Dealul Cârnipolia, sinkhole, 20.08.2003, near Peștera Cioploaia, 09.10.2003, Stârnice de Jos, 15.10.2003, Valea Nermet, 15.10.2003.

Fam. Dorypetalidae

18. *Dorypetalum degenerans* (Latzel, 1884) [Roumania, Serbia, Bosnia and Hercegovina, R. Macedonia, Hungary] **MSS:** Cheile Carașului, 23.05.2005 (–0.7 m), 27.06.2002 (–0.5 m), 27.07.2002 (–0.5 m), 26.08.2002 (–0.5 m), 2.10.2002 (–0.5 m), 03.06.2004 (–0.8 m), 18.08.2004 (–0.5 m), Valea Domanului, 23.05.2002 (–0.8 m), 04.01.2003 (–0.8 m), 01.06.2003 (–0.8 m).

Fam. Chordeumatidae

19. *Melogona transsylvanica* (Verhoeff, 1897) [Roumania, Austria and Hungary] **Soil:** near Peștera Cioploaia, 09.10.2003.

Fam. Paradoxosomatidae

20. *Stroglylosoma stigmatosum* (Eichwald, 1830) [Central-East European] **Soil:** Valea Topliței, 25.08.2003, Valea Săliștea, 21.08.2004.

Fam. Polydesmidae

21. *Brachydesmus polydesmoides* Verhoeff, 1895 [Balkanic] **Soil:** Valea Golumbu, 21.04.2004, **MSS:** Cheile Carașului, 29.11.2003 (−0.8 m), 14.03.2004 (−0.5 m, −0.7 m).
22. *Polydesmus collaris* C.L. Koch, 1847 [Roumania, Serbia, Bosnia and Hercegovina, R. Macedonia, Hungary] **Soil:** embankment, Comarnic, 16.08.2003, 19.08.2003.
23. *Polydesmus complanatus* (Linnaeus, 1761) [Central-South-East European] **Caves:** Peștera de la Izvor, 15.08.2006.
24. *Polydesmus montanus* Daday, 1889 [Carpathian endemite] **MSS:** Cheile Carașului, 01.06.2003 (−0.5 m, −0.8 m), 01.06.2003 (−0.5 m, −0.8 m)
25. *Polydesmus subscabratus* Latzel, 1864 [Bulgaria, Roumania, Serbia] **Soil:** embankment, Comarnic, upstream Peștera cu Gheață, 12.07.2003, **MSS:** Cheile Comarnicului, 27.07.2003 (−0.5 m).

Cls. Malacostraca**Ord. Isopoda****Subord. Oniscidea** (det. A. GIURGINCA)**Fam. Ligiidae**

1. *Ligidium germanicum* Verhoeff, 1901 [Central-East European]. **Soil:** embankment, Comarnic, upstream Peștera cu Gheață, 07.06.2003, 22.06.2003, 12.07.2003, Valea Mare (Bazinul Gârliște), 20.10.2004, Platoul Cârneală, 16.08.2006, Valea Minișului, 01.05.2002, **MSS:** Cheile Carașului, 22.04.2002 (−0.7 m, −0.8 m), 23.05.2002 (MCV1), 23.05.2002 (−0.5 m), 27.06.2002 (−0.8 m, MCV), 04.01.2003 (−0.8 m), 29.11.2003 (−0.8 m), 03.06.2004 (−0.5 m), 18.08.2004 (−0.7 m), Cheile Comarnicului, 29.11.2003 (−0.5 m, −0.7 m), 4.06.2004 (−1 m), 11.07.2004 (−1 m), 15.08.2004 (−0.7 m), Valea Domanului, 23.05.2002 (−0.5 m).

Fam. Trichoniscidae

2. *Hyloniscus riparius* (C.L. Koch, 1838) [Central-East European] **Soil:** embankment, Comarnic, upstream Peștera cu Gheață, 14.06.2003, 12.07.2003, Platoul Cârneală, 16–21.08.2006, Valea Minișului, 01.05.2002, **MSS:** Cheile Carașului, 27.06.2002 (MCV), 04.01.2003 (−0.5 m, −0.8 m), 03.06.2004 (−0.5 m, −0.8 m), Cheile Comarnicului, 29.11.2003 (−1 m), Valea Domanului, 23.05.02 (−0.8 m).

