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TRANSYLVANIAN REVIEW OF SYSTEMATICAL AND ECOLOGICAL RESEARCH

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The Rodna Mountains National Park

Editors

Angela Curtean-Bănăduc, Doru Bănăduc & Ioan Sîrbu

Sibiu - Romania

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Rodna Montains National Park

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IN MEMORIAM

Florian Porcius
(1816 - 1906)

"Impressive appears the example of the persevering and victorious fighter against all kind of difficulties offered by the personality and botanical career of *Florian Porcius*." These appreciative words of Professor Emil Pop (1897-1974), member of the Romanian Academy of Science, are an expression of respect for *Florian Porcius*, and a commemoration of the activity and exceptional achievements of a lifetime of botanical studies, realised alongside other professional activities, for his home landscape, for the Rodna Mountains.

He was born on 28 August 1816 in Rodna Veche (Bistrița-Năsăud County, Transylvania-Maramureş area, Romania) at the foot of the Rodna Mountains into a family of former border guards. As his parents died early, he was educated by his grandfather, the priest Gherasim Porcius. After primary school, *Florian Porcius* between 1827/1831 attended the Normal Military School of the Habsburg (Austrian) Empire in the German language at Năsăud, and in the following period secondary schools in Blaj and Cluj-Napoca. Back at Rodna Veche he worked up until 1836 as a teacher in his home village. With a scholarship from the "Border Guardians Fund", in 1844 he arrived in Vienna for further education, including botanical and agricultural knowledge. The lectures of the famous botanist Professor Ştefan Endlicher opened his great interest for botanical studies, which had never been aroused in his later pedagogical, political and administrative career. Returning to Transylvania, *Florian Porcius* worked as a teacher, as an employer in the local and regional administration, as a district judge, as a leading functionary in the border guardians' administration and as president of the Orphan Office. Retired in 1877, *Florian Porcius* continued his botanical studies for some thirty years. He died in his native locality on 30 May 1906 at the great age of about ninety years.

With his botanical researches *Florian Porcius* introduced a note of intensively floristic research of Transylvania. For his studies he made the choice for the mountains of Rodna, a representative massif of mountains in the Romanian Eastern Carpathians. He studied in detail the flora and conditions of vegetation of the whole Rodna Mountains, also in comparison with other massifs of the Romanian Carpathians, and in 1868 published the Flora of the Năsăud District and, following this, also other botanical papers. He described new species such as *Heracleum carpaticum*, *Centaurea carpatica* and other taxons; in his honour are named two other species, *Festuca porcii* Hack. and *Saussurea porcii* Degen. Being in contact with other researchers on the flora and vegetation of the Carpathians and other parts of Romania, his botanical work was recognised and highly appreciated.

From 1857 *Florian Porcius* was a member of the Transylvanian Society for Natural Sciences in Sibiu. As an active member of the Romanian Academy of Science from 1882, he had an important role in the creation of the Romanian terminology of plants, the phyto-geographical approach to research and also the liberal species concept in Romania.

Florian Porcius was one of the first Romanian botanists with extensive international relations, cultivated through exchanges of plants and scientific correspondence between botanists as well as cooperation with many other foreign collaborators. His plant collection includes not only material from Transylvania, but also important material of the European flora.

Through his comprehensive, accurate and profound botanical work and his leading scientific role in the second half of the 19th century, *Florian Porcius* can be considered to be one of the classic figures in Romanian Biology.

The Editors

Transylvanian Review of Systematical and Ecological Research

9. The Rodna Mountains National Park ***2010***

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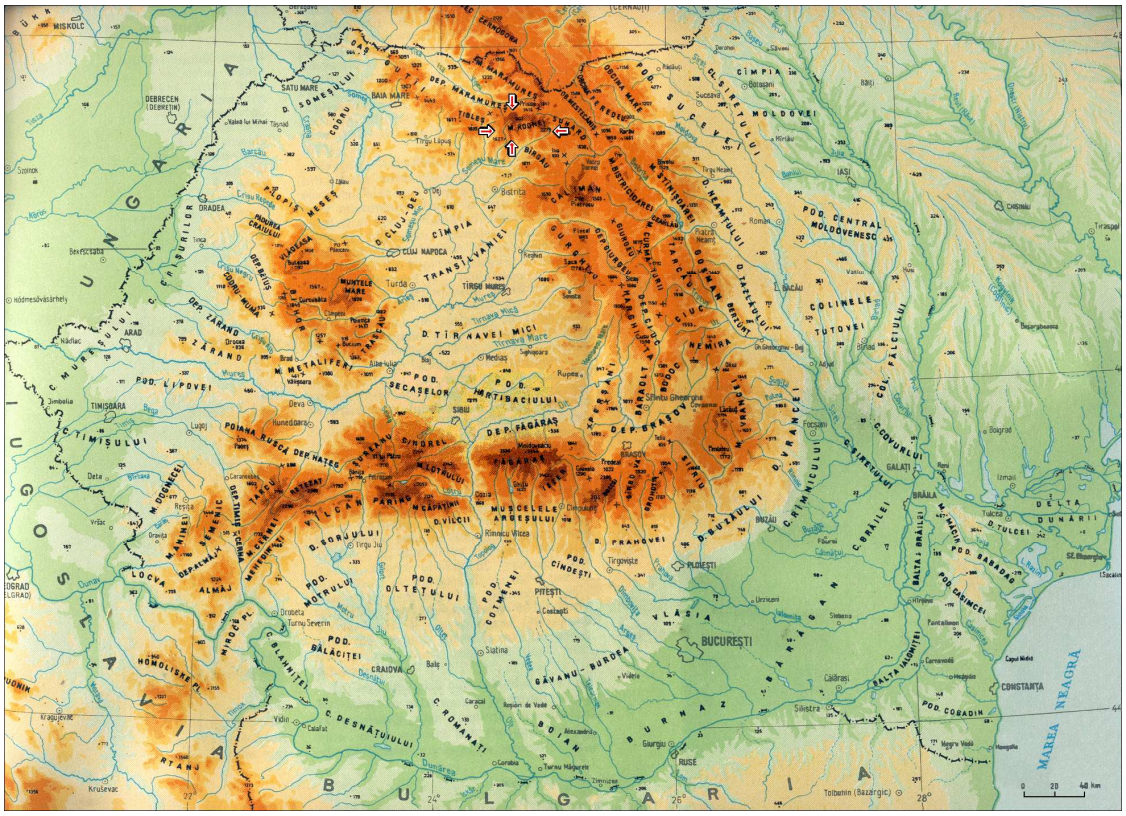
Preface

Rodna Mountains/Munţii Rodnei (47,975 ha) is located in the north of the Romanian Carpathians, in Transylvania-Maramureş regions area, in alpine bioregion. It overlaps the Rodna Mountains National Park, Pietrosu Mare Biosphere Reserve and two Natura 2000 sites ROSCI0125 Rodnei Mountains and ROSPA0085 Rodnei Mountains.



Location of the Rodna Moutains National Park (Badea et al., 1983 - modified).

The importance of this protected area lies in its geology, geomorphology, and numerous endemic or glacial relicts of flora and fauna, natural ecosystems at altitudes between 500 - 2,303 m.

Owing to its remarkable biodiversity and wildlife, the Rodna Mountains area was designated as a Special Area of Conservation (SAC) under the Habitats Directive and also, Special Protection Area (SPA) under Birds Directive, hosting 27 habitats and 25 species of community importance (six of which are priority species: *Ursus arctos, Canis lupus, Callimorpha quadripunctaria, Rosalia alpina, Campanula serrata* and *Pesudogaurotina excellens*), and five habitats are priority habitats: Bushes with Pinus mugo and Rhododendron myrtifolium - 4070*, Species-rich Nardus grasslands, in siliceous substrates in mountain areas - 6230*, Alluvial forest with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) - 91E0*, Active raised bogs - 7110*, Petrifying springs with tufa formations - Cratoneurion - 7220*, and Alpine pioneer formations of the Caricion bicoloris-atrofuscae 7240*).

These mountains harbour more than 7,200 species of flora and fauna, 270 of which are included on Rodna Mountains Red List. The most important nature values (endangered species, ecosystems) are included in four scientific reserves: Pietrosu Mare, Piatra Rea, Corongiş and Bila-Lala (in declaration process). Some vulnerable species which are spreading in Rodna Mountains are valuable species for biodiversity conservation, including brown bear (*Ursus artcos*), lynx (*Lynx lynx*), wolf (*Canis lupus*), Tatra pine vole (*Microtus tatricus* - in Romania present only in Rodna and Maramureş mountains), Carpathian newt (*Triturus montandoni*), *Carabus zawadszkii* (present only in Rodna and Maramureş Mountains), *Cucujus cinnaberinus* (rare in Romania), *Poa granitica disparilis* (present only in Rodna and Făgăraş mountains), *Pseudogaurotina excellens* (rare in Romania - Retezat, Parâng, Făgăraş, Rodna), *Carabus hampei* (present only in Făgăraş, Maramureş and Rodna mountains, and in Someşul Rece), *Hieraaetus pennatus* (rare in Romania), and *Silene nivalis* or Rodna Mountains rush-light (endemic species).

The Rodna Mountains appear as a horst of crystalline layers delimited by deep faults: Dragoş Vodă (to north) and Rodna (to south). There are three crystalline layers: Bretila, Repedea and Rebra. To south, some new volcanic rocks are to be found in the high hills located along the Someşul Mare River.

Sedimentary rocks (Cretaceous and Paleocene) surrounding the massif have been affected by tectonic movements and have stamped the landscape with some particular features. The mountain chain keeps the best traces of Quaternary glaciers. Glacial landscape is well developed on the northern slope where some glacial circuses can be found (Pietrosu, Buhăescu, Negoescu and so on). On the southern slope, the glacial landscape is less impressive: some suspended glacial circuses and snow niches. In the south, the limestone bedrock has made up a karst landscape, with some remarkable caves, such as Izvorul Tăuşoarelor (18 km), Jgheabul lui Zalion, Baia lui Schneider, Cobăşel, Grota Zânelor, and Izbucul Albastru al Izei. There are 26 mountain peaks higher than 2,000 m in the massif.

Different biological studies demonstrate the relevance of the Rodna Mountains from biodiversity point of view, especially by including the Pietrosu Mare site on the tentative list of UNESCO World Heritage Sites for Nature. The process of declaring as a full UNESCO site is ongoing, by collection of data in order to prove that the area is equivalent to an endemogenetic centre for an important constellation of flora and fauna species.

Inspired by the value of the area, the *Transylvanian Review of Systematical and Ecological Research* editors, with the support of the Rodna Mountains National Park Administration, have dedicated a first volume of this series to the Rodna Mountains National Park. This scientific volume represents an important step for promoting the nature values of this area, highlighting the relevance of the protected areas as biodiversity hotspots, and invites more and more naturalists to study and discover the mysteries of this wild area.

There is no doubt that these new data will develop knowledge and understanding of the ecological status of this special area, and that they will continue to evolve.

Acknowledgements

The editors would like to express their gratitude to the authors and the scientific reviewers whose work made the appearance of this volume possible, and to the Rodna Mountains National Park Administration, which supported a part of the field work on which a part of the necessary research was based, and also a part of the printing costs of this volume.

The Editors

GEOGRAPHICAL INTRODUCTARY CHARACTERIZATION OF THE RODNA MOUNTAINS - RODNA MOUNTAINS NATIONAL PARK (EASTERN CARPATHIANS, ROMANIA)

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KEYWORDS: Romanian Carpathians, location, limits, relief, general characterization, hydrology, climate, protected areas.

ABSTRACT

This paper, "Geographical introductary characterization of the Rodna Moutains - Rodna Mountains National Park", represents a brief description of the Rodna Mountains where occurs one of the most important protected areas of Romania.

This paper includes information regarding: location, limits, relief and general characterization, hydrology and climate, protected areas of the Rodna Mountains, both within the Rodna Mountains National Park and from different areas of its surroundings.

RESUMEN: Caracterización geográfica de introducción de la Montaña Rodna - Parque Nacional Montañas Rodna (Cárpatos Orientales, Rumania).

Este artículo „Caracterización general de la Montaña Rodna - Parque Nacional Montañas Rodna", representa una breve descripción de las montañas Rodna, donde hay una de las más importantes áreas naturales protegidas de Rumania.

El artículo incluye información relativa a: límites, relieve y caracterización general, hidrología y clima, áreas protegidas de las Montañas Rodna, ambos del Parque Nacional Montaña Rodna y de diferentes áreas de sus alrededores.

REZUMAT: Caracterizare geografică introductivă a Munților Rodna - Parcul Național Munții Rodna (Carpații Orientali, România).

Această lucrare „Caracterizarea generală a Munţiilor Rodna - Parcul Național Munții Rodna" reprezintă o descriere introductivă a Munţiilor Rodna, unde se află una dintre cele mai importante zone protejate din România.

Această lucrare cuprinde informații referitoare la: amplasare, delimitare, relief şi caracterizare generală, hidrologie şi climă, zone protejate din Munții Rodna, atât din Parcul Național Munții Rodna, cât şi din diverse zone limitrofe acestuia.

GEOGRAPHICAL ELEMENTS

Localisation

The Rodna Mountains (Fig. 1) are localized in the Transylvania-Maramureş areas (Romania) and are part of the northern group of the Eastern Romanian Carpathians.

Within the northern group of the Eastern Romanian Carpathians, the Rodna Mountains are surrounded by: the Ţibleş Mountains at West, the Maramureş Hills in North-West, the Maramureş Mountains at North and North-East, the Suhard Mountains at East, the Bârgău Mountains and the Năsăud Hills at South.

Figure 1: The Rodna Mountains landscape.

Limits

The geographic limits of the Rodna Mountains are delimited by few landforms.

The western limit is represented by the Sălăuţa Valley, between the Coşbuc Village and Ştefăniţa Hill (Bistriţa-Năsăud County), the Şetref Pass (818 m a.s.l.) and the Carelor Valley, the village of Săcel (Maramureş County), up to the confluence with the Iza River.

The northern and the north-eastern limits are the valley of Iza River, Moisei Hill (the Moisei Pass), Vişeu Valley and Prislop Pass (situated at an altitude of 1,416 m) (Maramureş County).

The eastern limit is given by the Bistriţa Aurie River, the Rotunda Creek, Rotunda Pass (1,217 m in altitude), Preluci Creek and Someşul Mare River up to the village of Valea Mare (Bistriţa Năsăud County).

The southern and south-eastern limits are the Năsăud Hills between Coşbuc Village and the city of Anieş and, from that point forward, the Someşul Mare River up to the Valea Mare Village (Bistriţa Năsăud County).

Geographical and geological characterization

The Rodna Mountains are the tallest most massive mountains of the Eastern Romanian Carpathians, distinguished by their heights surpassing 2,200 m, the length of the mountain range of almost 50 km and their area of 1,300 km^2.

The range is a profoundly asymmetrical over raised horst, due to its crystalline structure as well as to the fault lines determining the sinking of the neighboring areas. This tectonic character is emphasized on the northern side of the range by the short steep slope of the almost 1,000 m deep Dragoş Vodă fault line and the long gentle sloping of the Someş fault line.

Most of the Rodna Mountains range is composed of metamorphic rocks (Bretila series, Rebra series and Repedea series), containing gneiss, micaceous schist, amphibolites, quartzite, greenschists and graphitic schist, and crystalline limestone. In the southern part, due to Neocenic volcanic activities there are rhyolites, dacites, andesites and basalts. The metamorphic nucleus is surrounded by limestone, sandstone, siltstone, conglomerates and mudstones.

Although unitary, the Rodna Mountains can be divided in three distinct compartments due to their morphological and orographic particularities.

Ineu is the most eastern compartment and forms an orographic centre culminating with the pyramid shaped Ineu Peak (Fig. 2) of 2,282 m. From this centre are spreading the secondary ridges: Piciorul Tomnatecului (Tomnatec II Peak, 1,967 m), Piciorul Pleşcuţei Ridge (2,041 m a.s.l.), Gajei Ridge (Gajei Peak 1,847 m), Piciorul Ineuț (Ineuț Peak 2,222 m a.s.l., Roşu Peak 2,113 m a.s.l., Cobăşel Peak 1,835 m a.s.l.), Curățel Ridge (1,851 m a.s.l.), Piciorul Crăciunel (1,704 m), mountain's main ridge (Coasta Netedă Peak 2,060 m, Cişa Peak 2,036 m, Omu Peak 2,134 m a.s.l., Clăii Peak 2,121 m a.s.l., Gărgălău Peak 2,159 m) and its secondary ridge leading to Corongiş Peak (1,987 m). The mountain is mainly formed of strongly metamorphosized crystaline rocks (granate micaceous schists, paragneiss, epimorphic schists - Repedea series), sericitous grafitous schists, amphibolites, limestone, often covered by glacier deposits and scree.

Pietrosu is the central compartment of the mountain, being separated from the other two by the Tarnița Bătrânei Saddle (1,735 m) at West and Galați Saddle (1,882 m) at East.

This sector is morphologically divided in three branches:

a. a first branch situated between Galați Saddle and the Rebra Peak 2,119 m, and represents the main ridge of this mountain with altitudes over 2,000 m as Rebra Peak 2,119 m, Gropilor Peak 2,063 m, Cormaia Peak 2,033 m, Repede Peak 2,074 m, Negoiasa Mare Peak 2,041 m a.s.l., Puzdrelor Peak 2,189 m a.s.l., Galați Peak 2,048 m a.s.l., from where the longest secondary ridges are breaking.

b. Pietrosu branch is separating towards north from the central branch from the Rebra Peak 2,119 m, here being situated the tallest peaks of Rodna Range, Pietrosu Rodnei Peak 2,303 m (Fig. 3), Grohotu 2,203 m, Buhăiescu Mare Peak 2,268 m, Buhăiescu Mic Peak 2,221 m a.s.l.

c. the third branch is situated between the Rebra Peak 2,119 m and Tarnița Bătrânei Saddle (1,735 m) being emphasized by Gropilor Peak 2,063 m.

Bătrâna is the third compartment situated between Tarnița Bătrânei Saddle (1,735 m) and Șetref Pass (818 m) and is forming an orographic centre with valleys in a radial disposition around Muncelu Râios Peak of 1,703 m a.s.l. (Fig. 4) and Bătrâna Peak of 1,710 m a.s.l. (Fig. 5). The mountain is formed of sandstone, mudstone, menilites, bituminous schists (Borşa strata), siltstone flysch, wild flysch, bituminous schists (Valea Carelor strata).

Figure 2: Ineu Peak.

Figure 3: Pietrosu Rodnei Peak.

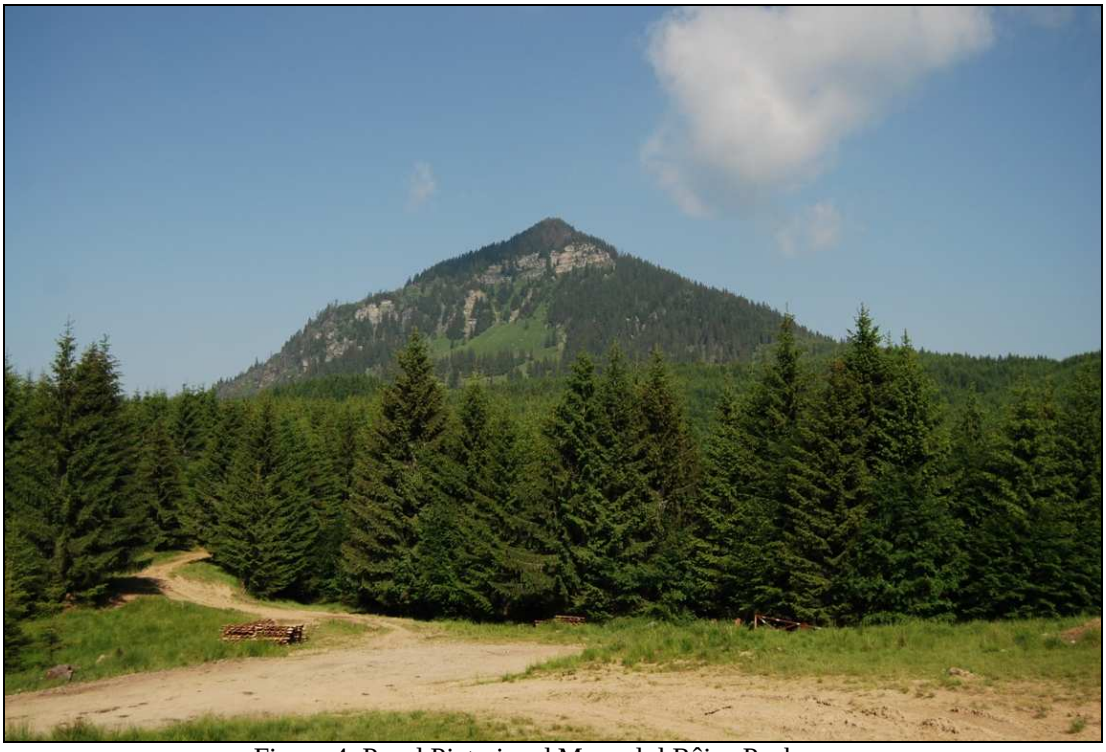

Figure 4: Pasul Pietrei and Muncelul Râios Peak.

Figure 5: Bătrâna Peak.

Figure 6: Izbucul Izei (The Iza River spring).

Figure 7: Peştera Izei (Iza's Cave).

There are four main characteristic features of the Rodna Mountains.

The denudation topography, for which T. Murariu established the presence of four erosion surfaces and I. Sârcu showed that only one surface is suitably represented, the Cerbul surface, which he assimilates to the Bătrâna surface identified by T. Murariu.

The glacial topography is represented by cirques (Pietrosu, Buhăiescu, Repede, Negoiescu, Cimpoiesei, Bistriței Aurii, Ineu and Lala), moraines (on Lala, on Bila, on Putredu, along Bistricioara River), erratic blocks, glaciers valleys.

The periglacial topography is represented by sandars (Lala, Bila and Pietrosu), protalus remparts (on Cobăşel, on Puzdrele), tills (Ineu), kames (Rodna, Fața Mesei) and avalanche paths.

The karst topography is poorly represented, only in form of limestone pavement, sinkholes, caves and subterranean streams - Piatra Rea, Bistricioara Valley, Mihăiasca, Corongiş, the springs of Iza (Fig. 6), etc. In Rodna Mountains around 90 caves have been mapped, from which we cite the most prominent: Izvorul Tăuşoarelor (Tăuşoarele Spring), Jgheabul lui Zalion (Zalion's Gully), Peştera lui Măglei (Măglei's Cave), Peştera Zânelor (Fairies Cave), Peştera Izei/Iza's Cave (Fig. 7), Peştera Laptelui (Milk Cave), Peştera Baia lui Schneider (Schneider's Mine Cave), etc.

Hydrology

Superficial waters are represented by streamlets and lakes and are collected by different rivers.

Iza River springs under the Bătrâna Peak and collects streamlets from the north-western side of the Rodna Mountains. The main valleys are: Măgura Valley, Celaru Valley, Runcu Valley, Obcioara Valley, Toplicioara Mare Valley, Izcioara Valley, Teilor Valley, Repede Creek and Carelor Valley.

Vişeu River springs under Prislop Passage and collects streams from the northern Rodna Mountains side. The main valleys are: Sfăracu Valley, Fântâna Valley, Negoiescu Valley, Repedea Valley, Pietroasa Valley, Hotar Valley, Purcărețul Valley, Dragoş Spring Valley and Negru Spring Valley.

Bistrița Aurie River springs under Gărgălău Peak, from the glacial lake Bistrița Aurie Spring and collects streamlets from the eastern side of the Rodna Mountains. The main valleys are: Putredu, Tomnatecu Mare, Bilei, Lala and Rotunda.

Someşul Mare is formed by the confluence of Preluci Valley (Rodna Mountains) with Zmeul Valley (Suhard Mountains), collects the valleys and streams from the eastern and southern sides of the Rodna Mountains. The main valleys are: Nichitaş Valley, Gaja Valley, Cobăşel Valley, Baia Valley, Anieş Valley, Cormaia Valley, Rebra Valley and Gersa Valley.

Sălăuța Valley, tributary of the Someşul Mare River, collects the valleys and streams from the western side of the Rodna Mountains. The main valleys are: Repede Stream, Strâmba Valley, Telcişor Valley, Babei Valley, Cerbu Valley, Stegii Valley, etc.

The lakes are represented by: glacial lakes, which lay behind some moraine deposits; there are around 23 and have a surface under 0.5 ha, and a maximum depth of 5.2 m (Buhăiescu II Lake). The most important glacial lakes are: Iezer Lake (Fig. 8), Buhăiesc lakes - I, II, III, IV (Fig. 9), Repede Lake, Izvorul Bistriței Lake, Ineu Lake, Lala Mică Lake (Fig. 10), Lala Mare Lake (the largest lake, 0.52 ha), etc.; periglacial lakes: Tăul Corongiş, Tăul La Cărți, La Tău, etc.; lakes situated behind a slide wave of earth: Tăul Muced (Fig. 11) on Bătrâna Mountains, at the springs of Iza River.

Figure 8: Iezer Lake.

Figure 9: The glacial caldron and Buhăiescu lakes (I, II, III).

Figure 10: Lala Mică Lake.

Figure 11: The Muced Mire.

The waterfalls are well represented, here is present one of the biggest in Romania: Cailor Waterfall of 80 m (Fig. 12), and also Buhăiescu Mare, Izvorul Verde (Fig. 13), Puzdra, Cimpoiasa, as well as from the valleys Pietroasa, Rebra, Cormaia, Anieş and Băilor Springs.

Figure 12: Horses Waterfall, Cascada Cailor.

Figure 13: Waterfall on Green Spring.

The mineral waters are present especially in the southern side of the area, where there is the Sângeorz Băi Resort. Other mineral springs are located in Anieş, Şanţ, Maieru, Rodna, under Prislop Passage, Romuli - Borcut Riversides Coppice Reservation (Fig. 14), and Borşa Complex.

Figure 14: Borcut Riversides Coppice Reservation.

Climate

The geographic position, its western-eastern direction of the summit and its altitude generate the climate in the Rodna Mountains, it is temperate-continental, with Atlantic influences and alpine character.

Average annual values widely oscillates, the differences being given by the altitude and the slope exposure, the northern one being cooler than the southern one. Annual temperature in the summit area is negative (at over 2,300 m, it is of -1.3˚C), at the altitude of 1,790 m, where the Iezeru meteorological station is situated, the average annual temperature is of 1.4˚C. In the southern slope, the average annual temperature is of 6-7˚C, at the base of the massive.

The average annual precipitations in the alpine and subalpine areas of the interest mountainous zone are of 1,200-1,400 mm, and at the base of the massive they reach a value of 750-800 mm. The number of the rainy days is an average of 130-150 days, the first snow falls at the end of September or the beginning of October, and the number of the snowy days is of 160-200.

The winds are present in this area especially in the alpine and also in the subalpine areas, their western direction being dominant, and their medium velocity is of 3.5-4.5 m/sec.

PROTECTED AREAS

In the Rodna Mountains are present an important number of protected areas with different conservation status.

Rodna Mountains National Park - Biosphere Reserve - 46,339 ha, overlaps on the Rodna Mountains. From the administrative point of view Rodna National Park belongs to both Maramureş County (9,798 ha) and Bistriţa-Năsăud County (3,6541 ha), category II IUCN.

Pietrosul Mare Nature Reserve (Rodna Mountains National Park) - code 2563, mixed scientific reservation, 3,300 ha. Location: Moisei and Borşa, Maramureş County, category I IUCN.

Piatra Rea Nature Reserve (Rodna Mountains National Park) - code 2589, mixed scientific reservation, 409 ha (Law 5/2000 - 50 ha), Maramureş County, category I IUCN.

Ponorul Izei Nature Reserve (Bătrâna Spring) (Rodna Mountains National Park) - code 2562, hydro-geological, 0.5 ha. Location: Moisei, Maramureş County, category III IUCN.

Peştera and Izbucul Izei Nature Reserve (Rodna Mountains National Park) - code 2582, speleological, 100 ha. Location: Moisei, Săcel, Maramureş County, category III IUCN.

Meadow with *Narcissus* Nature Reserve on Saca Mountain (Rodna Mountains National Park) - code 2209, botanical, 5 ha, Location: Rodna, Valea Vinului Village, Bistriţa-Năsăud County, category III IUCN.

Ineu-Lala Nature Reserve (Bila-Lala) (Rodna Mountains National Park) - code 2225, mixed, 2,568 ha. Location: Şanţ, Rodna, Bistriţa-Năsăud County, category IV IUCN.

Mihăiesei Springs Nature Reserve (Rodna Mountains National Park) - code 2223, mixed, 50 ha. Location: Maieru, Anieş Village, Bistriţa-Năsăud County, category IV IUCN.

Cobăşel Valley Cave Nature Reserve (Rodna Mountains National Park) - code 2210, speleologist, 1 ha. Location: Şanţ, Bistriţa-Năsăud County, category III IUCN.

Cormaia Valley (Rodna Mountains National Park) - code 2223, mixed, 50 ha. Location: Cormaia, Bistriţa-Năsăud County, category IV IUCN.

Tăuşoare Cave Nature Reserve (Rodna Mountains) - code 2206, speleologist, 71 ha. Location: Rebrişoara, Bistriţa-Năsăud County.

Zăvoaiele Borcut Nature Reserve (Rodna Mountains) - code 2205, hydro-geological, 1 ha, Location: Romuli, Bistriţa-Năsăud County.

There are also few Natura 2000 Sites situated in the Rodna Mountains.

SCI - Sites of Community Interest

ROSCI 0125 Rodna Mountains. Location: Maier 56%, Parva 17%, Redra 32%, Romuli 8%, Rodna 55%, Sângiorgi Băi 39%, Şanţ 31%, Telciu 11%, Bistriţa-Năsăud County and Borşa 10%, Moisei 42%, Săcel 9%, in Maramureş County.

ROSCI 0193 Tăuşoare Cave. Location: Rebrişoara, Bistriţa-Năsăud County.

ROSCI 0264 Izei Valley - Solovan Hill. Location: Romuli <1%, Telciu <1%, Zagra <1%, in Bistriţa-Năsăud County and Moisei <1%, Săcel 69%, in Maramureş County.

SPA - Special Protection Areas

ROSPA 0058 Rodna Mountains. Location: Maier 56%, Parva 17%, Redra 32%, Romuli 8%, Rodna 55%, Sângeorz Băi 39%, Şanţ 31%, Telciu 11%, in Bistriţa-Năsăud County and Borşa 10%, Moisei 42%, Săcel 9%, in Maramureş County.

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NATURAL CAVITIES IN THE PIATRA REA - ŞTIOL AREA, GURA FÂNTÂNII, BORŞA (RODNA MOUNTAINS) (TRANSYLVANIA-MARAMUREŞ, ROMANIA)

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KEYWORDS: Romanian Carpathians, Rodna Mountains, Piatra Rea Scientific Reserve, natural cavities.

ABSTRACT

Piatra Rea is a metamorphic limestone mountain, situated in the Rodna Mountains National Park, where 340 ha are constituated as a scientific reserve. On this mountain, there are known up to 22 cavities, only two of them having a development larger than 100 m. The karst of Piatra Rea - Ştiol has a complex character, being built in at least four stages, the oldest being more than 350,000 years old, while the last, the most recent, is made of travertine deposits from mineral water sources.

A speciality of the mountain are the gravitational traction cavities, such as the pothole of Podul Cailor (243.3 m in length and 108.3 m in depth), the deepest cave from the northern part of Romania.

The exokarst is well represented, as clints, sink-holes, swallets, gorges and one important exsurgence (Fântâna).

Equally remarkable are the osteological remains collected from the pothole of Podul Cailor, where bones of *Bos primigenius* were identified, probably from a period when human pressure drove them to an altitude above that of the species normal habitat.

RÉSUMÉ: Les cavités naturelles de la zone de Piatra Rea - Ştiol, Gura Fântânii, Borşa (Montagnes de Rodna) (Transilvanie-Maramureş, Roumanie).

Piatra Rea est un massif de calcaires métamorphiques situé dans le Parc National des Montagnes de Rodna, duquel une surface de 340 ha a un statut de réserve scientifique. Dans ce massif sont connues 22 cavités, dont seulement 2 ont un développement de plus de 100 m. Le karst de Piatra Rea - Ştiol a un caractère complexe, étant édifié en au moins 4 étapes, la plus ancienne ayant plus de 350.000 ans et la dernière, la plus récente, étant constituée de dépôts de travertin déposées par des sources minérales.

Une caractéristique du massif sont les cavités formées par soutirage gravitationnel tel l'Aven du Podul Cailor (développement 243,3 m, dénivellation -108,3 m) qui est la grotte la plus profonde du nord de la Roumanie.

L'exokarst et bien représenté, varié, sous forme des lapiès, dolines, embuts, canyons et une importante source vauclusienne (Fântâna).

Egalement remarquables sont les restes ostéologiques récoltées de l'Aven de Podul Cailor, où ont été identifiées des os de *Bos primigenius*, probablement d'une période dans la quelle la pression anthropique les a poussés à des altitudes inhabituelles pour l'habitat de l'espèce.

REZUMAT: Cavitățile naturale din zona Piatra Rea - Ştiol, Gura Fântânii, Borşa (Munții Rodna) (Transilvania-Maramureş, România).

Piatra Rea este un masiv de calcare metamorfice, situat în Parcul Național Munții Rodna, o suprafață de 340 ha, având statut de rezervație științifică. În acest masiv, se cunosc 22 de cavități, dintre care doar 2 au o dezvoltare de peste 100 m. Carstul din Piatra Rea - Ştiol are caracter complex, fiind edificat în cel puțin patru stadii, cel mai vechi de peste 350.000 ani, ultimul, mai recent, în depozite de travertin depuse de izvoare minerale.

O caracteristică a masivului sunt cavitățile formate prin tracțiune gravitațională, Avenul din Podul Cailor (dezvoltare 243,3 m, denivelare -108,3 m) este cea mai profundă cavitate din nordul României şi are această geneză.

Exocarstul este bine reprezentat, variat, reprezentat de lapiezuri, doline, ponoare, chei şi un important izbuc (Fântâna).

Remarcabile sunt resturile de oase prelevate din avenul din Podul Cailor, unde au fost identificate oase de bour, probabil dintr-o perioadă în care presiunea umană i-a împins la altitudini anormale pentru habitatul speciei.

INTRODUCTION

The Piatra Rea studied area (Figs. 1 and 2) is mostly included in the Piatra Rea Scientific Reserve of Rodna Mountains National Park.

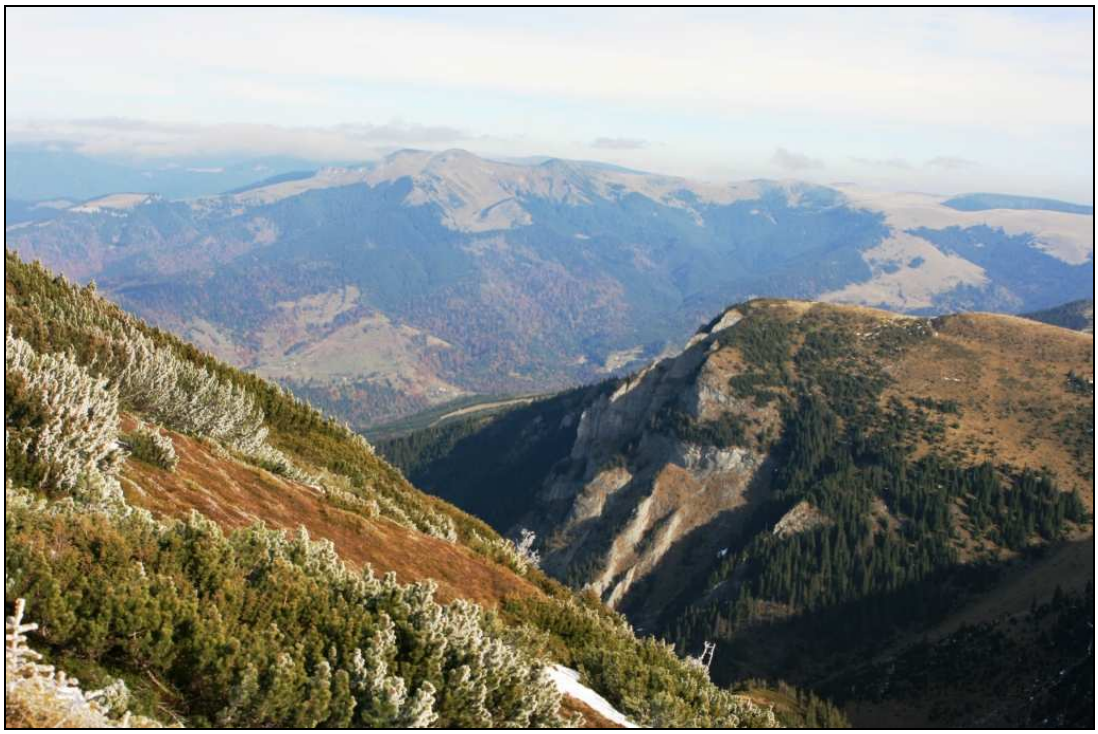

Figure 1: Piatra Rea area.

Figure 2: Piatra Rea area.

The Piatra Rea Scientific Reserve is proposed as county reservation by the Maramureş County Council Decision 57/1994 (geological, floristic and landscape reserve on an area of 50 hectares). The Law 5/2000 declared Piatra Rea area as a scientific reserve, in the 1st category of the IUCN status. In 2003, The Rodna Mountains National Park Administration was founded, and elaborated a management plan approved by the Romanian Government Emergency Order 57/2007, by which the Scientific Reserve of Piatra Rea is extended to an area of 340 hectares.

SPELEOLOGICAL RESEARCH

The exokarstic phenomena of the Ştiol - Bistricioara Valley area have been mentioned for the first time in 1910, although the author was considering them to have a glacier origin (Orghidan, 1910). Donisă (1963) analyses the exokarst of the same area, as a part of the field research for his doctoral thesis published in 1968. The karstic morphology of the same area is also mentioned by Sârcu, in his doctoral thesis of 1978. To be noted that the karstic phenomena of Piatra Rea, although impressive, are only studied recently, after 1978, due to the difficult access to this area.

The cave of Cailor Cascade/Horses' Waterfall is known and visited by the locals since the dawn of time, being also known as Şura Cailor/Horses' Barn or Şura lui Pintea/Pintea's Barn. The access to the cavity on the five meters vertical drop was made by introducing cuted Norway spruce trunks into the cavity and using them as ladders, from this cavity the locals extracting "stone milk" - mond milch (colloidal calcium carbonate), frequently used throughout Maramureş region as treatment for some sheep diseases.

The first mappings of the cavities in the area were made by the speleological clubs "Flacăra" of Iaşi and "Emil Racoviță" of Bucharest, in the years 1978-1981; in 1980 starting its own explorations the Mountain Speleology Club of Baia Mare, initially by mapping new cavities. The geologist M. Oşan discovers in 1980 the insurgence of the Bistricioara Gorge and the geologist A. Jurkiewicz identifies in 1984 the Ştiol swallets and the Podul Cailor Pothole. Later on, the Baia Mare locality speleologists will find more new cavities and will remap with a higher precision the cavities that other groups have already mapped, in order to obtain a more complete data and picture of the local karst.

GEOLOGICAL DATA

The geological structure of the Rodna Mountains is characterized by the presence of some groups of shearing nappes, partially overlapped. The Piatra Rea area belongs to the infrabucovinic Nappes (basement nappes) in which more shearing nappes are individualized. The rocks in the analyzed sector belong to the Ştiol nappe in which several rock series were evidentiated.

In the basement area the Bretila series is present (upper Precambrian), principally made of gneisses with amphibolites' intercalations (identified in the south and the south-east of the Borşa tourist complex).

In the succession, the Repedea series follows (Silurian), in which two formations are individualized. In the basement area the Ştiol formation is present, as a narrow ribbon over the Bretila series deposits, with a wider development in the Ştiol Peak and saddle. It is made of sericito-chloritous schists, sometimes graphitous, the Ştiol limestone being present at the top. In the lower third of the Ştiol formation levels of iron rich hematitic ore are present, investigated through the descending tunnels and the short galleries, locally known as "Ştioluri" (thus the origin of the toponym being obvious: Stollen = gallery in German, "Ştiol" meaning largely the same thing here).

The Fântâna formation (Silurian). Is the one in which appear the main natural cavities in the Piatra Rea - Ştiol area. The bulk of this formation is represented by sericitous-chloritous schists. On different levels appear intercalations of limestone as well as of metamorphic dolomites appear. In the middle section of the formation, the Fântâna limestones make a lenticular formation three km long having an average width of one kilometre, the maximum depth of the Fântâna limestones reaching 700 m in the Piatra Rea area (possible paleoreef).

The Cimpoiasa series (Devonian) follows in the metamorphic succession. In the Piatra Rea studied area, only the two lower formations out of the total of three are now present.

The Gura Fântânii Formation (Devonian) is located in the upper part of the Fântâna Formation, containing sericito-chloritic schists, quartzite, metaconglomerates, with a dolomite intercalation.

The Negoiescu Formation. The main segment of the formation is formed by sericito-chloritic schists. At different levels are appearing intercalations of quartzite, limestone, graphitous schists and even stratiform hematit-magnetit ore. On the upper part is located the Râpa Rea limestone, where a cave was identified.

The presented geological elements are according to Kräutner et al. (1983).

CAVITIES DESCRIPTION

The cavities description will be done in the order provided by Romanian Cave Cadastre (Tab. 1). The data from the table complete the data offered in the text; x: Rodna Mountains National Park; xx: Scientific Reserve Piatra Rea.

Table 1: The cavities description after the Romanian Caves Cadastre.