3. *Hyloniscus transsilvanicus* (Verhoeff, 1901 [East European] **Soil**: Comarnic, upstream Peștera cu Gheață, 16.08.2003, Valea Minișului, 01.05.2002, **MSS**: Cheile Carașului, 22.04.2002 (MCV1), 23.05.2002 (−0.8 m), 18.08.2004 (−0.7 m).
4. *Trichoniscus bosniensis* Verhoeff, 1901 [Croatia, Serbia, Bosnia and Hercegovina; SW-Roumania] **Soil**: embankment, Comarnic, 07.06.2003, **MSS**: Cheile Carașului, 29.11.2003 (−0.8 m), 03.06.2004 (0.5 m, −0.8 m), 18.08.2004 (−0.7 m), Cheile Comarnicului, 29.11.2004 (−1 m).
5. *Haplophthalmus banaticus* Radu, 1977 [Roumanian endemite] **Soil**: Valea Nermet, 15.10.2003.

Fam. Mesoniscidae

6. *Mesoniscus graniger* (Frivaldsky, 1865) [Dinaro-Carpathic] **Caves**: Peștera Exploratorii 85, 13.08.2003, Peștera de după Cârșă, 25.08.2006.

Fam. Cylisticidae

7. *Cylisticus convexus* (De Geer, 1778) [Cosmopolitan] **Soil**: Valea Domanului, 07.10.2003, Valea Săliștei, 21.08.2004, **MSS**: Cheile Carașului, 22.04.2002 (MCV1), 22.04.2002 (−0.5 m, −0.7 m, −0.8 m), 23.05.2002 (−0.5 m, −0.7 m, −0.8 m), 27.06.2002 (−0.5 m, −0.7 m, −0.8 m), 27.07.2002 (−0.5 m, −0.7 m, −0.8 m), 22.08.2002 (−0.7 m, −0.8 m), 02.10.2002 (−0.5 m), 04.01.2003 (−0.5 m, −0.7 m, −0.8 m), 29.11.2003 (−0.5 m, −0.7 m, −0.8 m), 03.06.2004 (−0.5 m, −0.7 m, 0.8 m), 10.07.2004 (−0.7 m), 18.08.2004 (−0.7 m, −0.8 m), Valea Domanului, 23.05.2002 (−0.8 m), 27.06.2002 (−0.8 m), 27.07.2002 (−0.8 m), 04.01.2003 (−0.8 m), 29.11.2003 (−0.8 m), **Caves**: Platoul Cârneală, Peștera de după Cârșă, 25.08.2006.

Fam. Trachelipodidae

8. *Porcellium recurvatum* Verhoeff, 1901 [Balkano-Central European] **Soil**: Valea Mare (Bazinul Gârliște), 20.10.2004.
9. *Protracheoniscus politus* (C. Koch, 1841) [Central-East European] **Soil**: Navesul Mare, 09.08.2003, Valea Domanului, 07.10.2003, near Peștera Cioploaia, 09.10.2003, Cheile Comarnicului, 12.10.2003, Valea Bârzavei, 21.04.2004, Valea Săliștei, 21.08.2004, Valea Mare (Bazinul Gârliște), 20.10.2004, Platoul Cârneală, 16.08.2006.
10. *Trachelipus arcuatus* (Budde-lund, 1885) [Balkano-Central European] **Soil**: embankment, Comarnic, upstream Peștera cu Gheață, 14.06.2003, 22.06.2003, Platoul Cârneală, 16.08.2006, Valea Minișului, 01.05.2002, **MSS**: Cheile Comarnicului, 29.11.2003 (−0.5 m, −1 m), 4.06.2004 (−1 m), 11.07.2004 (−1 m), 15.08.2004 (−0.7 m).
11. *Trachelipus trilobatus* (Stein, 1859) [Roumanian endemite] **Caves**: Peștera Ponorul Pecinișcăi.

Fam. Armadillididae

12. *Armadillidium banaticum* Verhoeff, 1907 [Roumanian endemite] **Soil:** embankment, Comarnic, 16.08.2003, Valea Domanului, 07.10.2003, **MSS:** Cheile Carașului, 23.05.2002 (–0.8 m), 03.06.2004 (–0.5 m), Valea Domanului, 29.11.2003 (–0.8 m).
13. *Armadillidium versicolor quinqueseriatum* Stein, 1859 [East-European] **MSS:** Cheile Carașului, 22.04.2002 (MCV1), 22.04.2002 (–0.5 m, –0.7 m, –0.8 m), 23.05.2002 (–0.5 m, –0.7 m, –0.8 m), 27.06.2002 (–0.5 m, –0.7 m, –0.8 m), 27.07.2002 (–0.5 m, –0.7 m, –0.8 m), 22.08.2002 (–0.7 m, –0.8 m), 02.10.2002 (–0.5 m), 29.11.2003 (–0.7 m, –0.8 m), 03.06.2004 (–0.7 m, –0.8 m), 18.08.2004 (–0.7 m), Valea Domanului, 23.05.2002 (–0.8 m), 27.06.2002 (–0.8 m), 27.07.2002 (–0.8 m), 04.01.2003 (–0.8 m).
14. *Armadillidium vulgare* (Latreille, 1859) [Cosmopolitan] **Soil:** embankment, Comarnic, 14.06.2003, **MSS:** Cheile Carașului, 23.05.2002 (–0.7 m), 04.01.2003 (–0.7 m, –0.8 m, MCV1), 29.11.2003 (–0.5 m), 03.06.2004 (–0.5 m), Valea Domanului, 27.06.2002 (–0.8 m), 29.11.2003 (–0.8 m).

4. DISCUSSIONS

From the total of 132 identified species, 78 (representing 59%) were found at different depths in the mesovoid shallow substratum MSS (36 of 62 Coleoptera, 20 of 31 Collembola, 9 of 14 Oniscidaea and 13 of 25 Diplopoda).

Each of the studied taxa is well represented in the MSS in vernal, aestival and autumnal seasons, the greatest number of species being trapped at 0.5 m depth (between 26 and 39 species). A visible increase on species number in MSS (at all levels) was observed in the aestival season. In comparison with the vernal season, when 26 (at 0.5 m) to 22 (at 0.8 m) species were found, 39 (at 0.5 m) to 32 (at 0.8 m) inhabited the MSS in the aestival season. An other increase of species number (excepting the springtails) in depth (at 1 m) was observed in the autumnal season (Fig. 2).

The increasing of the species number in the superficial subterranean environment in summer was observed by us in other MSS from Roumania (NITZU, 1997, NITZU and ILIE, 2004; NITZU *et al.*, 2010). This growing of species diversity in the MSS is the consequence, on the one hand, of the migration in the MSS of many soil species that use this environment as ecologic microrefuge in the dry and hot periods of the summer (the most of the cases) and on the other hand, of the period of activity of the new emerged imago stages of some characteristic species for this environment.