Code	Name	Localization	Amplitude (m)	Level difference (m)	Mapping	Part of: x or xx
1028/1	Horses'/Pintea's Barn Cave	Left versant of Horses' Creek	83.0	-9.0; +6.0	Flacăra Iaşi 1978, C. S. Montana Baia Mare, 1986	xx
1028/2	Mond-milch Cave	Piatra Rea-interme-diate ladder (Cățânii Izvorului)	52.5	-8.3	CSER Bucureşti 1980, Flacăra Iaşi 1981, C. S. Montana Baia Mare, 1986	xx
1028/3	Two entries potholes of Piatra Rea	Western part of Horses' Mountain	90.0	-26.0	Flacăra Iaşi 1980, C. S. Montana Baia Mare 1986, 1990	x
1028/4	The cave from the valley of Spring Bridge	Right versant of Horses' Creek	6.0	-2.0; +1.0	C. S. Montana, 1980	
1028/5	The diaclasis pothole from Jgheabul Peak	500 m NV from Piatra Rea Peak, on the ridge	210.2	-54.3	C. S. Montana 1990, 2004	xx
1028/6	Horses' Barn 2 Cave	Upstream Horses' Barn Cave	14.5	+6.0	C. S. Montana, 1986	xx
1028/7	Ciudii Cave	Above 1028/6	10.2	-1.5; +0.4	C. S. Montana, 2000	xx
1028/8	Cave beneath the sheepfold	Above Horses' Falls	16.5	-1.0; +2.0	C. S. Montana, 2001	xx

1028/9	Sheepfold Pothole	Upstream Horses' Falls	28.0	-14.0	C. S. Montana, 2001	x
1028/13	Swallet no. 1 of Ponoarele Ştiolului	South from Ştiol Saddle	9.4	-4.0	C. S. Montana, 1985	x
1028/14	Swallet no. 2 of Ponoarele Ştiolului	South from Ştiol Saddle	7.1	-4.0	C. S. Montana, 1985	x
1028/15	Horses' Bridge Pothole	Horses' Mountain	243.3	106.3	C. S. Montana 1985-1986, 2000	x
1028/16	The Hall Cave from Piatra Rea	100 m west of Piatra Rea Peak (1,702 m)	16.0	-4.0	C. S. Montana, 1986	x
1028/17	The Water Cave from Piatra Frânturii	MCH Fântâna	72.0	-1.5; +1.0	C. S. Montana, 1988	
1028/18	The Branched Cave from Ştiol Saddle	Ştiol Saddle	75.00	-4.7; +1.3	C. S. Montana, 1988	x
1028/19	The Tunnel Cave from Ştiol Saddle	Ştiol Saddle	21.5	-6.0	C. S. Montana, 1988	x
1028/20	The Brain Cave from Ştiol Saddle	Ştiol Saddle	32.0	-1.0; +1.5	C. S. Montana, 1989	x
1028/21	The Cristal Cave from Piatra Rea	Piatra Rea, lower ladder	21.0	+1.5	C. S. Montana, 1989	xx
1028/22	The Diaclasis Cave with potholes	Piatra Rea, lower ladder	20.0	-3.7; +4.0	C. S. Montana, 1989	xx
1028/26	The Cristal Cave 2	Piatra Rea	12.0	-4.5	C. S. Montana, 1998	xx
1028/27	Dingle Cave	Left versant of Horses' Hollow	10.0	-4.0	C. S. Montana, 2001	x
1028/28	Gipsy Cave	Piatra Rea Dingle	16.7	-5.0	C. S. Montana, 2008	x

Horses' Barn Cave (Pintea's Barn Cave). The cave (Fig. 3) is formed by two different sections, one on a high (6-9 m), narrow (0.8-1.0 m), east-west oriented diaclasis, which communicates through a five m threshold with a long (3-8 m), low (0.8-1.0 m) gallery, north-south oriented.

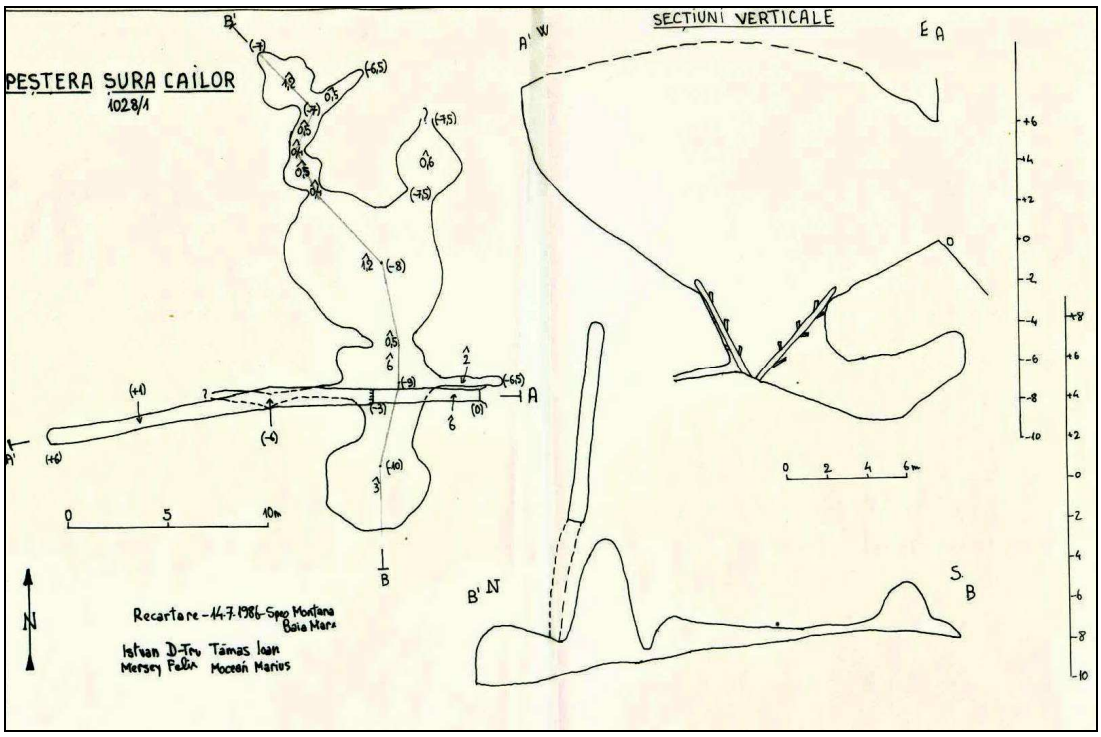

Figure 3: Horses' Barn Cave/Pintea's Barn Cave blueprint,
based on the original announcement and confirmation data sheet
sended at the "Emil Racoviță" Speleological Institute of Bucharest
by D. Istvan, I. Tămaș, F. Mersey and M. Mocean. (in Romanian)

The Mond-milch Cave. It develops on an ENE-WSW oriented descendent diaclasis, with a succession of six small thresholds (the largest one of 2.5 m). The diaclasis was mostly modelled by a deep water regime, the water accumulation surface being totally eroded. It presents carbonate deposits on the cave walls and a large number of mond-milch deposits.

The two entries pothole of Piatra Rea (Fig. 4). Two 12 and 15 m entries going down on a tilted, NW-SE oriented hall, with short lateral galleries at different levels (-4, -9, -11 m). On the NW, after a four m threshold, the diaclasis becomes impenetrable at -24 m, reaching out from the rocky wall. On the SE, the galleries are ascendant, with thresholds. The pothole develops on a tectonic diaclasis, modelled by erosion and dissolution.

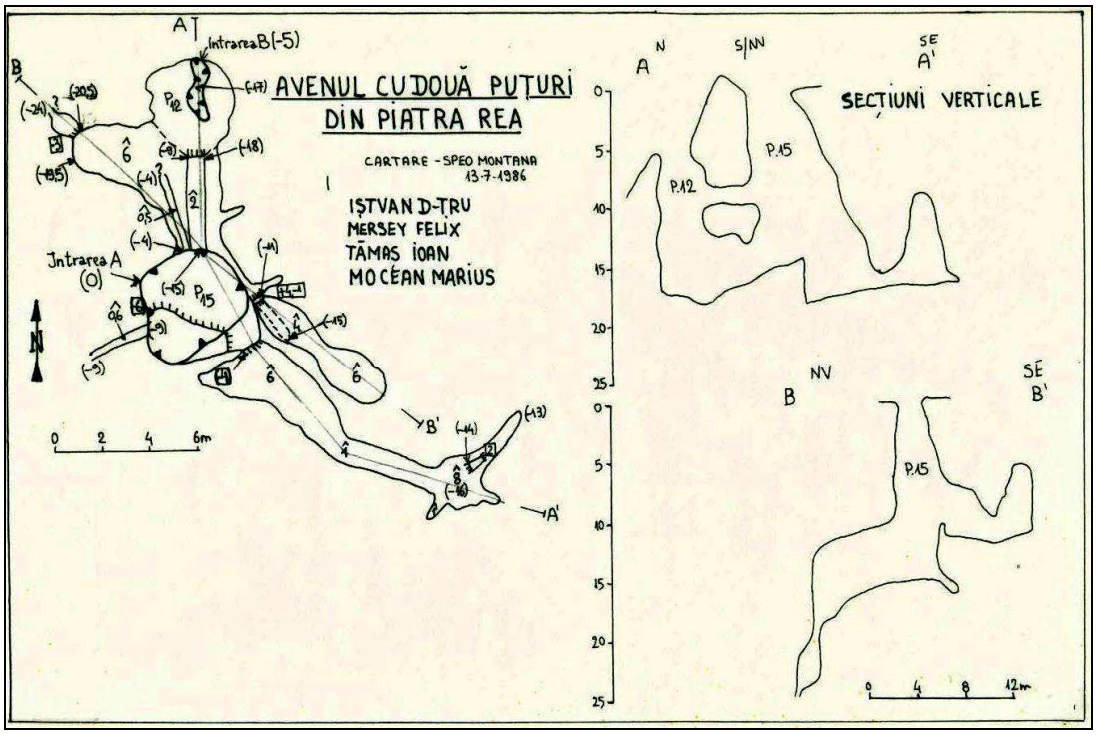

Figure 4: The two entries pothole of Piatra Rea blueprint,
based on the original announcement and confirmation data sheet
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The diaclasis pothole from Jgheabul Peak. It is developing on gravity traction diaclasis, marked at the surface by a 25 m long diaclasis, on which four accessible and several impenetrable entries line up. There are three larger levels with stable floor, at -10 m on the south-east, and at -25 to -30 m and -43 to -46 m, on the central part. The maximum width of the diaclasis (around two m) is on the upper side, narrowing progressively to the deep. The surface diaclasis largely extends on depth toward NNE, the horizontal extension of the cavity being 64.5 m.

Descending the 24.5 m entry, the -25 to -30 levels are reached. From here continues a diaclasis toward NNW, and an 18 m descending tunnel at its end leads to the -43 to -46 levels. A return to the SE margin of the cave leads to a five m descending tunnel and to another narrow two m tunnel, which opens at -54.3 m, where the diaclasis becomes impenetrable. From the five m descending tunnel's entry, climbing toward NNW a 6.5 m threshold, the NNW part of diaclasis, leading to its end, at -51.5 m.

The gravity traction diaclasis is linear, diagonally from the ridge, with a deeper opening to NNW, toward Rea Valley.

Sheepfold's Guardian Pothole. The ten m entry pothole is continued toward SV by a succession of thresholds (2.5 m) and then a three m descending tunnel reaches its end at -14 m. At -6 m, above a 4 m threshold, descending galleries with small thresholds (1.5 m) develop toward E.

Swallets no. 1 and 2 of Ponoarele Ştiolului. Two small depressions, frequently clogged, very important because of a 1986 test made by A. Jurkiewicz, where an EDTA (Ethylene DamineTetraAcetic, or polyamino-carboxylic acid) tracer agent showed the presence of an underground circulation under Piatra Rea, toward Izbucul Fântâna (the exit spring provides potable water to the area).

The Horses' Bridge Pothole. The most important cavity of the studied area, being the deepest pothole of northern and north-western part of the Romanian territory. This cavity was identified by A. Jurkiewicz in 1984, being mapped in several stages between 1985 and 2000, with ulterior (unsuccessful) attempts of surpassing the terminus.

The pothole develops on ENE-WNW oriented gravity traction diaclasis that deepens toward WSW (Valea Rea). The mapped part of the diaclasis extends horizontally on 125 m.

From the WNW-ern end direction of the surface diaclasis (8 m long and 3.5 m wide), a narrow slide is followed by a 10 m descending tunnel down to the collapsed floor of a 1-1.5 m diaclasis, from which -19 m are reachable toward ENE; on the WSW of the floor, at -22.5 m, a 24 m descending tunnel descends to a rocky platform embedded into diaclasis walls. From here, another 11 m descending tunnel leads down to another rocky platform at -52 m, from which a 52 m long -65 to -67 m floored level is reachable.

From the WSW-ern end of the studied diaclasis, a lumpy floored sector follows, with 7.5-8.5 potholes, separated by thresholds, leading to -78 m. From here, a 15.5 m descending tunnel, followed by a sector with boulders trapped in the diaclasis and another four m descending tunnel, leads to the minimum level (-108.3 m).

The Hall Cave from Piatra Rea. A four m descending tunnel leads in the middle of a NW-SE oriented, elongated hall, 10 m long, 1.5-4 m wide, 4 m high in the central part and 1.5-1.7 m high on the extremities.

The Water Cave from Piatra Frânturii. It develops on the travertine deposits from the mineral springs of the left versant of Fântâna Valley (upstream the confluence between Cailor and Cimpoiasa springs, in the inhabited area), being passed through by an active stream parallel with Fântâna Valley. The entry (now covered in concrete) was opened by the excavation made in 1988 for the Gura Fântânii micro-power station, and it reached straight to the central part of the cave - The Collapsed Hall (8 by 4 m, 1.8-2.5 m high), packed with travertine blocks from the ceiling, due to lack of support and low density of the travertine. Downstream, the active course was reachable through a six m long low (0.5 m), narrow (1 m) tunnel. Upstream, after a narrow part that was cleared of rocks, the gallery continues with a diaclasis aspect (0.3-0.4 m wide, 1.0 m high, 4.0 m long), followed by another lower gallery (0.5 m), with (lowering) ascendant branches toward East, leading to a higher parallel course, showing an evolution of the deepening toward West.

The Branched Cave from Ştiol Saddle. (Fig. 5) The entry hall (6 m by 4 m, and 0.4-1.5 m high) of this cavity is continued by three galleries. The ascendant (Southern) gallery is 1.4-3 m wide and 12 m long, with heights of about 1.2-1.5 m. The so called Leopard Gallery continues the entry hall of the cavity, after a two m threshold, with heights growing from 1.0 to 2.5 m. At its end, the "Leopard Skin" formation is visible (a parietal dissolution formation, with darker spots). The Diffuse Light Gallery (the northernmost gallery) is a 22 m ascendant one, with a 2.5 m threshold and low width and height (0.4-1.0 m).

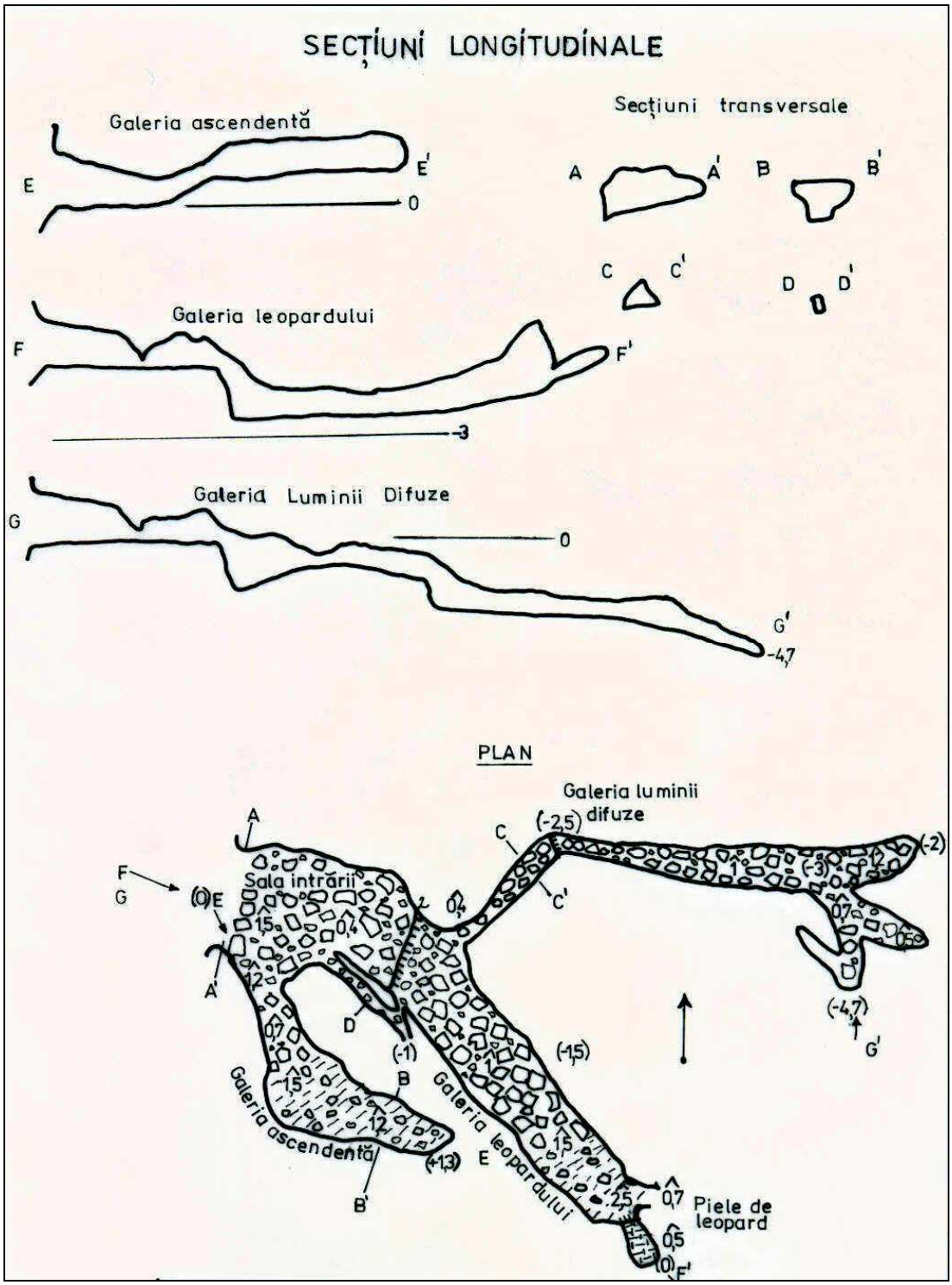

Figure 5: The Branched Cave of the Șaua Știol and longitudinal profiles through its galleries blueprint, based on the original announcement and confirmation data sheet sended at the "Emil Racoviță" Speleological Institute of Bucharest by D. Istvan, I. Tămaş, F. Mersey and M. Mocean. (in Romanian)

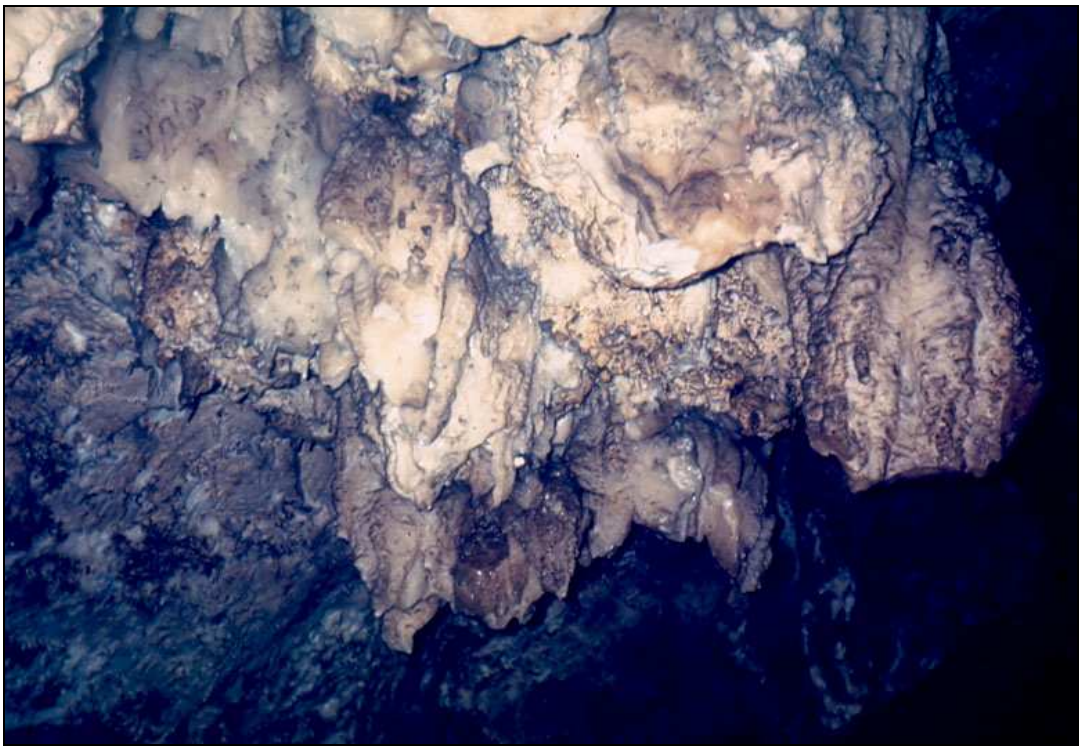

Figure 6: Calcite monochristals covered with mondmilch.

The Brain Cave of Ştiol Saddle. Is a low (0.5-1.8 m), small cavity, with walls covered in mond-milch (Fig. 6), one of the formations being brain-shaped.

The Cristal Cave from Piatra Rea. Is another small cavity, with walls and ceiling partially covered in rhomboedral calcite monocristals, up to 10-12 cm long and 2 cm thick. Crystallographic, microscopic, thermo-gravimetric, difractometric and quantitative spectral analysis showed the presence of aragonite, strontianite, dolomite and pyrite alongside calcite.

The Ştiol Pothole. Is mentioned in some touristic publications, being set on a structural level at 1,600 m, inside a small depression. It actually is an impenetrable diaclasis, 0.2 m wide, 45 degrees tilted toward SV, without an air current (Iştvan, 1983).

THE PIATRA REA AREA KARST

The metamorphic limestones of Fântâna (Silurian) formed a continuous layer, oriented NW-SE, almost four km long, between Bistricioara's source and Cimpoiasa Valley, 400-800 m wide in the south-eastern part (Ştiol - Cascada Cailor) and 1-1.5 km wide in the Piatra Rea area, where it reaches also a remarkable maximum depth (700 m). Most of the cavities are developed on the metamorphic limestone of Fântâna, only one cavity appearing on the crystalline schists of the Negoiescu formation (Peştera de la Râpă), another one on the Râpa Piatra Rea limestone (Peştera Ţiganului) and another one (Peştera cu apă din Piatra Frânturii) on recent travertine, deposited by mineral water sources.

The Exokarst. It is wider developed on the Ştiol - Izvorul Bistricioarei area and a lot less in Horses' Bridge, completely lacking in Piatra Rea area.

Karren/clints are frequent on the dip slope of the 1,600 m level. Linear, curved and circular karren were described (Figs. 7 and 8) (Donisa, 1963, 1968).

Figure 7: Tubular karrens.

Figure 8: Circular and linear karren.

Dolines/Sinkholes are present on the 1,530-1,540 m structural level. There are three large ones, 2-3 m deep (one of them transformed into a peat bog), of 60, 100 and 165 m in diameter (Donisa, 1963). On the right slope of Izvorul Bistricioarei there are a few dolines with steep walls, 3-5 m deep, one of them transformed into a permanent lake (Tăul Hârdău), of around 30 m in diameter. Two dolines are also on the 1,600 m structural level, one of 5 m in diameter and 4 m deep, functioning as a sinkhole, and another one, 5 m east, of 3 m in diameter and 2 m deep, at the contact between the micaschists (on the south) and the metamorphic limestones (on the north) - (Iştvan, 1983). A steep wall doline is found in Horses' Bridge, in the proximity of the Horses' Bridge Sinkhole.

Spring/Slopess. Within the area of Bistricioarei - Ştiol Spring there are several water leakages through sinkholes. At the structural level from 1,530 m to 1,540 m, a part of the dolines functions as sinkholes. Other small sinkholes are to the south of the Ştiol saddle. The most spectacular insurgence is placed on the left slope of the Bistricioara Spring, in gorges, where a part of the valley penetrates (when flows are high) underground, through a narrow diaclasis, at 30 m upstream the contact of the metamorphic limestone with the crystalline schist of the base. The opening which collects the water is triangular, with a side of 0.4 m. Deeply, there is a pit with a diameter of 1.0-1.5 m, with an irregular profile, of about 2 m deep; and then water directs north-westwards through a passage of a diaclasis type, which seems to be impervious (Iştvan, 1983). The marking made by A. Jurkiewicz, with an EDTA indium tracer, in 1986, did not occur in Fântâna spring (in comparison with the waters of Ştiol springs, which lays less than 1 km westwards), this thing suggesting a leakage in an unknown place, yet. Water of the Ştiol springs (height of 1,500 m, flow 1.0-1.5 l/sec) was marked with EDTA indium by A. Jurkiewicz in 1986. It appeared in Fântâna spring (height 950 m, average flow 150 l/sec) in a straight line distance of 2,930 m, with a velocity of 25 m/hour, suggesting the presence of some areas with large flooded surfaces, because the Fântâna spring is only the upper side of an aquifer placed in the metamorphic limestone, which goes downwards to north-west with 20-25º (Orăşeanu and Jurkiewicz, 2010). Another spring is upstream Bistricioara Gorges, on the left slope. The Bistricioara Gorges are placed on the structural level from 1,530 m to 1,540 m and are about 250 m long, 5-8 m wide and with vertical walls of 8-12 m (Istvan, 1983).

Morphology of limestone slopes. Piatra Rea massif presents impressive rocky slopes to the north, northeast and northwest. The pronounced declivity of slopes causes accumulation of debris and stones torrents. In the rocky slopes area (which appear as linear, insular, or walls floors) chimneys and edges are present, which break the monotony of the rocky edges. At the top, at Podul Cailor, a quasi-structural surface appears, developed mainly on the stratification of metamorphic limestone. Sometimes slope erosion and gelifraction individualize high and pointed towers, from the northwest slope of Piatra Rea, to the west slope, the most notable one being called "the Church".

A feature of the slope of Cațânii Izvorului (left of Cailor Spring) is the presence of two rather large horizontal surfaces. These are some structural surfaces, 2-10 m wide, developed on the strata, upward to the north and shaped by periglacial processes and gelifraction at the contact of layers with different mechanical resistance. The presence of several cavities in these levels suggests that these structural steps could be made of metamorphic dolomites, which have formed surfaces of accumulation of water infiltration and of water flows.

Diaclasis of gravitational traction. Cavities developed on diaclasis of gravitational traction are a feature of the Piatra Rea Massif, the most important ones in the area having this genesis. They are formed by the separation by gravitational traction of large masses of rocks, situated on the versants with pronounced flanks. Oance the separation is initiated, it's supported and continued by seepage of water. The deepest pothole of Piatra Rea, the pothole of Podul Cailor - is at the same time the deepest pothole in the northern part of the Romanian territory.

The separation plan is in fact the mapped route of the pothole. It is parallelogram-shaped and west-south-west inclined, with a length of 120 m and a width of 60-70 m, only 8-10 m being obvious at the surface. This vertical aspect of the gravitational traction diaclasis shows that the gravitational tension that caused shearing of rocks, had occurred in the downstream part of the diaclasis towards north-north-west (towards the tip of Piatra Rea and Rea Valley). The detachment was initiated on the basis of the rock mass displaced and then propagated toward the top, causing a slight tilt of the northern division, which makes the width of the diaclasis to increase slightly towards the top side. Interesting is the fact that the opening of the diaclasis to the surface has a very short length, suggesting that the phenomenon of separation is not completed, the cohesion of rocks at the top of diaclasis, moderating and stabilizing the already initiated and activated gravitational separation.

The diaclasis pothole of Jgheabului Peak cuts trough a peak between Rea Valley and Cailor Spring (the western one). The diaclasis of gravitational traction has an open surface of 25 m in length and in vertical extent; it also looks like a parallelogram inclined towards south-east, with sides of 55 x 30 m. It's a more advanced diaclasis than the one from the pothole of Podul Cailor, because the travelled width of the "parallelogram" is almost equal to the opening of the diaclasis to the surface. The traction which determined the rock shearing has occurred towards the north-east to Rea Valley.

It is worth noting that between the two cavities mentioned, at the surface of Piatra Rea northern peak (1,696 m) there is a diaclasis of gravitational traction crossing the ridge, with an east-north-east - west-south-west direction (similar to the one of the Podul Cailor Pothole), inaccessible because of the reduced width (0.3 to 0.4 m).

Karst dating and etapisation essays. The mond-milch cave is a descendent one, with vaduous drainage (with a free level, who's water acumulation surface is completely eroded), with the entrance situated in a cliff several hundreds of meters high, which suggests an old age of the karst. On a calcite crust collected from the cave, B. Onac has attempted the U-Th isotopic dating, but the age is larger than the method's maximal dating limit (aproximately 350,000 years), thus indirectly showing the age of this karst (from which other cavities of the Piatra Rea cliff are also part, as Peştera cu Cristale/The Cristals Cave), without being able to date it effectively.

The cavities from Ştiol area were formed recently, and those related to gravitational traction diaclasis are probably more recent or simultaneously with the previous ones. In Podul Cailor Pothole there is a lot of osteological material, which suggests that de entrance diaclasis worked a period as a trap for creatures from the surface. The material collected by T. Tămaş in 2001 and reviewed by M. Vremir, showed the presence of deers, wild boars and aurochs (*Bos taurus*) bones, the toponymy of Rodna Mountains confirming the "bold" presence of a mountain nucleus of aurochs in this massif (Filipaşcu, 1969).

The newest cavity is the Piatra Frânturii Cave, was recently formed in travertine by mineral springs.

CONCLUSIONS

After speleological researches which last around 25 years, the Piatra Rea - Ştiol karst starts to reveal its "secrets". On a relatively reduced surface, the karstification process started over 350,000 years ago, and there were observed three or four periods of karstic evolution, each one developed in new spaces, and no more than one period of evolution was found in all the studied cavities.

The cavities of gravitational traction have few chances to intersect the underground course between the swallets of Ştiol (Bistriţa Aurie Basin) and Fântâna Spring (Fântâna Basin), because the gravitational phenomena cut the slope till much superior levels in comparison with the present level.

The mentioned karstic abstraction is the biggest in Romania due to the surface surrounded by the waters which divagate from the upper basin of the Bistricioara Valley, moving on Bistriţa Aurie and Siret, to come across at Galaţi with the underground waters of the Vişeu Basin, through Tisa and Danube rivers, after which get around a big part of the Romanian territory, transit Ukraine, Hungary and Serbia and mark off at north Bulgaria. Obviously we are talking about few potential water molecules which can get together.

For an assembly image of the karst of this area, we present a karstogram, which reveal the developing and unevenness of the existent cavities at the surface of abruption of the karstifiable rocks. This relates only to the limestone of Fântâna, in which are localized 19 of the 22 cavities known in the area. The 19 cavities have a total development of 1,042.8 m and an average development of 54.88 m (the maximum development is of 243.3 m and minimum of 6 m). There are only two cavities with a development bigger than 100 m, both of them formed on gravitational potholes. Six cavities (31%) have a development of over 50 m. Ascribed to the total surface of the Fântâna limestone (3.6 km^2) situated at the surface, result an average of 5.27 cavities on km^2 of limestone and 269.67 m developing/km^2 limestone.

The cavities are predominantly descendant, only two caves are ascendant and seven others have ascendant sectors too. The cumulative negative unevenness is of -254.3 m (the average being of -13.38 m) and a pozitive unevenness of +23.7 m (the average being of +1.25 m).

It is easy to remark the fact that the northern slopes of the Rodna Mountains have many karstic areas, each of them with its individualities:

- Izvorul Izei, a karst area which evolved in Eocene limestones, reached the stability stage when the underground water reached the impermeable substrate. The clastokarst (probable of gravitational traction) prezent in Capul Muntelui (Muncelul Râios) and Buncher Hill (north of Bătrâna Peak);
- Klastokarst of Pietrosul - Piatra Albă (also of gravitational traction);
- The karst of Piatra Rea - Ştiol, interesting as explored proportions and theoretical potential, most likely the most complex as genesis from the northern slope of the Rodna Mountains.

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PIETROSUL RODNEI RESERVE TYPICAL TOPOCLIMATIC CONDITIONS AND THE FOREST VEGETATION (MARAMUREŞ, ROMANIA)

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KEYWORDS: Romanian Carpathians, Rodna Mountains, Rodna Mountains National Park, Pietrosul Rodnei Reserve, climate, forest vegetation.

ABSTRACT

This paper discusses the climatic role of the relief and the vegetation, also presenting the forest vegetation of the Nature Reserve Pietrosul Mare - Rodna Mountains National Park.

The author also presents the forest types of the Pietrosul Rodnei Reserve: pure Spruce forests (Picetae), forest communities of Spruce with Fir (Piceto-Abieta), forest communities of Spruce with Fir and Beech (Piceto-Abieto-Fageta), forest communities with Spruce and Beech (Piceto-Fageta) and Beech (Fageta montana).

ZUSAMMENFASSUNG: Die typischen topoklimatischen Bedingungen und die Waldvegetation des Reservats Pietrosul Rodnei (Maramuresch, Rumänien).

Die vorliegende Arbeit befasst sich mit der klimatischen Rolle des Reliefs und der Vegetation, insbesondere aber mit der und der Forstvegetation im Reservat Pietrosul Rodnei - Nationalpark Rodna-Gebirge.

In der Arbeit werden die verschiedenen Waldtypen des Reservats Pietrosul Rodnei vorgestellt und zwar reine Fichtenwälder (Picetae), Gesellschaften der Fichte mit Tanne (Piceto-Abieta), Gesellschaften von Fichte mit Tanne und Buche (Piceto-Abieto-Fageta), Fichte mit Buche (Piceto-Fageta) und Buche (Fageta montana).

REZUMAT: Condiţiile topoclimatice tipice Rezervaţiei Pietrosul Rodnei şi vegetaţia forestieră (Maramureş, România).

Lucrarea prezentă oferă date despre suprafaţa subiacentă şi rolul climatic al reliefului, rolul climatic al vegetaţiei şi vegetaţia forestieră din Rezervaţia Pietrosul Mare - Parcul Naţional Munţii Rodna.

În lucrare, sunt prezentate şi tipurile de pădure prezente în Rezervaţia Pietrosul Mare: molidişuri pure (Picetae), asociaţii de molid cu brad (Piceto-Abieta), asociaţii de molid cu brad şi fag (Piceto-Abieto-Fageta), molid cu fag (Piceto-Fageta) şi fag (Fageta montana).

INTRODUCTION

If we consider the vegetation, flora and fauna of the Pietrosu Rodnei Reserve, the most valuable area is represented by the subalpine and alpine zones. The formation of the notched Pietrosu surface determined the climate, the relief and the soil, leading to matchless floristic and forest vegetation, perfectly adapted to the existing topoclimate, determined by relief and altitude.

During the Quaternary glaciations, the Rodna Mountains relief was strongly modified, especially on the northern versant of the massif. Traces of glaciers (cirque and valley glaciers) that slided over the folded rocks of the high mountains, millions of years ago, can be easily identified as the deep rock hollows, or as the boulders spread in those hollows or clustered on the valleys.

On the northern versant, the thick ice layer dug impressive hollows during its slide, e.g. the Pietrosu Hollow, and the valleys springing from the northern hollows were strongly eroded by the glaciers descending towards lower altitudes. All those glacial marks complete the wonderful alpine landscape of Rodna Mountains.

RESULTS AND DISCUSSIONS

The subjacent surface and the climatic role of the relief

Scientifically speaking, the active subjacent surface represents the Earth's crust, with all its characteristics: relief, vegetation, hydrographic network and soil, together forming one of the genetic factors of a given region's climate, being known that the surface to which the air comes into contact plays an important role in the conversion of the solar energy into caloric energy, supplying the air with moisture. From progressive analysis, we have found out that from the characteristics of the subjacent surface, the aspect and altitudes of the relief have an important climatic role. The relief's shape determines the slope of the crust's surface and its exposure to cardinal points, influencing the intensity of direct solar radiation for each terrain. The relief's height leads to the elevation of the Earth's crust into higher or lower troposphere layers, different in temperature, pressure, humidity, etc. The more heterogeneous this surface is the more complex and diversified the climatic processes generated and influences by it will be. Out of the subjacent surface's particularities, the relief has the prime role, since it generates the dimensions of the "climatic space", in which the climate is relief's resultant, related to the altitude and the coordinates' values.

This relief has a high fragmentation, because high slope versants are dominant and plan or low slope surfaces are a rarity. The relief's influence makes the temperatures drop on the high summits, average annual temperatures being very low and freezing occurring throughout the year. Snow persists until July and snowing is possible anytime in the summer. Rainfall quantity is increasing, reaching 1,267 mm in average. In this way, at Iezer Meteorological Station, situated at an altitude of 1,785 m, under the highest peak, Pietrosu, the average annual temperature is 1.26 °C and the average annual rainfall is 1,267 mm/year (data collected in the 1971-2006 period). The local influence of the relief's shape is visible through slope values and versant exposure. Thus, high slope southern oriented versants receive perpendicular sunlight, increasing the intensity of direct radiation, while on the northern versants the insolation is far lower (Iezer Meteorological Station is located on a northern versant of Rodna Mountains).

The relief has one of the prime roles because it generates the most important climatic features. Versant exposure, valley orientation and relief's energy strongly influence the climate through Rodna Massif. Also, the altitude plays a determinant role in the massif's climate, in conformity with the relief forms developing throughout the massif.

The vegetation's part in the climate regulation

The vegetation, as an expression of the dominant climate features, confers, in its turn, certain climate and topoclimatic characteristics that vary with the coverage degree, the main species, the plant density, the height of the canopy, the form and the density of the leaves, the height of the prairies, the vegetation stage, etc. The main characteristic of the vegetation is the second active surface that forms at the upper limit of the vegetation, where differentiated processes of transformation of solar radiation into heat take place; over 80% of the solar radiation and 15-20% of the precipitations never reach the ground, being retained by the leaves. This is reflected in the rise of the temperature and the decrease of the relative air humidity at ground level.

The mixed beech and spruce forests are climbing up to 1,300-1,400 m on the south-western slopes, followed by the Norway spruce forests up to 1,750 m in altitude. In certain areas the beech is mixed with the European silver fir, the Arolla pine appears close to the upper limit (in the Lala glacial cirque, for example) as well as the Mugo pine associations. The higher areas are covered with alpine prairies.

The vegetation cover of the Rodna summit is disposed on different levels and almost constantly distributed on the slopes: at over 1,800 m in altitude, around 30% of the rocky surface is covered with alpine prairies that alternate with Mugo pine bushes (*Pinus mugo*), Arolla pine trees (*Pinus cembra*) and Kotschy's alpenrose heaths (*Rhododendron kotschyi*) etc.; between 1,800 and 1,100 m of altitude the forests of Norway spruce (*Picea abies*) are developing, between 1,100 and 500 m of altitude the area of beech (*Fagus sylvatica*) and European silver fir (*Abies alba*) is developing, and under 500 m of altitude are situated the cultivated lands; as botanical rarities we remind the existence of: the Carpathian harebell (*Campanula carpatica*), the lungwort (*Pulmonaria filarszkiana*), the edelweiss (*Leontopodium alpinum*), etc.

Of all the categories of vegetal formations, the forest has the most important topoclimatic characteristics: a moderate temperature variation with isothermal situations and temperature inversions, high humidity of the air and soil, weak air circulation inside and breeze-like circulation on the periphery. Since the forest is an obstacle in the air mass circulation system, the forest contributes to the increase of turbulences, the uneven snow layer formation, also influencing the neighbouring areas in that direction. During the summer days the temperature inside the forest is lower than in the surrounding region, while during the night and in winter time, the differences are smaller and in the opposite way. At 1,785m of altitude, where the meteorological station is situated, the vegetation period is short, so its role as an active surface is limited, being replaced by the snow that persists during 165.4 days/year in average.

Forest vegetation

The endemic Carpathian elements of the reserve's flora present a great importance, from both floragenetic and phytogenetic points of view, conferring a regional colour to the communities where they vegetate.

Among the rare species from Romania, having a range limited to Rodna Mountains, being thus endemic plants of this massif, we mention *Lychnis nivalis* Kit. and *Heracleum carpaticum* Porc. The first species is found more frequently in the Seslerio distichae-Juncetum trifidi and Rhododendro kotschzi-Vaccinietum plant associations patches from subalpine and lower alpine vegetation levels.

In the natural vegetation from Pietrosul Rodnei Biosphere Reserve, the main role is held by the pure spruce forests, representing 67% of the total forested area, followed by the mixed spruce-fir-beech forests, with 28%, and beech forests, representing 5%. The present structure of the forests, as well as its future tendencies, also in order to assess the capacity of this reserve's forest vegetation to accomplish its multifunctional protection role.

Extending from 183 ha in the year 1932, to 2,700 ha in 1962 and 3,300 ha in 1977, the Pietrosul Rodnei reserve includes also 1,770 ha covered with forest vegetation, which represent a belt on the eastern, northern and western slopes, having an important role in its protection. In the reserve's central area is situated the 1,530 ha alpine meadow, dominated by Pietrosu Peak, measuring 2,303 m a.s.l.

According to the last forest management plan from Borşa Forestry of Baia Mare Forestry Department, the eastern limit of the reserve is marked by Repede Valley and its tributary Buhăiescu, from the lower limit of the forest up to Buhăiescu Peak, being continued westwards along Izvorul Dragoş Valley and the ridge between Izvorul Râpilor and Sterpu, from the lower limit of the forest up to Bătrâna ridge.

The natural conditions that generate the characteristics of the forest vegetation within the reserve are:

- the minimum altitude of 740 m a.s.l. (at the forest cabin Izvorul Dragoş), and the maximum height of 2,303 m (Pietrosu Peak); the forests from the reserve present the following altitudinal repartition:

- under 800 m - 8%;
- 800-1,000 m - 10%;
- 1,000-1,200 m - 24%;
- 1,200-1,400 m - 37%;
- over 1,400 m - 21%.

- regarding the geomorphologic base, the rheology, the reserve is located on a horst with well expressed faults in relief, slopes which reach in some places up to 1,000 m, determining the steep character of the northern versant. Also, in the reserve are present glacial traces, like alpine crests with dentate aspect, glacial cirques and U-shaped valleys (Zănoaga Mare, Zănoaga Mică, Zănoaga Iezerului), glacial lakes (iezere), moraines which came down under 1,000 m a.s.l. (Valea Pietrosului/Pietrosului Valley). The slopes of the versants vary as following:

- under 16° - 5%;
- 16-30° - 44%;
- 31-40° - 35%;
- over 40° - 16%.

- the hydrographical network of the reserve includes the Pietrosul northern versant, which flows directly in the Vişeu River or in its tributaries Repede and Izvorul lui Dragoş.

- the exposure of the majority of the surfaces covered with forest vegetation is shady or partially sunny (86%).

- the predominant soils are the brown ones, with different degrees of podzolization, of variable depths.

In these general natural conditions, the forest vegetation of this reserve is formed of pure spruce forests, in the upper sectors of the versants, and of mixed compositions in the lower sectors of the versants, with Fir, Beech, Mountain Sycamore, White Alder, Green Alder, Birch, Goat Willow, etc. At the upper limit of the forest vegetation, at altitudes of over 1,700-1,800 m is remarkable the appearance of some rare individuals of *Pinus cembra*, of some associations of *Pinus mugo* and *Juniperus sibirica* that strongly decreased due to deforestations and fires and also to the *Rododendron kotschyi*, *Vaccinium myrtillus*, *Vaccinium vitis idaea* and *Vaccinium gaultherioides* extension.

In the revealed conditions the forest vegetation of the reserve created the following associations, in which are included the following types of forests, based on the Romanian classification of the types of forests:

Formation 11 pure spruce forests (Picetae)
111.1 Normal spruce forest with *Oxalis acetosella* 3%
111.3 Spruce forest of high altitude with *Oxalis* 1%
111.4 Spruce forest with *Oxalis* on skeletal soils 13%
111.5 Spruce forest with *Oxalis* on skeletal soils of low productivity 1%
114.1 Spruce forest with *Luzula sylvatica* 23%
114.2 Spruce forest of high altitude with *Luzula sylvatica* 1%
115.3 Spruce forest with *Vaccinium myrtillus* 6%
115.4 Spruce forest on the upper tree limit with *Vaccinium myrtillus* 9%
116.4 Spruce forest of crystalline rocks 6%
117.2 Spruce forest clearing with *Sphagnum girgensohnii* and *Vaccinium myrtillus* 3%
117.3 Spruce forest with Grey Alder of low productivity 1%

Formation 12 spruce-fir forests (Piceto-Abieta)
124.1 Spruce-fir forest on skeletal soils 1%
124.4 Mixt forest of spruce, fir, beech with *Asperula odorata* and *Dentaria glanduligera* 10%

Formation 13 mixed forests of spruce-fir-beech (Piceto-Abieto-Fageta)
133.1 Mixed forests of conifers and beech with *Festuca altissima* 1%
134.1 Mixed forests of conifers and beech on skeletal soils 10%
134.2 Mixed forest of spruce, fir and beech with *Festuca altissima* 1%
134.4 Mixed forest of conifers and beech with mull flora on mean profound soils 3%

Formation 14 spruce-beech forests (Piceto-Fageta)
143.1 Spruce-beech forest with *Luzula luzuloides* 2%

Formation 41 pure mountainous beech forests (Fageta montana)
411.8 Mountainous beech forest on mean profound soils with mull flora 2%
414.1 Mountainous beech forest with *Festuca altissima* 2%
414.2 Beech forest with mean productivity on acid soils

Juniperus sibirica, Pinus mugo and *Rhododendron kotschyi* plant associations with isolated *Pinus cembra* specimens are found in the subalpine vegetation level, at altitudes higher than 1,700-1,800 m a.s.l., beyond the upper limit of the spruce forests, especially downstream Zănoaga Mare.

The *Pinus mugo* shrubs cover 30% of the non-forested areas of the reserve, occupying different size patches. They have a very important role in maintaining the natural equilibrium in the area, especially in preventing soil erosion and slowing down the frequent snow avalanches, which follow a route along some narrow valleys, where tree growing is not possible. The sole other species which can be found along the avalanches' routes downstream is the green alder (*Alnus viridis*).

In order to consolidate the remaining mountain pine patches from high altitudes, the Borşa Forestry, to which the reserve belongs, produces for some years *Pinus cembra* and *Pinus mugo* saplings in Fântâna nursery, aiming to re-extend these species in the reserve, as well as in other areas with similar conditions.

Thus, from the earlier mentioned forest vegetation's distribution on forest types, arises that the pure spruce forests are dominant, representing 67% of the total forested area, followed by the mixed spruce-fir-beech forests, with 28% and beech forests, representing 5%.

According to some mappings, from the foresters' point of view in the stand treatments works, 3% of the forest are of first quality (first-second production class forests), 71% of second quality (third production class forests) and 26% of third quality (fourth-fifth production class forests).

The forest vegetation from Pietrosul Rodnei reserve, presented above, is part of the forestry management areas PU V Prislop, on 280 ha, and of PU VI Pietrosul on 1,420 ha within Borşa Forestry. This forestry administrates 29,052 ha, of which 9,626 ha, namely 33.2% represent forests from the first group, with special protection role, and 19,426 ha, namely 66.8%, represent forest from the second group, with production and protection role.

In order to be able to appreciate the capacity of forest vegetation from Pietrosul Rodnei forest reserve to accomplish its multifunctional protection role, altogether with its production role, we present the present structure of the forests that make up these PU areas, as well as its future tendencies.

CONCLUSIONS

Analyzing the main parameters that characterize the present structure of the forests forming the forest vegetation from the reserve, as well as the dynamics of their future modifications, some interesting and favourable conclusions can be drawn.

The present coppices composition of the studied area corresponds to the vegetation floors in which are located. Their future evolution should be orientated to better realize their functions of protection and production, through the reduction of the proportion of the Spruce, which is very sensible to the actions of biotic vectors attacks. With a higher resistance at these factors are the mixed compositions, which include Mountain Sycamore, Mountain Ash and even Beech. In these conditions the Spruce, present today in a proportion of 83% in the local production unit Prislop and of 70% in the Pietrosul production unit, will be reduced at 67%, respectively at 63%, in the favor of the Fir, Larch and Mountain Sycamore.

The changing of the vegetal associations will reflect also an increasing of the local wood productivity. It can be prefigured that the actual productivity of 7.4-7.6 m^2/year/ha will increase at 9.0-9.3 m^2/year/ha.

A special emphasis will be put on the permanent forestry interventions with plantations which will complete the natural regenerations.

The extension of the protection functions of this forest vegetation through the creation and extension of the Pietrosul Rodnei Nature Reserve represents a good action for that forest. Reciprocal, these forests will represent a factor of stability and protection for the reserve. It will not take long time until the forest vegetation of the Borşa Forestry unit, which covers in the majority of the cases the steep slopes areas, will have to respond first to their special protection function.

In the last 20 years, when a part of the forests nationalized by the communists half a century ago, were offered back to their owners, forests included also in the Rodna Mountains National Park and even in the Rodna Biosphere Reserve, a lot of bad things happened there, where the forestry regime was not respected properly. As examples can be highlighted the abusive cutting of some coppices in the Prislop area, and the abusive cuttings of the high altitude Spruce zone, and Spruce mixed with *Vaccinium mirtillus* and *Oxalis acetosella,* on the Pietrosul Mare.

Different themes of ecological reconstructions are very actual and desirable in the conditions in which today even the Rodna Biosphere Reserve needs some carefully and ecologically based interventions. The reintroduction of some autochthonous species (like *Pinus cembra*) which were common in the past, is a very good and much desired thing for the keeping of a natural equilibrium and a valuable biodiversity present in this reserve.

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THE CONTRIBUTIONS OF THE BOTANISTS ARTUR COMAN AND ADÁM BOROS TO THE KNOWLEDGE OF THE RODNA MOUNTAINS BRYOPHYTES (TRANSYLVANIA-MARAMUREŞ, ROMANIA)

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KEYWORDS: Romanian Carpathians, Rodna Mountains, bryophytes, 1948-1972.

ABSTRACT

In this paper are listed the bryophytes sampled during field trips by the botanist A. Coman alone and together with the botanist Á. Boros, in the Rodna Mountains. The biological material, field journals, identification lists and correspondence between the two botanists are part of the patrimony of the Botanical Museum of Budapest and the Maramureş Museum of Sighetu-Marmației, the Nature Sciences Department. The list of Bryophytes/mosses includes 130 taxonomic units, 24 of them mosses of the liverwort/Hepaticae group (23 species, one variety) and 106 taxa of leafy mosses (103 species, two varieties and one subspecies). Among the Bryophytes are some species of great scientific interest for their phytohistorical and phytogeographical importance**.**

ZUSAMMENFASSUNG: Beiträge der Botaniker Artur Coman und Adám Boros zur Kenntnis der Moosflora des Rodna-Gebirges (Transylvanien-Maramuresch, Rumänien).

Die vorliegende Arbeit umfasst eine Aufzählung sowohl der von A. Coman gesammelten Moose, als auch jener, die aus den gemeinsamen Geländebegehungen mit dem Botaniker A. Boros im Rodna-Gebirge stammen. Die gesammelten Belege, die Geländeaufzeichnungen, die Bestimmungslisten und der Briefwechsel zwischen den beiden Botanikern befindet sich in den Beständen des Botanischen Museums in Budapest und im Museum der Maramuresch in Sighetu Marmației, Naturwissenschaftliche Abteilung. Die Liste der Bryophyten umfasst 130 taxonomische Einheiten, bei denen es sich um 24 Lebermoose (23 Arten, eine Varietät) und 104 Taxa von Laubmoosen (103 Arten, zwei Varietäten und eine Unterart) handelt. Unter den Moosen finden sich einige von hohem wissenschaftlichem Wert, der auf ihrer vegetationsgeschichtlichen und pflanzengeographischen Bedeutung beruht.

REZUMAT: Contribuțiile botaniştilor Artur Coman şi Adam Boros la cunoaşterea briofitelor Munților Rodna (Transilvania-Maramureş, România).

În această lucrare, sunt enumerate briofitele colectate de botanistul A. Coman, precum şi cele din deplasările sale pe teren cu botanistul A. Boros în Munții Rodna. Eşantioanele colectate, jurnalele de teren, listele determinărilor, precum şi corespondența dintre cei doi botanişti se află în patrimoniul Muzeului Botanic din Budapesta şi a Muzeului Maramureşului din Sighetu-Marmației, Secția de Ştiințele Naturii. Lista briofitelor/muşchilor include 130 de unități taxonomice, 24 dintre ele fiind muşchi care aparțin grupului Hepaticae (23 specii, o varietate) şi 104 taxoni sunt muşchi frunzoşi (103 specii, două varietăți şi o subspecie). Între acestea, unele sunt de mare interes ştiințific pentru importanța lor fitoistorică şi fitogeografică.

INTRODUCTION

Their love for biology and nature, the punctuality and precision in scientific research, the passion for field research are the common features that brought the two botanists together. The connection was strictly by mail at first, turned into sharing biological material and identifications (since 1948) and personal contact (common field trips in Maramureş), becoming eventually a deep friendship lasting for over 24 years, until the death of A. Coman at the age of 91, in 1972. The results of their research completed our knowledge regarding the Maramureş bryoflora, in general, and the one of the Rodna Mountains, in particular.

Artemiu Alexandru Artur Coman (1881-1972) a Romanian forest engineer, botanist and topographer, put his name on 25 specialized studies which stand at over 500 pages, most of which having as object of study the flora of the vascular plants of Maramureş. Issues addressed in these studies relate to: taxonomy, systematics, ecology, chorology, phytogeography, geobotany, teratology, ethnobotany, toponymy and environmental protection. To all these add three major seed catalogues (1964, 1969, 1970) offered to the Botanic Garden of Iaşi, and herbaria with tens of thousands of examples of plants currently found in the major institutions in Bucharest, Vienna, Braşov, Cluj-Napoca, Iaşi, Sighetu-Marmaţiei, etc. The herbarium from the Sighetu-Marmaţiei Maramureş Museum includes 16,000 plates and an important number of bryophytes sampled on the field by him and identified by A. Boros and E. Plămadă. Of particular importance is the Flora Romania Exsiccata, in which are included hundreds of phytotaxonomic units of Maramureş, and the Inventory of Vascular Plants of Maramureş (1946), prestigious works including 1,270 vascular plant species. Through his research, the general vascular flora of Maramureş was enriched by 600 species, reaching over 1,500 taxons. These taxons were studied in respect of their vertical and horizontal spreading in the Maramureş area, presented in levels of 100 m, includind 8,000 bibliographical data. It should be noted that the herbarium of Artemiu Alexandru Artur Coman was used in drafting the monumental work "Flora R. S. R.". Two of his major scientific contributions were named as special homages: namely *Dianthus carthusianorum* ssp. *Florae-andercoianum*, dedicated to his mother, and *Cochlearia pyrenaica* var. *borzae* dedicated to the eminent Romanian botanist Alexandru Borza. (Curtean-Bănăduc et al., 2008)

Boros Ádám, (1900-1973) a Hungarian botanist and bryologist, is the author of many books and scientific paperworks, descriptions of many new species for science. It was preoccupied not only about the vegetation and flora of his country, but also about the flora of other countries from the Carpathian Mountains area. His masterwork is considered the book "Bryogeographie und Bryoflora Ungaria" and many bryological data concerning the Carpathians. He was also concerned about agrobotany and farmacobotany. His herbarium includes 65,000 plates with cormophites and 13,000 capsules with determined bryophytes. This personal herbarium it was in his life time officially declared as a protected collection with national patrimony importance, and after his death it was in the custody of the Budapest Botany Museum, where it can be found in the present. This herbarium's scientific value is special and also its field journal (51 volumes regarding its geographical, ecological, geological and botanical observations). In the Romanian Carpathians area he studied starting with 1942 the following areas of Transylvania and Maramureş: Toroiaga Mountains, Secu Mountains, Baia Borşa area and Ţâşla Valley, Pietrosul Rodna Mountains, Buhăiescu Valley, Puzdrea Mountains, Iştioara Valley, Iza River Gorge, Corongiş Mountains, Ineu Mountains, Mihăiasa Mountains, Galaţi Mountains and Vinului Valley.

A. Coman started to colect bryophytes from the Maramureş area, at the ideea of Á. Boros, which based on a previous agreement were sended and donated to A. Boros at its

domicile in Budapest (Hungary). A part of the bryophytes sampled from Maramureş area are preserved in the Botanic museum of Budapest and another part in the Maramureş Museum of Sighetu-Marmației - Nature Sciences Department. A part of the biological material, preserved in the Maramureş Museum of Sighetu-Marmației, was determined by E. Plămadă from Cluj-Napoca (Romania).

The bryophytes were sampled by A. Coman from different natural and semi-natural zones of Maramureş area, from a high variety of substrata, and some were sampled during common field trips in the period of 1962-1963 in Maramureş (Igniş volcanic plateau: Runcu Valley, Brazilor Valley, Tătarului Gorge, floating oligotrophic swamp of Hoteni, Vişeu Gorge between Bistra and Valea Vişeului localities and in Rodna Mountains from Puzdrele Mountain, Galaț Mountain, Laptelui Mountains, Negoiescu Valley).

The real friendship between the two botanists offered science valuable results, enriching our knowledge about the variety and the spreading of the bryophytes from the Maramureş area, completing the studies of other researchers which worked in this area.

Quoting Á. Boros in a letter for his friend and collaborator A. Coman, dated in 04.IV.1964: "I confer a special attention to scientific collaborations, because is very difficult to work isolated, on the other hand is very advantageous to work based on scientific collaborations. A relation like ours has to be fruitful for the both sides. This fact is an eloquent example that in spite the fact that the borders between different nations create some difficulties, these problems can not be long term obstacles for the scientific collaboration".

MATERIAL AND METHODS

When the moss samples were collected, A. Coman numbered each sample, also registering exact data regarding the sampling stations: locality, place, substratum, altitude, exposure and sampling date, without species identification. For altitude measurement, an aneroid altimeter was used.

Newspaper wrapped mosses were sent to the Cluj-Napoca Romanian Academy Branch, where they were rewrapped by C. Váczy and, alongside the initial table numbered by A. Coman and the data regarding the collecting sites, were officially sent in boxes, through customs, to Á. Boros in Hungary.

Following the initial agreement between the two botanists, Á. Boros sorted each sample, identified the species and sent back to A. Coman and the Cluj-Napoca Romanian Academy Branch (or the Cluj-Napoca Botanical Garden) the determination lists with the original numbering alongside the doubles.

Studying both "The A. Boros Inheritance" from The Botanical Museum of Budapest and "The A. Coman Collection" from Sighetu Marmației, we compiled the alphabetical species list, according to the initial nomenclator used by Á. Boros, with the following abbreviations:

N = North; NE = North-East; NV = North-West; S = South; SE = South-East; SV = South-West;

m. = meter;
alt. = altitude;
exp. = exposure;
mt. = mountain;
mți. = mountains;
leg. = initials of the sampler,
mscr. = A. Coman manuscript.

RESULTS

In the present paperwork, we reproduce the moss list identified by Á. Boros and collected either by A. Coman from Rodna Mountains, or by the two scientists on their expedition from May 1963 in Negoiescu Valley, Puzdrele Mountain (Puzdrea Vişeunească and Puzdrea Borşenească), Galaţ Mountain and Laptelui Mountain.

LIVERWORT

Anastrepta orcadensis (Hook.) Schiffn.
Borşa, Laptelui Mt., alt. 1,700-1,800 m., exp. N., VIII.1963

Anthelia Juratzkana (Limpr.) Trevis
Borşa, Laptelui Mt. and Galaţ Mt., on the top of the mountains, exp. N., 26.VII.1963

Blasia pusilla L.
Moisei, Bătrâna Mt., 1,407-1,615 m. a.s.l., exp. NE., N., NW., 02.VI.1949

Blepharostoma tricophyllum (L.) Dum.
Borşa, Negoiescu Valley, piceetum, 900-1,500 m., 26.VII.1963 (Boros' journal)

Conocephalum concinnatum (Lightf.) Corda
Borşa, Negoiescu Valley, 26.VIII.1963

Conocephalum conicum (L.) Dum.
Săcel, upper Iza course, alt. 909 m., exp. E., 06.V.1949
Săcel, Fundu Izei, on wet rocks, alt. 757-795 m., exp. N., W., 20.V.1950
Borşa, Pietrosu Rodnei Mountains, Zănoaga din Sus, alt. 1,510; 1,517 m., exp. 19-20.VII.1950 and 1,551 m alt., exp. NE. 01.VIII.1950; alt. 1,608 m., exp. E. 29.VIII.1954

Diplophyllum taxifolium (Wahl.) Dum.
Borşa, Pietrosu Rodnei Mountains, Turnu Roşu, on limestone, alt. 2,186 m., exp. N., and on wet granite, alt. 2,153-2,156 m., exp. NE., 19-20.VI.1950

Gymnomitrium concinnatum (Lightf.) Corda
Borşa, Mt. Pietrosu Mare, alt. 2,250 m., exp. NE., l19.VIII.1950

Gymnomitrium coralloides Nees.
Borşa, Pietrosu Rodnei Mountains, alt. 2,108 m., exp. NE., 19.VIII.1950

Lepidozia reptans (L.) Dum.
Borşa, Pietrosu Rodnei Mountains, Aria Zimbrului, alt. 1,186 m., exp. NE., 09.VI.1950

Lophozia incisa (Schrad.) Dum.
Borşa, Val. Negoiescu, molidiş, alt. 900-1,500 m., 26.VII.1963

Lophozia ventricosa (Dicks.) Dum.
Borşa, Val. Negoiescu, molidi;, alt. 900-1,500 m., 26.VII.1963 (Boros' journal)

Marchantia polymorpha L.
Moisei, Izvorul Negru, on an old hearth, exp. NE., 21.V.1949
Borşa, Puzdrea Borşenească Mt., alt. 1,800 m., exp. NW., 27.VII.1963
var. *aquatica* Nees: Borşa, Runcu Pietrosului, 1,148 m. a.s.l., exp. N., leg. 29.VI.1954

Metzgeria pubescens (Schrok.) Raddi
Borşa, Pietrosu Rodnei Mts., under Turnu Roşu rocks area, alt. 1,846 m., exp. N., leg. 29.VI.1955
Borşa, Galaţ Mt., alt. 1,800 m., exp. N., 25.VIII.1962

Mylia Taylori (Hook.) Tayl.
Borşa, Galaţ Mt., alt. 1,800-1,900 m., VIII.1963

Pellia fabbroniana Roddi
Săcel, Fundu Izei, on limestone, alt. 903 m., exp. E., 03.VI.1949 şi alt. 906 m., exp. N., 20.V.1950
Plagiochila asplenioides (L.) Dum.
Borşa, Pietrosu Rodnei Mountains, Turnu Roşu, alt. 2,151 m. a.s.l., exp. NW., 19-20.VII.1950
Borşa, Galaţ Mt., alt. 1,800 m., exp. N., 25.VIII.1962
Plectocolea hyalina (Lyell.) Mitt.
Moisei, Lazuri, alt. 951 m. a.s.l., exp. N., 23-27.VII.1948
Preissia quadrata (Scop.) Nees
Borşa, Pietrosu Rodnei Mountains, Aria Zimbrului, alt. 1,212 m., exp. N., on limestone, 09.VI.1950
Borşa, Pietrosu Mare Mt., Turnu Roşu, on limestone rocks, alt. 1,986 m., exp. N., 29.VI.1954
Borşa, Val. Tisa, alt. 1,103 m., exp. N., 03.V.1949
Ptilidium ciliare (L.) Nees.
Borşa, Izvorul Cailor Mt., alt. 1,817 m., exp. V., 15.VII.1950
Riccardia palmata (Hedw.) Carr.
Borşa, in piceetum under Puzdrea Mt., alt. 1,500-1,600 m., VIII.1963
Solenostoma sphaerocarpum (Hook.) Steph.
Săcel, Fundu Izei, on wet rocks, alt. 780 m., exp. N., and alt. 840 m., exp. NW., 20.V.1950
Borşa, Negoiescu Valley, Spuce forest, 26.VII.1963
Sphenolobus minutus (Cr.) Steph.
Borşa, Pietrosu Rodnei Mountains, Turnu Roşu, alt. 1,680 m., exp. N., 01.VIII.1950
Borşa, Negoiescu Valley, Spruce forest, 26.VII.1963
Borşa, Galaţ Mt. and Laptelui Mt., on rocks, alt. 1,700-2,000 m., VIII.1963
Tritomaria quinquedentata (Huds.) Buch.
Borşa, Pietrosu Rodnei Mountains, Aria Zimbrului, alt. 1,121 m. a.s.l., exp. N., 29.V.1948
Tritomaria scitula (Tayl.) Jörg. var. *spinosa* Herzog
Borşa, Laptelui Mt., alt. 1,700-2,000 m., VIII.1963

LEAFY MOSSES

Amblystegium jungermannioides (Brid.) Boros
Borşa, Laptelui Mt. alt. 1,500-1,700 m, 28.VII.1963
Amphidium Mougeotti (B. E.) Schimp.
Borşa, Puzdrea Boşenească, alt. 1,760 m., exp. N., leg. 26.VIII.1959
Moisei, Bătrâna Mt., 1,456 m. a.s.l., exp. N. E., leg. 18.VI.1956
Borşa, Begoiescu Valley, piceetum, alt. 900-1,500 m., 26.VII.1963
Anoectangium compactum Schvagr.
Borşa, Pietrosu Rodnei Mountains, Turnu Roşu, on chrystaline roks, alt. 1,900 m., exp. W., 01.VIII.1950
Anomodon attenuatus (Hedw.) Hüb.
Borşa, Puzdrea Vişeonească, alt. 1,700 m., exp. N., 07.VII.1965
Anthelia Juratzkana (Limpr.) Trevis.
Borşa, Galaţ Mt. and Laptelui Mt., on the top, 26.VII.1963
Atrichum undulatum (Hedw.) P. Beauv.
Borşa, Puzdrea Vişeonească, alt. 1,632 m., exp. NW, 27.VII.1965
Săcel, Fundu Izei, on rocks, 26.VII.1962

Aulacomnium turgidum (Wahlbg.) Schwagr.
Borşa, Puzdrea Borşănească and Laptelui Mt., alt. 1,700-2,000 m., VIII.1963. (mscr.)
Barbula rigidula (Hedw.) Műtt.
Moisei, Bătrâna Mt., alt. 1,517 m., exp. N., 27.V.1949 and alt. 1,407-1,615 m., exp. NE., N., NW., 02.VI.1949
Moisei, the forests of Valea Rea, alt. 603 m., exp. N., 31.V.1953
Bartramia ithyphylla (Hall.) Brid.
Borşa, Pietrosu Rodnei Mts., Zănoaga din Jos, 1,472 m. a.s.l., exp. N.W., 29.VI.1954
Bartramia norvegica (Gunn.) Lindb.
Borşa, Pietrosu Rodnei Mountains, Turnu Roşu, alt. 1,680 - 1,686 m., exp. N., l01.VIII.1950
Bartramia Oederi (Gunn.) SW.
Borşa, Pietrosul Rodnei Mts., Aria Zimbrului, on limestone, alt. 1,108 m., exp. N., 29.V.1948, and alt. 1,232 m., exp. E. 09.VI.1950
Moisei, Bătrâna Mt., alt. 1,407-1,615-1,650 m., exp. NE., N., NW., 02.VI.1949
Săcel, Iza River upper course, on limestone, alt. 907 m., exp. E., 03.VI.1954
Borşa, Pietrosu Rodnei Mt., under Turnu Roşu, alt. 1,777 m., exp. N., 29.VI.1954
Borşa, Izvorul Cailor Mt., on limestone, alt. 1,801 m. a.s.l., exp. W., 15.V.1950 and alt. 1,812 m., exp. NE, 26.VI.1950
Borşa, Ştiol Mt., alt. 1,632 m., exp. E., 15.VII.1950
Brachythecium populeum (Hedw.) B. E.
Moisei, Izvorul Dragoş Valley, exp. N., 10.V.1949
Brachythecium reflexum (Starke) B. E.
Borşa, Puzdrea Borşenească, alt. 1,750 m., exp. N.W., 26.VIII.1959
Bryum ventricosum Dicks.
Moisei, the forests of Valea Rea, alt. 602 m., exp. N., 31.V.1953
Calliergon cuspidatum (L.) Kindb.
Borşa, Izvorul Cailor Mt., alt. 1,793 m., exp. W., 15.VII.1950
Campylopus flexuosus (L.) Brid.
Borşa, Puzdrea Borşănească, alt. 1,700-2,000 m., 27.VII.1963
Borşa, Laptelui Mt., on chrystaline rokc, alt. 1,700-3,000 m., 27.VII.1963
Catharinea undulata (L.) W. and M.
Moisei, the forests of Rea Valley, alt. 602 m., exp. N., 31.V.1953
Ceratodon purpureus (L.) Brid.
Moisei, the forests of Rea Valley, alt. 602 m., exp. N., 31.V.1953
Borşa-Fântâna, Priseci, alt. 908-950 m., exp. E., 19-22.V.1948
Borşa, Pietrosu Rodnei Mountains, Aria Zimbrului, alt. 1,126 m., exp. N., 29.V.1948
Borşa, Pietrosu Rodnei Mt., Pietroasa Valley, exp. N., 04.V.1949
Borşa, Pietrosu Rodnei Mt., Tisa Valley, alt. 1,103 m., exp. N., 03.V.1949
Borşa, Pietrosu Rodnei Mt., Zănoaga de Jos, exp. N., 06.V.1949
Moisei, Izvorul Dragoş Valley, exp. N., leg. 10.V.1949
Moisei, Bătrâna Mt., alt. 1,407-1,615 m., exp. NE., N., NW., 02.VI.1949
Borşa, Pietrosu Rodnei Mt., Piciorul Moşului, alt. 1,708 m., exp. N., 19-20.VI.1950
Borşa, Coasta Plaiului, alt. 1,276-1,322 m., exp. S., 19.V.1951
Moisei, Rea Valley, alt. 603 m., exp. N., in forest, 31.V.1953
var. *conicus* (Hampe) Mönk.: Moisei, Bătrâna Mt., alt. 1,407-1,615 m., exp. NE, N., NW., 02.VI.1949

Chrysohypnum Halleri (Sw.) Roth
Borşa, Izvorul Cailor Mt., on limestone, alt. 1,832 m., exp. N., 26.VI.1950
Cinclidotus fontinaloides (Hedw.) P. Beauw.
Borşa, Galaţ Mt., in flowing water, alt. 1,720 m., 07.VII.1963
Cratoneurum commutatum (Hedw.) Moenk.
Borşa, Priseci, valley, Chindrik, alt. 937 m., exp. N., 10.VI.1948
Borşa, Coasta Plaiului, alt. 1,252 m., exp. S.W., 19.V.1951
Borşa, at the Rea Valley mouth, alt. 686 m., exp. S., 10.XII.1953
Borşa, Puzdrea Vişeonească, alt. 1,650 m., 1,610 m., 1,700 m., exp. N., 25.VIII.1962
Borşa, Negoiescu Valley, alt. 780 m., 26.VIII.1963
Cratoneurum filicinum (L.) Moenk.
Borşa - Făntâna, Făntâna Valley, in water with lime, alt. 881 m. a.s.l., exp. W., 13.VIII.1954
Ctenidium molluscum (Hedw.) Mitt.
Săcel, the uppermost course of the Iza River, on limestone, alt. 911 m. a.s.l., exp. E., 31.VI.1949
Cynodontium polycarpum (Ehrh.) Hedw.
Borşa, Pietrosu Rodnei Mt., Tisa Valley, alt. 1,103 m., exp. N., 03.V.1949
Desmatodon latifolius (Hedw.) B. E
Borşa, Coasta Plaiului, alt. 1,252 m., exp. S.W., 19.V.1951
Borşa, Pietrosu Rodnei Mt., alt. 2,197 m., exp. N., 19.V.1951
Dichodontium pellucidum (L.) Schimp.
Moisei, Lazuri, alt. 936 m., exp. N., 23-27.VII.1948
Dicranella rubra (Huds.) Meenkem
Moisei, Bătrâna Mt., alt. 1,517 m., exp. N., 27.V.1949
Borşa, Pietrosu Rodnei Mt., Zănoaga din Jos, 1,430 m. a.s.l., exp. N., 29.VI.1954
Dicranella secunda (Sw.) Lindb.
Moisei, Bătrâna Mt., alt. 1,420-1,650 m., exp. N., NW., 02.VI.1949
Moisei, Bătrâna Mt., alt. 1,513-1,670 m. a.s.l., exp. N., 27.V.1949
Borşa, Pietrosu Rodnei Mt., alt. 2,105 m., exp. NE., 19.VIII.1950
Dicranum acutifolium (Lindb. and Arnell) C. Jens.
Borşa, Pietrosu Rodnei Mt., Turnu Roşu, alt. 2,000 m., 26.VII.1963
Dicranum albicans B. E.
Borşa, under Galaţ Mt., alt. 1,720 m., 27.VII.1963
Dicranum bonjeanii De Not.
Borşa, Galaţ Mt., alt. 1,720 m., exp. N., 25.VIII.1962 and 27.VII.1963
Dicranum fuscescens Turn.
Borşa, Pietrosu Rodnei Mt., exp. NE., 18.VIII.1950
Dicranum longifolium Ehrh.
Moisei, Lazuri, alt. 927-933 m., exp. N., 23-27.VII.1948
Borşa, Pietrosu Rodnei Mt., under Turnu Roşu, alt. 1,789 m., exp. E., 29.VI.1954
Borşa, Negoiescu Valley, piceetum, alt. 900-1,500 m., 26.VII.1963
Dicranum majus Sm.
Săcel, under Izvorul Izei, on limestone, alt. 909 m., exp. E., 03.VI.1949

Dicranum montanum Hedw.
Moisei, Bătrâna Mt., alt. 1,315 m. a.s.l., exp. N., 06.VI.1949
Borşa, Pietrosu Rodnei Mt., Aria Zimbrului, alt. 1,186 m., exp. NE., 09.VI.1950
Borşa, Negoiescu Valley, piceetum, alt. 900-1,500 m., 26.VII.1963
Dicranum scoparium (L.) Hedw.
Borşa, Pietrosu Rodnei Mt., Tisa Valley, 03.V.1949
Moisei, Dealul lui Traian, alt. 1,056 m., exp. S., 18.V.1949
Moisei, Bătrâna Mt., alt. 1,513-1,650 m. a.s.l., exp. N., 27.V.1949 and alt. 1,420-1,650 m., exp. N., NW., 03.VI.1949
Borşa, Pietrosu Rodnei Mt., Aria Zimbrului, on limestone, alt. 1,232 m., exp. E., NE., 09.VI.1950
Borşa, Pietrosu Rodnei Mt., Izvorul Cailor, alt. 1,690 and 1,817 m., exp. W., 15.VII.1950
Borşa, Pietrosu Mare Mt., Turnu Roşu, alt. 1,856-2,102 m., exp. N.NW., 19-20.VII.1950
Borşa, Pietrosu Rodnei Mt., near Iezer Lake, alt. 1,837 m., exp. N., 19-20.VII.1950
Săcel. Plai, alt. 856 m., exp. NE., 27.VIII.1951
Borşa, Coasta Plaiului, alt. 1,252-1,276 m., exp. SW., 19.V.1951 şi alt. 1,755 m., exp. W., 26.VIII.1959
Borşa, Puzdrea Borşănească, alt. 1,788 m., exp. NW., 26.VIII.1959
Borşa, Puzdrea Vişeonească, alt. 1,610 m., exp. N. and 25.VIII.1962-26.VII.1963
Dicranum Starkei W. and M.
Borşa, Galaţ Mt., alt. 1,877 m., exp. NE., 26.VIII.1959
Dicranoweisia crispula (Hedw.) Lindb.
Moisei, Bătrâna Mt., alt. 1,407-1,615 m., exp. NE., N., NW., 02.VI.1949
Borşa, Pietrosul Rodnei Mt., Pietroasa Valley, exp. N., 04.V.1949
Borşa, Pietrosu Rodnei Mt., Izvorul Cailor, alt. 1,765-1,856 m., exp. N. and W., 15.VII.1950
Borşa, Pietrosu Rodnei Mt., Turnu Roşu, on limestone, alt. 1,832 m., exp. N., 01.VII.1950
Borşa, Pietrosu Rodnei Mt., Zănoaga din Sus, on rocks, alt. 1,551 m. a.s.l., exp. NE., 01.VIII.1950
Borşa, Pietrosu Rodnei Mt., Zănoaga din Jos, alt. 1,486 m., exp. N., 29.VI.1954
Borşa, Negoiescu Valley, piceetum, alt. 900-1,500 m., 26.VII.1963
Borşa, Galaţ Mt., alt. 1,810 m., exp. N., 25.VIII.1962
Distichium capillaceum (Hedw.) B. S. G.
Borşa, Puzdrea Vişeunească, alt. 1,620 m., exp. W., 25.VIII.1962
Distichium inclinatum (Ehrh.) B. S. G.
Borşa, Galaţ Mt., alt. 1,670 m., (c. sporog.) 27.VII.1963
Distichium montanum (Lam.) Hagen.
Săcel, Fundu Izei, in water, alt. 917 m., exp. S., 20.V.1950
Borşa, Izvorul Cailor Mt., on limestone, alt. 1,801 and 1,816 m., exp. W., 15.VII.1950 and 1,832-1,846 m., 26.VI.1950
Borşa, Pietrosu Mare Mt., near Iezer Lake, alt. 1,901 m. a.s.l., exp. NE., 19-20.VII.1950
Borşa, Pietrosu Mare Mt., Turnu Roşu, alt. 1,986-2,156 m., exp. NW, 19-20.VII.1950 and alt. 1,986 m., exp. N, 29.VI.1954
Borşa, Pietrosu Mare Mt., under Turnu Roşu, alt. 1,717-1,777-1,846 m., exp. E., 29.VI.1954
Borşa, Pietrosu Mare Mt., Aria Zimbrului, alt. 1,212 m., exp. N., on limestone, 09.VI.1950
Ditrichum flexicaule (Schleich.) Hpe.
Borşa, Pietrosu Rodnei Mt., at Iezer, alt. 1,901 m. a.s.l., exp. NE., 19-20.VII.1950
Borşa, Izvorul Cailor Mt., on limestone rocks, alt. 1,795 and 1,842, 1,847 m., exp. W., 15.VII.1950

Borşa, Pietrosu Mare Mt., Turnu Roşu, on limestone, alt. 2,001 m. a.s.l., exp. N., 29.VI.1954
Ditrichium undulatum (Hedw.) P. Beauw.
Săcel, Fundu Izei, on rocks, 26.VII.1960
Drepanoclaudus revolvens (Sw.) Warnst.
Borşa, Galaţ Mt., in swampy area, alt. 1,730 m., 28.VII.1963
Drepanocladus uncinatus (Hedw.) Warnstş
Moisei, Lazuri, alt. 1,102 m., exp. E., 17.VII.1948
Borşa, Galaţ Mt., alt. 1,796 m.; 1,810 m., exp. N., 25.VIII.1961
Encalypta ciliate (Hedw.) Hoffm.
Borşa, Coasta Plaiului, alt. 1,256 m., exp. S., 19.V.1951
Encalypta contorta (Wulf.) Lindb.
Moisei, the forests of Rea Valley, in forests, alt. 603 m., exp. N., 31.V.1953
Borşa, Negoiescu Valley, piceetum, alt. 900-1,500 m., 26.VII.1963
Encalypta streptocarpa Hedw.
Borşa, Puydrea Vişeoneasca, alt. 1,660 m., exp. W., 25.VIII.1962
Entodon Schreberi (Willd.) Moenk.
Borşa-Fântâna, Priseci, alt. 908-950 m., exp. E., 19-22.V.1948
Funaria hygrometrica (L.) Sibth.
Borşa, Pietrosu Mare Mt., Tisa Valley, alt. 1,157 m, exp. N., 03.V.1949
Borşa, Izvorul Cailor Mt., alt. 1,156 m, exp. N. 09.VI.1960
Săcel, Iza River valley bottom, 706 m., exp. W., 03.VI.1949 and alt. 517 m., exp. W., 13.V.1955
Georgia pellucida (L.) Rabenh.
Moisei, Lazuri, alt. 927-933 m., exp. N., 23-27.VII.1948
Moisei, Bătrâna Mt. alt. 1,515-1,660 m., exp. N., 27.V.1949
Săcel, Plai, alt. 856 m, exp. NE., 27.VIII.1951
Grimmia trichophylla Grev.
Borşa, Pietrosu Mare Mt., alt. 2,156 m., exp. N., 19.VIII.1950
Hygramplystegium irriguum (Wils.) Loeske
Borşa - Fântâna, in water, alt. 881 m. a.s.l., exp. W., 13.VI.1954
Hylocomium proliferum 8 (L.) Lindb.
Săcel, Măgura Săcelului, alt. 1,137 m. a.s.l., exp. W., 21.V.1949
Hylocomium pyrenaicum (Spreuce) Lindb.
Borşa, Pietrosu Rodnei Mt., alt. 2,056 m., exp. N., 19.VIII.1950
Hymenostylium curvirostre (Ehrh.) Lindb.
Borşa, Izvorul Cailor Mt., alt. 1,861 m. a.s.l., exp. W., 15.VII.1950
Hypnum callichroum (Brid.) B. S. G.
Borşa, Negoiescu Valley, alt. 1,120 m., exp. N., 24.VIII.1963
Borşa, Laptelui Mt., alt. 1,700-2,000 m, VIII.1963
Hypnum cupressiforme Hedw.
Borşa, Negoiescu Valley, alt. 1,860 m., exp. NE., 26.VII.1862
Borşa, Puzdrea Vişeonească, alt. 1,680 m., exp. NW, 25.VIII.1962
Borşa, Faţa Meselor Mt., alt. 1,600 m., exp. S., 25.VII.1963
Hypnum hamulosum B. S. G.
Borşa, Galaţ Mt., alt. 1,800., exp. N., VIII.1963
Isopterigium pulchellum /Dicks. (Delonge).