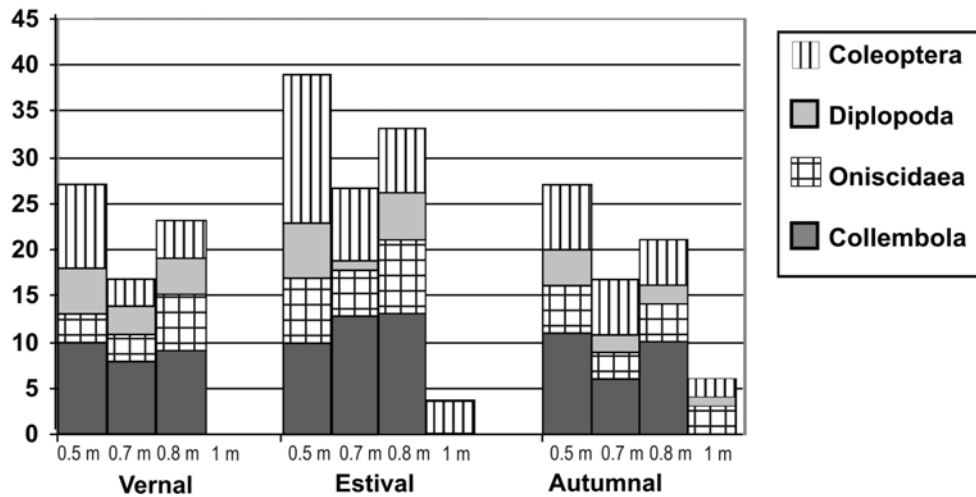


Fig. 2. The contribution of each analyzed taxa in seasonal variation of the species number occurred in MSS at 0.5–1 m in depth.

Among the Coleoptera, *Catops tristis*, *Catops subfuscus* are characteristic for the MSS in the Carpathians (NITZU *et al.*, 2010). *Hylaia rubricollis* and, most of all, *Mycetaea subterranea* are characteristic for the subterranean superficial environment (MSS) of South-Western karst areas of Roumania, being frequently captured up to now only in the Motru Sec basin (NITZU and ILIE, 2004) and in the Aninei Mountains. *Duvalius milleri*, a troglobitic endemic species for the Reșița-Comnarnic of the Banat Mountains (JEANNEL, 1928) was found by us in the Exploratorilor Cave (leg. Ilie and Popa) (a cave periodically filled up) and for the first time in the subterranean superficial environment at 1 m in depth in summer time.

Among the springtails found in MSS, only *Pygmarrhopalites ornatus* (Stach, 1945) can be considered as characteristic for this type of habitat. The species was recently reported for the first time in Romanian fauna from the MSS of Piatra Craiului Massif (the Carpathians) (POPA, 2010).

Beside the considered *characteristic* species, frequently found from spring to autumn in many investigated types of MSS, there are other *preferential* species, not so frequent in all seasons in the MSS, but that inhabit the MSS as ecologic microrefuge in summer or winter in a large number of individuals. The soil beetles *Abax parallelus*, *Bryaxis nodicornis*, *Nargus anisotomoides*, *Ptomaphagus sericatus*, *Sciodrepoides watsoni*, *Cryptophagus deubeli* are preferential for the MSS.

Taking into account the presence of collembolan species in MSS from other investigated zones (NITZU *et al.*, 2010), we consider as preferential species for MSS the following species: *Kalaphorura tuberculata* (Moniez, 1890) (also found in Piatra Craiului and Motru Mare), *Protaphorura quadriocellata* (Gisin, 1947)

(also found in Piatra Craiului, Motru Mare and Cheile Varghisului), *Heteromurus nitidus* (Templeton, 1835) (also found in Movile and Motru Mare), *Pygmarrhopalites pygmaeus* (Wankel, 1860) (also found in Motru Mare and Cheile Varghisului).

Ceratophysella granulata Stach, 1949 is reported for the second time in the Roumanian fauna; until now the species was recorded only from the Rodnei Mountains (DANYI *et al.*, 2006). It is a forest litter species, both in coniferous and broadleaf forests (FJELLBERG, 1998).

According to GRUIA & ILIE (2001), there are two endemic species for the Banatului Mountains: *Orthonychiurus doinae* (Gruia, 1972) and *Deuteraphorura banatica* (Gruia, 1965). *Orthonychiurus doinae* (Gruia, 1972) is a troglophilic form found in caves on the stalagmitic floor covered with clay; outside, it was collected from soil and lithoclasts (rock fractures); it is an endemic species for the Southern Carpathians and Almajului Mountains (Banat). *Deuteraphorura banatica* (Gruia, 1965) is a troglobitic form found only in caves from Almajului Mountains and Berzasca Basin (Banat).

None of these species was found in soil or in MSS from the Banatului Mountains.