Borşa, Galaţ Mt. and Laptelui Mt., alt. 1,500-2,000 m., VIII.1963
Isothecium myurum (Pollich) Brid.
Borşa, Puzdra Vişeonească, alt. 1,550 m., exp. W., 24.VIII.1962
Leucobryum glaucum (L.) Schimp.
Moisei, Bătrâna Mt., alt. 1,407-1,615 m., exp. N., NE., NW, 02.VI.1940
Meesea trichodes (L.) Spruce
Săcel, Fundu Izei, on limestone, alt. 910 m., exp. E., 03.VI.1949
Borşa, Ştiol Mt., alt. 1,632 m., exp. E., 15.VII.1950
Borşa, Izvorul Cailor Mt., on limestone, alt. 1,812 m., exp. NE., 26.VI.1950
Borşa, Pietrosu Rodnei Mt., Turnu Roşu, on limestone, alt. 1,786 m., exp. N., 01.VIII.1950
Mnium cuspidatum (L.) Leyss
Moisei, Bătrâna Mt., alt. 1,420-1,650 m., exp. N., NW., 03.VI.1949
Mnium orthorrhynchum Brid.
Borşa, Pietrosu Mare Mt., Turnu Roşu, alt. 1,686 m., exp. N., leg.01.VIII.1950
Mnium pseudopunctatum B. E.
Borşa, Puzdrea Vişeonească, alt. 1,610 m., exp. W., 25.VIII.1962
Mnium punctatum Hedw.
Moisei, Lazuri, alt. 986 m., exp. S., 23-27.VII.1948
Săcel, Fundu Izei, alt. 780-788 m., exp. N., 20.V.1950
Borşa, Puzdrea Vişeonească, alt. 1,610 m., exp. N., 25.VIII.1962
Mnium rostratum Schrad.
Borşa, Pietrosu Mare Mt., la Iezer, alt. 1,858 m., exp. N., leg. 19-20.VII.1950
Mnium Seligeri Jur.
Moisei, the forests of Rea Valley, alt. 606 m., exp. N., leg. 31.V.1953
Neckera complanata (Hedw.) Hüb.
Borşa, Negoiescu Valley, alt. 900-1,500 m., 26.VII.1863
Oligotrichum hercynicum (Hedw.) Lam. and D.C.
Borşa, Puzdrea Vişeonească, alt. 1,620 m., exp. W., 25.VIII.1962
Oligotrichum incurvum (Huds.) Lindb.
Borşa, Laptelui Mt., and Galaţ Mt., alt. 1,700-2,000 m., alpine zone, 27.VII.1963
subsp. *floridula* Mot.: Moisei, Bătrâna Mt., sunny place, alt. 1,615 m, exp. N., and 1,420-1,650 m. exp. N., NW., 02.VI.1949
Orthothecium intricatum (Hartm.) B. E.
Borşa, Pietrosu Mare Mt., Turnu Roşu, on limestone, alt. 1,487-1,615 m., exp. NE., N., NW, and 1,780 m., exp. N., 01.VIII.1950
Borşa, Laptelui Mt., alt. 1,700-2,999 m, on chrystaline schist, 28.VII.1963
Orthothecium rufescens (Dicks.) B. E.
Borşa, Pietrosu Rodnei Mt., Turnu Roşu, alt. 1,816-2,153 m., exp. NW., exp. N., 19-20.VII.1950
Paraleucobryum longifolium (Hedw.) loeske
Borşa, Galaţ Mt., alt. 1,710 m., exp. N., 25.VIII.1962
Philonotis caespitosa Wils.
Săcell, Fundu Izei, on wet rocks, 26.VII.1962
Philonotis Fontana (L.) Brid.
Borşa, Izvorul Cailor Mt., alt. 1,403 m., exp. N., 09.VII.1950
Moisei, Rea Valley forests, alt. 602 m., exp. N., 31.V.1953
Borşa, Runcu Pietrosului, in mire, 1,149 m. a.s.l., exp. N., 29.VI.1954
Borşa, Negoiescu Valley, piceetum, 900-1,500 m. a.s.l., 26.VII.1963

Philonotis scriata (Mitt.) Lindb.
Borşa, Puzdrea Vişeonească, 1,680 m. a.s.l., exp. N., 21.VIII.1962
Philonotis tomentella Mol.
Borla, Pietrosu Mare Mt., Turnu Roşu, 2,147 m. a.s.l., exp. NW., 19-20.VII.1950
Plagiobryum Zieri (Dicks.) Lindb.
Moisei, Bătrâna Mt., alt. 1,400-1,600 m., 1849
Plagiothecium curvifolium Schlieph.
Moisei, Bătrâna Mt., alt. 1,513-1,650 m. a.s.l., exp. N., 27.V.1949
Borşa, Puzdrea Borşenească, alt. 1,746 m., exp. NW., 26.VIII.1959
Plagiothecium laetum B. S. G.
Borşa, Puzdrea Vişeonească Mt., alt. 1,660 m., exp. W., 25.VII.1962
Pogonatum urnigerum (L.) P. Beauv.
Moisei, Traian Hill, exp. N., 19.V.1949
Moisei, Bătrâna Mt., lt. 1,407-1,650 m., exp. NW., N., NE., 02 - 3.VI.1949
Borşa, Pietrosu Rodnei Mt., alt. 2,156 m., exp. N., 19.VII.1950
Borşa, Negoiescu Valley, on rock, 1,416 m. a.s.l., exp. NW, 25.VIII.1959
Borşa, Zănoaga din Jos, alt. 1,537 m., exp. NW., 29.XI.1954
Borşa, Galaţ Mt., alt. 1,796 m., exp. N., 25.VIII.1962
Borşa, Puzdrea Vişeonească, alt. 1,700 m., exp. NW., 25.VIII.1962
Pohlia elongata Hedw.
Borşa, Negoiescu Valley, alt. 900-1,500 m., 26.VII.1963
Pohlia longicolla (Sw.) Lindb.
Borşa, Galaţ Mt., alt. 1,800-1,900 m., -VIII.1963
Polytrichum alpinum L.
Borşa, Pietrosu Rodnei Mt., Piciorul Moşului, alt. 1,698 m., and 1,936 m., exp. N., 19-20.VI.1950
Borşa, Coasta Plaiului, alt. 1,301 m. a.s.l., exp. N., 19.V.1951
Borşa, Pietrosu Rodnei Mt., alt. 2,160 m., exp. NE., 19.VIII.1950
Borşa, Izvorul Cailor, alt. 1,836 m., exp. N., 26.VIII.1959
Borşa, Pietrosu Mare Mt., Zănoaga din Jos, 1,456 m. a.s.l., exp. NW., and alt. 1,506 m., exp. W., leg. 29.VI.1954
Polytrichum attenuatum Menz.
Borşa, Pietrosu Rodnei Mt., Aria Zimbrului, alt. 1,101 m. a.s.l., exp. W., 29.V.1948
Moisei, Rea Valley forests, alt. 603 m., exp. N., 31.V.1953
Polytrichum commune Hedw.
Borşa, Galaţ Mt., alt. 1,850 m., exp. W., 27.VII.1963
Borşa, Puzdrea Borşănească Mt., alt. 1,710 m., exp. N., 27.VII.1963
Polytrichum juniperinum Willd.
Borşa, Pietrosu Rodnei Mt., Aria Zimbrului, alt. 1,107 m., exp. N., 29.V.1948
Moisei, Bătrâna Mt., alt. 1,515-1,650 m., exp. N., 27.V.1949
Borşa, Ştiol Mt., alt. 1,601 m. a.s.l., exp. N., 15.VII.1950
Borşa, Mt. Puzdrea Vişeunească, alt. 1,700 m., exp. NW., 25.VIII.1962
Borşa, Galaţ Mt., alt. 1,850 m., exp. W., 27.VII.1963
Borşa, Puzdrea Vişeunească Mt., alt. 1,680 m., exp. N., 08.VII.1963

Polytrichum sexangulare Floerke.
Borşa, Laptelui Mt., alt. 1,700-2,000 m., on chrystaline rocks, 28.VII.1963
Rhacomitrium canescens (Timm.) Brid.
Moisei, Bătrâna Mt., alt. 1,407-1,615 m., exp. NE., 02.VI.1949
Borşa, Puzdrea Vişeunească Mt., alt. 1,500 m., exp. N., 26.VIII.1962
Rhacomitrium heterostichum (Hedw.) Brid.
var. *affine* (Schleich) Aman and var. *gracilescens* B. S. G.: Borşa, Galaţ Mt., on chrystaline rocks, alt. 1,800-1,900 m., VIII.1963
Rhacomitrium hypnoides (L.) Lindb.
Borşa, Pietrosu Rodnei Mt., on granite, alt. 2,153 m., exp. NW., 19-20.VII.1950
Borşa, Pietrosu Rodnei Mt., Turnu Roşu, on limestone, alt. 2,201 m. a.s.l., exp. N., 19-20.VII.1950
Borşa, Puzdrea Vişeunească Mt., alt. 1,500 m., exp. N., 26.VIII.1962
Rhacomitrium patens Hübens
Borşa, Pietrosu Rodnei Mt., alt. 2,160-2,300 m., exp. NE., 19.VIII.1950
Rhacomitrium protensum A. Br.
Borşa, Negoiescu Valley, on chrystaline rocks, alt. 900-1,500 m., 26.VII.1863
Rhacomitrium sudeticum (Funck) B. E.
Borşa, Pietrosu Mare Mt., on wet granite, alt. 2,153 m., exp. NW., 19-20.VI.1950 and alt. 2,153 and 2,156 m., exp. NW., 19.VIII.1950
Borşa, Galaţ Mt., alt. 1,700 m., exp. N., 25.VIII.1962
Rhytidiadelphus squarrosus (Hedw.) Warnst.
Borşa, Puzdrea Vişeunească Mt., alt. 1,650 m., exp. N., 25.VIII.1962
Borşa, Galaţ Mt., alt. 1,700 m., exp. N., 25.VIII.1962
Rhytidiadelphus triquetrus (Hedw.) Warnst.
Borşa, Pietrosu Rodnei Mt., Pietroasa Valley, alt. 911 m. a.s.l., exp. N., 11.VI.1949
Borşa, Izvorul Cailor Mt., alt. 1,815 m., exp. E., 15.VII.1950
Borşa, Pietrosu Rodnei Mt., Zănoaga din Sus, alt. 1,515 m., exp. NW, 01.VIII.1950
Borşa, Puzdrea Vişeunească, alt. 1,620-1,650 m., exp. N., 25.VIII.1862
Rhitidium rugosum (Ehrh.) Kindb.
Borşa, Izvorul Cailor Mt., alt. 1,815 m., exp. N., 15.VII.1950
Borşa, Pietrosu Rodnei Mt., Turnu Roşu, on limestone, alt. 1,834 m., exp. N., 01.VIII.1950
Schistidium apocarpum (Hedw.) B. S. G.
Borşa, Puzdrea Vişeunească Mt., alt. 1,700 m., exp. N., 07.VII.1963
Sphagnum girgensohnii Russ.
Borşa, Galaţ Mt., alt. 1,790 m., exp. N., 25.VIII.1962
Sphagnum magellanicum Brid.
Săcel, upper Iza River course, on limestone rocks, exp. E., 03.VI.1949
Borşa, Coasta Plaiului, alt. 1,252 m., exp. SW., 19.V.1951
Syntrichia ruralis Brid.
Borşa, Puzdrea Vişeunească Mt., alt. 1,680 m., exp. NW., 25.VIII.1962
Tetraphis pellucida Hedw.
Borşa, Galaţ Mt., alt. 1,720 m., exp. N., 25.VIII.1962
Timmia Bavarica Hessl.
Borşa, Izvorul Cailor Mt., on limestone, alt. 1,806 m., exp. N., 16.VI.1950
Borşa, Pudrea Vişeunească Mt., alt. 1,630 m., 25.VIII.1962

Tortella tortuosa (L.) Linqr.
Moisei, Bătrâna Mt., alt. 1,057 m., exp. N., 29.V.1949
Săcel, upper Iza River course, on limestone, alt. 909 m., exp. E., 03.VI.1949
Borşa, Izvorul cailor Mt., on limestone, alt. 1,811 m. a.s.l., exp. N., 26.VI.1950
Borşa, Pietrosu Rodnei Mt., near Iezer Lake, alt. 1,901 m. a.s.l., exp. NE., 19-20.VII.1950
Borşa, Pietrosu Rodnei Mt., Turnu Roşu, alt. 1,811 m. a.s.l., exp. N. 01.VIII.1950
Borşa, Pripor, alt. 986 m., exp. N., 13.V.1956
Borşa, Laptelui Mt., alt. 1,850 m, exp. N., on rocks, 28.VII.1963
Borşa, Galaț Mt., alt. 1,670-1,710 m, exp. N., 25.VIII.1962 and 28.VIII.1963

CONCLUSIONS

The list of Bryophytes/mosses include 130 taxonomic units, 24 of them being mosses of the liverwort/Hepaticae group (23 species, one variety) and 104 taxa are leaves mosses (103 species, two varieties and one subspecies). Between the Bryophytes are some species of great scientific interest for their phytohistorical and phytogeographical importance**.**

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THE BRYOPHYTES OF THE RODNA MOUNTAINS NATIONAL PARK (TRANSYLVANIA-MARAMUREŞ, ROMANIA)

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KEYWORDS: Romanian Carpathians, Rodna Mountains National Park, bryophytes, distribution.

ABSTRACT

This paper presents the distribution of bryophyte species in the Rodna Mountains National Park, based on literature, herbarium and field data. In this area 351 bryophyte species were recorded. Of these, 47 species are threatened at national and international level. Special attention should be given to the species *Buxbaumia viridis*, *Dicranum viride* and *Meesia longiseta*, included in the Convention on the Conservation of European Wildlife and Nature Habitats (Bern 1979), the EU Council Habitats Directive 92/43/EEC (1992) and the Government Ordinance 57/2007.

ZUSAMMENFASSUNG: Die Moose des Nationalparks Rodnaer Gebirge (Transylvanien-Maramuresch, Rumänien).

Die Arbeit zeigt die Verbreitung der Moosarten des Nationalparks Rodnaer Gebirge auf, die anhand von Literaturangaben, Herbarien und eigener Feldforschung ausgearbeitet wurde. In diesem Gebiet wurden 351 Moosarten festgestellt, von denen 47 auf nationaler und internationaler Ebene gefährdet sind. Besondere Aufmerksamkeit gilt dem Vorkommen von Grünem Koboldmoos (*Buxbaumia viridis*), Grünem Besenmoos (*Dicranum viride*) und *Meesia longiseta*, die in den Anhanglisten der Berner Konvention (1979), der Europäischen Flora-Fauna-Habitatrichtlinie 92/43/EEC sowie in der Dringlichkeitsverordnung der Rumänischen Regierung (Ordonanța de Urgență) 57/2007 aufgeführt sind.

REZUMAT: Briofitele din Parcul Național Munții Rodna (Transilvania-Maramureş, România).

Lucrarea prezintă distribuția speciilor de briofite din cadrul Parcului Național Munții Rodna, distribuție realizată pe baza datelor de literatură, de herbar precum şi de teren. În această zonă au fost identificate 351 specii de briofite. Dintre acestea, 47 de specii sunt periclitate la nivel național şi internațional. O atenție deosebită trebuie acordată prezenței speciilor *Buxbaumia viridis*, *Dicranum viride* şi *Meesia longiseta*, listate în Convenția de la Berna (1979), Directiva Habitate 92/43/EEC (1992) şi Ordonanța de Urgență 57/2007.

INTRODUCTION

The first bryophyte data from Rodna Mountains were published by J. C. G. Baumgarten (1846), who reported the presence of thirteen species: *Aulacomnium turgidum, Campylophyllum halleri, Encalypta rhaptocarpa, E. streptocarpa, Grimmia ramondii, Polytrichastrum alpinum, P. pallidisetum, P. sexangulare, Pseudoleskea incurvata, Sphagnum squarrosum, Stegonia latifolia* and *Tortula hoppeana*. Over time, many works are devoted to bryophytes of this Massif. In the XIXth Century bryophyte species have been reported by J. C. G. Baumgarten, F. Schur, M. Fuss, F. Hazslinszky, J. Breidler, C. Warnstorf, K. Demeter and L. Simonkai.

In the XXth Century many papers have been published by F. Matouschek, F. Pax, I. Györffy, M. Péterfi, V. Schiffner, J. Szepesfalvi, Á. Boros, L. Vajda, S. Orbán, A. Borza, A. Racoviță, E. Eftimie, E. Olos, T. Ştefureac, E. Plămadă, G. Coldea and G. Dihoru.

Many bryophyte species were collected by A. Coman who gave them for identification mostly to Á. Boros and a smaller part to T. Ştefureac. A good bryophyte collection is that of A. Nyárády, who wrote a Monograph of Rodna Mountains Cryptogams, unpublished manuscript.

In the summer of 1999, I collected bryophytes from Lala Valley, Ineu Peak, Iezerul Pietrosului, Pietrosul Peak and Iezerele Buhăescu from the Rodna Mountains. In the collected bryophyte samples I identified *Haplomitrium hookei*, a new species for Romania (Ştefănuţ, 2000a). Since then, *H. hookei* was reported in Romania from Bucegi Mountains (Ştefănuţ, 2007a), Făgăraş and Retezat Mountains (Ştefănuţ, 2010b).

This paper includes personal field data since 1999, BUCA herbarium data and unpublished data from the A. Nyárády manuscript (1948).

MATERIALS AND METHODS

The nomenclature of liverworts (Marchantiophyta) is according to Ştefănuţ (2008) and the nomenclature of moss (Bryophyta) is according to Hill et al. (2006) and Sabovljević et al. (2008), except *Rhytidiadelphus triquetrus* which was recently included to *Hylocomiadelphus* (Hedw.) Ochyra and Stebel (2008).

The cited or consulted herbaria or exsiccata are:

BUCA - The Romanian Academy Herbarium, Bucharest Institute of Biology, Romania.
CL - The "Babeş-Bolyai" University Herbarium, Cluj-Napoca, Romania.
BRHE - Bryophyta Regni Hungariae Exsiccata, Edita a Sectione Botanica Musei Nationalis Transsilvanici.
BP - The Herbarium of the Hungarian Museum of Nature Sciences, Budapest, Hungary.
FRE - Flora Romaniae Exsiccata.
HMS - The Herbarium of the Sighet Nature Science Museum.

RESULTS AND DISCUSSIONS

After performing the inventory, 91 liverwort species and 260 moss species, totally 351 bryophytes species, were identified. Eleven bryophytes species (one liverwort and ten mosses) are new records for Rodna Mountains National Park. No hornwort species (Anthocerotophyta) has been recorded from this area.

Based on the distribution data and the Convention on the Conservation of European Wildlife and Natural Habitats (Bern 1979), the Council Directive 92/43/EEC (1992), Red Data Book of European Bryophytes, Government Ordinance 57/2007 and Red list of Romanian Bryophytes (unpublished) was achieved the list of threatened liverworts (Tab. 1) and the list of threatened mosses (Tab. 2) from the Rodna Mountains National Park.

LIVERWORTS (Marchantiophyta)

Families: **(1)** - Aneuraceae, **(2)** - Antheliaceae, **(3)** - Calypogeiaceae, **(4)** - Cephaloziaceae, **(5)** - Cephaloziellaceae, **(6)** - Conocephalaceae, **(7)** - Frullaniaceae, **(8)** - Geocalycaceae, **(9)** - Gymnomitriaceae, **(10)** - Haplomitriaceae, **(11)** - Jungermanniaceae, **(12)** - Lejeuneaceae, **(13)** - Lepidoziaceae, **(14)** - Lophoziaceae, **(15)** - Marchantiaceae, **(16)** - Metzgeriaceae, **(17)** - Pallaviciniaceae, **(18)** - Pelliaceae, **(19)** - Plagiochilaceae, **(20)** - Porellaceae, **(21)** - Pseudolepicoleaceae, **(22)** - Ptilidiaceae, **(23)** - Radulaceae, **(24)** - Scapaniaceae

Anastrepta orcadensis (Hook.) Schiffn. - **(14)**

Ineu, Crestele Găgii, Tăul Mare, 2,000 m a.s.l. (Ştefureac, 1942; Boros, 1951; Müller, 1954; Ştefureac, 1963a; Ştefănuţ, 2008); Ineu Peak, Crestele Găgii, 1,800 m a.s.l. (Ştefureac, 1945; Boros, 1951; Müller, 1954; Plămadă, 1973; Ştefănuţ, 2008); Pietrosul Rodnei, north-western slope, 2,280 m a.s.l., 8-9.VII.1948 (Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1968; Plămadă, 1973; Ştefureac, 1977; Ştefureac, 1983b; Ştefureac, 1971; Ştefănuţ, 2008); Iezerul Pietrosului, VIII.2005, leg. Onete Marilena, det. Ştefănuţ S. [BUCA *B3205*] (Ştefănuţ, 2008); Ineu, VIII.2005, leg. Onete Marilena, det. Ştefănuţ S. [BUCA *B3206*] (Ştefănuţ, 2008).

Anastrophyllum minutum (Schreb.) R. M. Schust. var. ***weberi*** (Mart.) Kartt. **- (14)**

Pietrosul Rodnei, sub *Jungermannia* (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885; Ştefănuţ, 2008); Ineu Peak, 2,200 m a.s.l., sub *Jungermannia* (Breidler, 1890a; Ştefănuţ, 2008); Galaţu Mountain, 2,000 m a.s.l., sub *Diplophyllum* (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains, sub *Lophozia minuta* (Pax, 1908; Ştefănuţ, 2008); Galaţu Mountain, sub *Sphenolobus* (Schiffner, 1914; Ştefănuţ, 2008); Ineu, 1942, leg. and det. Á. Boros, sub *Sphenolobus* (Györffy, 1943; Ştefănuţ, 2008); Pietrosul Rodnei, north-western slope, 2,260-2,290 m a.s.l., 8-9.VIII.1948, sub *Sphenolobus* [BUCA *B6844*] (Ştefureac, 1952; Ştefureac, 1968; Ştefureac, 1983b; Ştefureac, 1971; Ştefănuţ, 2008); Pietrosul Rodnei, Piciorul Moşului, on rocks, 1,600 m a.s.l., sub *Sphenolobus* (Ştefureac, 1958a; Ştefănuţ, 2008); Ineu, sub *Sphenolobus* (Györffy, 1943; Ştefureac, 1952; Ştefănuţ, 2008); Rodna Mountains (Ştefureac, 1963b; Ştefănuţ, 2008); Corongiş, leg. and det. Péterfi M., sub *Sphenolobus* (Boros and Vajda 1967; Ştefănuţ, 2008); Ineu Peak, 2,100-2,280 m a.s.l., leg. and det. Á. Boros, sub *Sphenolobus* (Boros and Vajda, 1967; Ştefănuţ, 2008); Negrileasa Peak, 1,800 m a.s.l., leg. and det. Nyárády E. I. and Nyárády A., sub *Sphenolobus* (Boros and Vajda, 1967; Ştefănuţ, 2008); Galaţu Mountain, 1,700-2,000 m a.s.l., leg. and det. Á. Boros, sub *Sphenolobus* (Boros and Vajda, 1967; Ştefănuţ, 2008); Pietrosul Rodnei, "Turnu Roşu", 1,680 m a.s.l., leg. and det. A. Coman, sub *Sphenolobus* (Boros and Vajda, 1967; Ştefănuţ, 2008); Turnu Roşu, 1,680 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Sphenolobus* (Bereş, 1983); Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2208*] (Ştefănuţ, 2008).

Anthelia julacea (L.) Dumort. - **(2)**

Pietrosul Rodnei, sub *Jungermannia* (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885; Ştefănuţ, 2008); Galaţu Mountain, 2,000 m a.s.l., (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains (Pax, 1908; Ştefănuţ, 2008).

Anthelia juratzkana (Limpr.) Trevis. - **(2)**

Below Ineu Peak, on bank of Lala Lake, 1,920 m a.s.l., 14.VIII.1924, leg. and det. A. Mühldorf [FRE *509*] (Borza, 1925; Borza and Nyárády, 1940; Boros and Vajda, 1967; Ştefănuţ, 2007b; Ştefănuţ, 2008); Ineu, leg. and det. L. Felföldy, M. Péterfi and Á. Boros

(Györffy, 1943; Soó, 1944; Ştefureac, 1952; Boros and Vajda, 1967; Ştefănuţ, 2008); Rodna Mountains (Ştefureac, 1963b; Ştefănuţ, 2008); Pietrosul Rodnei, north-western slope, 2,260 m a.s.l., 8-9.VIII.1948 (Ştefureac, 1952; Boros and Vajda, 1967; Ştefănuţ, 2008); Galaţu Peak, leg. and det. Á. Boros (Boros and Vajda, 1967; Ştefănuţ, 2008); Laptelui Peak, leg. and det. Á. Boros (Boros and Vajda, 1967; Ştefănuţ, 2008); Pietrosul Mare, 2,150 m a.s.l., 19.VII.1977, Buhăiescu Mare, 2,080 m a.s.l., 24.VII.1967, Gărgălău, 2,080 m a.s.l., 19.VI.1982, Anieşul Mare, 2,100 m a.s.l., 15.VIII.1982, Galaţu, 2,100 m a.s.l., 18.VII.1982, ass. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985 (Coldea, 1985; Ştefănuţ, 2008); Lala Glacial Ring, 15.VIII.1985 (Coldea and Pînzaru, 1986; Ştefănuţ, 2008); Gărgălău Peak, 2,050 m a.s.l., 19.VII.1982, Omul Peak, 2,060 m a.s.l., 20.VII.1982, Anieşul Mare Peak, 2,050 m a.s.l., 15.VIII.1982, ass. *Salicetum herbaceae* Br.-Bl. 1931, Pietrosul Mare Peak, 2,150 m a.s.l., 17.VII.1977, Rebra Peak, 2,080 m a.s.l., 24.VII.1976, Ineu Peak, 2,100 m a.s.l., 17.VIII.1982, Anieşul Mare Peak, 2,060 m a.s.l., Gărgălău Peak, 2,100 m a.s.l., 19.VII.1982, ass. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985, Piciorul Galaţului, 1,740-1,750 m a.s.l., 18.VII.1982, Galaţu Glacial Ring, 1,800 m a.s.l., 22.IX.1982, Corongiş Peak, 1,680 m a.s.l., 28.IX.1982, ass. *Nardo-Gnaphalietum supini* Bartsch 1940 (Coldea, 1990; Coldea et al. 1997; Ştefănuţ 2008); Ineu Glacial Ring, BN, 47°31'37"N / 24°53'36"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2422*] (Ştefănuţ, 2008).

Apometzgeria pubescens (Schrank) Kuwah. - **(16)**

Below Turnu Roşu, 1,846 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Metzgeria* (Bereş, 1983).

Barbilophozia barbata (Schmidel ex Schreb.) Loeske - **(14)**

Pietrosul Rodnei, sub *Jungermannia* (Hazslinszky, 1866; Hazslinszky, 1868; Ştefănuţ, 2008); Iezerele Buhăescu, MM, 47°35'18"N / 24°38'40"E, 1,880 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ (Ştefănuţ, 2000a; Ştefănuţ, 2008).

Barbilophozia hatcheri (A. Evans) Loeske - **(14)**

Below Ineu Peak, Tomnatec ridge towards Cuşca (Ştefureac, 1945; Ştefureac, 1955; Pócs, 1958; Ştefureac, 1963a; Ştefănuţ, 2008); Iezerele Buhăescu, MM, 47°35'19"N / 24°38'37"E, 1,910 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2481*] (Ştefănuţ, 2000b; Ştefănuţ, 2008); Ineu Glacial Ring, BN, 47°31'38"N / 24°53'33"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3718*] (Ştefănuţ, 2008).

Barbilophozia lycopodioides (Wallr.) Loeske - **(14)**

Pietrosul Rodnei, north-western slope, 2,280 m a.s.l., 8-9.VIII.1948 (Ştefureac, 1952; Ştefănuţ, 2008); Pietrosul Rodnei, 2,230 m a.s.l., VIII.1948, sub *Lophozia* [BUCA B5755, B5756] (Ştefureac, 1958a; Ştefănuţ, 2008), western slope, on rocks, 2,150 m a.s.l., sub *Lophozia lycopodioides* var. *parvifolia* Schiffn. (Ştefureac, 1958a; Ştefănuţ, 2008); Pietrosul Rodnei, MM, 47°36'33"N / 24°39'11"E, 1,500 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2844*] (Ştefănuţ, 2008); Iezerele Buhăescu, MM, 47°35'19"N / 24°38'37"E, 1,910 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3458*] (Ştefănuţ, 2008).

Bazzania flaccida (Dumort.) Grolle - **(13)**

Galaţu Mountain, 2,000 m a.s.l., *B. triangularis* var. *implexa* (Matouschek, 1905); Pietrosul Rodnei, north-western slope, 2,280 m a.s.l., 8-9.VIII.1948, sub *Pleuroschisma tricrenatum* var. *implexum* (Ştefureac, 1952; Ştefureac, 1968; Ştefureac, 1983b).

Bazzania tricrenata (Wahlenb.) Lindb. - **(13)**

Pietrosul Rodnei, sub *Mastigobryum deflexum* (Hazslinszky, 1866; Hazslinszky, 1868; Ştefănuţ, 2008); Ineu Peak, 2,250 m a.s.l., sub *Mastigobryum deflexum* (Breidler, 1890a; Ştefănuţ, 2008); Rodna Mountains, sub *B. triangularis* (Pax, 1908; Ştefănuţ, 2008); Pietrosul Rodnei, 23.VIII.1942, leg. and det. Á. Boros (Györffy, 1943; Ştefănuţ 2008); Ineu, 1942, leg.

and det. Á. Boros (Györffy, 1943; Ştefureac, 1952; Ştefănuţ, 2008); below Ineu Peak, Tomnatec Ridge towards Cuşca, 2,230 m a.s.l., VIII.1937, sub *Pleuroschisma* (Ştefureac, 1945; Ştefănuţ, 2008); Pietrosul Rodnei, north-western slope, 2,260-2,290 m a.s.l., 8-9.VIII.1948, sub *Pleuroschisma* (Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1971; Ştefănuţ, 2008); Pietrosul Rodnei, western slope, on rocks, 2,150 m a.s.l., (Ştefureac, 1958a; Ştefureac, 1977; Ştefănuţ, 2008); Rodna Mountains (Ştefureac, 1963b; Ştefănuţ, 2008); Pietrosul Mare Glacial Ring, 1,950-2,000 m a.s.l., 19.VII.1975, ass. *Luzuletum alpino-pilosae* Br.-Bl. 1926, *Soldanello pusillae-Ranunculetum crenati* (Borza 1931, Etoldea et al, 1981; Ştefănuţ, 2008); Pietrosul Rodnei, 2,260-2,290 alt., ass. *Racomitrio-Aulacomnietum turgidae* (Ştefur., 1952) Ştefur. 1977 (Ştefureac, 1986b; Ştefureac, 1971; Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2204*, *B2210*] (Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'53"N / 24°38'49"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2502*] (Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'50"N / 24°38'50"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2013*] (Ştefănuţ, 2008); Pietrosu Peak, 08.VIII.1948, leg. Ştefureac T. [BUCA *B1239*, *B1266*].

Bazzania trilobata (L.) Gray - **(13)**

Rodna Mountains (Pax, 1908; Ştefănuţ, 2008); Puzdra Peak, 2,050 m a.s.l., 15.VIII.1982, ass. *Saxifragetum carpaticae-cymosae* Coldea 1990, Piciorul Anieşului, 1,500 m a.s.l., 7.VIII.1977, Negrileasa-Anieşului Mare Valley, 1,320 m a.s.l., 25.VII.1981, Valea lui Dragoş Brook, 980 m a.s.l., 31.VIII.1983, ass. *Hieracio rotundati-Piceetum*, Anieşul Mare Valley, Negrileasa - Cepelor Basin, 1,400 m a.s.l., 15.VII.1981, ass. *Leucanthemo waldsteinii-Piceetum* Krajina 1933 (Coldea, 1990; Ştefănuţ, 2008).

Blepharostoma trichophyllum (L.) Dumort. - **(21)**

Galaţu Mountain, 2,000 m a.s.l., Corongiş (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains (Pax, 1908; Ştefănuţ, 2008); Lala Valley, 1,200 m a.s.l., 17.VIII.1937 (Ştefureac, 1938; Ştefureac, 1963b; Ştefănuţ, 2008); Pietrosul Rodnei, 2,260 m a.s.l., 31.VIII.1983, leg. and det. T. Ştefureac, ass. *Bucegietum romanicae* Ştefur. 1984 subass. *jungermannietosum sphaerocarpae* Ştefur. 1986 (Ştefureac, 1986c; Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2206*] (Ştefănuţ, 2008); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5835*].

Bucegia romanica Radian - **(15)**

Pietrosul Rodnei, 2,280 m a.s.l., 4.IX.1982 (Ştefureac, 1983a; Ştefureac, 1983b; Coldea, 1990; Dihoru, 1999; Ştefănuţ, 2008); Pietrosul Rodnei, 2,260 m a.s.l., 31.VIII.1983, leg. and det. T. Ştefureac, ass. *Bucegietum romanicae* Ştefur. 1984 subass. *jungermannietosum sphaerocarpae* Ştefur. 1986 (Ştefureac, 1986c; Ştefureac, 1986a; Plămadă, 1987; Dihoru, 1999; Nădişan and Cherches, 2002; Ştefănuţ, 2008).

Calypogeia azurea Sotler and Crotz - **(3)**

Puzdra Mountain, 1,500-1,600 m a.s.l., leg. and det. Á. Boros, sub *C. trichomanis* (Boros and Vajda, 1967; Ştefănuţ, 2008); Pietrosul Rodnei, sub *C. trichomanis* (Ştefureac, 1983b; Ştefănuţ, 2008).

Calypogeia neesiana (C. Massal. and Carestia) Müll. Frib. - **(3)**

Pietrosul Rodnei, Piciorul Moşului, 1,600 m a.s.l. (Ştefureac, 1958a; Ştefănuţ, 2008).

Cephalozia bicuspidata (L.) Dumort. var. ***bicuspidata*** **- (4)**

Lala Valley, 1,200 m a.s.l., 17.VIII.1937 (Ştefureac, 1938; Ştefănuţ 2008); Ineu Mountain, 1,600-2,100 m a.s.l., 1937 (Ştefureac, 1945; Ştefănuţ 2008); Pietrosul Rodnei, north-west slope, 2,280 m a.s.l., 8-9.VIII.1948 (Ştefureac, 1952; Ştefănuţ 2008); Rodna Mountains (Ştefureac, 1963b; Ştefănuţ, 2008); Pietrosul Rodnei, 2,280 m a.s.l., 4.IX.1982, ass. *Bucegietum romanicae* Ştefur. 1984 subass. *jungermannietosum sphaerocarpae* Ştefur. 1986 (Ştefureac, 1986c; Ştefănuţ 2008); Iezerul Pietrosului, MM, 47°35'53"N / 24°38'48"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2192*] (Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'53"N / 24°38'49"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2014*] (Ştefănuţ, 2008).

var. ***lammersiana*** (Huebener) Breidl.

Rodna Mountains (Ştefureac, 1963b; Ştefănuţ 2008); Ineu Glacial Ring, BN, 47°31'35"N / 24°53'35"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2415*] (Ştefănuţ, 2008).

Cephalozia connivens (Dicks.) Lindb. - **(4)**

Rodna Mountains (Pax, 1908; Ştefănuţ, 2008).

Cephalozia loitlesbergeri Schiffn. - **(4)**

Iezerul Pietrosului, MM, 47°35'53"N / 24°38'53"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2122*] (Ştefănuţ, 2008); ♀♂ - Ineu Glacial Ring, BN, 47°31'35"N / 24°53'35"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2225, B2226*] (Ştefănuţ, 2008).

Cephalozia lunulifolia (Dumort.) Dumort. - **(4)**

Pietrosul Rodnei, north-west slope, 2,260 m a.s.l., 8.-9.VIII.1948, sub *C. media* (Ştefureac, 1952; Ştefănuţ, 2008).

Cephaloziella rubella (Nees) Warnst. - **(5)**

Rodna Mountains, 20.VIII.1937 (Ştefureac, 1958b; Ştefănuţ, 2008); ♀♂ - Pietrosu Peak, north-western slope, 47°35'46"N / 24°38'33"E, alt. 2,000 m, 8.VIII.1948, leg. Ştefureac T., det. Ştefănuţ S. [BUCA *B3365*] (Ştefănuţ, 2008).

Chiloscyphus polyanthos (L.) Corda - **(8)**

Vinului Valley, leg. Demeter K. and det. Hagen [CL] (Szepesfalvi, 1929; Igmándy, 1943; Ştefănuţ, 2008); Prislop (Warnstorf, 1,895);

Conocephalum conicum (L.) Dumort. - **(6)**

Corongiş, sub *Fegatella* (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains (Pax, 1908; Ştefănuţ, 2008); Piatra Rea, Fântânele Valley above Izvorul Cailor Waterfall, 1,220-1,240 m a.s.l., 21.VIII.1982 (Olos, 1983; Ştefănuţ, 2008); Zănoaga de Sus, 1,517-1,551 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Piatra Rea, 1,260 m a.s.l., 27.VII.1979, ass. *Cardaminetum opizii* Szafer., Pawl., Kulcz. 1923, Guşeţel Valley - Rebra Valley, 900-1,000 m a.s.l., 10.VI.1981, ass. *Cratoneuretum filicino-commutati* (Kuhn, 1937) Oberd. 1977, Cormaia Valley - Vinului Brook, 960 m a.s.l., 16.VII.1980, Pietrosul Mare Reserve, 1,060 m a.s.l., 24.VI.1981, ass. *Phyllitidi-Fagetum* Soó 1964 (Coldea, 1990; Ştefănuţ, 2008).

Diplophyllum albicans (L.) Dumort. - **(24)**

Vinului Valley, 700 m a.s.l., Corongiş (Matouschek, 1905; Ştefănuţ 2008); Rodna Mountains (Pax, 1908; Ştefănuţ, 2008); Ineu, Crestele Găgii, Tăul Mare, 2,000 m a.s.l. (Ştefureac, 1942; Ştefănuţ, 2008); Pietrosul Rodnei, north-west slope, 2,260 m a.s.l., 2,290 m a.s.l., 8-9.VIII.1948 (Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1968; Ştefureac, 1971; Ştefănuţ, 2008); Rodna Mountains (Ştefureac, 1963b; Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'50"N / 24°38'50"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2012, B2292*] (Ştefănuţ, 2008).

Diplophyllum obtusifolium (Hook.) Dumort. - **(24)**

Pietrosul Rodnei, sub *Jungermannia* (Hazslinszky, 1866; Hazslinszky, 1868; Ştefănuţ, 2008); Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountain (Pax, 1908; Ştefănuţ, 2008).

Diplophyllum taxifolium (Wahlenb.) Dumort. - **(24)**

Ineu Peak, 2,250 m a.s.l., sub *Jungermannia albicans* var. *taxifolia* (Breidler, 1890a; Ştefănuţ, 2008); Corongiş, Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905; Ştefănuţ, 2008); Ineu, Crestele Găgii, Tăul Mare, 2,000 m a.s.l. (Ştefureac, 1942; Ştefănuţ, 2008); below Ineu Peak, Tomnatec Ridge towards Cuşca (Ştefureac, 1945; Ştefănuţ, 2008); Pietrosul Rodnei, north-west slope, 2,280 m a.s.l., 8-9.VIII.1948 (Ştefureac, 1952; Ştefănuţ, 2008); Rodna Mountains (Ştefureac, 1963b; Ştefănuţ, 2008); Ineu, 25.VIII.1937 (Ştefureac, 1958b; Ştefănuţ, 2008); Pietrosul Mare Glacial Ring, 1,950-2,000 m a.s.l., 19.VII.1975, ass. *Luzuletum alpino-pilosae* Br.-Bl. 1926, *Soldanello pusillae-Ranunculetum crenati* Borza 1931 (Coldea et al., 1981; Ştefănuţ, 2008); Buhăiescu Mare Peak, 2,080 m a.s.l., 24.VII.1976, ass. *Soldanello pusillae-Ranunculetum crenati* (Coldea et al., 1981; Ştefănuţ, 2008); Anieşul Mare Peak, 2,000 m a.s.l., in wet places, 17.VII.1975 (Plămadă and Coldea, 1982; Ştefănuţ, 2008); Pietrosul Mare, 2,150 m a.s.l., 19.VII.1977, Buhăiescu Mare, 2,080 m a.s.l., 24.VII.1967, Puzdra-Anieşul Mare, 1,800 m a.s.l., 27.VII.1976, ass. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985 (Coldea, 1985; Ştefănuţ, 2008); Anieşul Mare Peak, 1,980-2,000 m a.s.l., 17.VII.1975, 7.VII.1977, ass. *Salicetum herbaceae* Br.-Bl. 1931, Rebra Peak, 2,080 m a.s.l., 24.VII.1976, Puzdra-Anieş Saddle, 1,800 m a.s.l., 27.VII.1976, ass. *Soldanello hungaricae-Ranunculetum crenati* (Coldea, 1990; Ştefănuţ, 2008); Pietrosu, 2,153-2,156 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Buhăescu Peak, MM, 2,100 m a.s.l., 26.VI.1982, leg. Roman N., det. Ştefănuţ S. [BUCA *B2948*, *B2950*] (Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2205*], 47°35'53"N / 24°38'49"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2148*], 47°35'49"N / 24°38'49"E, 1,860 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2228*]; 47°35'50"N / 24°38'50"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3453*] (Ştefănuţ, 2008); ♂ - Iezerele Buhăescu, MM, 47°35'19"N / 24°38'37"E, 1,910 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3456*] (Ştefănuţ, 2008); Ineu Glacial Ring, BN, 47°31'38"N / 24°53'33"E, 1,920 m a.s.l., 26.VII.1999, leg. and det. S. Ştefănuţ [BUCA *B3717*, *B3720*] (Ştefănuţ, 2008).

Frullania dilatata (L.) Dumort. - **(7)**

Rodna Mountains (Pax, 1908; Ştefănuţ, 2008); Lala Valley, 1,200 m a.s.l., on rocks, 17.VIII.1937 (Ştefureac, 1938; Ştefănuţ, 2008).

Frullania tamarisci (L.) Dumort. - **(7)**

Rodna Mountains (Pax, 1908; Ştefănuţ, 2008); Between Prislop and Poiana Rotundă (Warnstorf, 1895); Pietrosul Rodnei, Piciorul Moşului, northen slope, 1,650 m a.s.l. (Ştefureac, 1958a; Ştefănuţ, 2008).

Gymnocolea inflata (Huds.) Dumort. subsp. ***inflata*** - **(14)**

Pietrosul Rodnei, sub *Jungermannia* (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885; Ştefănuţ, 2008).

Gymnomitrion concinnatum (Lightf.) Lindb. - **(9)**

Pietrosul Rodnei (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885; Pax, 1908; Boros and Vajda, 1967; Ştefănuţ, 2008); Ineu Peak, 2,250 m a.s.l. (Breidler, 1890a; Pax, 1908; Ştefănuţ, 2008); Pietrosul Rodnei, north-western slope, 2,270 m, 2,260 m and 2,280-

2,290 m a.s.l., 8-9.VIII.1948 (Ştefureac, 1952; Ştefureac, 1963b; Boros and Vajda, 1967; Ştefureac, 1977; Ştefureac, 1983b; Ştefănuţ, 2008); Galaţu Mountain, 1,800-1,900 m a.s.l., leg. and det. Á. Boros (Boros and Vajda, 1967; Ştefănuţ, 2008); Pietrosu, 2,108 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Buhăescu Peak, 2,100 m a.s.l., 26.VI.1982, leg. Roman N., det. Ştefănuţ S. [BUCA *B2949*] (Ştefănuţ, 2008); Iezerul Pietrosului, 47°35'53"N / 24°38'49"E, 1,835 m a.s.l., 28.VII.1999, leg. and det. S. Ştefănuţ [BUCA *B2149*] (Ştefănuţ, 2008); Pietrosul Rodnei, northern slope, 2,100 m a.s.l., 7.VIII.1948, leg. and det. T. Ştefureac, conf. Ştefănuţ S., 2006 [BUCA *B5290*] (Ştefănuţ, 2008); Ineu Glacial Ring, BN, 47°31'38"N / 24°53'33"E, 1,920 m a.s.l., 26.VIII.1999, leg. Ştefănuţ S., det. Váňa J. [BUCA *B3719*] (Ştefănuţ, 2008); Pietrosul Peak, 7.-8.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5289*, *B5290*].

Gymnomitrion corallioides Nees - **(9)**

Pietrosul Rodnei (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885; Ştefănuţ, 2008); below Ineu Peak, Tomnatec Ridge towards Cuşca (Ştefureac, 1945; Ştefănuţ, 2008); Pietrosul Rodnei, north-western slope, 2,260 m a.s.l., 8.-9.VIII.1948 (Ştefureac, 1952; Racoviţă, 1963; Ştefănuţ, 2008); Pietrosu, 2,250 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Below Pietrosul Peak, 2,100 m a.s.l., 8.VIII.1948, leg. and det. T. Ştefureac, sub *G. concinnatum, rev*. Ştefănuţ S., 2006 [BUCA *B5289*] (Ştefănuţ, 2008).

Haplomitrium hookeri (Sm.) Nees - **(10)**

Iezerele Buhăescu, MM, 47°35'18"N / 24°38'40"E, 1,880 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ, conf. Dihoru G. [BUCA *B0932*] (Ştefănuţ, 2000a; Ştefănuţ, 2000b; Sabovljević et al., 2001; Ştefănuţ, 2003a; Ştefănuţ, 2003b; Dihoru, 2004; Ştefănuţ, 2008; Ştefănuţ, 2010b); Ineu Glacial Ring, 9.VIII.1918, leg. Péterfi M., det. T. Ştefureac [CL *85058*] (Ştefănuţ, 2003b; Ştefănuţ, 2008).

Jamesoniella autumnalis (DC.) Steph. - **(14)**

Rodna Mountains, sub *Aplozia* (Pax, 1908; Ştefănuţ, 2007b; Ştefănuţ, 2008); Iezerele Buhăescu, MM, 47°35'21"N / 24°38'37"E, 1,920 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3451*, *B3452*] (Ştefănuţ, 2008).

Jungermannia atrovirens Dumort. - **(11)**

Vinului Valley, 700 m a.s.l., sub *Haplozia riparia* (Matouschek, 1905; Ştefănuţ, 2008), sub *Aplozia riparia* (Pax, 1908; Ştefănuţ, 2008).

Jungermannia caespiticia Lindenb. - **(11)**

Iezerele Buhăescu, MM, 47°35'18"N / 24°38'40"E, 1,880 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ (Ştefănuţ, 2000a; Ştefănuţ, 2008).

Jungermannia confertissima Nees - **(11)**

Vinului Valley, sub *J. levieri* (Boros, 1951; Schuster, 1969; Ştefănuţ, 2008); ♀♂ - Iezerele Buhăescu, 47°35'18"N / 24°38'40"E, 1,880 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2371*] (Ştefănuţ, 2008); ♀♂ - Iezerul Pietrosului, 47°35'53"N / 24°38'49"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3362*] (Ştefănuţ, 2008).

Jungermannia hyalina Lyell - **(11)**

Iezerele Buhăescu, 47°35'19"N / 24°38'37"E, 1,910 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3449*], 47°35'21"N / 24°38'37"E, 1,920 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3450*] (Ştefănuţ, 2007b; Ştefănuţ, 2008).

Jungermannia obovata Nees - **(11)**

Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2190*] (Ştefănuţ, 2008).