Three species of the identified Oniscidea, are endemic for Romania: *Haplophthalmus banaticus*, *Trachelipus trilobatus* and *Armadillidium banaticum*; all three are found only in Banat. *Porcellium recurvatum*, recorded for the first time in Romania in the Retezat Mountains (GIURGINCA *et al.*, 2007), eastward of our investigated area, is now recorded for the second time. The spreading of this species, just like that of *Trichoniscus bosniensis*, seems to be limited to the South-Western part of Romania.

We consider *Ligidium germanicum*, *Hyloniscus riparius*, *Trichoniscus bosniensis*, *Armadillidium banaticum* and *Armadillidium versicolor quinqueseriatum* as preferential for the MSS as all of them are found at -1 m (or -0,8 m) in depth. *Ligidium germanicum* was also found in the MSS from the Piatra Craiului and Vârghișului Gorges (in both cases in covered colluvial MSS), *Hyloniscus riparius* in the MSS from Motru Mare, Vârghișului Gorges and Piatra Craiului (mostly, in covered colluvial, but also in nude colluvial MSS) and *Armadillidium versicolor quinqueseriatum* was found in the MSS from Motru Mare and Vârghișului Gorges (in covered and nude but also in cleitric MSS) (NITZU *et al.*, 2010); unlike them, *Trichoniscus bosniensis* is found only in Banat.

Among the Diplopoda, there is only one species endemic for Romania: *Alloporoiulus verhoeffi*.

Both species of *Glomeris* (*G. guttata* and *G. hexasticha*), seem to be preferential for the MSS, as both of them were collected to a depth of -0,8 m; the latter species, was also recorded in the nude colluvial MSS from the Piatra Craiului Massif (NITZU *et al.*, 2010). Among the Julidae, *Typhloiulus strictus* is preferential for the MSS, just like *Dorypetalum degenerans* (from the Dorypetalidae) and *Brachydesmus polydesmoides* and *Polydesmus montanus* (from the Polydesmidae). *Polydesmus montanus* was also found in the covered colluvial MSS from the Vârghișului Gorges and the Piatra Craiului Massif and also from the nude colluvial in the Piatra Craiului Massif (NITZU *et al.*, 2010).

5. CONCLUSIONS

1. From a total of 130 identified species (14 Oniscidea, 25 Diplopoda, 31 Collembola and 60 Coleoptera), 76 of them (representing 58%) were found at depths from 0.5 to 1 m in the mesovoid shallow substratum (MSS). Of these, *Catops tristis*, *Catops subfuscus* (Coleoptera, Leiodiadae) and *Pygmarrhopalites ornatus* (Collembola) are characteristic species for the MSS in the Carpathians and *Mycetaea subterranea*, *Hylaia rubricollis* (Coleoptera, Lathridiidae) are characteristic for the subterranean superficial environment (MSS) of South-Western karst areas of Roumania.

2. Beside the considered *characteristic* species, frequently found from spring to autumn in many investigated types of MSS other 17 species are *preferential* species for the MSS: 6 species of Coleoptera (*Abax parallelus*, *Bryaxis nodicornis*, *Nargus anisotomoides*, *Ptomaphagus sericatus*, *Sciodrepoides watsoni*, *Cryptophagus deubeli*), 4 species of Collembola (*Kalaphorura tuberculata*, *Protaphorura quadriocellata*, *Heteromurus nitidus*, *Pygmarrhopalites pygmaeus*), 5 species of Oniscidea (*Ligidium germanicum*, *Hyloniscus riparius*, *Trichoniscus bosniensis*, *Armadillidium banaticum* and *Armadillidium versicolor quinqueseptatum*) and 2 of Diplopoda (*Glomeris guttata* and *G. hexasticha*).

3. An evident increasing of the number of species in the MSS was observed for the aestival period, related to the microrefugial role of this environment for many soil species during the dry and warm periods of the year.