Jungermannia sphaerocarpa Hook. - **(11)**

Ineu Peak, 2,200 m a.s.l., sub *Jungermannia tersa* (Breidler, 1890a; Ştefănuţ, 2008); Corongiş, sub *Haplozia* (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains, sub *Aplozia* (Pax, 1908; Ştefănuţ, 2008); Ineu, Crestele Găgii, Tăul Mare, 2,000 m a.s.l., sub *Haplozia* (Ştefureac, 1942; Ştefănuţ, 2008); Ineu Peak, Crestele Găgii, 1,800 m a.s.l., sub *Haplozia* (Ştefureac, 1945; Ştefănuţ, 2008); Pietrosul Rodnei, 23.VIII.1942, leg. and det. Á. Boros, sub *Solenostoma* (Györffy, 1943; Ştefănuţ, 2008); Pietrosul Rodnei, north-western slope, 2,280 m and 2,280 m a.s.l., 8-9.VIII.1948, sub *Haplozia* (Ştefureac, 1952); Ineu, 1942, leg. and det. Á. Boros (Györffy, 1943; Ştefureac, 1952; Ştefănuţ, 2008); Rodna Mountains, sub *Haplozia* (Ştefureac, 1963b; Ştefănuţ, 2008); Pietrosul Mare Glacial Ring, 1,810 m a.s.l., 19.VII.1975, sub *Solenostoma*, ass. *Cardaminetum opizii* Szafer., Pawl., Kulcz. 1923 (Coldea et al., 1981; Coldea 1990; Ştefănuţ 2008); Pietrosul Rodnei, 2,280 m a.s.l., 4.IX.1982, 2,260 m a.s.l., 31.VIII.1983, leg. and det. T. Ştefureac, ass. *Bucegietum romanicae* Ştefur. 1984 subass. *jungermannietosum sphaerocarpae* Ştefur. 1986 (Ştefureac, 1986c; Ştefănuţ, 2008); ♀♂ - Iezerul Pietrosului, MM, 47°35'53"N / 24°38'49"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2875*], ***s*** - [BUCA *B2489*]; Iezerele Buhăescu, MM, 47°35'19"N / 24°38'37"E, 1,910 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2366*] (Ştefănuţ, 2008); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac, sub *Haplozia* [BUCA *B5301*, *B5302*, *B5303*]

Leiocolea collaris (Nees) Schljakov - **(14)**

Pietrosul Rodnei, sub *Jungermannia collaris* (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885; Ştefureac, 1945; Ştefureac, 1955; Ştefureac, 1955; Ştefureac, 1963a; Ştefănuţ, 2008); Lala Lake, 2,000 m a.s.l., sub *Lophozia alpestris* (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains, sub *Lophozia alpestris* (Pax, 1908; Ştefănuţ, 2008); the edge of Tăul Mic Lake, below Ineu, 21.VIII.1937, sub *Lophozia alpestris* (Ştefureac, 1945; Ştefănuţ, 2008); Rodna Mountains, sub *Lophozia alpestris* (Ştefureac, 1963b; Ştefănuţ, 2008).

Leiocolea heterocolpos (Thed. ex C. Hartm.) H. Buch - **(14)**

? - Rodna Mountains, sub *Lophozia* (Ştefureac, 1986a; Ştefănuţ, 2008).

Lejeunea cavifolia (Ehrh.) Lindb. - **(12)**

Ineu Peak, 2,250 m a.s.l., sub *L. serpyllifolia* (Breidler, 1890a; Pax, 1908; Ştefănuţ, 2008); Vinului Valley, 700 m a.s.l. (Matouschek, 1905; Ştefănuţ, 2008); Vinului Valley, 800 m a.s.l., 7.VIII.1918, leg. and det. Péterfi M. [FRE *1126*] (Borza, 1935; Ştefănuţ, 2008).

Lepidozia reptans (L.) Dumort. - **(13)**

Lala Valley, 1,200 m a.s.l., 17.VIII.1937 (Ştefureac, 1938; Ştefănuţ, 2008); Aria Zimbrului, 1,186 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Pietrosul Rodnei, MM, 47°36'33"N / 24°39'11"E, 1,500 m a.s.l., 29.VII.1999, leg. and det. S. Ştefănuţ [BUCA *B2229*] (Ştefănuţ, 2008).

Lophocolea bidentata (L.) Dumort. var. ***bidentata*** - **(8)**

Lala Valley, 1,200 m a.s.l., 17.VIII.1937 (Ştefureac, 1938; Ştefănuţ, 2008).

Lophocolea heterophylla (Schrad.) Dumort. - **(8)**

? - Rodna Mountains (Pax, 1908; Ştefănuţ, 2008).

Lophozia bicrenata (Schmidel ex Hoffm.) Dumort. - **(14)**

Iezerul Pietrosului, MM, 47°35'53"N / 24°38'53"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2203*] (Ştefănuţ, 2008).

Lophozia excisa (Dicks.) Dumort. - **(14)**

Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg.

and det. S. Ştefănuţ [BUCA *B2303*] (Ştefănuţ, 2008); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5743*].

Lophozia incisa (Schrad.) Dumort. - **(14)**

Prislop, sub *Jungermannia* (Warnstorf, 1895); Pietrosul Rodnei, the north-westen slope, 2,270 m a.s.l., 8-9.VIII.1948 (Ştefureac, 1952; Ştefănuţ 2008); Pietrosul Rodnei, Piciorul Moşului, the northern slope, in forest, 1,400-1,500 m a.s.l., VIII.1948 (Ştefureac, 1958a; Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2084, B2085, B2361*], 47°35'50"N / 24°38'50"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2008, B2293*] (Ştefănuţ, 2008); Pietrosul Rodnei on Piciorul Moşului, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5748*].

Lophozia longidens (Lindb.) Macoun - **(14)**

Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2876*] (Ştefănuţ, 2008).

Lophozia longiflora (Nees) Schiffn. - **(14)**

Pietrosul Rodnei, north-west slope, 2,260-2,280 m a.s.l., 8-9.VIII.1948 (Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1968; Ştefureac, 1977; Ştefureac, 1983b; Goia, 2001; Ştefureac, 1971; Ştefănuţ, 2008).

Lophozia obtusa (Lindb.) A. Evans - **(14)**

? - Rodna Mountains (Ştefureac, 1986a; Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2191*] (Ştefănuţ, 2008).

Lophozia sudetica (Nees ex Huebener) Grolle - **(14)**

Pietrosul Rodnei, 2,260 m a.s.l., 31.VIII.1983, leg. and det. T. Ştefureac, ass. *Bucegietum romanicae* Ştefur. 1984 subass. *jungermannietosum sphaerocarpae* Ştefur. 1986 (Ştefureac, 1986c; Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'53"N / 24°38'49"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2407, B3122, B3363*], 47°35'50"N / 24°38'48"E, 1,845 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2364*], 47°35'50"N / 24°38'50"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2133*], 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3370*] (Ştefănuţ, 2008); Iezerele Buhăescu, MM, 47°35'19"N / 24°38'37"E, 1,910 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2367*] (Ştefănuţ, 2008).

Lophozia ventricosa (Dicks.) Dumort. - **(14)**

Ineu Peak, 2,250 m a.s.l., sub *Jungermannia* (Breidler, 1890a; Pax, 1908; Ştefănuţ, 2008); Pietrosul Rodnei, 23.VIII.1942, leg. and det. Á. Boros, sub var. *confertifolia* (Györffy, 1943; Ştefănuţ, 2008); Pietrosul Rodnei (Boros, 1951; Ştefănuţ 2008); Pietrosul Rodnei, north-western slope, 2,280 m a.s.l., 8-9.VIII.1948, sub *L. confertifolia* (Ştefureac, 1952; Ştefureac, 1963b; Ştefănuţ, 2008).

Lophozia wenzelii (Nees) Steph. - **(14)**

Vinului Valley (Boros, 1951; Ştefănuţ, 2008); Rodna Mountain (Ştefureac, 1963b; Ştefureac, 1971; Ştefănuţ, 2008); the peatbogs from Ştiol, 1,850 m a.s.l., 16.VII.1975, ass. *Carici dacicae-Drepanocladetum exannulatae* Boşcaiu et al. 1972 (Coldea et al., 1977; Ştefănuţ, 2008); Pietrosul Mare Glacial Ring, 2,000 m a.s.l., 19.VII.1975, ass. *Luzuletum alpino-pilosae* Br.-Bl. 1926, Pietrosul Mare Peak, 2,275 m a.s.l., 17.VII.1977, ass. *Soldanello pusillae-Ranunculetum crenati* Borza 1931 (Coldea et al., 1981; Ştefănuţ, 2008); Anieşul Mare Peak, 2,000 m a.s.l., near the snow places, 17.VII.1975 (Plămadă and Coldea, 1982; Ştefănuţ, 2008); Pietrosul Rodnei, 2,260 m a.s.l., 31.VIII.1983, leg. and det. T. Ştefureac, ass. *Bucegietum romanicae* Ştefur. 1984 subass. *jungermannietosum sphaerocarpae* Ştefur. 1986

(Ştefureac, 1986c; Ştefănuţ, 2008); Anieşul Mare Peak, 1,980-2,000 m a.s.l., 17.VII.1975, 7.VIII.1977, ass. *Salicetum herbaceae* Br.-Bl. 1931, Pietrosul Mare Peak, 2,270 m a.s.l., 21.VIII.1983, ass. *Luzuletum alpino-pilosae* Br.-Bl. 1926, Pietrosul Mare Peak, 2,240-2,260 m a.s.l., 31.VIII.1983, ass. *Aconitetum taurici* Borza 1934 (Coldea, 1990; Ştefănuţ, 2008); Ineu Glacial Ring, BN, 47°31'37"N / 24°53'36"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2423*] (Ştefănuţ, 2008); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5770*].

Marchantia polymorpha L. subsp. ***polymorpha*** **- (15)**

Rodna (Pax, 1908; Ştefănuţ, 2008); Rebra Valley, 630 m a.s.l., 13.VI.1981, ass. *Symphyto-Fagetum* Vida 1959 (Coldea, 1990; Ştefănuţ, 2008).

subsp. ***ruderalis*** Bischl. and Boisselier

Runcu Pietrosului, 1,148 m a.s.l., leg. A. Coman, det. Á. Boros, sub var. *aquatica* (Bereş, 1983).

Marsupella brevissima (Dumort.) Grolle **- (9)**

Pietrosul Rodnei, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac, ass. *Bucegietum romanicae* Ştefur. 1984 subass. *jungermannietosum sphaerocarpae* Ştefur. 1986 (Ştefureac, 1986c; Ştefănuţ, 2007b; Ştefănuţ, 2008).

Marsupella emarginata (Ehrh.) Dumort. **- (9)**

Ineu Peak, on Coasta Netedă, 1,900 m a.s.l., sub *Sarcoscyphus ehrhardtii* (Breidler, 1890a; Pax, 1908; Ştefănuţ, 2008); Pietrosul Rodnei (Ştefureac, 1983b; Nădişan and Chercheş, 2002; Ştefănuţ, 2008).

Marsupella funckii (F. Weber and D. Mohr) Dumort. **- (9)**

Pietrosul Rodnei, sub *Sarcoscyphus* (Hazslinszky, 1885; Ştefănuţ, 2008); Ineu, 15.VII.1888, leg. Demeter K. [CL] (Igmándy, 1943; Plămadă, 1973; Ştefănuţ, 2008); Rodna Mountain (Ştefureac, 1963b; Ştefănuţ, 2008).

Metzgeria furcata (L.) Dumort. **- (16)**

Rodna Mountains, (Pax 1908; Ştefănuţ, 2008).

Moerckia blyttii (Moerch) Brockm. **- (17)**

Below Ineu Peak, 1,920 m a.s.l., 13.VIII.1918, leg. Péterfi M. [FRE *17*] (Borza, 1921; Györffy, 1924; Borza and Nyárády, 1940; Ştefureac, 1951; Ştefănuţ, 2008); Ineu, above Lala Lake, 1,920 m a.s.l., 19.VIII.1917, leg. Mühldorf A. (Ştefureac, 1951; Ştefănuţ, 2008); Ineu (Ştefureac, 1951; Ştefănuţ, 2008); Pietrosul Rodnei, the edge of Pietrosu Lake, on stones, 7.VIII.1948 (Ştefureac, 1951; Ştefureac, 1983b; Nădişan and Chercheş, 2002; Ştefănuţ, 2008); Rodna Mountains, ass. *Polytrichetum sexangularis* (Ştefureac, 1957b; Ştefănuţ, 2008); Rodna Mountains, the edge of glacial lakes (Ştefureac, 1963b; Ştefureac, 1967a; Ştefureac, 1979; Ştefănuţ, 2008); Iezerele Buhăescu, MM, 47°35'18"N / 24°38'40"E, 29.VIII.1999, 1,880 m a.s.l., leg. and det. S. Ştefănuţ (Ştefănuţ, 2000a; Ştefănuţ, 2000b; Ştefănuţ, 2008); *s* - Iezerul Pietrosului, MM, 47°35'52"N / 24°38'53"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2018*, *B2500*], ♀ - [BUCA *B2019*], ***s*** - 47°35'50"N / 24°38'48"E, 1,845 m a.s.l. [BUCA *B2363*, *B2365*]; Ineu Glacial Ring, BN, 47°31'35"N / 24°53'35"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2223*, *B2227*, *B2409*, *B2410*, *B2413*], 47°31'37"N / 24°53'36"E, 1,920 m a.s.l. [BUCA *B2421*, *B2424-B2426*] (Ştefănuţ, 2000b; Ştefănuţ, 2008); Iezerul Pietrosului Lake, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5949*].

Mylia taylorii (Hook.) Gray - **(11)**

Rodna Mountains, *without locality* (Pax, 1908; Ştefureac, 1969; Ştefănuţ, 2008); Galaţu Mountain, 1,800-1,900 m a.s.l., leg. and det. Á. Boros (Boros and Vajda, 1967; Ştefureac, 1969; Ştefănuţ, 2008); Pietrosul Rodnei (Ştefureac, 1983b; Plămadă, 1987; Nădişan and Chercheş, 2002; Ştefănuţ, 2008).

Nardia geoscyphus (De Not.) Lindb. - **(11)**

Ineu, Crestele Găgii, Tăul Mare, 2,000 m a.s.l., sub *Alicularia* (Ştefureac, 1942; Ştefănuţ, 2008); Pietrosul Rodnei, Piciorul Moşului, northen slope, in forest, 1,400-1,500 m a.s.l., VIII.1948 (Ştefureac, 1958a; Ştefănuţ, 2008); Rodna Mountains (Ştefureac, 1963b; Ştefănuţ, 2008).

Nardia scalaris S. F. Gray - **(11)**

Rodna Mountains, (Pax, 1908; Ştefureac, 1963b; Ştefănuţ, 2008); Ineu, Crestele Găgii, Tăul Mare, 2,000 m a.s.l., sub *Alicularia* (Ştefureac, 1942; Ştefănuţ, 2008); Pietrosul Rodnei, north-western slope, 2,260-2,290 m a.s.l., 8-9.VIII.1948 (Ştefureac, 1952; Ştefureac, 1971; Ştefănuţ, 2008); Anieşul Mare Peak, 2,000 m a.s.l., 17.VII.1975 (Plămadă and Coldea, 1982; Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'50"N / 24°38'50"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2294*] (Ştefănuţ, 2008); Ineu Glacial Ring, BN, 47°31'37"N / 24°53'36"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2420*] (Ştefănuţ, 2008); Pietrosul Rodnei, 08.VIII.1948, leg. Ştefureac T., sub *Alicularia* [BUCA *B1020*].

Pedinophyllum interruptum (Nees) Kaal. - **(19)**

Pietrosul Rodnei, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6111*].

Pellia endiviifolia (Dicks.) Dumort. - **(18)**

Corongiş, sub *P. calycina* var. *furcigera* (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains, sub *P. fabbroniana* (Pax, 1908; Soó, 1944; Ştefănuţ, 2008); Livezi, 1,600 m a.s.l., 15.VII.1977, ass. *Chrysosplenio alpini-Saxifragetum stellaris* Pawl. and Walas 1949 (Coldea, 1990; Ştefănuţ, 2008).

Pellia epiphylla (L.) Corda - **(18)**

Rodna Mountains, *without locality* (Pax, 1908; Plămadă, 1968; Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2358*] (Ştefănuţ, 2008).

Pellia neesiana (Gottsche) Limpr. - **(18)**

Ineu Glacial Ring, BN, 47°31'36"N / 24°53'35"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3146*] (Ştefănuţ, 2008).

Plagiochila asplenioides (L. emend. Taylor) Dumort. - **(19)**

Below Ineu Peak, VIII.1937 (Ştefureac, 1945, Ştefureac 1952; Ştefănuţ 2008); Turnu Roşu, 2,151 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Pietrosul Rodnei, 2,280 m a.s.l., 4.IX.1982, 2,260 m a.s.l., 31.VIII.1983, leg. and det. T. Ştefureac, ass. *Bucegietum romanicae* Ştefur. 1984 subass. *jungermannietosum sphaerocarpae* Ştefur. 1986 (Ştefureac, 1986c; Ştefănuţ, 2008); Rebra Valley - Guşatu Valley, 960 m a.s.l., 10.VI.1981, ass. *Asplenium-Cystopteridetum fragilis* Oberd. (1939) 1949, Galaţu Saddle, 1,630 m a.s.l., 5.VII.1977, ass. *Asplenium-Cystopteridetum fragilis* subass. *veronicetorum baumgartenii* Coldea 1990, Rebra Valley, 630 m a.s.l., 13.VI.1981, ass. *Symphyto-Fagetum* Vida 1959 (Coldea, 1990; Ştefănuţ, 2008); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6384*].

Plagiochila porelloides (Torr. ex Nees) Lindenb. - **(19)**

Lala Valley, 1,200 m a.s.l., 17.VIII.1937, sub *P. asplenioides* var. *porelloides* (Ştefureac, 1938; Ştefănuţ, 2008); the edge of Tăul Mic Lake below Ineu, 21.VIII.1937, sub *P. asplenioides* var. *humilis* (Ştefureac, 1945; Ştefănuţ, 2008).

Pleurocladula albescens (Hook.) Grolle var. ***albescens*** - **(4)**

Ineu Glacial Ring, BN, 47°31'35"N / 24°53'35"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2224*, *B2408*, *B2411*, *B2412*, *B2414*], 47°31'37"N / 24°53'36"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2419*], 47°31'36"N / 24°53'35"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2416*, *B2417*, *B2445*], ♀ - 47°31'36"N / 24°53'35"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2418*] (Ştefănuţ, 2000b; Ştefănuţ, 2003a; Ştefănuţ and Ştefănuţ, 2003; Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'50"N / 24°38'50"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3454*] (Ştefănuţ, 2008).

var. ***islandica*** (Nees) L. Söderstr. and Váňa

Anieşul Mare Peak, 2,000 m a.s.l., near the snow places, in wet places, 17.VII.1975, ass. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985 (Plămadă, 1977; Ştefureac, 1979; Ştefureac, 1983b; Plămadă and Coldea, 1982; Ştefureac, 1986a; Plămadă, 1988; Coldea et al., 1997; Plămadă et al., 2000; Nădişan and Chercheş, 2002; Ştefănuţ, 2008); Anieşul Mare Peak, 2,000 m a.s.l., 19.VII.1975, leg. Coldea G., det. Plămadă E., conf. Ştefănuţ S. [BUCA *B2450*] (Ştefănuţ, 2000b; Ştefănuţ and Ştefănuţ, 2003; Ştefănuţ, 2008).

Porella arboris-vitae (With.) Grolle - **(20)**

Rodna Mountains, *without locality*, sub *P. laevigata* (Pax, 1908; Ştefănuţ, 2008).

Porella cordaeana (Huebener) Moore - **(20)**

Vinului Valley, leg. and det. Péterfi M., sub *P. rivularis* (Péterfi, 1910; Szurák, 1912; Ştefănuţ, 2008).

Preissia quadrata (Scop.) Nees - **(15)**

Corongiş, Matouschek 1905; Ştefănuţ, 2008); Rodna Mountains, sub *Chomiocarpon* (Pax, 1908; Györffy, 1948; Ştefănuţ, 2008); Between Prislop and Poiana Rotundă, sub *P. commutata* (Warnstorf, 1895); Pietrosul Peak, leg. and det. T. Ştefureac, 08.VIII.1948, sub *P. commutata* [BUCA *B6336*].

Ptilidium ciliare (L.) Hampe - **(22)**

Rodna Mountains (Pax, 1908; Ştefănuţ, 2008); Pietrosul Rodnei, north-west slope, 2,260 m a.s.l., 8-9.VIII.1948, sub fo. *inundata* (Ştefureac, 1952; Ştefănuţ, 2008); Pietrosul Rodnei, Piciorul Moşului, on rocks, 1,650 m a.s.l., (Ştefureac, 1958a; Ştefănuţ, 2008); above Piciorului Moşului, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6531*].

Ptilidium pulcherrimum (Weber) Vanio - **(22)**

Lala Valley, 1,200 m a.s.l., 17.VIII.1937, sub fo. *rupicola* (Ştefureac, 1938; Ştefănuţ, 2008).

Radula complanata (L.) Dumort. - **(23)**

Rodna Mountains, *without locality* (Pax, 1908; Ştefănuţ, 2008); Lala Valley, 1,200 m a.s.l., on stones and soil, 17.VIII.1937 (Ştefureac, 1938; Ştefănuţ, 2008).

Riccardia palmata (Hedw.) Carruth. - **(1)**

Vinului Valley, 700 m a.s.l., leg. and det. Á. Boros (Boros and Vajda, 1967; Ştefănuţ, 2008); Pietrosul Rodnei (Ştefureac, 1983b; Nădişan and Chercheş, 2002; Ştefănuţ, 2008).

Scapania aequiloba (Schwägr.) Dumort. - **(24)**

Pietrosul Rodnei, 1,500 m a.s.l., leg. and det. Á. Boros (Boros and Vajda, 1967; Ştefureac, 1983b; Ştefănuţ, 2008); Vinului Valley, 1,700 m a.s.l., leg. and det. Á. Boros (Boros and Vajda, 1967; Ştefănuţ, 2008); Anieşul Mare Glacial Ring, 1,520-1,600 m a.s.l., 17.VII.1975, ass. *Doronico carpati-Saxifragetum aizoides* Coldea 1990 (Coldea, 1990; Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2047*] (Ştefănuţ, 2008).

Scapania brevicaulis Taylor - **(24)**

Pietrosul Rodnei, western slope, on rocks, 2,150 m a.s.l., sub *S. degenii* (Ştefureac, 1958a; Paton, 1999; Ştefănuţ, 2003b; Ştefănuţ, 2008).

Scapania curta (Mart.) Dumort. - **(24)**

Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains (Pax, 1908; Ştefănuţ, 2008); Pietrosul Rodnei, north-western slope, 2,280 m a.s.l., 8-9.VIII.1948 (Ştefureac, 1952; Ştefănuţ, 2008).

Scapania irrigua (Nees) Nees - **(24)**

Lala Lake (Ştefureac, 1963b; Ştefănuţ, 2008).

Scapania mucronata H. Buch - **(24)**

Iezerul Pietrosului, MM, 47°35'53"N / 24°38'53"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA B2007] (Ştefănuţ, 2008).

Scapania nemorea (L.) Grolle - **(24)**

Corongiş, Galaţu Mountain, 2,000 m a.s.l., sub *S. nemorosa* (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains, sub *S. nemorosa* (Pax, 1908; Ştefănuţ, 2008); Vinului Valley, leg. and det. Á. Boros and Felföldy L., sub *S. nemorosa* (Boros and Vajda, 1967; Ştefănuţ, 2008); Pietrosul Rodnei on Repede Valley, 12.VIII.1948, leg. and det. T. Ştefureac [BUCA B6737].

Scapania scandica (Arnell and H. Buch) Macvicar - **(24)**

Iezerul Pietrosului, MM, 47°35'50"N / 24°38'50"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B3455*] (Ştefănuţ, 2008).

Scapania subalpina (Nees ex Lindenb.) Lindb. - **(24)**

Lala Lake (Ştefureac, 1963b, Vajda and Orbán, 1975; Ştefănuţ, 2008).

Scapania umbrosa (Schrad.) Dumort. - **(24)**

Corongiş, sub *S. convexa* (Matouschek, 1905; Ştefănuţ, 2008).

Scapania undulata (L.) Dumort. - **(24)**

Rodna Mountains, leg. and det. Demeter K. [CL] (Igmándy, 1943; Ştefănuţ, 2008); Piatra Neagră, 1,650 m a.s.l., 15.VII.1977, ass. *Philonotido seriatae-Saxifragetum stellaris* Horv. 1949 (Coldea et al., 1981; Ştefănuţ, 2008); Livezi, 1,600-1,620 m a.s.l., 15.VII.1977, Galaţu Peak - Căldare, 1,690 m a.s.l., 6.VIII.1977, ass. *Chrysosplenio alpini-Saxifragetum stellaris* Pawl. and Walas, 1949 (Coldea, 1990; Ştefănuţ, 2008); Iezerele Buhăescu, MM, 47°35'18"N / 24°38'40"E, 1,880 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2370*], 47°35'19"N / 24°38'37"E, 1,910 m a.s.l., 29.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2368, B2369, B2877, B2878*] (Ştefănuţ, 2008); Iezerul Pietrosului, MM, 47°35'53"N / 24°38'48"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2009*], 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2211*], ♂ - [BUCA *B2356*], *s* - 47°35'53"N / 24°38'48"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2231*], 47°35'53"N / 24°38'53"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2357, B3371*] (Ştefănuţ, 2008); Ineu Glacial Ring, BN, 47°31'34"N / 24°53'34"E, 1,920 m a.s.l., 26.VIII.1999, leg. and det. S. Ştefănuţ [BUCA

B2198, *B2222*, *B3457*] (Ştefănuţ, 2008); Pietrosul Peak, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6765*, *B6766*]

Scapania verrucosa Heeg - **(24)**

Vinului Valley (Boros, 1951; Ştefureac et al., 1955; Ştefănuţ, 2003b; Ştefănuţ, 2008).

Tritomaria exsecta (Schmidel) Schiffn. ex Loeske - **(14)**

Ineu, 2,000-2,200 m a.s.l., sub *Diplophyllum* (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains, sub *Lophozia* (Pax, 1908; Ştefănuţ, 2008); Lala Valley, 1,200 m a.s.l., on sandy soil with humus, 17.VIII.1937, sub *Sphenolobus* (Ştefureac, 1938; Ştefănuţ, 2008); the Bank of Tăul Mic Lake below Ineu, 21.VIII.1937, sub *Sphenolobus* (Ştefureac, 1945; Ştefănuţ, 2008).

Tritomaria exsectiformis (Breidl.) Loeske - **(14)**

Rodna Mountains, sub *Sphenolobus* (Ştefureac, 1963b; Ştefănuţ, 2008).

Tritomaria quinquedentata (Huds.) H. Buch - **(14)**

Pietrosul Rodnei, sub var. *alpigena* (Hazslinszky, 1885; Ştefănuţ, 2008); Galaţu Mountain, 2,000 m a.s.l., sub *Jungermannia* (Matouschek, 1905; Ştefănuţ, 2008); Rodna Mountains, sub *Lophozia* (Pax, 1908; Ştefănuţ, 2008); Ineu, Crestele Găgii, Tăul Mare, 2000 m a.s.l., sub *Lophozia* (Ştefureac, 1942; Ştefănuţ, 2008); Pietrosul Rodnei, north-western slope, 2,260-2,280 m a.s.l., 8-9.VIII.1948, western slope, 2,150 m a.s.l., sub *Lophozia* (Ştefureac, 1952; Ştefureac, 1958a; Ştefureac, 1968; Ştefureac, 1977; Ştefureac, 1983b; Nădişan and Chercheş, 2002; Ştefureac, 1971; Ştefănuţ, 2008); Ineu, the glacial ring below Roşu Peak, VIII.1937 (Ştefureac, 1958a; Ştefănuţ, 2008); Rodna Mountains, sub *Lophozia* (Ştefureac, 1963b; Ştefănuţ, 2008); Aria Zimbrului, 1,121 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VII.1999, leg. and det. S. Ştefănuţ [BUCA *B2207*], 47°35'53"N / 24°38'49"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2501*], 47°35'50"N / 24°38'50"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2010*, *B2011*, *B2132*, *B2907*] (Ştefănuţ, 2008); Pietrosul Rodnei, Repedea Valley, 12.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5758*]

Tritomaria scitula (Taylor) Jörg. - **(14)**

Pietrosul Rodnei, 23.VIII.1942, leg. and det. Á. Boros, sub *Sphenolobus* (Györffy, 1943; Boros, 1951; Ştefureac, 1952; Boros and Vajda, 1967; Schuster, 1969; Ştefureac, 1983b; Ştefănuţ, 2008); Laptelui Mountain, 1,700-2,000 m a.s.l., leg. and det. Á. Boros, sub var. *spinosa* (Boros and Vajda, 1967; Ştefănuţ, 2008); Pietrosul Rodnei, 2,280 m a.s.l., leg. and det. T. Ştefureac, ass. *Bucegietum romanicae* Ştefur. 1984 subass. *jungermannietosum sphaerocarpae* Ştefur. 1986 (Ştefureac, 1986c; Ştefănuţ, 2008); ♀ - Iezerul Pietrosului, MM, 47°35'51"N / 24°38'48"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. Ştefănuţ S. [BUCA *B2209*], ***s*** - 47°35'53"N / 24°38'49"E, 1,835 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2304*], 47°35'50"N / 24°38'50"E, 1,840 m a.s.l., 28.VIII.1999, leg. and det. S. Ştefănuţ [BUCA *B2291*] (Ştefănuţ, 2008).

MOSSES (Bryophyta)

Families: (1) - Amblystegiaceae, **(2)** - Andreaeaceae, **(3)** - Anomodontaceae, **(4)** - Aulacomniaceae, **(5)** - Bartramiaceae, **(6)** - Brachytheciaceae, **(7)** - Bryaceae, **(8)** - Buxbaumiaceae, **(9)** - Calliergonaceae, **(10)** - Cinclidiaceae, **(11)** - Climaciaceae, **(12)** - Dicranaceae, **(13)** - Ditrichaceae, **(14)** - Encalyptaceae, **(15)** - Entodontaceae, **(16)** - Fissidentaceae, **(17)** - Funariaceae, **(18)** - Grimmiaceae, **(19)** - Hedwigiaceae, **(20)** - Hookeriaceae, **(21)** - Hylocomiaceae, **(22)** - Hypnaceae, **(23)** - Lembophyllaceae,

(24) - Leskeaceae, **(25)** - Leucobryaceae, **(26)** - Meesiaceae, **(27)** - Mielichhoferiaceae, **(28)** - Mniaceae, **(29)** - Neckeraceae, **(30)** - Orthotrichaceae, **(31)** - Plagiomniaceae, **(32)** - Plagiotheciaceae, **(33)** - Polytrichaceae, **(34)** - Pottiaceae, **(35)** - Pterigynandraceae, **(36)** - Pylaisiadelphaceae, **(37)** - Rhabdoweisiaceae, **(38)** - Rhytidiaceae, **(39)** - Schistostegaceae, **(40)** - Seligeriaceae, **(41)** - Sphagnaceae, **(42)** - Splachnaceae, **(43)** - Tetraphidaceae, **(44)** - Thuidiaceae, **(45)** - Timmiaceae.

Amphidium mougeotii (Schimp.) Schimp. **- (37)**

Vinului Valley (Matouschek, 1905; Ştefureac et al., 1955); Coasta Netedă and Ineu Peak, 1,900-2,250 m a.s.l., sub *Amphoridium* (Breidler, 1890b); Vinului Valley, 650 m alt, leg. M. Péterfi, det. C. Papp [FRE *2603*] (Borza, 1945); Bătrâna Mountain, 1,456 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Andreaea alpestris (Thed.) Schimp. **- (2)**

Ineu Peak towards the Hut, 2,280 m a.s.l., 1888, leg. K. Demeter, det. T. Ştefureac 1942 [CL 559] (Plămadă and Dumitru, 1998); Pietrosul Peak (Maloch, 1933; Plămadă and Dumitru, 1998).

Andreaea rupestris Hedw. **- (2)**

Ineu, 2,000-2,200 m a.s.l., sub *A. petrophila* (Matouschek, 1905; Plămadă and Dumitru, 1998). Ineu, 2,150 m a.s.l., 26.VIII.1999, leg. K. Demeter [CL *16889*] (Igmándy 1943; Plămadă and Dumitru 1998); Vinului Valley, 30.VII.1902, leg. M. Péterfi [CL *82437*] (Plămadă and Dumitru, 1998); Pietrosul Peak, 2,260-2,290 m a.s.l., incl. sub *A. petrophila* (Ştefureac, 1952; Ştefureac, 1977; Plămadă and Dumitru, 1998; Ştefureac, 1977; Ştefureac, 1971); Pietrosul Rodnei, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B1092*, *B1094*]; Valea Seacă, 09.VIII.1948, leg. and det. T. Ştefureac [BUCA B1093].

Anoectangium aestivum (Hedw.) Mitt. **- (34)**

Ineu, leg. M. Péterfi, sub *A. compactum* (Boros, 1951); Turnul Roşu, 1,900 m a.s.l., leg. A. Coman, sub *A. compactum* (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Anomodon attenuatus (Hedw.) Huebener **- (3)**

Pietrosul Rodnei (Hazslinszky, 1866; Hazslinszky, 1868).

Anomodon longifolius (Schleich. ex Brid.) Hartm. **- (3)**

Vinului Valley, 700 m a.s.l. (Matouschek, 1905).

Arctoa fulvella (Dicks.) Bruch and Schimp. **- (37)**

Pietrosul Rodnei, 2,270 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952; Ştefureac 1977; Ştefureac 1971); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Atrichum undulatum (Hedw.) P. Beauv. **- (33)**

Rebra Valley, Parva (Rebra Valley), Rebra (Rebra Valley), Cormaia Valley, Anieşul Mare Valley, Negrileasa - Cepelor Basin (Coldea, 1990); Prislop, sub *Catharinaea* (Warnstorf, 1895).

var. ***minus*** (Hedw.) Paris

Roşu Valley Brook, leg. M. Péterfi, 30.VII.1902 [CL*99266*] (Plămadă and Dumitru, 1998); Rebra Valley, Negru Brook, 110 m a.s.l., leg. E. Plămadă, 3.VII.1986 (Plămadă and Dumitru, 1998).

var. ***polycarpum*** (Jaap) Plăm.

Vinului Valley, 700 m a.s.l., sub *Catharinea undulata* var. *polycarpa* (Matouschek, 1905; Plămadă and Dumitru, 1998); Rebra Valley (Plămadă and Dumitru, 1998).

Aulacomnium palustre (Hedw.) Schwägr. **- (4)**

Vinului Valley, sub *Hypnum palustre* Hedw. (Matouschek, 1905); Piciorul Galaţului, Bătrâna Mountain, Galaţu Glacial Ring - Izvorul Fântânii, Puzdra Mare (Coldea, 1990); Lala

Lake, 1,750-2,150 m a.s.l., leg. E. I. Nyárády (Papp, 1940); Pietrosul Rodnei, near Pietrosu Lake, 07.-22.VIII.1948, leg. and det. T. Ştefureac [BUCA *B1185, B1191*].

Aulacomnium turgidum (Wahlenb.) Schwägr. - **(4)**

Pietrosul Peak (Baumgarten, 1846; Schur, 1866; Hazslinszky, 1885; Ştefureac, 1945; Nyárády, 1948; Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1967b; Ştefureac, 1977; Ştefureac, 1971; Ştefureac, 1986b; Boros, 1951), 2,100-2,305 m a.s.l., leg. A. Boros 1942 (Ştefureac, 1945; Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1977), leg. J. Györffy 1943 (Ştefureac, 1945; Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1968; Ştefureac, 1977; Boros, 1951), 2,260-2,290 m a.s.l., leg. T. Ştefureac 1948 (Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1977; Boros, 1951; Boros and Vajda, 1967; Plămadă, 1977; Ştefureac, 1979); below Ineu Peak, southern slope, 2,230-2,250 m a.s.l., leg. T. Ştefureac 21-23.VIII.1937 (Ştefureac, 1945; Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1977; Ştefureac, 1986a; Boros, 1951; Plămadă, 1977; Ştefureac, 1979); Ineu, 2,250-2,280 m a.s.l., 15.VIII.1941, leg. A. Nyárády and A. Szucs, det. L. Felföldy 15.VIII.1941 [CL] (Györffy, 1943; Nyárády, 1948; Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1977; Boros, 1951), 27.VII.1942, 20.VIII.1942, leg. A. Boros 1942 (Nyárády, 1948; Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1977; Boros, 1951); Pietrosu Peak, 2,200-2,300 m a.s.l., Piciorul Moşului, northen slope, 1,650 m a.s.l. (Ştefureac, 1952; Ştefureac, 1958a; Ştefureac, 1977); Puzdra, 1,700-2,000 m a.s.l., leg, Á. Boros (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b; Nădişan and Chercheş, 2002); Pietrosu Peak, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B1195*]

Barbula unguiculata Hedw. - **(34)**

Between Prislop and Poiana Rotundă (Warnstorf, 1895).

Bartramia halleriana Hedw. - **(5)**

Pietrosul Rodnei, 1,500-1,680 m, leg. A. Coman, sub *B. norvegica* (Boros and Vajda, 1967); Turnu Roşu, 1,686 m a.s.l., leg. A. Coman, det. Á. Boros, sub *B. norvegica* (Bereş, 1983); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b); Pietrosul Rodnei, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B1239*].

Bartramia ithyphylla Brid. - **(5)**

Pietrosul Rodnei (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885); Lala Lake, 2,200 m a.s.l., Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905); Ineu Mountain, 2,200 m a.s.l. (Breidler, 1890b); Pietrosul Rodnei, 2,280 m a.s.l., 1948, leg. and det. T. Ştefureac (Ştefureac, 1952; Ştefureac, 1963b); between Tâul Mic and Scărişoara, VIII.1937, leg. and det. T. Ştefureac (Ştefureac, 1945); Zănoaga de Jos, 2,147 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Pietrosul Rodnei, Valea Pietroasă, 7.VIII.1948, leg. T. Ştefureac [BUCA *B1249, B6500*].

Bartramia pomiformis Hedw. - **(5)**

Anieşul Mare Valley (Coldea, 1990).

Blindia acuta (Hedw.) Bruch and Schimp. - **(40)**

Pietrosul Rodnei (Hazslinszky, 1868; Boros, 1951; Plămadă and Dumitru, 1998); Corongiş (Matouschek, 1905; Boros, 1951; Plămadă and Dumitru, 1998).

Brachydontium trichodes (F. Weber) Milde - **(40)**

Rodna Mountains, leg. and det. T. Ştefureac (Ştefureac, 1963b).

Brachytheciastrum trachypodium (Brid.) Ignatov and Huttunen - **(6)**

Ineu Peak, 22.VIII.1937, leg. and det. T. Ştefureac, sub *Brachythecium* [BUCA *B1359*].

Brachytheciastrum velutinum (Hedw.) Ignatov and Huttunen - **(6)**

Repedea Valley, sub *Brachythecium* (Coldea, 1990); Lala Valley, sub *Brachythecium velutinum* var. *intricatum* (Ştefureac, 1938).

Brachythecium rivulare Schimp. - **(6)**

Buhăiescu Glacial Ring - Livezi, Livezi, Galaţu Peak - Glacial Ring, Piatra Rea (Coldea, 1990); Coasta netedă, Ineu Mountain, 1,900 m a.s.l. (Breidler, 1890b); Prislop (Warnstorf, 1895).

Brachythecium rutabulum (Hedw.) Schimp. - **(6)**

Cormaia Valley - Vinului Brook, Rebra Valley - Guşeţel Valley (Coldea, 1990).

Brachythecium salebrosum (Hoffm. ex F. Weber and D. Mohr) Schimp. - **(6)**

Puzdra Peak, Cailor Mountain, Zănoaga Mare, Buhăiescu Glacial Ring - Livezi, Corongişul Mare, Pietrosul Mare Peak (Coldea, 1990).

Brachythecium tommasinii (Sendtner ex Boulay) Ignatov and Huttunen - **(6)**

Galaţu Mountain, 2,000 m a.s.l., sub *Eurrhynchium* (Matouschek, 1905).

Brotherella lorenziana (Molendo ex Lorentz) Loeske ex M. Fleisch - **(36)**

Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b; Nădişan and Chercheş 2002).

Bryoerythrophyllum alpigenum (Venturi) P. C. Chen - **(34)**

Vinului Valley, sub *Erythrophyllum alpigenum* (Venturi) Loeske (Péterfi, 1910).

Bryoerythrophyllum recurvirostrum (Hedw.) P. C. Chen - **(34)**

Vinului Valley, 700 m a.s.l., Galaţu Mountain, 2,000 m a.s.l., sub *Didymodon rubellus* var. *intermedius* (Matouschek, 1905); Vinului Valley, sub *Didymodon rubellus* var. *brevirostris* (Matouschek, 1905); Vinului Valley, 750 m a.s.l., leg. E. I. Nyárády, sub *Didymodon rubellus* (Papp, 1940).

Bryum algovicum Sendt. ex Müll. Hal. - **(7)**

Pietrosul Rodnei on Piciorul Moşului, 07.VIII.1948, leg. and det. T. Ştefureac, *B. pendulum* (Hornsch.) Schimp. [BUCA B1446].

Bryum argenteum Hedw. - **(7)**

Rodna Mountains (Warnstorf, 1895); Pietrosul Rodnei, 12.VIII.1948, leg. and det. T. Ştefureac [BUCA *B1386*].

Bryum capillare Hedw. - **(7)**

Ineu, 2,000-2,200 m a.s.l. (Matouschek, 1905).

var. ***flaccidum*** (Brid.) Bruch and Schimp.

Borşa, 700 m a.s.l., Vinului Valley (Matouschek, 1905); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, leg. and det. T. Ştefureac, sub *B. flaccidum* (Ştefureac, 1986c).

Bryum elegans Nees - **(7)**

Vinului Valley, 13.VI.1996, sub *B. stirtonii* (Plămadă et al., 2000; Plămadă, 1985).

Bryum pallens Sw. ex anon. - **(7)**

Corongiş, Ineu, 2,000-2,200 m a.s.l., Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905); Prislop (Warnstorf, 1895).

Bryum pallescens Schleich. ex Schwägr. - **(7)**

Crăciunel Mountains, sub var. *contextum*, Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905) Ineu Mountain, 2,200 m a.s.l. (Breidler, 1890b).

Bryum pseudotriquetrum (Hedw.) P. Gaertn. et al. - **(7)**

"Teufelsschlucht" (Matouschek, 1905); Ineu Mountain, 2,000 m a.s.l. (Breidler, 1890b); Prislop, sub *B. bimum* (Warnstorf, 1895); Rodna Mountains, leg. and det. T. Ştefureac, sub *B. ventricosum* and *B. bimum* (Ştefureac, 1963b); Ştiol, 1,850 m a.s.l., 16.VII.1975, ass. *Carici dacicae-Drepanocladetum exannulatae* Boşcaiu et al. 1971, below Buhăescu Peak, 1,900 m a.s.l., 26.VIII.1976, ass. *Eriophoretum scheuchzeri* Rüb. 1912, sub *B. bimum* Etoldea

et al., 1977); Ştiol, Livezi, Rebra Peak, Corongişul Mare, Pintu Mic Brook - Puzdrele, Anieşul Mare Glacial Ring, Piatra Rea, Şaua Galaţu - Gărgălău, Gropi Glacial Ring, Piatra Rea - Prisăci Hill, Rebra Valley (Coldea, 1990); Pietrosu Lake, 08.VIII.1948, leg. and det. T. Ştefureac, *B. ventricosum* [BUCA *B1462*].