4. Among the identified material 10 taxa are endemic: 3 for the Roumanian Carpathians [*Molops piceus orthogonius*, *Quedius cincticollis carpathicola* (Coleoptera), *Allopodoiulus verhoeffi* (Diplopoda)] and 7 for the Banat province [*Carabus scheidleri kollari*, *Platynus banaticus*, *Duvalius herculus*, *Duvalius milleri* (Coleoptera) and *Haplophthalmus banaticus*, *Trachelipus trilobatus*, *Armadillidium banaticum* (Oniscidea)]. None of the known springtails endemic for Banat (*Orthonychiurus doinae* and *Deuteraphorura banatica*) were found in our faunal research.

5. *Dienerella separanda* (Reitter, 1887) (Coleoptera, Latridiidae) is for the first time recorded in the Roumanian fauna and *Duvalius milleri* (Frivaldszkyi, 1862), a troglobitic species was found in the MSS at 1 m depth.

ACKNOWLEDGEMENTS. This paper was elaborated within the framework of Program I, Project 1 of the Speleological Institute "Emile Racovitza" of the Romanian Academy.

REFERENCES

- CSIKI, E., *Ujabb adatok Magyarország bogirfaunijához (5. p6tjegyztk a faunakatalogushoz)*, Rovartani Lapok 11 : 5. (in Hungarian), 1904.
- CSIKI, E., *Magyarország Bog6rfaun6ja, II K6tet*, 1 f6zet, 80 p., 1909.

- DANCĂU, D., TABACARU, I., *Observații zoogeografice asupra faunei cavernicole din Oltenia și Banat*. Lucr. Inst. Speol. „Emil Racoviță”, **III**, 293 – 310, 1964.
- DANYI, L., TRASER, G., FIERA, C., RADWANSKI, M., *Preliminary data on the Collembola fauna of Maramureș County*. Studia Universitatis Vasile Goldiș, Seria Științele Vieții, **17**: 47–51, 2006.
- FJELLBERG, A., *Collembola of Fennoscandia and Denmark. Part I Poduromorpha*. Fauna Entomologica Scandinavica **35**, 1–184, 1998.
- FRIVALDSZKY, J., *Adatok Temes Cs Krasso megyek faunhjahoz. Data ad faunam Hungariae Meridionalis Comitatum Temes et Krass6*. Math es TermCszettud. KozlemCnyek, 13: 3 10–3 13. (in Hungarian), 1876.
- GIURGINCA, A., ILIE, V., *Preliminary data regarding the Oniscidea (Isopoda, Crustacea) from the North-Western part of the Caraș-Severin County (Banat, Romania)*. Arch. Biol. Sci., Belgrade, **55** (3–4), 81 – 86, 2003.
- GIURGINCA, A., PLĂIAȘU, R., MUNTEANU, C.- M., *On some Oniscidea and Diplopoda from the Retezat Massif. First record of Porcellium productum Frankenberger, 1940 and Porcellium recurvatum Verhoeff, 1901 in Romania*. Arch. Biol. Belgrade, **59** (3), 233–238, 2007.
- GRUIA, M., *Collembola from Romanian caves*. Travaux du Museum d’Histoire Naturelle „Grigore Antipa” **35**: 139–158, 2003.
- GRUIA, M., ILIE, V., *Collembola of the karstic system of Romania (II)*. Travaux de l’Institut de Spéologie «Émile Racovitza», **39–40**: 59–114, 2000–2001.
- ILIE, V., *Chilopoda from the edaphic and subterranean environments in the Reșița-Carașova area (Banat, Romania). A preliminary note*, Arch. Biol. Belgrade, **55** (3–4), 87–92, 2003.
- ILIE, V., NEGREA, ȘT., MITIĆ, B., *The diversity of the Chilopoda species from the karstic area of the Anina Mountains (Banat, Romania)*. Arch. Biol. Belgrade, **55** (3–4), 93–100, 2003.
- ILIE, V., *Cercetări taxonomice, ecologice și biogeografice asupra chilopodelor din mediile edafic și subteran superficial din aria carstică a Munților Banatului*. Ph.D. Thesis (in Roumanian), Universitatea București, Facultatea de Biologie, Catedra de biologie animală, 189 p., 2007.
- IURKIEWICZ, A., *Banat Mountians (Reșița – Moldova Nouă Synclitorium)*. In Orășeanu, I., and Iurkiewicz, A. (Eds.) Karst Hydrogeology of Romania, p. 137–168, Belvedere Ed., Oradea, 2010.
- JEANNEL, R., *Monographie des Trechinae*. L’Abeille, Journal d’Entomologie XXXV, 1–808.
- JENO, V., *Adatok Magyarorszig rovar – faunijahoz IV. Coleoptera Bogarak*. Rovartani, 1906.
- KUTHY, D., *Coleoptera*, in: Fauna Regni Hungariae, III. Arthropoda, Budapest, 213 p. Lapok, 13: 18–19. (in Hungarian), 1896.
- NAE, A., *Data concerning the Araneae fauna from the Aninei Mountains Karstic area (Banat, Romania)*. Travaux de l’Institut de Spéologie «Emile Racovitza», XLVII, 53–63, 2008.
- NEGREA ȘT., NEGREA, A., *Sur les associations de plancher des grottes du Banat (Roumanie)*. Trav. Inst. Spéol. «É. Racovitza», **XVI**, 99–139, 1977.
- NITZU, E., *Edaphicolous, endogeous and subterranean Coleoptera from the Movable karstic area (Southern Romania)*. Trav. Inst. Spéol. «E. Racovitza», **XXXVI**, 73–98, 1997.
- NITZU, E., ILIE, V., *Contribution to the knowledge of edaphic and subterranean Coleoptera from the Cloșani karstic area (Oltenia, Romania) – with special references on the mesovoid shallow substratum*. Trav. Inst. Spéol. «E. Racovitza», **XLI** (2002) – **XLII** (2003), 159–168, 2004.
- NITZU, E., NAE, A., GIURGINCA, A., POPA, I., *Invertebrate communities from the mesovoid shallow substratum of the Carpatho-Euxinic area: ecofaunistic and zoogeographic analysys*. Trav. Inst. Spéol. «E. Racovitza», **XLIX**, 41–79, 2010.