Bryum schleicheri DC. - **(7)**

Buhăiescu Mountain (Boros, 1951).

Buxbaumia aphylla Hedw. - **(8)**

Rodna Mountains (Ştefureac, 1967a); Lala Valley, 1,200 m a.s.l. (Ştefureac, 1938; Ştefureac 1979; Eftimie 1973); Pietrosul Rodnei, between Piciorul Moşului and Lacul Pietrosul, 1,700-1,900 m a.s.l., below Piciorul Moşului, Lala Valley, 1,350 m a.s.l. (Ştefureac, 1949; Ştefureac, 1971; Ştefureac, 1986a; Plămadă and Dumitru, 1998; Ştefureac, 1979; Eftimie, 1973); Piciorul Moşului (Ştefureac, 1983b); Pietrosul Rodnei, below Piciorul Moşului, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B1481*]; Pietrosul Rodnei, 1,600 m a.s.l., 28.VIII.1999, det. Ştefănuţ S.

Buxbaumia viridis (Moug. ex Lam. and DC.) Brid. ex Moug. and Nestl. - **(8)**

Rodna Mountains (Pax 1898; Plămadă and Dumitru, 1998).

Calliergonella cuspidata (Hedw.) Loeske - **(22)**

Ştiol, Buhăiescu Glacial Ring - Livezi, Livezi, Bătrâna Mountain, Buhăiescu Peak, Piatra Rea - Prisăci Hill, Rebra Valley, Puzdra Mare - Izvorul Fântânii (Coldea, 1990).

Calliergonella lindbergii (Mitt.) Hedenäs - **(22)**

Galaţu Mountain, 2,000 m a.s.l., sub *Hypnum* (Matouschek, 1905); Between Prislop and Poiana Rotundă (Warnstorf, 1895);

Calliergon cordifolium (Hedw.) Kindb. - **(9)**

Ştiol 1,850 m a.s.l., 16.VII.1975, ass. *Carici dacicae-Drepanocladetum exannulatae* Boşcaiu et al. 1971 (Coldea et al., 1977; Coldea, 1990).

Campyliadelphus chrysophyllus (Brid.) R. S. Chopra - **(1)**

Pietrosul Rodnei, sub *Hypnum* (Hazslinszky, 1866; Hazslinszky, 1868).

Campylium stellatum (Hedw.) Lange and C. E. O. Jensen - **(1)**

Ineu Mountain, 2,200 m a.s.l., sub *Hypnum* (Breidler, 1890b); Piciorul Galaţului, Gropi Glacial Ring (Coldea, 1990); Lala Lake (Ştefureac, 1958a; Ştefureac 1952); below Buhăescu Peak, 1,900 m a.s.l., 26.VII.1976, ass. *Eriophoretum scheuchzeri* Rüb. 1912 (Coldea et al., 1977); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac (Ştefureac, 1986c); Ineu Peak, 22.VIII.1937, leg. and det. Ştefureac Tr. [BUCA B1561]; Pietrosul Rodnei, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA B1562].

Campylophyllum halleri (Hedw.) M. Fleisch. - **(22)**

Galaţu Mountain, Ştiol, sub *Hypnum* (Baumgarten, 1846; Schur, 1866; Fuss, 1878); Izvorul Cailor, 1,800 m a.s.l., leg. A. Coman, sub *Chrysohypnum* (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve, sub *Campylium* (Ştefureac, 1983b; Nădişan and Chercheş, 2002).

Campylopus flexuosus (Hedw.) Brid. - **(25)**

Puzdra Mountains, 1,700-2,000 m a.s.l., leg. Á. Boros (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Ceratodon purpureus (Hedw.) Brid. - **(13)**

Bătrâna Mountains, 1,407-1,615 m a.s.l., Tisa Valley, 1,103 m a.s.l., Aria Zimbrului, 1,126 m a.s.l., Izvorul lui Dragoş Valley, Pietroasa Valley, Zănoaga de Jos, Piciorul Moşului, 1,708 m a.s.l., Pietriceaua Valley, 1,217 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Climacium dendroides (Hedw.) F. Weber and D. Mohr - **(11)**

Ştiol, 1,850 m a.s.l., 16.VII.1975, ass. *Carici dacicae-Drepanocladetum exannulatae* Boşcaiu et al. 1971 (Coldea et al., 1977); Piciorul Galaţului, Şaua Galaţu -Gărgălău (Coldea, 1990).

Cratoneuron filicinum (Hedw.) Spruce - **(1)**

Galaţu Mountain, 2,000 m a.s.l., Vinului Valley, sub *Amblystegium* (Matouschek, 1905); Rebra Peak, Corongişul Mare, Piatra Rea, Puzdrele Hut (Coldea, 1990; Lalal Lake, 1,750-2,150 m a.s.l., leg. E. I. Nyárády (Papp, 1940).

Ctenidium molluscum (Hedw.) Mitt. - **(22)**

Rodna Mountains, sub *Hypnum* (Matouschek, 1905); Piatra Rea, Rebra Valley - Guşatu Valley, Corongişul Mare, Iezerul Glacial Ring - Pietrosul Mare, Şaua Galaţului, Rebra Valley - Guşeţel Valley (Coldea, 1990).

Cynodontium bruntonii (Sm.) Bruch and Schimp. - **(37)**

Rodna Mountains, sub *Oreoweisia bruntonii* (Sm.) Milde (Orbán, 1977).

Cynodontium gracilescens (F. Weber and D. Mohr) Schimp. - **(37)**

Ineu, 2,000-2,200 m a.s.l. [BP] (Matouschek, 1905; Orbán, 1977).

Cynodontium fallax Limpr. - **(37)**

Pietrosul Rodnei, Piciorul Moşului, 1,650 m a.s.l., on rocks (Ştefureac, 1958a).

Cynodontium polycarpum (Hedw.) Schimp. - **(37)**

Pietrosul Rodnei [BP] (Hazslinszky, 1866; Hazslinszky, 1868; Orbán, 1977); Borşa, 700 m a.s.l. (Matouschek, 1905); Ineu, 2,000-2,200 m a.s.l. (Matouschek, 1905).

Cynodontium strumiferum (Hedw.) Lindb. - **(37)**

Lala Valley, sub *C. poycarpum* var. *strumiferum* [BP] (Ştefureac, 1938; Orbán, 1977).

Cynodontium tenellum (Schimp.) Limpr. - **(37)**

Vinului Valley, sub *Cynodontium torquescens* Limpr. [BP] (Demeter, 1890; Simonkai, 1890; Orbán, 1977; Papp, 1967).

Dichodontium flavescens (Dicks.) Lindb. - **(37)**

Rebra Valley, 13.VI.1981 (Plămadă et al., 2000).

Dichodontium palustre (Dicks.) M. Stech - **(37)**

Ineu, 1,800 m a.s.l., leg. Á. Boros, L. Felföldy, sub *Dicranella* (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve, sub *Dicranella* (Ştefureac, 1983b; Nădişan and Chercheş, 2002).

Dichodontium pellucidum (Hedw.) Schimp. - **(37)**

Corongiş (Matouschek, 1905); Between Prislop and Poiana Rotundă (Warnstorf, 1895).

Dicranella cerviculata (Hedw.) Schimp. - **(12)**

Vinului Valley, leg. E. I. Nyárády, sub var. *pusila* (Papp, 1940); Vinului Valley, 1,000-1,500 m a.s.l., leg. Á. Boros (Boros and Vajda, 1967; Orbán, 1976).

Dicranella heteromalla (Hedw.) Schimp. - **(12)**

Rebra Peak, Puzdra Peak, Anieşul Mare Peak, Buhăiescu, 2,120 m a.s.l., 8.VIII.1979, Anieşul Mic Peak, 2,100 m a.s.l., 15.VIII.1982, Ineu Peak, 2,100 m a.s.l., 17.VIII.1982, ass. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985, Puzdra, 2,120 m a.s.l., 15.VIII.1982, Anieşu Mare, 2,080 m a.s.l., 17.VII.1982, ass. *Soldanello hungaricae-Salicetum kitaibelianae* Coldea 1985 (Coldea, 1985; Coldea, 1990).

var. ***sericea*** (Schimp.) Pfeff.

Vinului Valley, 700 m a.s.l. (Matouschek, 1905).

Dicranella schreberiana (Hedw.) Dixon - **(12)**

Lala Valley, sub *D. schreberi* (Ştefureac, 1938).

Dicranella subulata (Hedw.) Schimp. - **(12)**

Anieşul Mare Valley, 1,500 m a.s.l., leg. Á. Boros (Boros and Vajda, 1967); Zănoaga de Jos, 1,432 m a.s.l., leg. A. Coman, det. Á. Boros, sub *D. secunda* (Bereş, 1983)

Dicranella varia (Hedw.) Schimp. - **(12)**

Zănoaga de Jos, 1,432 m a.s.l., leg. A. Coman, det. Á. Boros, sub *D. rubra* (Bereş, 1983).

Dicranodontium denudatum (Brid.) E. Britton - **(25)**

Roşu Valley, 1918, leg. M. Péterfi (Györffy, 1924).

Dicranoweisia crispula (Hedw.) Milde - **(37)**

Pietrosul Rodnei, sub *Weissia* (Hazslinszky, 1866; Hazslinszky, 1868); Ineu Peak, 2,200 m a.s.l. (Breidler, 1890a); Ineu, 2,000-2,200 m a.s.l., Galaţu Mountain, 2,000 m a.s.l., incl. sub var. *nigrescens* (Matouschek, 1905); Rodna Mountains, 1,800 m a.s.l., leg. E. I. Nyárády (Papp, 1940); Bătrâna, 1,407-1,615 m a.s.l., Pietroasa Valley, Turnu Roşu, 1,832 m a.s.l., Zănoaga de Jos, 1,486 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Dicranum acutifolium (Lindb. and Arnell.) C. E. O. Jensen - **(12)**

Turnul Roşu, 2,000 m a.s.l., leg. A. Coman (Boros and Vajda, 1967); Pietrosu, 2,000 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Dicranum bonjeanii De Not. - **(12)**

Galaţu Mountain, 1,720 m a.s.l., leg. A. Coman (Boros and Vajda, 1967; Plămadă, 1985); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Dicranum elongatum Schleich. ex Schwägr. - **(12)**

Pietrosul Rodnei, Piciorul Moşului, northen slope, 1,650 m a.s.l. (Ştefureac, 1958a).

Dicranum fragilifolium Lindb. - **(12)**

Lala Valley (Ştefureac, 1938).

Dicranum fuscescens Sm. - **(12)**

Pietrosul Peak, 2,260-2,290 m a.s.l., leg. T. Ştefureac 1948 (Ştefureac, 1952; Ştefureac 1967a; Ştefureac 1968; Ştefureac 1977; Ştefureac 1971; Ştefureac 1986b; Ştefureac 1979); Pietrosul Peak, 2,230 m a.s.l. (Ştefureac, 1967a); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac (Ştefureac, 1986c); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Dicranum montanum Hedw. - **(12)**

Rodna Mountains (Schur, 1866; Hazslinszky, 1885; Fuss, 1878); Prislop (Warnstorf, 1895); Aria Zimbrului, 1,186 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Dicranum muehlenbeckii Bruch and Schimp. - **(12)**

Pietrosul Rodnei (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885); Pietrosul Rodnei, 2,270-2,270 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952; Ştefureac, 1963b; Ştefureac, 1968; Ştefureac, 1977; Ştefureac, 1971); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Dicranum scoparium Hedw. - **(12)**

Pietrosul Rodnei (Hazslinszky, 1866; Hazslinszky, 1868); Prislop (Warnstorf, 1895); Pietrosul Rodnei, 2,270-2,280 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952); Ineu, 21.VIII.1937 (Ştefureac, 1958b); Bătrâna, 1,420-1,650 m a.s.l., Turnu Roşu, 1,856 m a.s.l., Tisa Valley, Iezer, 1,837 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Lala Glacial Ring, 1,800-2,000 m a.s.l., 11-15.VIII.1985, Lala Valley, 1,530-1,730 m a.s.l., 14-15.VIII.1985, Preluca Frumoli-Golgota, 1,550 m a.s.l., 28.VI.1981, Zănoaga de Jos, 1,560-

1,650 m a.s.l., 28.VI.1981, Jneapănul Bătrânei, 1,670 m a.s.l., 25.VI.1981, Piciorul Pleşcuţei, 1,840 m a.s.l., 14.VIII.1985 (Coldea and Pînzaru, 1986); Cormaia, 1,900 m a.s.l., 8.IX.1979, Puzdra, 2,120 m a.s.l., 15.VIII.1982, Ineu, 2,100 m a.s.l., 17.VIII.1982, ass. *Soldanello hungaricae-Salicetum kitaibelianae* Coldea 1985 (Coldea, 1985); Puzdra Peak, Zănoaga Mare - Pietrosul, Piatra Albă Peak, Gărgălău Peak, Galaţu Peak, Ştiol, Buhăiescu Glacial Ring - Livezi, Pietrosul Mare Peak, Rebra Peak, Anieş Peak, Cormaia Peak, Ineu Peak, Şaua Gărgălău - Galaţu, Şaua Galaţului, Anieşul Mare Peak, Puzdra Mică, Pietrosul Reserve, Piatra Rea - Runcu Ştiol, Cormaia Valley - Vinului Brook, Parva (Rebra Valley), Cormaia Valley, Piciorul Anieşului, Fundul Rebrei, Negrileasa - Anieşul Mare Valley, Jneapănul Bătrânei, Runcu Ştiol, Guşatu Valley - Rebra Valley, Valea lui Dragoş Brook, Anieşul Mare Valley, Negrileasa - Cepelor Basin, Repedea Valley - Faţa Cătinului, Izvorul Mare, Preluca Frumoli - Golgota, Căldarea Zănoaga de Jos, Lala Valley, Jneapănul Bătrânei, Căldarea Lala, Negoiescu Mare Peak, Culmea Galaţului, Anieşul Mic Peak, Piatra Rea, Golgota Peak, Căldarea Bila, Rabla Peak (Coldea, 1990); Pietrosul Rodnei, Piciorul Moşului, 1,650 m a.s.l., sub fo. *integrifolia* (Ştefureac, 1958a); Lala Valley, sub var. *orthophyllum* (Ştefureac, 1938).

Dicranum undulatum Schrad. ex Brid. - **(12)**

Negoiasa Peak, 1,900 m a.s.l., sub *D. bergeri* (Boros, 1951).

Dicranum viride (Sull. and Lesq.) Lindb. - **(12)**

Galaţu Peak (Boros, 1951); Galaţu Mountain, 2,000 m a.s.l., leg. Á. Boros (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Didymodon rigidulus Hedw. - **(34)**

Bătrâna Mountain, 1,407-1,615 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Barbula rigidula* (Bereş, 1983).

Distichium capillaceum (Hedw.) Bruch and Schimp. - **(13)**

Rodna Mountains, Crăciunel Mountains, Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905); Turnu Roşu, 1,717-2,156 m a.s.l., Iezer, 1,901 m a.s.l., leg. A. Coman, det. Á. Boros, sub *D. montanum* (Bereş, 1983); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac (Ştefureac, 1986c); Rodna Mountains, sub *D. montanum* (Orbán, 1974).

Distichium inclinatum (Hedw.) Bruch and Schimp. - **(13)**

Galaţu, 1,670 m a.s.l., leg. A. Coman (Boros and Vajda, 1967).

Ditrichum flexicaule (Schwägr.) Hampe - **(13)**

Rodna Mountains (Matouschek, 1905); Iezer, 1,901 m a.s.l., Turnu Roşu, 2,001 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Ditrichum pusillum (Hedw.) Hampe - **(13)**

Corongiş, sub *D. tortile* (Matouschek, 1905); Anieşul Mare Valley, 1,500 m a.s.l., leg. Á. Boros, sub *D. tortile* (Boros and Vajda, 1967; Orbán, 1974); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Drepanocladus aduncus (Hedw.) Warnst. - **(1)**

Pietrosul Rodnei, sub *Hypnum* (Hazslinszky, 1866; Hazslinszky, 1868).

Drepanocladus sendtneri (Schimp ex. H. Müll.) Warnst. - **(1)**

Prislop, sub *Hypnum* (Warnstorf, 1895, Vajda, 1975);

Encalypta ciliata Hedw. - **(14)**

Vinului Valley (Matouschek, 1905).

Encalypta rhaptocarpa Schwägr. - **(14)**

Rodna Mountains, sub *E. rhabdocarpa* (Baumgarten, 1846; Hazslinszky, 1885; Schur, 1866; Fuss, 1878); Rebra Valley - Guşeţel Valley (Coldea, 1990).

Encalypta streptocarpa Hedw. - **(14)**

Ineu Mountain, Omului Peak (Baumgarten, 1846; Fuss, 1878); Rodna Mountains (Schur, 1866).

Encalypta vulgaris Hedw. - **(14)**

Crăciunel Mountains (Matouschek, 1905).

Entodon concinnus (De Not.) Paris - **(15)**

Galaţu Mountain, 2,000 m a.s.l., sub *Cylindrothecium* (Matouschek, 1905).

Eurhynchium striatum (Hedw.) Schimp. - **(6)**

Vinului Valley, 700 m a.s.l. (Matouschek, 1905); Guşeţel Valley - Rebra Valley, Guşatu Valley - Rebra Valley (Coldea, 1990); Prislop (Warnstorf, 1895).

Fissidens adianthoides Hedw. - **(16)**

Corongiş (Matouschek, 1905; Plămadă and Dumitru, 1998).

Fissidens dubius P. Beauv. - **(16)**

Corongiş, sub *F. cristatus* (Matouschek, 1905; Plămadă and Dumitru, 1998).

Fissidens osmundoides Hedw. - **(16)**

Pietrosul Peak, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac, sub var. *microcarpus* (Ştefureac, 1986c; Plămadă and Dumitru, 1998).

Funaria hygrometrica Hedw. - **(17)**

Pietriceaua, 1,213 m a.s.l., Tisa Valley, 1,157 m a.s.l., Runcu Pietrosului, 1,151 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Grimmia alpestris (F. Weber and D. Mohr) Schleich. - **(18)**

Ineu, 1,180 m a.s.l., leg. E. I. Nyárády, sub G. *donniana* var. *arenaria* (Papp, 1940).

Grimmia donniana Sm. - **(18)**

Pietrosul Rodnei, 2,260 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952).

Grimmia elongata Kaulf. - **(18)**

Pietrosul Rodnei, 2,290 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952; Ştefureac, 1977); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Grimmia funalis (Schwägr.) Bruch and Schimp. - **(18)**

Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905).

Grimmia hartmanii Schimp. - **(18)**

Vinului Valley, 700 m a.s.l., sub *Dryptodon* (Matouschek, 1905).

Grimmia incurva Schwägr. - **(18)**

Ineu Mountain, 2,250 m a.s.l. (Breidler, 1890b).

Grimmia ovalis (Hedw.) Lindb. - **(18)**

Pietrosul Rodnei, sub *G. ovata* and *G. commutata* (Hazslinszky, 1866; Hazslinszky, 1868).

Grimmia ramondii (Lam. and DC.) Margad. - **(18)**

Omului Peak, sub *Dryptodon patens* (Baumgarten, 1846; Fuss, 1878); Omului Peak, sub *Racomitrium patens* (Schur, 1866); Pietrosul Rodnei, leg. and det. T. Ştefureac, sub *Racomitrium patens* (Ştefureac, 1952); Pietrosu, 2,160 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Racomitrium patens* (Bereş, 1983); Pietrosul Rodnei Nature Reserve, sub *Dryptodon patens* (Ştefureac, 1983b).

Grimmia torquata Drumm. - **(18)**

Ineu Mountain (Breidler, 1890b).

Grimmia trichophylla Grev. - **(18)**

Pietrosu, 2,156 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Gymnostomum aeruginosum Sm. - **(34)**

Vinului Valley, sub *G. rupestre* (Matouschek, 1905).

Gyroweisia tenuis (Hedw.) Schimp. - **(34)**

Vinului Valley (Péterfi, 1910).

Hedwigia ciliata (Hedw.) P. Beauv. - **(19)**

Galaţu Peak (Coldea, 1990); Pietrosul Rodnei, Valea Pietroasă, 07.VIII.1948, leg. and det. T. Ştefureac, sub *H. albicans* [BUCA B5310].

Herzogiella seligeri (Brid.) Z. Iwats. - **(32)**

Vinului Valley, 700 m a.s.l., sub *Plagiothecium silesiacum* (P. Beauv.) Bruch and Schimp. (Matouschek, 1905). Vinului Valley, 1,200 m a.s.l., 10.VII.1918, leg. and det., M. Péterfi, sub *Plagiothecium silesiacum* [FRE *719*] (Borza, 1928; Borza and Nyárády, 1940);

Herzogiella striatella (Brid.) Z. Iwats. - **(32)**

Lala Lake, 2,080 m a.s.l., 13.VIII.1918, leg. and det. M. Péterfi, sub *Plagiothecium striatellum* (Brid.) Lindb. [FRE *613*] (Borza, 1926; Borza and Nyárády, 1940).

Heterocladium dimorphum (Brid.) Schimp. - **(35)**

Şesu Mountain (Hazslinszky, 1885); Pietrosul Rodnei, 20.VIII.1948, sub *H. squarrosulum* (Ştefureac, 1958b).

Heterocladium heteropterum (Brid.) Schimp. - **(35)**

Ineu Mountain, 2,250 m a.s.l. (Breidler, 1890b).

Homalothecium lutescens (Hedw.) H. Rob. - **(6)**

Lala Valley, sub *Camptothecium* (Ştefureac, 1938).

Homalothecium philippeanum (Spruce) Schimp. - **(6)**

Corongiş (Matouschek, 1905).

Hookeria lucens (Hedw.) Sm. - **(20)**

Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b; Nădişan and Chercheş, 2002).

Hygrohypnum alpestre (Hedw.) Loeske - **(1)**

Pietrosul Rodnei, sub *Limnobium alpestre* (Hazslinszky, 1866; Hazslinszky, 1868).

Hygrohypnum alpinum (Lindb.) Loeske - **(1)**

Lala Valley, leg. and det. T. Ştefureac (Ştefureac, 1963b); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5372*].

Hygrohypnum duriusculum (De Not.) D. W. Jamieson - **(1)**

Lala Valley, leg. and det. T. Ştefureac, sub *H. dilatatum* (Ştefureac, 1963b); Galaţu Peak, sub *H. dilatatum* (Coldea, 1990); Pietrosul Rodnei, 07.VIII.1948, leg. and det. T. Ştefureac, sub *H. dilatatum* [BUCA B5373].

Hygrohypnum smithii (Sw.) Broth. - **(1)**

Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5378*].

Hylocomiadelphus triquetrus (Hedw.) Ochyra and Stebel - **(21)**

Pietrosul Rodnei, 2,280 m a.s.l., leg. and det. T. Ştefureac, sub *Rhytidiadelphus* (Ştefureac, 1952); Prislop, sub *Hypnum* (Warnstorf, 1895); Zănoaga de Sus, 1,515 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Rhytidiadelphus* (Bereş, 1983); Rebra, 2,100 m a.s.l., 17.VII.1977, Cormaia, 1,900 m a.s.l., 8.IX.1979, Anieşu Mare, 2,080 m a.s.l., 17.VII.1982, Gărgălău, 2,060 m a.s.l., 19.VII.1982, Clăilor Peak, 2,050 m a.s.l., 20.VII.1982, Ineu, 2,100 m a.s.l., 17.VIII.1982, ass. *Soldanello hungaricae-Salicetum kitaibelianae* Coldea 1985, sub *Rhytidiadelphus* (Coldea, 1985); Rebra Valley - Guşatu Valley, Piatra Rea, Bila Glacial Ring - Ineu, Iezerul Glacial Ring - Pietrosul Mare, Pietrosul Mare Peak, Anieş Peak, Cormaia Peak, Anieşul Mare Peak, Gărgălău Peak, Clăilor Peak, Ineu Peak, Corongişul Mare, Cailor Mountain, Iezerul Pietrosului, Turnu Roşu, Iezerul, Guşatu Valley - Rebra Valley, Preluca Frumoli - Golgota, Zănoaga de Jos Glacial Ring, Gărgălău Peak, Feţei Peak, Culmea Galaţului,

sub *Rhytidiadelphus* (Coldea, 1990); Zănoaga de Jos, 1,560-1,650 m a.s.l., 28.VI.1981, sub *Rhytidiadelphus* (Coldea and Pînzaru, 1986).

Hylocomiastrum umbratum (Hedw.) M. Fleisch. - **(21)**

Pietrosul Rodnei, sub *Hylocomium* (Hazslinszky, 1868).

Hylocomiastrum pyrenaicum (Spruce) M. Fleisch. - **(21)**

Galaţu Mountain, 2,000 m a.s.l., sub *Hylocomium* (Matouschek, 1905; Ştefureac, 1945; Plămadă, 1977); Tăul Mic, Ineu Valley, 1,600 m a.s.l., 19.VIII.1937, leg. and det. T. Ştefureac, sub *Hylocomium* (Ştefureac, 1945; Plămadă, 1977); Pietrosul Rodnei, 2,050 m a.s.l., leg. A. Coman, sub *Hylocomium* (Boros and Vajda, 1967; Plămadă, 1977); Pietrosul Rodnei Nature Reserve, sub *Hylocomium* (Ştefureac, 1983b).

Hylocomium splendens (Hedw.) Schimp. - **(21)**

Bila Glacial Ring, 1,500-1,650 m a.s.l., 14.VIII.1985, Piciorul Pleşcuţei, 1,840-1,950 m a.s.l., 14.VIII.1985, Preluca Frumoli-Golgota, 1,550 m a.s.l., 28.VI.1981, Zănoaga de Jos, 1,560-1,650 m a.s.l., 28.VI.1981, Jneapănul Bătrânei, 1,670 m a.s.l., 25.VI.1981 (Coldea and Pînzaru, 1986); Rebra, 2,100 m a.s.l., 17.VII.1977, Cormaia, 1,900 m a.s.l., 8.IX.1979, Gărgălău, 2,060 m a.s.l., 19.VII.1982, Clăilor Peak, 2,050 m a.s.l., 20.VII.1982, ass. *Soldanello hungaricae-Salicetum kitaibelianae* Coldea 1985 (Coldea, 1985); Anieşul Mare Valley, Rebrei Valley-Guşatu Valley, Piatra Rea, Cormaia Peak, Gărgălău Peak, Clăilor Peak, Corongişul Mare, Cailor Mountain, Piciorul Galaţului, Iezerul Pietrosului, Buhăiescu - Livezi, Corongiş, Turnu Roşu, Iezerul, Parva (Rebra Valley), Piciorul Anieşului, Jneapănul Bătrânei, Valea lui Dragoş Brook, Prelucra Frumoli - Golgota, Zănoaga de Jos Glacial Ring, Lala Valley, Jneapănul Bătrânii, Buhăiescu Glacial Ring - Livezi, Puzdrele Peak, Anieşul Mare Peak, Ştiol, Negoiescu Mare Peak, Piatra Rea, Feţei Peak, Faţa Pietrosului, Zănoaga Mare Glacial Ring, Rebra Peak, Bila Glacial Ring - Ineu (Coldea, 1990); Pietrosul Rodnei, 2,260-2,280 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952; Ştefureac, 1977); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, leg. and det. T. Ştefureac (Ştefureac, 1986c).

Hymenostylium recurvirostrum (Hedw.) Dixon - **(34)**

Galaţu Mountain, 2,000 m a.s.l., sub var. *scabrum* (Matouschek, 1905).

Hyocomium armoricum (Brid.) Wijk and Margad. - **(22)**

Pietrosul Rodnei, sub *H. flagellare* (Hazslinszky, 1866; Hazslinszky, 1868).

Hypnum bambergeri Schimp. - **(22)**

Puzdra Mountain, 1,700-2,000 m a.s.l., leg. Á. Boros (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Hypnum callichroum Brid. - **(22)**

Puzdra Mountain, 1,700-2,000 m a.s.l., leg. Á. Boros (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Hypnum cupressiforme Hedw. - **(22)**

Anieşul Mare Valley, Anieşul Mic Valley, Repedea Valley, Căldarea Iezerul - Pietrosul Mare (Coldea, 1990); Pietrosul Rodnei on Valea Pietroasă, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5458*].

var. ***subjulaceum*** Molendo

Galaţu Mountain, 2,000 m a.s.l., sub var. *cuspidatum* (Matouschek, 1905).

Hypnum hamulosum Schimp. - **(22)**

Galaţu Mountain, 1,800-1,900 m a.s.l., leg. Á. Boros (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5501*].

Hypnum lacunosum (Brid.) Hoffm. ex Brid. - **(22)**

Pietrosul Rodnei on Valea Pietroasă, 07.VIII.1948, leg. and det. T. Ştefureac, sub *H. cupressiforme* Hedw. var. *lacuosum* Brid. [BUCA *B5465, B6500*].

Hypnum pallescens (Hedw.) P. Beauv. - **(22)**

Pietrosul Rodnei on Valea Pietroasă, 07.VIII.1948, leg. and det. T. Ştefureac, sub *H. reptile* [BUCA *B5539*].

Hypnum recurvatum (Lindb. and Arnell) Kindb. - **(22)**

Pietrosul Mountain, Corongiş, sub *H. fastigiatum* (Boros, 1951); Ineu, leg. and det. Á. Boros (Györffy, 1943).

Hypnum revolutum (Mitt.) Lindb. - **(22)**

Ineu, 15.VIII.1941, leg A. Nyárády-Szucs (Plămadă, 1974; Plămadă, 1977; Papp, 1967).

Isopterygiopsis pulchella (Hedw.) Z. Iwats. - **(32)**

Galaţu Mountain, 2,000 m a.s.l., sub *Plagiothecium* (Matouschek, 1905); Pietrosul Rodnei, Galaţiu, Laptelui Mountain, 1,500-2,000 m a.s.l., leg. Á. Boros, sub *Isopterigium* (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve, sub *Isopterigium* (Ştefureac, 1983b).

Isothecium alopecuroides (Lam. ex Dubois.) Isov. - **(23)**

Rebra Valley - Guşeţel Valley, Piatra Rea - Runcu Ştiol (Coldea, 1990); Lala Valley, sub *I. myurum* var. *circinans* (Ştefureac, 1938).

Isothecium myosuroides Brid. - **(23)**

Rebra Valley, Parva (Coldea, 1990).

Kiaeria blyttii (Bruch and Schimp.) Broth. - **(37)**

Ineu, leg. and det. T. Ştefureac, sub *Dicranum* (Ştefureac, 1942; Boros and Vajda 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Kiaeria falcata (Hedw.) I. Hagen - **(37)**

Pietrosul Rodnei, sub *Dicranum* (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885); Lala Valley, 1,600 m a.s.l., 9.VIII.1918, leg. and det., M. Péterfi, sub *Dicranum* [FRE *709*] (Borza, 1928; Borza and Nyárády, 1940); Coasta Netedă, Ineu Mountain, 1,900 m a.s.l., sub *Dicranum* (Breidler, 1890a); Pietrosul Mare Peak, 2,150 m a.s.l., 19.VII.1977, Anieşul Mic Peak, 1,850 m a.s.l., 17.VII.1982, Anieşul Mare Peak, 2,100 m a.s.l., 15.VIII.1982, Galaţu Peak, 1,880 m a.s.l., 18.VII.1982, Gărgălău Peak, 2,000 m a.s.l., 19.VII.1982, ass. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985 (Coldea, 1985; Coldea, 1990; Coldea et al., 1997).

Kiaeria starkei (F. Weber and D. Mohr) I. Hagen - **(37)**

Pietrosul Rodnei, sub *Dicranum* (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885); Vinului Valley, 1,600 m a.s.l., 8.VIII.1918, leg. and det., M. Péterfi, sub *Dicranum* [FRE *710*] (Borza, 1928; Borza and Nyárády, 1940); between Tâul Mic and Scărişoara, VIII.1937, leg. and det. T. Ştefureac, sub *Dicranum* (Ştefureac, 1945); Pietrosul Rodnei, 2,260-2,280 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952); Pietrosul Rodnei, the edge of Pietrosu Lake, on stones, 7.VIII.1948, leg. and det. T. Ştefureac, sub *Dicranum* (Ştefureac, 1951; Ştefureac, 1957b; Ştefureac, 1971); Anieşul Mare Peak, 2,000 m a.s.l., 17.VII.1975 (Plămadă and Coldea, 1982); Bila Glacial Ring, 14.VIII.1985 (Coldea and Pînzaru, 1986); Rodna Mountains, leg. and det. T. Ştefureac (Ştefureac, 1963b); Anieşul Mare Peak, Omul Peak, Gărgălău Valley, Piatra Albă, Bila Glacial Ring, Pietrosul Mare Peak, 2,150 m a.s.l., 19.VII.1977, Şaua Puzdra - Anieş, Rebra Peak, Ineu Peak, 2,100 m a.s.l., 17.VIII.1982, Gărgălău Peak, 2,000-2,080 m a.s.l., 19.VII.1982, Coasta Netedă - Ineu, Momaia Peak, Căldarea Gărgălău, Şaua Anieş - Galaţu, Puzdrele Peak, Puzdra-Anieşu Mare, 1,800 m a.s.l.,

27.VII.1976, Buhăiescu, 2,120 m a.s.l., 8.VIII.1979, ass. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985 (Coldea, 1985; Coldea, 1990; Coldea et al., 1997); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, leg. and det. T. Ştefureac (Ştefureac, 1986c).

Leptodontium styriacum (Jur.) Limpr. - **(34)**

Ineu, 2,000-2,200 m a.s.l. (Matouschek, 1905; Plămadă et al., 2000).

Lescuraea saxicola (Schimp.) Molendo - **(24)**

Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac, sub *L. mutabilis* var. *saxicola* (Ştefureac, 1986c); Pietrosul Rodnei, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B5659*].

Meesia longiseta Hedw. - **(26)**

Corongiş, leg. M. Péterfi (Ştefureac, 1967a; Ştefureac, 1967b); Ineu - Lala Lake, 2,000 m a.s.l., leg. T. Ştefureac 1937 (Ştefureac, 1967a; Ştefureac, 1967b).

Meesia triquetra (L. ex Jolycl.) Ångstr. - **(26)**

Lala Valley, leg. and det. T. Ştefureac (Ştefureac, 1963b).

Meesia uliginosa Hedw. - **(26)**

Turnul Răşu, Izvorul Cailor, Ştiol, 1,600-1,800 m, leg. A. Coman, Vinului Valley, 1,800-1,950 m, leg. Á. Boros, sub *M. trichodes* (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac, sub *M. trichodes* [BUCA B5835].

Mnium marginatum (Dicks.) P. Beauv. - **(28)**

Rodnei Mountain, sub *M. serratum* (Hazslinszky, 1885; Sabovljević et al., 2008; Orbán, 1975); Galaţu Mountain, 2,000 m a.s.l., sub *M. orthorrhynchum* (Matouschek, 1905).

Mnium spinosum (Voit) Schwägr. - **(28)**

Rodnei Mountain (Hazslinszky, 1885; Sabovljević et al., 2008; Orbán, 1975).

Mnium stellare Hedw. - **(28)**

Rodnei Mountain (b78; Orbán, 1975).

Mnium thomsonii Schimp. - **(28)**

Turnu Roşu, 1,686 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Myurella julacea (Schwägr.) Schimp. - **(32)**

Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905); Vinului Valley, Galaţu Mountain (Boros, 1951).

Neckera complanata (Hedw.) Huebener - **(29)**

Repedea Valley (Coldea, 1990).

Neckera crispa Hedw. - **(29)**

Aria Zimbrului, 1,087 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Oligotrichum hercynicum (Hedw.) Lam. and DC. - **(33)**

Lala Lake, 2,200 m a.s.l. (Matouschek, 1905; Györffy 1911; Plămadă and Dumitru 1998); Rodna Mountains (Pax, 1898; Plămadă and Dumitru 1998); Bila Glacial Ring, 8.VIII.1981, 14.VIII.1985 (Coldea and Pînzaru, 1986); Ineu Peak (Igmándy, 1943; Plămadă and Dumitru, 1998); Anieşul Mare Peak, Gărgălău Valley, below Galaţu Peak, Rebra Peak, Bila Glacial Ring, Gărgălău Peak, 2,000 m a.s.l., 19.VII.1982, Pietrosul Mare Peak, 2,150 m a.s.l., 19.VII.1977, Ineu Peak, 2,100 m a.s.l., 17.VIII.1982, Galaţu Peak, 1,880 m a.s.l., 18.VII.1982, ass. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985, Galaţu Glacial Ring, 1,830 m a.s.l., 18.VII.1981, Nedeia Corongiş, 1,840 m a.s.l., 28.VIII.1982, Buhăiescu Mare, 1,880-1,890 m, 7.IX.1979, Şaua Anieş, 23.IX.1982, 1,770 m a.s.l., Bila Glacial Ring, 1,800 m a.s.l., 12.VIII.1983, ass. *Poo supinae-Cerastietum cerastioidis* (Söyr, 1954) Oberd.

1957 *chrysosplenietosum alpinae* Coldea 1985 (Coldea, 1985; Coldea, 1990; Plămadă and Dumitru, 1998); between Tâul Mic and Scărişoara, VIII.1937, leg. and det. T. Ştefureac, sub *O. incurvatum* (Ştefureac, 1945; Plămadă and Dumitru, 1998); Puzdra Mountain, Galaţu Mountain, 1,700-2,000 m a.s.l., leg. Á. Boros, sub *O. incurvatum* (Boros and Vajda, 1967; Plămadă and Dumitru, 1998); Puzdra Mountain, 1,620 m a.s.l., leg. A. Coman, 25.VIII.1962, det. E. Plămadă [HMS] (Plămadă and Dumitru, 1998); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac, sub *O. incurvum* [BUCA *B6033*].

Oncophorus virens (Hedw.) Brid. **- (37)**

Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905), Negoiasa Peak, Repede Peak, sub *Cynodontium* [BP] (Boros, 1951; Orbán, 1977); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6034*].

Orthothecium intricatum (Hartm.) Schimp. - **(32)**

Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905); Puzdra Mountain, 1,500-1,700 m a.s.l., leg. Á. Boros, Turnul Roşu, 1,780 m a.s.l., leg. A. Coman (Boros and Vajda, 1967); Turnu Roşu, 1,780 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Orthothecium rufescens (Dicks. ex Brid.) Schimp. **- (32)**

Cotongişul Mic, 1,100-1,200 m a.s.l., 2.VII.1918, leg. and det. M. Péterfi [FRE *1136*] (Borza, 1935; Borza and Nyárády, 1940); Turnul Roşu, 1,980-2,150 m a.s.l., leg. A. Coman, J. Papp (Boros and Vajda, 1967); Turnu Roşu, 1,834 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Orthotrichum cupulatum Hoffm. ex Brid. var. ***sardagnanum*** (Venturi) Venturi **- (30)**

Corongiş, 12.VIII.1918, leg. and det. M. Péterfi [FRE *1841*] (Borza, 1940; Borza and Nyárády, 1940).

Oxystegus tenuirostris (Hook. and Taylor) A. J. E. Sm. **- (34)**

Piatra Rea, Şaua Galaţului (Coldea, 1990).

Palustriella commutata (Hedw.) Ochyra **- (1)**

Corongiş, sub *Hypnum* (Matouschek, 1905); Galaţu Mountain, 2,000 m a.s.l., sub *Hypnum sulcatum* (Matouschek, 1905); Prislop, sub *Hypnum* (Warnstorf, 1895); Lala Valley, leg. and det. T. Ştefureac, sub *Cratoneurum* (Ştefureac, 1963b); Cişia Ineu, 1,700-2,000 m a.s.l., leg. E. I. Nyárády, incl. sub var. *irrigata* fo. *fluitans* (Papp, 1940); below Buhăescu Peak, 1,900 m a.s.l., 26.VII.1976, ass. *Eriophoretum scheuchzeri* Rüb. 1912, sub *Cratoneurum* (Coldea et al., 1977); Buhăiescu Mare, 1,880-1,890 m, 7.IX.1979, ass. *Poo supinae-Cerastietum cerastioidis* (Söyr, 1954) Oberd. 1957 *chrysosplenietosum alpinae* Coldea 1985, sub *Cratoneurum* (Coldea, 1985); Rebra - Glacial Ring, Ştiol, Bătrâna - Fundul Râpilor, Piatra Rea, Rebra Peak, Guşeţel Valley - Rebra Valley, Izvorul Fântânii, Corongişul Mare, Pintu Mic Brook - Puzdrele, Anieşul Mare Glacial Ring, Galaţu Glacial Ring, Cobăşel Valley, Puzdrele Hut, Gropi Glacial Ring, Bătrâna Mountain, Buhăiescu Peak, Puzdra Mare - Izvorul Fântânii, Piciorul Galaţului, sub *Cratoneurum* (Coldea, 1990).

Palustriella decipiens (De Not.) Ochyra **- (1)**

Lala Valley, leg. and det. T. Ştefureac, sub *Cratoneurum* (Ştefureac, 1963b; Boros, 1951).

Paraleucobryum enerve (Thed.) Loeske **- (12)**

Pietrosul Rodnei, sub *Dicranum albicans* (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky, 1885; Boros, 1951; Boros and Vajda, 1967); Pietrosul Rodnei, 23.VIII.1942, Ineu, leg. and det. Á. Boros, sub *Dicranum albicans* (Györffy, 1943); Pietrosul Rodnei, 2,280 m a.s.l., leg. and det. T. Ştefureac, sub *Dicranum albicans* (Ştefureac, 1952; Ştefureac, 1968; Ştefureac, 1977; Boros and Vajda, 1967); Ineu, 2,000-2,200 m a.s.l., Galaţu Mountain, 2,000

m a.s.l., sub *Dicranum albicans* (Matouschek, 1905; Boros and Vajda, 1967); Lala Lake, 1,900-2,250 m a.s.l., leg. and det. T. Ştefureac, sub *Dicranum albicans* (Ştefureac, 1963b; Boros and Vajda, 1967); Ştiol (Boros, 1951); Pietrosu, 2,100 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Dicranum albicans* (Bereş, 1983); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Paraleucobryum longifolium (Hedw.) Loeske - **(12)**

Pietrosul Rodnei, sub *Dicranum* (Hazslinszky, 1866; Hazslinszky, 1868); Below Turnu Roşu, 1,789 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Dicranum* (Bereş, 1983).

Philonotis caespitosa Jur. - **(5)**

Pintu Mic Brook - Puzdrele, Puzdrele Hut, Piatra Rea, Iezerul Pietrosului (Coldea, 1990); Iezerul Pietrosului, ass. *Eriophoretum scheuchzeri* (Coldea and Plămadă, 1980; Coldea et al., 1997).