- POPA, I., *First records and rare species of Collembola in the Romanian fauna – the Piatra Craiului Massif (the Carpathians)*. Travaux de l'Institut de Speologie «Emile Racovitza», **49**, 87–96, 2010.
- RAIANU, L., *Considerațiuni sistematice și ecologice asupra genului Ontholestes Ganglb. din R.S. România (Coleoptera Staphylinidae) V*. Analele științifice ale Universității „Al. I. Cuza” Iași. Secțiunea II a. Biologie 12 (1): 73–84. (in Romanian), 1966.
- SZEKESY, V., *Die Staphyliniden des Historischen Ungarn I*. Fragmenta Faunistica Hungarica, **1** (2–3): 37–42, 1938 a.
- SZEKESY, V., *Die Staphyliniden des Historischen Ungarn II*. Fragmenta Faunistica Hungarica, **1** (4): 75–78, 1938 b.
- SZEKESY, V., *Die Staphyliniden des Historischen Ungarn III*. Fragmenta Faunistica Hungarica, **2** (1): 1–4, 1939 a.
- SZEKESY, V., *Die Staphyliniden des Historischen Ungarn IV*. Fragmenta Faunistica Hungarica, **2** (2): 17–20, 1939 b.
- SZEKESY, V., *Die Staphyliniden des Historischen Ungarn V*. Fragmenta Faunistica Hungarica, **2** (3): 33–36, 1939 c.
- SZEKESY, V., *Die Staphyliniden des Historischen Ungarn VI*. Fragmenta Faunistica Hungarica, **2** (4): 49–52, 1939 d.
- SZEKESY, V., *Die Staphyliniden des Historischen Ungarn VII*. Fragmenta Faunistica Hungarica, **3** (2): 49–59 1940.
- SZEKESY, V., *Die Staphyliniden Ungarns VIII*. Fragmenta Faunistica Hungarica, **6** (3): 101–112, 1943.

*Institute of Speleology “Emile Racovitza”
of the Romanian Academy
Calea 13 Septembrie no. 13
Sect. 5, Bucharest, RO – 050711*