Philonotis calcarea (Bruch and Schimp.) Schimp. - **(5)**

Corongiş, Vinului Valley (Matouschek, 1905; Ştefureac, 1963b).

Philonotis fontana (Hedw.) Brid. - **(5)**

Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905); Cucureasa, leg. Dörfler (Breidler, 1890a; Ştefureac, 1963b; Breidler, 1890b); Vinului Valley, leg. R. Soó (Ştefureac, 1963b); Ineu Mountain, 1,750 m a.s.l. (Breidler, 1890b); Prislop (Warnstorf, 1895); Runcu Pietrosului, 1,149 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Ştiol, 1,850 m a.s.l., 16.VII.1975, ass. *Carici dacicae-Drepanocladetum exannulatae* Boşcaiu et al. 1971, below Buhăescu Peak, 1,900 m a.s.l., 26.VI.1976, ass. *Eriophoretum scheuchzeri* Rüb. 1912 (Coldea et al., 1977); Buhăiescu Mare, 1,880-1,890 m, 7.IX.1979, ass. *Poo supinae-Cerastietum cerastioidis* (Söyr, 1954) Oberd. 1957 *chrysosplenietosum alpinae* Coldea 1985, sub *Polytrichum* (Coldea, 1985); Rebra Peak, Buhăiescu Glacial Ring, Piciorul Galaţului, Şaua Galaţu - Gărgălău, Gropi Glacial Ring, Piciorul Buhăiescu Mare, Rebra Valley, Puzdra Mare - Izvorul Fântânii (Coldea, 1990).

Philonotis seriata Mitt. - **(5)**

Lala Mică Glacial Ring, Izvoarele Lalei, 15.VIII.1985 (Coldea and Pînzaru, 1986); Lala Lake, leg. R. Soó (Ştefureac, 1963b), leg. T. Ştefureac (Ştefureac, 1963b); Pietrosul Glacial Ring - Iezerul, Buhăiescu Glacial Ring - Livezi, Livezi, Galaţu Peak - Glacial Ring, Rebra - Glacial Ring, Piatra Rea, Cailor Mountain, Anieşul Mare Valley - Glacial Ring, Cişa Valley, Cormaia Valley, Anieş Vally - Izvorul Cepelor, Galaţu Glacial Ring - Izvorul Fântânii (Coldea, 1990); Iezerul Lake (Ştefureac, 1958a); Pietrosul Peak, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6159*].

Philonotis tomentella Molendo - **(5)**

Vinului Valley, leg. M. Péterfi (Ştefureac, 1963b; Péterfi, 1910); Turnu Roşu, 2,147 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, leg. and det. T. Ştefureac (Ştefureac, 1986c); Pietrosul Rodnei, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6160*].

Plagiobryum zieri (Hedw.) Lindb - **(7)**

Vinului Valley, leg. M. Péterfi (Boros, 1951).

Plagiomnium affine (Blandow ex Funck) T. J. Kop. - **(31)**

Borşa, 700 m a.s.l., sub *Mnium* (Matouschek, 1905; Orbán, 1975).

Plagiomnium cuspidatum (Hedw.) T. J. Kop. - **(31)**

Bătrâna, 1,420-1,650 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Mnium* (Bereş, 1983); Pietrosul Rodnei on Valea Pietroasă, 07.VIII.1948, leg. and det. T. Ştefureac, sub *Mnium* [BUCA *B5896*].

Plagiomnium rostratum (Schrad.) T. J. Kop. - **(31)**

Iezer, 1,858 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Mnium* (Bereş, 1983).

Plagiomnium undulatum (Hedw.) T. J. Kop. - **(31)**

Guşeţel Valley - Rebra Valley, Bătrâna Mountain, Piatra Rea - Prisăci Hill, Pietrosul Mare Peak, Rebra Valley, Anieşul Mare Valley, Cormaia Valley - Pârâul Vinului, Piatra Rea - Runcu Ştiol, Pietrosul Mare Reserve, Negrileasa - Anieşul Mare Valley, Jneapănul Bătrânei, Anieşul Mare Valley, Negrileasa - Cepelor Basin, sub *Mnium* (Coldea, 1990; Orbán, 1975).

Plagiopus oederianus (Sw.) H. A. Crum. and L. E. Anderson - **(5)**

Galaţu Mountain, 2,000 m a.s.l., sub *P. oederi* and var. *condensata* (Matouschek, 1905); Aria Zimbrului, 1,108 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Bartramia* (Bereş, 1983).

Plagiothecium curvifolium Schlieph. ex Limpr. - **(32)**

Corongiş, leg. M. Péterfi, Vinului Valley, 1,200-1,300 m a.s.l., leg. Á. Boros, sub *P. roseanum* (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Plagiothecium denticulatum (Hedw.) Schimp. - **(32)**

Pietrosul Rodnei (Hazslinszky, 1866; Hazslinszky, 1868); Ineu Mountain, 2,250 m a.s.l. (Breidler, 1890b).

Plagiothecium laetum Schimp. - **(32)**

Lala Valley, sub fo. *vulgaris* (Ştefureac, 1938); Pietrosul Rodnei (Boros, 1951); Vinului Valley, leg. M. Péterfi, sub fo. *tenellum* (Boros, 1951).

Plagiothecium neckeroideum Schimp. - **(32)**

Pietrosul Peak, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6425*].

Plagiothecium succulentum (Wilson) Lindb. - **(32)**

Vinului Valley, 750 m a.s.l. leg. C. Papp (Papp, 1940; Boros, 1951); Vinului Valley, leg. L. Felföldy (Boros and Vajda, 1967).

Plagiothecium undulatum (Hedw.) Schimp. - **(32)**

Rebra Valley, Parva (Rebra Valley), Fundul Rebra, Guşatu Valley - Rebra Valley, Valea lui Dragoş Brook (Coldea, 1990); Prislop (Warnstorf, 1895); Vinului Valley, leg. L. Felföldy (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Plasteurhynchium striatulum (Spruce) M. Fleisch. - **(6)**

Vinului Valley, leg. Á. Boros, sub *Eurhynchium striatum* (Boros and Vajda, 1967).

Platydictya jungermannioides (Brid.) H. A. Crum - **(32)**

Puzdra Mountain, 1,500-1,700 m a.s.l., leg. Á. Boros, sub *Amblystegium* (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve, sub *Amblystegium* (Ştefureac, 1983b).

Platygyrium repens (Brid.) Schimp. - **(36)**

Rodna Mountains (Warnstorf, 1895).

Pleurozium schreberi (Willd. ex Brid.) Mitt. - **(21)**

Pietrosul Rodnei, 2,270-2,280 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952); Bila Glacial Ring, 1,650-1,670 m a.s.l., 14.VIII.1985, Gajei Saddle, 1,700 m a.s.l., 11.VIII.1983, Zănoaga de Jos, 1,650 m a.s.l., 28.VI.1981, Jneapănul Bătrânei, 1,670 m a.s.l., 25.VI.1981 (Coldea and Pînzaru, 1986); Rebra, 2,100 m a.s.l., 17.VII.1977, Ineu, 2,100 m a.s.l., 17.VIII.1982, ass. *Soldanello hungaricae-Salicetum kitaibelianae* Coldea 1985 (Coldea, 1985); Galaţu Peak, Pietrosul Mare Peak, Ineu Peak, Anieşul Mare Peak, Puzdra Mică Pasture, Pietrosul Mare Reserve, Picorului Anieşului, Fundul Rebrei, Negrileasa - Anieşul Mare

Valley, Piatra Neagră - Pietrosul Reserve, Guşatu Valley - Rebra Valley, Repedea Valley - Fața Cătinului, Izvorul Mare, Zănoaga de Jos Glacial Ring, Lala Valley, Buhăiescu Glacial Ring - Livezi, Puzdrele Peak, Ştiol, Gărgălău Peak, Corongişul Mare Peak, Feței Peak, Momaia Peak, Anieşului Valley - Cepelor Basin, Piatra Rea, Fața Pietrosului, Zănoaga Mare Glacial Ring, Rebra Peak (Coldea, 1990); Lala Valley, sub *Hypnum* (Ştefureac, 1938); Lala Lake (Ştefureac, 1958a).

Pogonatum aloides (Hedw.) P. Beauv. **- (33)**

Zănoaga de Jos, 1,537 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Pogonatum urnigerum (Hedw.) P. Beauv. **- (33)**

Pietrosul Rodnei, 2,260 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952; Ştefureac 1963b); Corongiş, Lala Lake, 2,200 m a.s.l., Galațu Mountain, 2,000 m a.s.l., sub var. *humile* (Matouschek, 1905; Plămadă and Dumitru, 1998); Prislop (Warnstorf, 1895); Lala Valley (Ştefureac, 1938) between Tâul Mic and Scărişoara, VIII.1937, leg. and det. T. Ştefureac (Ştefureac, 1945); Zănoaga de Jos, 1,537 m a.s.l., Bătrâna, 1,407-1,650 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

Pohlia annotina (Hedw.) Lindb. **- (27)**

Rodna Mountains, leg. and det. T. Ştefureac (Ştefureac, 1963b).

Pohlia cruda (Hedw.) Lindb. **- (27)**

Corongiş, Galațu Mountain, 2,000 m a.s.l., sub *Webera* (Matouschek, 1905; Ştefureac, 1963b); Ineu Mountain, 2,250 m a.s.l., sub *Webera* (Breidler, 1890b); Ineu, leg. Dörfler (Breidler, 1890a, Ştefureac, 1963b); Lala Lake (Ştefureac, 1963b); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac (Ştefureac, 1986c); Iezerul Pietrosului, ass. *Eriophoretum scheuchzeri* (Coldea and Plămadă, 1980; Coldea et al., 1997); Pietrosul Rodnei below Piciorul Moşului, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6204*]; Pietrosul Peak, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6205*].

Pohlia drummondii (Müll. Hal.) A. L. Andrews **- (27)**

Lala Lake, 1,900-2,250 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1963b); between Tâul Mic and Scărişoara, sub *P. commutata* (Ştefureac, 1945); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac (Ştefureac, 1986c); Ineu Peak, 22.VIII.1937, leg. and det. T. Ştefureac, sub *P. commutata* [BUCA *B6203*].

Pohlia elongata Hedw. **- (27)**

Pietrosul Rodnei, subs *Webera* (Hazslinszky, 1866; Hazslinszky 1868; Hazslinszky 1885; Ştefureac 1963b). Vinului Valley, Galațu Peak (Boros, 1951);

Pohlia filum (Schimp.) Martensson **- (27)**

Rodna Mountains, leg. and det. T. Ştefureac, sub *P. gracilis* (Ştefureac, 1963b; Nădişan and Chercheş, 2002).

Pohlia longicolla (Hedw.) Lindb. **- (27)**

Pietrosul Rodnei, sub *Webera* (Hazslinszky, 1866; Hazslinszky, 1868); Galațu Mountain, 2,000 m a.s.l., sub *Webera* (Matouschek, 1905; Ştefureac, 1963b); Galațu Mountain, 1,800-1,900 m a.s.l. (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve, sub *P. longicollis* (Ştefureac, 1983b); Pietrosul Rodnei, 08.VIII.1948, leg. and det. T. Ştefureac, sub *P. longicollis* [BUCA *B6213*].

Pohlia ludwigii (Spreng. ex Schwägr.) Broth. **- (27)**

Rodna Mountains, leg. and det. T. Ştefureac (Ştefureac, 1963b), Buhăiescu Mare, 1,880-1,890 m, 7.IX.1979, ass. *Poo supinae-Cerastietum cerastioidis* (Söyr, 1954) Oberd. 1957 *chrysosplenietosum alpinae* Coldea 1985 (Coldea, 1985); Rebra Peak (Coldea, 1990).

Pohlia nutans (Hedw.) Lindb. **- (27)**

Galaţu Mountain, 2,000 m a.s.l., sub *Webera nutans* var. *strangulata* (Matouschek, 1905; Ştefureac 1963b); Rodna (Breidler, 1890a, Ştefureac 1963b); Pietrosul Rodnei, 2,260-2,280 m a.s.l., 7.VIII.1948, leg. and det. T. Ştefureac (Ştefureac, 1952; Ştefureac, 1971); Iezerul Pietrosului (Coldea, 1990); Lala Valley, sub var. *strangulata* (Ştefureac, 1938).

Pohlia obtusifolia (Vill. ex Brid.) L. F. Koch **- (27)**

Rodna Mountains, leg. and det. T. Ştefureac, sub *P. cucullata* (Ştefureac, 1963b).

Pohlia proligera (Kindb.) Lindb. ex Broth. **- (27)**

Rodna Mountains, leg. and det. T. Ştefureac (Ştefureac, 1963b; Plămadă, 1968).

Polytrichastrum alpinum (Hedw.) G. L. Sm. **- (33)**

Pietrosu and Ineu, sub *Polytrichum alpinum* var. *affine* (Baumgarten, 1846); Pietrosul Rodnei, sub *Pogonatum* (Schur, 1866; Hazslinszky, 1866; Hazslinszky, 1868; Fuss, 1878; Pax, 1898; Plămadă and Dumitru, 1998); Ineu Mountain, 2,250 m a.s.l., sub *Pogonatum* (Breidler, 1890b); Pietrosul Rodnei, the edge of Pietrosu Lake, on stones, 2,260-2,290 m a.s.l., 7.VIII.1948, leg. and det. T. Ştefureac, sub *Polytrichum* [BUCA *B6229*] (Ştefureac, 1951; Ştefureac, 1952; Ştefureac 1967a; Ştefureac 1971; Ştefureac 1977; Ştefureac 1979); between Tâul Mic and Scărişoara, VIII.1937, leg. and det. T. Ştefureac, sub *Polytrichum* (Ştefureac, 1945); Ineu, 2,000-2,200 m a.s.l., Galaţu Mountain, 2,000 m a.s.l., sub *Polytrichum* (Matouschek, 1905; Plămadă and Dumitru, 1998); Ineu (Györffy, 1911; Plămadă and Dumitru, 1998); Pietrosul Rodnei, 1,400-1,500 m a.s.l., Piciorul Moşului, Inău, Roşu Glacial Ring, sub *Polytrichum* (Ştefureac, 1958a); Lala Lake, 1,900-2,250 m a.s.l., leg. and det. T. Ştefureac, sub *Polytrichum* (Ştefureac, 1963b); Bila Glacial Ring, 2,030-2,120 m a.s.l., 14.VIII.1985, Ineuţ Peak, 2,100 m a.s.l., 15.VIII.1985, Lala Glacial Ring, 15.VIII.1985, Ineu Peak, 2,100 m a.s.l., 15.VIII.1985, Piciorul Pleşcuţei, 2,050 m a.s.l., 14.VIII.1985, sub *Polytrichum* (Coldea and Pînzaru, 1986); Rebra, 2,100 m a.s.l., 17.VII.1977, Puzdra, 2,120 m a.s.l., 15.VIII.1982, Anieşu Mare, 2,050-2,080 m a.s.l., 17.VII.1982, Gărgălău, 2,060-2,110 m a.s.l., 19.VII.1982, Clăilor Peak, 2,050 m a.s.l., 20.VII.1982, Pietrosul Rodnei, 2,270 m a.s.l., 3.VIII.1982, Ineu, 2,100 m a.s.l., 17.VIII.1982, ass. *Soldanello hungaricae-Salicetum kitaibelianae* Coldea 1985, sub *Polytrichum* (Coldea, 1985); Puzdra Peak, Anieşul Mare Peak, Piatra Albă Peak, Zănoaga Mare - Pietrosul, Anieşul Mic Peak, Pietrosul Mare Peak, Anieş Peak, Piciorul Galaţului, Corongiş Peak, Galaţu Glacial Ring, Gărgălău Peak, Clăilor Peak, Ineu Peak, Şaua Gărgălău - Galaţu, Galaţu Peak, Şaua Galaţului, Cormaia Peak, Cişa Valley, Faţa Cătinului, Cobăşel, Rabla Peak, Omul Peak, Corongişul Mare, Pietrosul Mare - Zănoaga Mică Peak, Faţa Vârful Rebra, Buhăiescu, Şaua Anieş - Galaţu, Buhăiescu Glacial Ring, Gropile Glacial Ring, Bătrânei Brook, Ţapului Peak - Cormaia Valley, Pudra Mică Pastre, sub *Polytrichum* (Coldea, 1985; Coldea 1990); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac, sub *Polytrichum* (Ştefureac, 1986c); Piciorul Moşului, 1,698-1,936 m a.s.l., leg. A. Coman, 20.VII.1950, det. Á. Boros, sub *Polytrichum* (Plămadă and Dumitru, 1998); Zănoaga, 1,456-1,506 m a.s.l., leg. A. Coman, 29.VI.1954, det. Á. Boros, sub *Polytrichum* (Plămadă and Dumitru, 1998); Piciorul Moşului, 1,936 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Polytrichum* (Bereş, 1983); Şaua below Golgota, leg. G. Coldea, 26.V.1981, det. E. Plămadă, sub *Polytrichum* (Plămadă and Dumitru, 1998).

Polytrichastrum formosum (Hedw.) G. L. Sm. **- (33)**

Rebra Valley, Parva, sub *Polytrichum* (Coldea, 1990); Aria Zimbrului, 1,103 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Polytrichum* (Bereş, 1983).

Polytrichastrum pallidisetum (Funck) G. L. Sm. - **(33)**

Corongiș Mountain, sub *Polytrichum* (Baumgarten, 1846; Schur, 1866; Fuss, 1878; Hazslinszky, 1885; Plămadă and Dumitru, 1998); Ineu Peak, sub *Polytrichum* (Papp, 1967; Plămadă and Dumitru, 1998).

Polytrichastrum sexangulare (Brid.) G. L. Sm. - **(33)**

Rodna Mountains, sub *Polytrichum* (Baumgarten, 1846; Schur, 1866; Plămadă and Dumitru, 1998); Ineu Valley, 1,600-2,100 m a.s.l., sub *Polytrichum* (Ştefureac, 1945); Pietrosul Rodnei, the edge of Iezer Lake, on stones, 7.VIII.1948, leg. and det. T. Ştefureac, sub *Polytrichum* [BUCA *B6299*] (Ştefureac, 1951; Ştefureac 1957b; Ştefureac 1971; Ştefureac 1986a; Plămadă and Dumitru 1998); Lala Lake, 1,900-2,250 m a.s.l., leg. and det. T. Ştefureac, sub *Polytrichum norvegicum* (Ştefureac, 1963b; Ştefureac 1963a); Anieşul Mare Peak, 2,000 m a.s.l., 17.VII.1975, sub *Polytrichum norvegicum* (Plămadă and Coldea, 1982); Bila Glacial Ring, 8.VIII.1981, 14.VIII.1985, Lala Mică Glacial Ring, 15.VIII.1985, sub *Polytrichum* (Coldea and Pînzaru, 1986); Pietrosul Mare Peak, Rebra Peak, Anieşul Mare Peak, Omul Peak, Gărgălău Valley, Şaua Cişa-Omu, Piatra Albă, Bila Glacial Ring, Şaua Puzdra - Anieş, Galaţu Peak, Coasta Netedă - Ineu, Buhăiescu Mic, Momaia Peak, Gărgălău Peak, 2,000-2,080 m a.s.l., 19.VII.1982, Buhăiescu Mare, 2,080 m a.s.l., 24.VII.1967, Puzdra-Anieşul Mare, 1,800 m a.s.l., 27.VII.1976, Buhăiescu 2,120 m a.s.l., 8.VIII.1979, Ineu Peak, 2,100 m a.s.l., 15.VIII.1982, Galaţu Peak 1,880 m a.s.l., 18.VII.1982, ass. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985, Coasta Netedă - Ineu, 2,010-2,020 m a.s.l., 8.VIII.1981, Buhăiescu Mare, 1,880-1,890 m, 7.IX.1979, ass. *Poo supinae-Cerastietum cerastioidis* (Söyr, 1954) Oberd. 1957 *chrysosplenietosum alpinae* Coldea 1985, sub *Polytrichum* (Coldea, 1985; Coldea, 1990, Coldea et al. 1997); Puzdra Mountain, 1,700-2,000 m a.s.l., leg. Á. Boros, sub *Polytrichum* (Boros and Vajda, 1967; Plămadă and Dumitru 1998); Pietrosul and Anieşul Mare, 2,000 m a.s.l., leg. G. Coldea, 19.VII.1975, det. Plămadă E., sub *Polytrichum* (Plămadă and Dumitru, 1998); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Polytrichum commune Hedw. - **(33)**

Bila Glacial Ring - Piciorul Pleşcuţei, 1,600 m a.s.l., 14.VIII.1985, Bila Glacial Ring, 1,490-1,670 m a.s.l., 14.VIII.1985, Lala Valley, 1,530-1,600 m a.s.l., 15.VIII.1985, Preluca Frumoli-Golgota, 1,550 m a.s.l., 28.VI.1981, Jneapănul Bătrânei, 1,670 m a.s.l., 25.VI.1981 (Coldea and Pînzaru, 1986); Prislop (Warnstorf, 1895); Rotunda - Preluci, Ştiol, Piciorul Galaţului, Galaţu Glacial Ring - Izvorul Fântânii, Puzdra Mare, Anieşul Mare Glacial Ring, Piatra Rea - Runcu Ştiol, Fundul Rebrei, Negrileasa - Anieşul Mare Valley, Jneapănul Bătrânei, Runcu Ştiol, Guşatu Valley - Rebra Valley, Valea lui Dragoş Brook, Zănoaga de Jos, Hotarului Valley -Pietrosu Reserve, Corongişul Mic, Repedea Valley - Faţa Cătinului, Izvorul Mare, Piatra Neagră - Pietrosu Reserve, Preluca Frumoli - Golgota, Zănoaga de Jos Glacial Ring, Lala Valley, Jneapănul Bătrânei (Coldea, 1990); Ineu, Tăul Mic (Ştefureac, 1945; Ştefureac, 1952).

Polytrichum juniperinum Hedw. - **(33)**

Pietrosul Rodnei (Hazslinszky, 1868); Golgota Peak, Coasta Netedă, Anieşul Mare Peak, Şaua Gărgălău - Galaţu, Omul Peak, Buhăiescu Glacial Ring - Livezi, Galaţu Peak, Rebra Valley, Anieşul Mic Peak, Piatra Rea, Puzdra Mică, Faţa Pietrosului, Negoiescu, Corongişul Mare, Bila Glacial Ring - Ineu, Rabla Peak (Coldea, 1990); Lala Valley (Ştefureac, 1938); Lala Lake (Ştefureac, 1958a); Aria Zimbrului, 1,107 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983).

var. ***alpinum*** Schimp.

Pietrosul Rodnei, the edge of Pietrosu Lake, on stones, 2,260 m a.s.l., 7.VIII.1948, leg. and det. T. Ştefureac (Ştefureac, 1952; Plămadă and Dumitru 1998); Şaua below Golgota, leg. G. Coldea, 26.V.1981, det. Plămadă E. (Plămadă and Dumitru, 1998);

Polytrichum piliferum Hedw. - **(33)**

Lala Valley (Ştefureac, 1938); Iezerul Pietrosului Lake, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA B6295].

Polytrichum strictum Menzies ex Brid. - **(33)**

Pietrosul, Ineu, sub *Polytrichum alpestre* (Schur, 1866; Fuss 1878); Pietrosul Peak, 2,260-2,290 m a.s.l., leg. T. Ştefureac 1948 (Ştefureac, 1952; Ştefureac 1967a; Ştefureac 1968; Ştefureac 1977; Ştefureac 1971; Ştefureac 1986b; Ştefureac 1979); Lala Lake, 2,200 m a.s.l. (Matouschek, 1905); Lala Glacial Ring, 1,800 m a.s.l., 11.VII.1985, Lala Valley, 1,640-1,730 m a.s.l., 14.VIII.1985 (Coldea and Pînzaru, 1986); Ştiol, Puzdra Mică, Piciorul Galaţului, Puzdra Mare, Lala Glacial Ring, Negoiescu Mare Peak (Coldea, 1990), Bila-Lala Plateau, 1,500 m a.s.l., sub *P. ştefureacii* (Plămadă and Dumitru, 1998); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b; Nădişan and Cherches, 2002); Ineu Peak, leg. and det. T. Ştefureac, 16.VIII.1948 [BUCA B6302].

Pseudobryum cinclidioides (Huebener) T. J. Kop. - **(31)**

Rodna Mountains, sub *Mnium* (Ştefureac, 1967a; Ştefureac, 1967b; Plămadă, 1977; Orbán, 1975); Pietrosul Rodnei, 07.VIII.1948, leg. and det. T. Ştefureac, sub *Mnium* [BUCA *B5888*].

Pseudoleskea incurvata (Hedw.) Loeske - **(24)**

Corongiş, sub *P. atrovirens* (Baumgarten, 1846; Schur 1866; Hazslinszky 1866; Hazslinszky 1868; Fuss 1878; Hazslinszky 1885), Ineu, Vinului Valley, 1,800 m a.s.l., 8.VII.1918, leg. M. Péterfi, det. C. Papp, sub *Lescuraea atrovirens* (Brid.) Kindb. [FRE *1626*] (Borza, 1938; Borza and Nyárády, 1940); Pietrosu Peak, leg. and det. T. Ştefureac, 7.VIII.1948, sub *P. atrovirens* [BUCA *B6345*]

Pseudoleskea radicosa (Mitt.) Macoun and Kindb. - **(24)**

Corongiş (Schur, 1866).

Pseudoleskeella nervosa (Brid.) Nyholm - **(24)**

Ineu Mountain, sub *Leskea* (Breidler, 1890b).

Pterigynandrum filiforme Hedw. - **(35)**

Corongiş, Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905); Ineu Mountain, 2,200 m a.s.l. (Breidler, 1890b); Pietrosul Rodnei, Valea Pietroasă, 7.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6500*].

Ptychodium plicatum (Schleich. ex F. Weber and D. Mohr) Schimp. - **(24)**

Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905; Pócs, 1958; Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve, sub *Lescuraea* (Ştefureac, 1983b).

Pylaisia polyantha (Hedw.) Schimp. - **(22)**

Rodna (Breidler, 1890b).

Racomitrium affine (F. Weber and D. Mohr) Lindb. - **(18)**

Pietrosu, 2,150 m a.s.l., leg. A. Coman, det. Á. Boros, sub *R. heterostichum* var. *gracilescens* (Bereş, 1983).

Racomitrium canescens (Hedw.) Brid. - **(18)**

Pietrosul Rodnei, Valea Pietroasă, 7.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6574*].

Racomitrium fasciculare (Hedw.) Brid. - **(18)**

Pietrosul Rodnei, 2,260-2,290 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952; Ştefureac, 1977; Ştefureac, 1971); Roşu Peak, 28.VIII.1937 (Ştefureac, 1958b); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b); Pietrosul Rodnei, 08.VIII.1948, leg. and det. Stefureac T. [BUCA *B1489*].

Racomitrium heterostichum (Hedw.) Brid. - **(18)**

Vinului Valley, 700 m a.s.l., Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905); Pietrosul Rodnei, 2,150 m a.s.l., leg. O. Hanasiewicz-Hajnády, A. Coman (Boros and Vajda, 1967).

Racomitrium lanuginosum (Hedw.) Brid. - **(18)**

Pietrosul Rodnei (Hazslinszky, 1866; Hazslinszky, 1868; Hazslinszky 1885); Pietrosul Peak, 2,260-2,290 m a.s.l., 7.VIII.1948 leg. and det. T. Ştefureac [BUCA *B6599*] (Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1968; Ştefureac, 1977; Ştefureac, 1971; Ştefureac, 1986a; Ştefureac, 1986b); Ineu, leg. and det. Á. Boros, sub *Racomitrium hypnoides* (Györffy, 1943); Ineu, 2,000-2,200 m a.s.l., Lala Lake, 2,200 m a.s.l. (Matouschek, 1905); Piciorul Galaţului, Galaţu Peak, Anieşul Mare Peak (Coldea, 1990); Ineu Mountain, 2,250 m a.s.l. (Breidler, 1890b); Pietrosu, 2,150 m a.s.l., leg. A. Coman, det. Á. Boros, sub *R. hypnoides* (Bereş, 1983); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Racomitrium sudeticum (Funck) Bruch and Schimp. - **(18)**

Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905); Lala Valley (Ştefureac, 1938); Ineu Mountain, 2,250 m a.s.l. (Breidler, 1890b); Pietrosul Rodnei, 2,150 m a.s.l., leg. A. Coman (Boros and Vajda, 1967); Valea Pietroasă, 1948, leg. T. Ştefureac (Racoviţă, 1963); Pietrosu, 2,156 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Rhabdoweisia fugax (Hedw.) Bruch and Schimp. - **(37)**

Ineu, 2,000-2,200 m a.s.l. (Matouschek, 1905).

Rhizomnium magnifolium (Horik.) T. J. Kop. - **(10)**

Pietrosul Rodnei, 07.VIII.1948, leg. and det. T. Ştefureac, sub *Mnium punctatum* Hedw. var. *elatum* Schimp. [BUCA *B5916*].

Rhizomnium punctatum (Hedw.) T. J. Kop. - **(10)**

Anieşul Mic Valley, Căldarea Buhăiescu - Livezi, Livezi, Puzdra Peak, Cailor Mountain, Pietrosul Nare Peak, Parva (Rebra Valley), sub *Mnium* (Coldea, 1990); Prislop, sub *Mnium* (Warnstorf, 1895; Orbán, 1975).

Rhytidiadelphus loreus (Hedw.) Warnst. - **(21)**

Rodna Mountains, sub *Hypnum* (Hazslinszky, 1885; Schur, 1866; Fuss, 1878); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b).

Rhytidiadelphus squarrosus (Hedw.) Warnst. - **(21)**

Puzdra Peak, Cailor Mountain, Zănoaga Mare, Buhăiescu Glacial Ring - Livezi, Pietrosul Mare Peak (Coldea, 1990); Lala Valley, sub *Hylocomium squarosum* var. *calvescens* (Ştefureac, 1938); below Piciorul Moşului, 7.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6661*].

Rhytidium rugosum (Hedw.) Kindb. - **(38)**

Vinului Valley, sub *Hylocomium* (Matouschek, 1905); Turnu Roşu, 1,834 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Pietrosul Peak, 7.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6679*].

Sanionia uncinata (Hedw.) Loeske - **(1)**

Rodna Mountains, sub *Hypnum* (Matouschek, 1905); Prislop, sub *Hypnum* (Warnstorf, 1895); Vinului Valley, 21.VIII.1923, leg. A. Borza, det. C. Papp, sub *Drepanocladus unicinatus* fo. *plumosa* [FRE *1413*] (Borza, 1936; Borza and Nyárády, 1940); Lala Lake, 1,900-2,250 m a.s.l., leg. and det. T. Ştefureac, sub *Drepanocladus* (Ştefureac, 1963b); Pietrosul Mare, leg. and det. T. Ştefureac, 2,260-2,280 m a.s.l., sub *Drepanocladus* (Ştefureac, 1952; Ştefureac 1977); Şaua Anieşului, Pietrosul Mare Peak, Anieşul Mare Peak, 2,100 m a.s.l., 15.VIII.1982, ass. *Soldanello hungaricae-Ranunculetum crenati* Coldea 1985, Şaua Anieş, 1,770 m a.s.l., 23.IX.1982, ass. *Poo supinae-Cerastietum cerastioidis* (Söyr, 1954) Oberd. 1957 *chrysosplenietosum alpinae* Coldea 1985 Puzdra, 2,120 m a.s.l., 15.VIII.1982, ass. *Soldanello hungaricae-Salicetum kitaibelianae* Coldea 1985, sub *Drepanocladus* (Coldea, 1985; Coldea 1990; Coldea et al., 1997); Lala Valley, sub *Drepanocladus uncinatus* var. *plumosum* (Ştefureac, 1938); Tăul Mic, sub *Drepanocladus uncinatus* (Ştefureac, 1945); Pietrosul Peak, 2,260 m a.s.l., 31.VIII.1983, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac, sub *Drepanocladus uncinatus* fo. *plumulosa* (Ştefureac, 1986c).

Schistidium apocarpum (Hedw.) Bruch and Schimp. - **(18)**

Ineu Mountain, 2,200 m a.s.l. (Breidler, 1890b).

Schistidium confertum (Funck) Bruch and Schimp. - **(18)**

Lala Valley, sub *Grimmia apocarpa* var. *conferta* fo. *pruinosa* (Ştefureac, 1938).

Schistidium rivulare (Brid.) Podp. - **(18)**

Lala Valley, sub *Grimmia alpicola* var. *rivulare* (Ştefureac, 1938); Pietrosu Peak, 07.VIII.1948, leg. and det. T. Ştefureac, sub *Grimmia alpicola* var. *rivulare* [BUCA *B6345*].

Schistostega pennata (Hedw.) F. Weber and D. Mohr - **(39)**

Vinului Valley, leg. and det. K. Demeter, sub *S. osmundacea* (Borza, 1921; Igmándy 1943; Ştefureac 1957a); Vinului Valley, leg. E. Plămadă, 4.VII.1963 (Plămadă and Dumitru, 1998); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b; Nădişan and Chercheş, 2002).

Sciuro-hypnum plumosum (Hedw.) Ignatov and Huttunen - **(6)**

Vinului Valley, 700 m a.s.l., sub *Brachythecium* (Matouschek, 1905).

Sciuro-hypnum populeum (Hedw.) Ignatov and Huttunen - **(6)**

Izvorul lui Dragoş, leg. A. Coman, det. Á. Boros, sub *Brachythecium* (Bereş, 1983).

Sciuro-hypnum starkei (Brid.) Ignatov and Huttunen - **(6)**

Corongiş, sub *Brachythecium* (Matouschek, 1905).

Scorpidium revolvens (Sw. ex anon.) Rubers - **(9)**

Lala Mică, 1,900 m a.s.l., sub *Drepanocladus* (Ştefureac, 1979); Pietrosul Rodnei Nature Reserve, sub *Drepanocladus* (Ştefureac, 1983b).

Seligeria recurvata (Hedw.) Bruch. and Schimp. - **(40)**

Vinului Valley and Corongiş Mountain, leg. M. Péterfi (Boros and Vajda, 1967; Plămadă and Dumitru, 1998; Orbán, 1974).

Sphagnum capillifolium (Ehrh.) Hedw. - **(41)**

Pietrosul Rodnei, sub *S. acutifolium* (Hazslinszky, 1866; Hazslinszky, 1868); Pietrosul Peak, 2,260-2,290 m a.s.l., 7.IX.1948, leg. T. Ştefureac, sub *S. acutifolium* and *S. nemoreum* [BUCA *B6861*] (Ştefureac, 1952; Ştefureac, 1967a; Ştefureac, 1968; Ştefureac, 1977; Ştefureac, 1971; Ştefureac, 1986b; Ştefureac, 1979); Galaţu Mountain, at Lake, 2,000 m a.s.l., sub *S. acutifolium* var. *viride* Warnst. (Matouschek, 1905); Lala Glacial Ring, 1,800 m a.s.l., 11.VIII.1985, Lala Valley, 1,640-1,730 m a.s.l., 14.VIII.1985, Galaţu Peak, 1,800-1,850 m a.s.l., Negrioasa Peak, 1955, leg. A. Nyárády, sub *S. nemoreum* (Ştefureac, 1978; Plămadă and Dumitru, 1998; Coldea and Pînzaru, 1986); Galaţu Peak, Puzdrele Peak, Puzdra Mare - Izvorul Fântânii, Puzdra Mică, Piciorul Galaţului, Galaţu Glacial Ring - Izvorul Fântânii, Puzdra Mare,

Piciorul Anieşului, Ştiol, Lala Glacial Ring, Negoiescu Mare Peak, Golgota Peak , Bila Glacial Ring - Ineu (Coldea, 1990); Lala Valley, sub *S. acutifolium* (Ştefureac, 1938); Inău, Lala Valley, 1,200 m a.s.l., Pietrosul Rodnei, Piciorul Moşului, northen slope, 1,650 m a.s.l., below Pietrosu Peak, 2,200-2,300 m a.s.l., sub *S. acutifolium* (Ştefureac, 1958a); Pietrosul Rodnei Nature Reserve, sub *S. capillifolium* (Ştefureac, 1983b).

Sphagnum centrale C. E. O. Jensen - **(41)**

Buhăiescu Glacial Ring, 7.IX.1979, leg. G. Coldea, det. E. Plămadă (Plămadă and Dumitru, 1998); Rebra Peak (Coldea, 1990).

Sphagnum cuspidatum Ehrh. ex. Hoffm. - **(41)**

Ştiol, 15.VIII.1983, leg. G. Coldea, det. E. Plămadă (Plămadă and Dumitru, 1998); Ştiol (Coldea, 1990).

Sphagnum compactum Lam. and DC. - **(41)**

Lala Lake, incl. sub var. *subsquarrosum* Warnst. and fo. *submersum* (Limpr.) Warnst. (Ştefureac, 1958a; Plămadă and Dumitru, 1998); Lala Mică (Ştefureac, 1958a; Coldea and Pînzaru, 1986; Plămadă and Dumitru, 1998); Ştiol, 19.VII.1975, leg. G. Coldea, det. E. Plămadă (Plămadă and Dumitru, 1998); Ştiol, 1,850 m a.s.l., 16.VII.1975, ass. *Carici dacicae-Drepanocladetum exannulatae* Boşcaiu et al., 1971 (Coldea et al., 1977).

Sphagnum fallax (H. Klinggr.) H. Klinggr. - **(41)**

Rotunda - Preluci, Ştiol (Coldea, 1990).

Sphagnum fimbriatum Wilson - **(41)**

Pietrosul Rodnei (Hazslinszky, 1885; Plămadă and Dumitru, 1998; Péterfi, 1904).

Sphagnum fuscum (Schimp.) H. Klinggr. - **(41)**

Inău, Lala Lake, 1,950 m a.s.l. (Ştefureac, 1958a).

Sphagnum girgensohnii Russow - **(41)**

Lala Lake, 2,200 m a.s.l., sub var. *stachyodes* Russow (Matouschek, 1905); Ineu, 8.VIII.1918, leg. M. Péterfi, sub var. *stachyodes* fo. *alpina* [BRHE *59*] (Györffy and Péterfi, 1919); Pietrosul Rodnei, 2,280 m a.s.l., leg. and det. T. Ştefureac (Ştefureac, 1952); Negrioasa Peak, 1955, leg. A. Nyárády (Ştefureac, 1978; Plămadă and Dumitru, 1998); Lala Valley, 1,580-1,600 m a.s.l., 15.VIII.1985, Preluca Frumoli-Golgota, 1,550 m a.s.l., 28.VI.1981, Jneapănul Bătrânei, 1,670 m a.s.l., 25.VI.1981 (Coldea and Pînzaru, 1986); Piciorul Anieşului, Guşatu Valley - Rebra Valley, Valea lui Dragoş Brook, Ştiol, Preluca Frumoli - Golgota, Zănoaga de Jos Glacial Ring, Jneapănul Bătrânei, Galaţu Peak (Coldea, 1990); Iezerul Lake, below Pietrosul Peak, 2,200-2,300 m a.s.l., incl. sub var. *gracilis* Grav. and var. *robustum* Warnst., Lala Lake (Ştefureac, 1958a; Ştefureac, 1977); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b); Iezerul Pietrosului Lake, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6933*]; Pietrosul Peak, 08.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6934*, *B6935*].

Sphagnum magellanicum Brid. - **(41)**

Ştiol, Puzdra Mică, Puzdra Mare (Coldea, 1990).

Sphagnum quinquefarium (Braithw.) Warnst. - **(41)**

Roşu Valley, 750 m a.s.l., 7.VIII.1918, leg. M. Péterfi, sub var. *viridis* [BRHE *86*] (Györffy and Péterfi, 1919); Galaţu Peak, 1,800-1,850 m a.s.l., 1955, leg. A. Nyárády (Ştefureac, 1978; Plămadă and Dumitru, 1998); Pietrosul Rodnei, 1,400-1,500 m a.s.l., Piciorul Moşului, Inău, Roşu Glacial Ring, Lala Lake, incl. var. *viride* (Ştefureac, 1958a); Pietrosul Rodnei, 7.VIII.1948, leg. and det. T. Ştefureac [BUCA *B6995*].

Sphagnum rubellum Wilson - **(41)**

Pietrosu Lake, Ineu Lake, Lala Valley (Ştefureac, 1958a; Plămadă and Dumitru, 1998); Izvorul Cailor, 1955, leg. A. Nyárády (Ştefureac, 1978; Plămadă and Dumitru, 1998); Iezerul Pietrosului Lake, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B7014*].

Sphagnum russowii Warnst. - **(41)**

Ineu Mountain, Lala Lake, 13.VIII.1918, leg. M. Péterfi, sub *S. robustum* var. *poecila* [BRHE *64*] (Györffy and Péterfi, 1919); Pietrosul Peak, 2,290 m a.s.l., leg. T. Ştefureac 1948, sub *S. robustum* var. *purpurascens* (Ştefureac, 1952); Galaţu Mountain, at Lake, 2,000 m a.s.l., sub var. *purpureum* Russow (Matouschek, 1905); Galaţu Peak, 1955, leg. A. Nyárády, sub *S. robustum* (Ştefureac, 1978; Plămadă and Dumitru, 1998); Ştiol, 1,850 m a.s.l., 16.VII.1975, ass. *Carici dacicae-Drepanocladetum exannulatae* Boşcaiu et al., 1971 (Coldea et al., 1977); Lala Lake, Pietosul Borşei, Piciorul Moşului, 1,650 m a.s.l., sub *S. robustum* a.s.l. (Ştefureac, 1958a); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b); above Piciorului Moşului, 7.VIII.1948, leg. and det. T. Ştefureac, sub *S. robustum* [BUCA *B7012*].

Sphagnum squarrosum Crome - **(41)**

Corongiş Mountain, sub *Polytrichum* (Baumgarten, 1846; Hazslinszky, 1885; Fuss, 1878); Rodna (Warnstorf, 1895; Plămadă and Dumitru, 1998); Iezerul Peak (Fuss, 1878; Plămadă and Dumitru, 1998).

Sphagnum subnitens Russow and Warnst. - **(41)**

Pietrosu Peak, 2,150 m a.s.l., sub *S. plumosum* (Ştefureac, 1958a; Plămadă and Dumitru, 1998).

Sphagnum teres (Schimp.) Ångstr. - **(41)**

Between Prislop and Poiana Rotundă (Warnstorf, 1895; Plămadă and Dumitru, 1998); Buhăiescu Glacial Ring, 7.IX.1979, leg. G. Coldea, det. E. Plămadă (Plămadă and Dumitru, 1998), Rebra Peak (Coldea, 1990).

Sphagnum warnstorfii Russow - **(41)**

Bistriţa Aurie Valley (Warnstorf, 1895; Plămadă and Dumitru, 1998).

Stegonia latifolia (Schwägr.) Venturi ex Broth. - **(34)**

Ineu Mountain, Pietrosul Rodnei, sub *Weissia* and *Anacalypta* (Baumgarten, 1846; Schur, 1866; Hazslinszky, 1885; Fuss, 1878).

Straminergon stramineum (Dicks. ex Brid.) Hedenäs - **(9)**

Lala Valley, leg. and det. T. Ştefureac, sub *Calliergon* (Ştefureac, 1963b); Ştiol, Piciorul Galaţului, Rebra Peak, sub *Calliergon* (Coldea, 1990); Buhăiescu Valley, 1,879 m a.s.l., leg. Á. Boros, sub *Calliergon* (Boros and Vajda, 1967); Buhăescu Valley, 1,879 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Calliergon* (Bereş, 1983); Pietrosul Rodnei Nature Reserve, sub *Calliergon* (Ştefureac, 1983b).

Syntrichia montana Nees - **(34)**

Pietrosul Rodnei, Repedea Valley, 12.VIII.1948, leg. and det. T. Ştefureac [BUCA *B7083*].

Syntrichia ruralis (Hedw.) F. Weber and D. Mohr - **(34)**

Ineu Mountain, sub *Barbula* (Breidler, 1890a); Petriceaua, 1,187 m a.s.l., leg. A. Coman, det. Á. Boros, sub *Tortula* (Bereş, 1983); Pietrosul Rodnei, Repedea Valley, 12.VIII.1948, leg. and det. T. Ştefureac [BUCA *B7088*].

Tayloria froelichiana (Hedw.) Mitt. ex Broth. - **(42)**

Rodna Mountains, leg. and det. T. Ştefureac, sub *Dissodon* (Ştefureac, 1963b) Pietrosul Peak, 2,280 m a.s.l., 4.IX.1982, leg. and det. T. Ştefureac (Ştefureac, 1986c).

Tayloria lingulata (Dicks.) Lindb. - **(42)**

Lala Lake, 2,200 m a.s.l., sub *Dissodon splachnoides* (Matouschek, 1905; Ştefureac, 1945); Ineu, 1,600 m a.s.l., 14.VIII.1924, leg. A. Mühldorf [FRE *510*] (Borza, 1925; Borza and

Nyárády, 1940; Ştefureac 1945); Rodna Mountains, leg. and det. T. Ştefureac (Ştefureac, 1963b); Lala Mică, 1,900 m a.s.l., 26.VIII.1973, leg. and det. T. Ştefureac (Ştefureac, 1974; Ştefureac 1979); Ştiol, 1,850 m a.s.l., 16.VII.1975, ass. *Carici dacicae-Drepanocladetum exannulatae* Boşcaiu et al., 1971 (Coldea et al., 1977); The Saddle from Tomnatec towards Cuşca, 2,100 m a.s.l., below this saddle, 1,900 m a.s.l. (Ştefureac, 1945); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b); Lala Lake, 22.VIII.1937, leg. and det. T. Ştefureac [BUCA *B7110*].

Tetraphis pellucida Hedw. - **(43)**

Prislop (Warnstorf, 1895).

Tetraplodon angustatus (Hedw.) Bruch and Schimp. - **(42)**

Galaţu Mountain, 2,000 m a.s.l., leg. Á. Boros, 22.VIII.1942 (Boros, 1943; Boros, 1951; Ştefureac, 1955); Laptelui Peak, 1,950 m a.s.l., leg. A. Nyárády 1955, det. T. Ştefureac 1968 (Ştefureac, 1963a; Ştefureac, 1974); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b; Nădişan and Chercheş, 2002).

Thuidium assimile (Mitt.) A. Jaeger - **(44)**

Galaţu Mountain, 2,000 m a.s.l., Vinului Valley, sub *T. philibertii* (Matouschek, 1905). Rebra Valley-Guşatu Valley, Şaua Galaţului, sub *T. philibertii* (Coldea, 1990).

Thuidium delicatulum (Hedw.) Schimp. - **(44)**

Pietrosul Rodnei, Repedea Valley, 12.VIII.1948, leg. and det. T. Ştefureac [BUCA *B7153*].

Thuidium tamariscinum (Hedw.) Schimp. - **(44)**

Corongiş, Vinului Valley (Boros, 1951).

Timmia bavarica Hessl. - **(45)**

Izvorul Cailor, 1,800 m a.s.l., Puzdrea, 1,630 m, leg. A. Coman (Boros and Vajda, 1967); Pietrosul Rodnei Nature Reserve (Ştefureac, 1983b; Nădişan and Chercheş, 2002).

Tortella tortuosa (Hedw.) Limpr. - **(34)**

Rodna Mountains, Galaţu Mountain, 2,000 m a.s.l. (Matouschek, 1905); Ineu (Ştefureac, 1952); Rebra Valley-Guşatu Valley (Coldea, 1990); Turnu Roşu, 1,811 m a.s.l., Iezer, 1,901 m a.s.l., leg. A. Coman, det. Á. Boros (Bereş, 1983); Pietrosul Rodnei, 07.VIII.1948, leg. and det. T. Ştefureac [BUCA *B7202*].

var. ***fragilifolia*** (Jur.) Limpr.

Corongiş (Matouschek, 1905).

Tortula hoppeana (Schultz) Ochyra - **(34)**

Rodna Mountains, sub *Desmatodon latifolius* (Baumgarten, 1846; Hazslinszky, 1885; Schur, 1866; Fuss, 1878); Ineu, 2,000-2,200 m a.s.l., Galaţu Mountain, 2,000 m a.s.l., sub *Desmatodon latifolius* (Matouschek, 1905).

Tortula schimperi M. J. Cano, O. Werner and J. Guerra - **(34)**

Ineu, 2,000-2,200 m a.s.l., sub *T. subulata* var. *angustata* (Matouschek, 1905).

Trichodon cylindricus (Hedw.) Schimp. - **(13)**

Rodna Mountains, "La Poartă", 1,600 m a.s.l., leg. E. I. Nyárády, sub *Ditrichum tenuifolium* (Papp, 1940).

Warnstorfia exannulata (Schimp.) Loeske - **(9)**

Lala Lake, 2,200 m a.s.l., sub *Hypnum* (Matouschek, 1905); Pietrosul Rodnei, 2,260-2,280 m a.s.l., 7.VIII.1948, leg. and det. T. Ştefureac, sub *Drepanocladus* (Ştefureac, 1952; Ştefureac 1967a); Lala Mică, 1,900 m a.s.l. (Ştefureac, 1979); Groapa Glaciar Ring, 1,900 m a.s.l., 25.VII.1976, ass. *Carici dacicae-Drepanocladetum exannulatae* Boşcaiu et al., 1971,

below Buhăescu Peak, 1,900 m a.s.l., 26.VII.1976, ass. *Eriophoretum scheuchzeri* Rüb. 1912, sub *Drepanocladus* (Coldea et al., 1977); Lala Mică Glacial Ring, Lala Mică Lake, Lalal Mare Lake, Izvoarele Lalei, 15.VIII.1985, sub *Drepanocladus* (Coldea and Pînzaru, 1986); Lala Valley, leg. and det. T. Ştefureac, sub *Drepanocladus* (Ştefureac, 1963b); Pietrosul Glacial Ring - Iezer, Buhăiescu Glacial Ring, Ştiol, Tarnița la Cruce, Piciorul Galaţului, Şaua Galaţu - Gărgălău, Rebra Peak, Căldarea Galaţu - Izvorul Fântânii, sub *Drepanocladus* (Coldea, 1990); Iezerul Lake, sub *Drepanocladus* (Ştefureac, 1958a); Iezerul Pietrosului, ass. *Eriophoretum scheuchzeri*, sub *Drepanocladus* (Coldea and Plămadă, 1980; Coldea et al., 1997).

Warnstorfia fluitans (Hedw.) Loeske **- (9)**

Ştiol, 1,850 m a.s.l., 16.VII.1975, ass. *Carici dacicae-Drepanocladetum exannulatae* Boşcaiu et al. 1971, sub *Drepanocladus* (Coldea et al., 1977).

Warnstorfia sarmentosa (Wahlenb.) Hedenäs **- (9)**

Lala Lake, 2,200 m a.s.l., leg. A. Degen, 1902, det. F. Matouschek, sub *Hypnum* (Matouschek, 1905); Tăul Mic below Ineu Peak, 1,600 m a.s.l., VIII.1937, leg. and det. Ştefureac, sub *Calliergon* (Ştefureac, 1945).

The threatened bryophytes from the Rodna Mountains National Park

In the Rodna Mountains National Park there are nine threatened hornworts species and 38 threatened mosses species threatened (Tabs. 1 and 2). Three species (*Buxbaumia viridis*, *Dicranum viride* and *Meesia longiseta*) are included in the Convention on the Conservation of European Wildlife and Natural Habitats (Bern 1979), the Council Directive 92/43/EEC (1992) and Government Ordinance 57/2007.

Table 1: The list of threatened liverworts from the Rodna Mountains National Park (CB - Convention on the Conservation of European Wildlife and Natural Habitats, Bern 1979; DH - Council Directive 92/43/EEC 1992; ECCB - Red Data Book of European Bryophytes, 1995; OUG57 - Government Ordinance 57/2007; RO - Red list of Romanian Bryophytes, unpublished; CR - critically endangered species, EN - endangered species, VU - vulnerable species, R - rare species and K - insufficiently known.

No.	Species	CB	DH	ECCB	OUG57	RO
1.	*Bucegia romanica* Radian	-	-	R	-	VU
2.	*Cephalozia loitlesbergeri* Schiffn.	-	-	-	-	EN
3.	*Haplomitrium hookeri* (Sm.) Nees	-	-	R	-	CR
4.	*Marsupella brevissima* (Dumort.) Grolle	-	-	-	-	EN
5.	*Moerckia blyttii* (Moerch) Brockm.	-	-	-	-	EN
6.	*Pleurocladula albescens* (Hook.) Grolle	-	-	-	-	EN
7.	*Scapania brevicaulis* Taylor	-	-	K	-	CR
8.	*Scapania scandica* (Arnell and Buch) Macvicar	-	-	-	-	EN
9.	*Scapania verrucosa* Heeg	-	-	R	-	VU

Table 2: The Rodna Mountains National Park threatened mosses list (CB - Convention on the Conservation of European Wildlife and Natural Habitats, Bern 1979; DH - Council Directive 92/43/EEC 1992; ECCB - Red Data Book of European Bryophytes, 1995; OUG57 - Government Ordinance 57/2007; RO - Red list of Romanian Bryophytes; V - vulnerable, R - rare, RT - regionally threatened; CR - critically endangered, EN - endangered and VU - vulnerable).

No.	Species	CB	DH	ECCB	OUG 57	RO
1.	*Arctoa fulvella* (Dicks.) Bruch and Schimp.	-	-	-	-	EN
2.	*Brachydontium trichodes* (F. Weber) Milde	-	-	R	-	EN
3.	*Brotherella lorenziana* (Molendo ex Lorentz) Loeske ex M. Fleisch	-	-	R	-	EN
4.	*Bryoerythrophyllum alpigenum* (Venturi) P. C. Chen	-	-	R	-	CR
5.	*Bryum elegans* Nees	-	-	-	-	CR
6.	*Buxbaumia aphylla* Hedw.	-	-	RT	-	VU
7.	*Buxbaumia viridis* (Moug. ex Lam. and DC.) Brid. ex Moug. and Nestl.	+	+	V	+	CR
8.	*Cynodontium bruntonii* (Sm.) Bruch and Schimp.	-	-	-	-	EN
9.	*Cynodontium gracilescens* (F. Weber and D. Mohr) Schimp.	-	-	-	-	EN
10.	*Cynodontium tenellum* (Schimp.) Limpr.	-	-	-	-	EN
11.	*Dichodontium flavescens* (Dicks.) Lindb.	-	-	-	-	EN
12.	*Dicranella schreberiana* (Hedw.) Dixon	-	-	-	-	VU
13.	*Dicranum viride* (Sull. and Lesq.) Lindb.	+	+	V	+	EN
14.	*Drepanocladus sendtneri* (Schimp ex. Müll.) Warnst.	-	-	RT	-	VU
15.	*Fissidens osmundoides* Hedw.	-	-	-	-	EN
16.	*Grimmia elongata* Kaulf.	-	-	-	-	VU
17.	*Grimmia torquata* Drumm.	-	-	-	-	EN
18.	*Hygrohypnum alpinum* (Lindb.) Loeske	-	-	-	-	EN
19.	*Hypnum hamulosum* Schimp.	-	-	-	-	VU
20.	*Leptodontium styriacum* (Jur.) Limpr.	-	-	R	-	CR
21.	*Meesia longiseta* Hedw.	+	+	R	+	CR
22.	*Myurella julacea* (Schwägr.) Schimp.	-	-	-	-	VU
23.	*Philonotis tomentella* Molendo	-	-	-	-	VU
24.	*Plagiothecium neckeroideum* Schimp.	-	-	R	-	EN
25.	*Pohlia filum* (Schimp.) Martensson	-	-	-	-	CR
26.	*Pohlia ludwigii* (Spreng. ex Schwägr.) Broth.	-	-	-	-	VU
27.	*Pohlia obtusifolia* (Vill. ex Brid.) L. F. Koch	-	-	-	-	VU
28.	*Pohlia proligera* (Kindb.) Lindb. ex Broth.	-	-	-	-	VU
29.	*Pseudobryum cinclidioides* (Huebener) T. J. Kop.	-	-	-	-	VU
30.	*Pseudoleskea radicosa* (Mitt.) Macoun and Kindb.	-	-	-	-	VU
31.	*Ptychodium plicatum* (Schleich. ex F. Weber and D. Mohr) Schimp.	-	-	-	-	VU
32.	*Racomitrium fasciculare* (Hedw.) Brid.	-	-	-	-	EN
33.	*Sphagnum fimbriatum* Wilson	-	-	-	-	VU
34.	*Sphagnum subnitens* Russow and Warnst.	-	-	-	-	VU
35.	*Sphagnum warnstorfii* Russow	-	-	-	-	EN
36.	*Tayloria froelichiana* (Hedw.) Mitt. ex Broth.	-	-	RT	-	EN
37.	*Trichodon cylindricus* (Hedw.) Schimp.	-	-	-	-	VU
38.	Warnstorfia sarmentosa (Wahlenb.) Hedenäs	-	-	-	-	VU

CONCLUSIONS

In the Rodna Mountains National Park were recorded 91 liverwort species, 42,9% from the 22 liverwort species of Romania (Ştefănuţ, 2008a, 2010) and 260 moss species, 34,6% from the 750 moss species of Romania (749 species according Sabovljević et al., 2008). The 351 bryophyte species of the Rodna Mountains National Park represents 36.4% from the 962 liverwort and moss species of Romania (Ştefănuţ, 2008, 2010a; Sabovljević et al., 2008).

From the four hornwort species of Romania, none had been recorded on this area.

In the Rodna Mountains National Park there are 47 species threatened on national and international level. From these, *Buxbaumia viridis*, *Dicranum viride* and *Meesia longiseta* are included in the Convention on the Conservation of European Wildlife and Natural Habitats (Bern 1979), the Council Directive 92/43/EEC (1992) and Government Ordinance 57/2007. For these species and for *Bucegia romanica*, *Haplomitrium hookeri*, *Scapania verrucosa*, *Brachydontium trichodes*, *Brotherella lorenziana*, *Bryoerythrophyllum alpigenum*, *Leptodontium styriacum* and *Plagiothecium neckeroideum* should be designated special areas of conservation.

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ALPINE WET HABITAT TYPES OF COMMUNITY INTEREST IN THE RODNA MOUNTAINS NATIONAL PARK (EASTERN CARPATHIANS, ROMANIA)

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ABSTRACT

The FFH habitat type *7240 Alpine pioneer formation of Caricion bicoloris-atrofuscae is described with regard to its distribution in the alpine mountain system. Characteristic species are discussed and data from varying areas are illustrated in a comparative presentation.

Typical site factors, species and vegetation structures will be analyzed for the Rodna Mountains as well. Furthermore the characteristic beetle species of this habitat type are duly considered; they are bound to the wetlands of the alpine, partly of the subalpine, area and particularly to alluvial soils and seepage areas. Together with the characteristic plant species they act as indicators for the presence of this habitat type in the Carpathians, even though on a very small scale and as fragmentary relicts.

ZUSAMMENFASSUNG: Alpine Feuchtgebiets-Habitattypen von gemeinschaftlichem Interesse im Nationalpark Rodna-Gebirge (Ostkarpaten/Rumänien).

Der FFH-Lebensraumtyp *7240 Alpine pioneer formation of Caricion bicoloris-atrofuscae wird in seiner Verbreitung im alpinen Gebirgssytem dargestellt, wobei die kennzeichnenden Arten besprochen und ihre Angaben aus den verschiedenen Gebieten vergleichend dargestellt werden.

Die charakteristischen Standortfaktoren, Arten und Vegetationsstrukturen werden auch für das Rodna - Gebirge/Karpaten genauer analysiert. Erwähnt sind auch die für den Lebensraumtyp charakteristischen Laufkäferarten, die an Feuchtgebiete in der alpinen, teilweise auch der subalpinen Stufe, vor allem an Schwemmböden und Sickerflächen gebunden sind. Sie belegen, wie auch die charakteristischen Pflanzenarten, das Vorkommen des LRT für die Karpaten, auch wenn es sich um sehr kleinflächige, fragmentarische Reliktvorkommen handelt.

REZUMAT: Tipuri de habitate umede, de interes comunitar, în etajul alpin al Parcului Național Munții Rodnei (Carpații Răsăriteni/România).

Tipul de habitat *7240 Formațiuni pioniere alpine din Caricion bicoloris-atrofuscae, listat în Directiva FFH, este prezentat în aria sa de răspândire din munții sistemului alpin. Sunt discutate speciile caracteristice tipului de habitat, datele din diferitele arii de răspândire fiind analizate şi prezentate în mod comparativ.

Datele staționale caracteristice, speciile şi structura vegetației sunt prezentate şi pentru Munții Rodnei, unde au fost semnalate specii aparținând alianței, care reprezintă tipul de habitat discutat. Menționate sunt şi speciile de Carabide caracteristice, legate de zone umede alpine, mai ales arii aluvionare alpine şi subalpine şi mustiri de apă, împrejurimi de izvoare, zăcători de zăpadă şi stadii inițiale de înmlăştinire. Ele documentează, ca şi speciile caracteristice de plante, prezența acestui tip de habitat, chiar dacă e vorbă de arii relictare, dezvoltate fragmentar pe suprafețe foarte mici.

INTRODUCTION

Wet habitat types of the alpine level in the Alpine mountains system - the Pyrenees, Alps and Carpathians - are well represented by springs and their surrounding area, alpine rivulets and streams with their alluvial deposits, protosoils and soils composed of different grain sizes, smaller or larger seepage areas, snowmelt depressions, along the edges of glaciers, glacial torrents as well as around the glacial lakes and as bogs and fens.

Given that the Alps have larger and higher mountain peaks as compared to the Carpathians, this habitat type is rather representative of the Alps than of the Carpathians. But despite of all differences the alpine bioregion is well represented in the Carpathians as well, with a large mountainous and subalpine level, the alpine level covering a smaller area in few mountain ranges and peaks exceeding an altitude of 2,000 m.

All these mountains show visible traces of the quaternary glacial period with glaciers on a smaller (Pyrenees) or larger scale (Alps). Glaciers do not exist in the Carpathians, but witnesses of the quaternary glacial period are still existent: glacial lakes, glacier calderas and U-shaped glacial valleys, moraines and numerous glacial relict habitats, arctic-alpine relict plants, plant communities and fauna species. Glacial geomorphologic forms and their specific habitats mainly occur in the North-Western part of the Carpathians i.e. in the Slovakian Tatra Mountains, the Southern Carpathians (Făgăraş, Cindrel, Parâng, Retezat and Țarcu-Godeanu Mountains) called “Transylvanian Alps” in older scientific papers, as well as in the Rodna Mountains of the Eastern Carpathians (Ozenda, 1988, 1994; Oancea et al., 1987; Drăgulescu, Schneider and Benedek, 2007).

The Interpretation Manual of European Union habitats EUR 27 (2007) lists the Alpine pioneer formation of Caricion bicoloris-atrofuscae under number 7240 (Palearctic classification 54.3), a priority habitat with Alpine, peri-Alpine and Northern British communities. They are colonising neutral to slightly acid gravel, sandy, stony, sometimes slightly argillaceous or peaty substrates that are soaked by cold water in moraines and along the edges of springs, rivulets, glacial torrents of the alpine or sub-alpine levels of pure, cold, slowly running rivers and calm backwaters. Permanent or ongoing ground frosts that persist for a longer period of the year are essential for the existence of this habitat type.

The low vegetation of this habitat type is mainly composed by species of *Carex* and *Juncus* of the Caricion bicoloris-atrofuscae alliance. Characteristic plants of this habitat type are *Carex atrofusca, Carex bicolor, Carex maritima, Carex microglochin, Carex vaginata, Juncus alpino-articulatus, Juncus arcticus, Juncus castanaeus, Juncus triglumis, Kobresia simpliciuscula, Typha lugdunensis, Typha minima, Typha shuttleworthii, Tofieldia pusilla.*

The corresponding categories of the German classification are "6402 Alpine Schwemmböden mit niedriger Vegetation" (Alpine alluvial soils with low vegetation), for the Northern vegetation types "3422 *Carex atrofusca-Drepanocladus revolvens*-typ" and "3423 *Carex saxatilis-Drepanocladus revolvens*-typ". The habitat is mentioned as being associated to humid, extensively managed meadows and communities of the Caricion davallianae alliance that are part of the same Tofieldietala order as is the alliance Caricion bicoloris atrofuscae Nordh. 1939 (= Caricion maritimae Br.-Bl-ap. Volk, 1939).

The comprehensive habitats work on all Romanian habitats, considering not only those of community interest (Doniță et al., 2005) mentions the habitat type 7240 Alpine pioneer formations of Caricion bicoloris-atrofuscae for Romania (Romanian habitat number R5403). However, this habitat type title comprises following the above mentioned authors the South-Eastern Carpathian meso-oligothrophic bogs and fens with *Carex rostrata* and *Sphagnum recurvum* and not pioneer habitats of alpine alluvial sites, initial phases of fens as well as transition stages to vegetation of snowmelt depressions. Schneider and Drăgulescu (2005) mention the habitat type for Romania noting that the characteristic species are present, but that its existence has to be confirmed and that the repartition of this habitat type still has to be clarified by additional studies.

In the Interpretation Manual for Romania the habitat type is mentioned "with uncertain presence in Romania" (Gafta and Mountford, 2008). This statement is justified by the mentioned authors with the evidence that no corresponding associations have yet been described for Romania, the Caricion bicoloris-atrofuscae alliance has not been indicated for Romania, *Carex bicolor* is mentioned only for the Rodna Mountains and following recent data *Carex atrofusca* is (Ciocârlan, 2009) lacking completely in the Rodna Mountains and in the whole Romanian Carpathians.

The wish to contribute to the clarification of these different facts and opinions gave the impetus to analyse the habitat in its repartition with all characteristic site conditions and species of plants as well as typical macroinvertebrates for such pioneer areas of seepages, springs, smaller and larger water courses, snowmelts, to compare the habitat type 7240 from different area and to find an answer to the question, if the habitat type, even in fragments, can be considered as present in the subalpine and alpine bioregion of the Carpathians.

MATERIALS AND METHODS

The priority habitat type *7240 (European Commission, 2007) has been subject to a comparative analysis of different sites of the alpine bioregion Europe - Alps in Germany, Switzerland, Austria, Italy (Ssymank et al., 1998; Pouchol, 2001; Le réseau Natura 2000 France 2010; Oberdorfer et al., 1998; Ellmauer and Traxler, 2000; Ellmauer, 2005; Provincia Autonoma di Bolzano-Alto Adige, 2011) and the Carpathians with special regard to the Rodna Mountains. It has been effected with special regard to interrelations with neighbouring habitat types in similar site conditions such as seepage area, snow melting area, spring area and alpine rivulet courses with chiono-hygrophytes as part of the Montio-Cardaminetea (Coldea, 1990) class.

The repartition area of characteristic species for the alliance Caricion bicoloris-atrofuscae of the order of Tofildietalia Prsg ap. Oberd. 1949 (=Caricetalia davallianae Br.-Bl. 1949), classe Scheuchzerio-Caricetea nigrae Nordh. 1936 in the bioregion has been considered as well. The points analysed were not only the repartition of characteristic species of the phytocoenological units mentioned, but also the phytocoenological units themselves on the basis of literature data. They were brought together with data of own field experiences in the Alps and Carpathians. Parallel to this data concerning typical fauna elements of the habitat type and generally of the alpine alluvial wetland types, in particular Carabidae species of the *Bembidion* and *Nebria* genus have been considered in the analysis of the habitat type. These data were presented in synthetic tables.

RESULTS AND DISCUSSIONS

Ongoing from the general description of the habitat type in the Interpretation Manual (EUR 27/2007), data of countries with alpine bioregions have been analysed to compare these data to those that are indicated as being characteristic of this habitat in each country.

The habitat type represented by the Caricion bicoloris-atrofuscae alliance is well developed in Northern Europe, in the Alps, however, it constitutes a rare glacial relict (Ozenda, 1988). The alliance's eponymous species, i.e. the small sedges *Carex bicolor* and *Carex atrofusca*, are both circumpolar arctic-alpine species (Meusel, Jäger and Weinert, 1965). In Central Europe *Carex bicolor* merely occurs in the Central Pyrenees and disjunctly in the Central Alps and the Northern part of the Carpathians (Meusel, Jäger and Weinert, 1965, p. 108), reaching the Southern border of its distribution in the Alpine mountain system. Few dispersed populations of *Carex atrofusca* in Central Europe could merely be located in the Central Alps and the Carpathians (Meusel, Jäger and Weinert, 1965, p. 109). Both species are rare (Ozenda, 1988; Adler, Oswald and Fischer, 1994; Oberdorfer, 2001) and occur mainly in alpine, to some extent in subalpine bog and marshland communities or in seepage and high altitude alluvial areas. In these spots *Kobresia simpliciuscula*, *Trichophorum pumilum*, *Carex maritima*, *Carex microglochin*, *Tofieldia pusilla* and others may be found all the same (Tab. 1). Both species altogether give the impression that even ecologically speaking they are of arctic provenance (Meusel, Jäger and Weinert, 1965).

The data on the Carpathians *Carex bicolor* regard the Rodna Mountains in the Northern part of the Eastern Carpathians, where the species originating from the Izvoru Mare Valley occurs on alpine, wet gravel area (Nyàrády, 1966). This specification has also been made by Oprea (2005) and Ciocârlan (2000, 2009). Two further locations have been recorded in the Rodna Mountains, in particular Obârşia Rebrei (springs of the Rebra Rivulet) and the Izvorul Cailor-Mountains, where they have been found at an altitude of 1,670 m (Oprea, 2005, pursuant to studies by I. Resmeriță 1973 and 1975-1987).

Carex atrofusca has also been mentioned for the Rodna Mountains/ Carpathians (Nyárády, 1966, p. 804-807), however, following newer data, *Carex atrofusca* Schkuhr does not occur in the Carpathians (Ciocârlan, 2000, 2009), only *Carex atrofusca* auct. non Schkuhr = *Carex atrata* L. In this context Oprea (2005) observes, that *Carex atrofusca* Schkuhr is mentioned in the online data bank of Flora Europaea (www.euromed.org.uk) and notwithstanding this Ciocârlan (2000) states its non-occurrence.

Habitat type 7240 is listed among the alpine habitat types of Germany (Ssymank et al., 1998), however, it merely occurs in an impoverished form. *Juncus alpinus* is considered as dominant species, characteristic species are *Carex microglochin, Equisetum variegatum, Juncus alpinus, Juncus triglumis, Kobresia simpliciuscula, Tofieldia pusilla, Typha minima* and *Typha shuttleworthii*. The following associations belong to this habitat type and are represented by the Caricion-bicoloris atrofuscae alliance (= Caricion maritimae): Astero bellidiastro-Kobresietum simpliciusculae (Br.-Bl. ap. Nadig, 1942) Dierssen 1982 Caricetum maritimae Br.-Bl. 18, Juncetum alpino-articulatae (Oberd. 57) Philippi 1960 and Equiseto-Typhetum minimae Br.-Bl. ap. Volk 49 (Ssymank et al., 1998).

In France the habitat type occurs in altogether 20 areas situated in the Central Pyrenees, the areas of Provence-Alpes-Côte D'Azur and Rhône-Alpes (Le réseau Natura 2000 en France 2010, http://natura2000.environment.gouv.fr/habitats/HAB7240.html). For France, the associations belonging to this habitat are the following: Juncetum arctici, Junco triglumis-Caricetum bicoloris caricetosum maritimae, Junco triglumis-Caricetum bicoloris caricetosum bicoloris, Caricetum microglochinis caricetosum microglochinis, Caricetum microglochinis caricetosum scirpetosum pumili, Caricetum microglochinis caricetosum kobrietosum simpliciusculae, Caricetum atrofusco-vaginatae.

For the Swiss Alps the alpine formations of the *Caricion bicoloris-atrofuscae* FFH habitat type 7240 have been summarized in an outline (Pouchol, 2010; WWF-Switzerland). In the Central Alps (Switzerland) the vegetation of the Caricion bicoloris-atrofuscae alliance, which is now contained as habitat type 7240 in the list of FFH habitat types has been proven with characteristic communities: Kobresietum simpliciusculae Br.-Bl. ap. Nadig 1942, Caricetum maritimae Br.-Bl. 1918, community of *Juncus arcticus*, Caricetum frigidae Rüb. 1912, and Juncetum alpini (Oberd, 1957) Phil. 1960 (Görs, 1998; Steiner in Grabherr and Mucina, 1993).

In the Austrian Alps the habitat type has been proven in the Salzburg area, Carinthia and Tyrol, the broadest and most representative habitats of this type occurring in the Hohe Tauern National Park (Ellmauer and Traxler, 2000; Ellmauer, 2005; www.hohetauern.at/Natur-Wissen/Wissenschaft.Forschung). This is where species-abundant occurrences of *Carex bicolor* may be found. The typical phytocoenological units represented in the Austrian Alps included in this habitat type are the alliance Caricion atrofuscae-saxatilis Nordh. 1943 (=Caricion bicoloris-atrofuscae Nordh. 1936) with the associations Juncetum castanei Wagner 19665 and Astero bellidiastro-Kobresietum simpliciusculae (Br.-Bl. in Nadig 1942) Dierßen 1982, and the alliance Caricion davallianae Klika 1934 with the associations Juncetum alpini Philippi 1960 and Equiseto variegati-Typhetum minimae Br.-Bl. in Volk 1940 (Grabherr and Mucina, 1993).

In the Italian part of the Alps, the habitat type 7240 with characteristic species and phytocoenological units included is mentioned in the area of the Nature Park Rieserferner-Ahrn, Nature Park Sextner Dolomiten and the Nationalpark Stilfser Joch (Provincia Autonoma di Bolzano-Alto Adige, 2011).

No characteristic associations of this alliance have been recorded for the Romanian Carpathians (Sanda, Öllerer and Burescu, 2008). Merely one association of the Swertio perennis-Caricetum chordorrhizae Coldea (1986) 1990 that has been found in the glacier caldera of Gărgălău in the Rodna Mountains is assigned to the Tofieldietalia order, alliance Caricion davallianae and have some species which occurs also in the

Caricion bicoloris-atrofuscae alliance representing the habitat type 7240. In the Ţarcu-Godeanu-Mountains/Southern Carpathians is mentioned the order Tofieldietalia, alliance Caricion davalllianae only with one association Carici flavae-Eriophoretum (Boşcaiu, 1971).

For the Rodna Mountains phytocoenoses of the Tofieldietalia order (which include the Caricion bicoloris atrofuscae alliance), are quoted as sporadic and small-scale occurrences (Coldea, 1990). However, when analyzing the presence of this habitat's very specific species and their repartition in the Carpathians, more especially in the Rodna Mountains, it becomes apparent that these species occur all the same in characteristic sites of this habitat type in the Rodna Mountains, even though on a small scale and in close interaction with further habitat types. Comparable habitats may be found in the Făgăraş, Parâng, Retezat and Ţarcu-Godeanu Mountains of the Southern Carpathians also on a small scale. In the Ministerial Order No. 776/6.VI.2007, annexe 4 are listed four sites of community interest including the habitat type 7240. These sites are: 19. Căliman-Gurghiu Mountains, Eastern Carpathians, 122. Făgăraş Mountains, Southern Carpathians 125. Rodna Mountains, Eastern Carpathians and 217. Retezat Mountains, Southern Carpathians (Minsterul Mediului şi Dezvoltării Durabile 2007).

Arctic-alpine species that are characteristic for this habitat type, for example such as *Carex bicolor*, *Juncus castaneus*, *Juncus triglumis*, *Kobresia simpliciuscula* and *Juncus alpinoarticulatus*, occur on wet alluvial soils and spring sites, in seepage areas, along brooks and in the marshes of the Rodna Mountains (Ciocârlan, 2009; Nyárády, 1966). The Izvorul Mare-area, where the first *Carex bicolor* plant have been recorded (Nyárády, 1966), also shelters *Juncus castaneus* and *Juncus triglumis*. Further areas of the Rodna Mountains offer sites to specific species of this specific habitat type (Oprea, 2005; Ciocârlan, 2009). *Juncus triglumis, Juncus alpinoarticulatus, Kobresia simpliciuscula* and *Carex atrata* are known for various mountain ranges of the Southern Carpathians (Nyárády, 1966; Boşcaiu, 1971; Ciocârlan, 2009; Drăgulescu, 2010) and may be counted among the habitat type 7240 species.

Even associations specific for alpine seepages such as e.g. Doronico carpatici-Saxifragetum aizoidis Coldea 1990 comprise species like *Juncus triglumis* or *Juncus alpino-articulatus* that are also characteristic of habitat type 7240. A close interaction of habitat type 7240 with springs of the Cratoneuro commutati W. Koch 1928 alliance and the interrelation with snowmelt area vegetation become apparent here. When comparing the data of site specific conditions and characteristic species (Tabs. 1, 2 and 3) of the alpine habitat type to the habitat type's characteristic species that occur as well in the Rodna Mountains, it stands to reason that the occurrence, even though fragmentary, is assured for the Rodna Mountains. Except for the Central Alps this habitat type usually occurs in fragments and on a very small scale (Steiner, 1993, in Grabherr and Mucina, 1993). The habitat type's fundamental site factor, i.e. continuous ground frosts that persist for a major part of the year, is given for some places of the subalpine and alpine level of the Rodna Mountains and for all alpine areas of the Carpathians.

For the Northern respectively northwestern part of the Carpathians, especially the High Tatra Mountains, fragmentary occurrences of the habitat type have to be assumed even though they have not been quoted for Slovakia (Seffer and Lasák, 2004). Also in the High Tatra Mountains of Poland, the Northern side of the Tatra it is possible to find fragments of the habitat type 7240 as site conditions as alpine alluvial soils, rivulets, springs, seepage area, snowmelt depressions are know from the area (Mirek and Piekos-Mirkova, 1992).

Table 1: Dominant and characteristic species mentioned for the habitat type 7240 in France (F), Germany (G), Switzerland (Sw), Italy (It), Austria (A) existing also in the Rodna Mountains.

	1	2	3	4	5	6
Mountains	Alps	Alps	Alps	Alps	Alps	Carp
	F	G	Sw	It	A	Ro
Caricion bicoloris-atrofuscae = Caricion maritimae						
Carex bicolor	+	-	+	+	+	+
Carex atrofusca	+	-	+	-	+	(+)
Carex maritima	+	-	+	+	+	-
Juncus arcticus	+	-	+	+	+	-
Juncus castaneus	-	-	-	-	+	+
Trichophorum pumilum	+	-	+	+	-	-
Carex microglochin	+	+	-	+	-	-
Equisetum variegatum	-	+	+	-	-	-
Carex vaginata	-	-	-	+	+	-
Kobresia simpliciuscula	+	+	-	+	-	+
Tofieldia pusilla	+	+	-	+	-	-
Typha minima	-	+	-	-	+	-
Typha shuttleworthii	-	+	-	-	-	-
Caricetalia davallianae = Tofieldietalia						
Juncus alpinoarticulatus (= *alpinus*)	+	+	+	+		+
Juncus triglumis	-	+	-	+	-	+
Bartsia alpina	+	-	-	+	-	+
Carex capillaris	+	-	-	-	-	-
Carex davalliana	+			+		
Carex frigida	+			+		
Eleocharis quinqueflora	+	-	-	-	-	-
Equisetum variegatum	+	-	-	-	-	-
Parnassia palustris	+	-	-	-	-	+
Primula farinosa	+	-	-	+	-	-
Saxifraga aizoides	+	-	-	+	-	+
Sesleria coerulea	-	-	-	+	-	+
Trichophorum caespitosum	-	-	-	+	-	-
Aster bellidiastrum	+	-	-	+	-	-
Carex lachenalii	-	-	-	+	-	+
Carex nigra (*C. fusca*)	-	-	-	+	-	+
Deschampsia caespitosa	-	-	-	+	-	+
Mooses						
Meesia uliginosa	-	-	+	-	-	-
Oncophorum virens	-	-	+	-	-	-
Catoscopium nigritum	-	-	+	-	-	-
Pohlia wahlenbergii	-	-	-	-	+	+

In France are mentioned as frequently occuring in the habitat type 7240 also the following species: *Polygonum viviparum*, *Salix foetida*, *Saliex reticulata*, *Salix retusa*. This list include only the mentioned species in the FFH habitats lists of the countries and the species of the habitat type occuring in Rodna Mountains following one experience in Carpathians/Rodna Mountains and data from literature.

Besides these habitat-specific plant species, certain animal species are just as characterstic of this habitat as they are bound to alpine alluvial sites, seepage areas, snowmelt areas, rivulets, spring areas, initial stades of fens and fens. Moreover, their habitat requires a well determined ground and vegetation structure with specific moisture conditions as well. This mainly concerns ground beetles (Carabidae) species of the Bembidion genus and various Nebria species (Burmeister, 1939; Csiki, 1946; Hurka, 1975).

The data gathered in the Alps of Germany (Ssymank et al., 1998), Switzerland (WWF/CH Pouchol, 2010) and Austria (Elmauer, 2005), - unfortunately no faunistic data were available for France - have been pooled in a comparative table (Tab. 2) together with the data obtained in the Romanian Carpathians/Rodna Mountains (Hurka, 1975). Some species of this habitat type such as *Nebria hellwigi* Panzer and *Nebria germari* Heer, occur only in the Alps, others both in the Alps and in the Carpathians as e.g. *Bembidion bipunctatum* L., *Nebria jokischi* Sturm, further species such as *Bembidion glaciale dacicum* Jeannel, *Nebria transsylvanica* Germ., *Nebria carpathica* Fuss, *Nebria reitteri* Ryb. ssp. *rodnaensis* Horv., *Nebria tatrica* Mill., *Nebria reichi* Dej. var. *Bissenica* E. A. Bielz do only occur in the Carpathians if not merely in the Rodna Mountains (Csiki, 1946; Hurka, 1975, 1997) in typical site conditions of the habitat type 7240 (Burmeister, 1939; Csiki, 1946).

Bembidion glaciale dacicum Jeannel, *Bembidion bipunctatum* L. ssp. *nivale* Heer, *Nebria transsylvanica* Germ. are mentioned from the alpin level of Rodna Mountains (Hurka, 1975) on rivulets, springs, around snowmelt area und seepage area (Csiki, 1946; Hurka, 1975), (Tab. 3).

For the habitat type are mentioned in the Alps (Austria, Switzerland) also a butterfly species *Arctia flavia* (Ellmauer, 2005; Pouchol, 2010) and in the Alps in Germany and Austria the spider species *Pardosa saturatior* (Ellmauer, 2005; Ssymank et al., 1998), *Pardosa pedestris* and *Arctosa alpigena* (Ssymank et al., 1998).

Table 2: Ground beetle species of the habitat type 7240 in the Alps (France/F, Switzerland/Sw, Italy/It, Germany/G, Austria/A) and their occurence in similar site conditions in the Carpathians/Rodna Mountains.

Species	Alps F	Alps Sw	Alps It	Alps G	Alps A	Carp. all	Rodna Mount.
Bembidion bipunctatum L.				+	+	+	+ niv.
Nebria crenatostriata Bossi		+	+				
Nebria germari Heer				+	+		
Nebria gyllenhali Schoenb.				+			+
Nebria hellwigi Panzer				+			
Nebria jockischi Sturm		+			+	+	+
Nebria laticollis Dejeau	+	+	+				

The column Carpathians include the whole high mountains with alpine level/belt apart from Rodna Mountains, which are given in a separate column.

Tab. 3: Ground beetle species occuring in the Carpathians, in particular in the Rodna Mountains in site conditions of habitat type 7240, alpine wet area (seepage area, springs, rivulets, snowmelt area).

Species	Carpathians/Rodna Mountains
Bembidion bipunctatum L. ssp. nivale Heer	alpine level snowmelt area in Rodna Mountains, Southern Carpathians: Făgăraş, Parâng, Retezat (Hurka, 1975)
Bembidion glaciale dacicum Jeannel	alpine level rivulets, seepage area, springs Rodna Mountains, (Hurka, 1975, 1997)
Nebria carpathica Fuss	Alpine level on snowmelt area, Southern Carpathians (Burmeister, 1939)
Nebria fuscipes Fuss (=Nebria fussi Bielz)	North-Eastern Carpathians, Rodna Mountains (Csiki, 1946)
Nebria gyllenhali Schönb.(= *Nebria rufescens* Stroem)	Subalpine level on rivulets Rodna Mountains, (Hurka, 1975)
Nebria jockischi Sturm ssp. *hoepfneri* Dej.	Subalpine and alpine level seepage area, rivulets Rodna Mountains (Csiki, 1946; Hurka, 1975), Southern Carpathians (Csiki, 1946)
Nebria reichi Dej. var. *bissenica* E. A. Bielz	Subalpine and alpine level, rivulets and seepage area, Southern Carpathians, Făgăraş Mountains
Nebria reitteri Ryb. *radnaensis* Horv.	Alpine level rivulets, seepage area Rodna Mountains, (Csiki, 1946)
Nebria tatrica Mill.	Alpine level rivulets, springs, seepage area Carpathians Tatra (Csiki, 1946; Hurka, 1997)
Nebria transsylvanica Germ.	Alpine level on rivulets, springs, snowmelt area Carpathians Tatra, Rodna Mountains to Southern Carpathians (Burmeister, 1939; Csiki, 1946; Hurka, 1975)
Trechus fontinalis Ryb.	Subalpine level Rodna Mountains, on rivulets, springs (Hurka, 1975)

The habitat type 7240 lives on changes and on a certain dynamics. The prerequisite for its long term sustainability is a periodical disturbance of the sites which is mainly assured by the water: flooding of the sites, aggradation and erosion processes, solifluction and alterations caused by frost and thawing. Whenever site conditions stabilize this leads to a suppression of the species occurring on these alpine alluvial sites by more competitive fen species (see also Ellmauer, 2005). Under stable conditions the habitat may thus transform into a calcareous lightly basiphilous or neutrophilous fen and be replaced by succession processes.

CONCLUSIONS

The registration of characteristic sites whilst considering not merely plant but also animal species can help provide a more exhaustive illustration of the habitat type.

Both long-lasting ground frosts and periodical disturbances caused by the waters represent this habitat type's major site factors.

Protosoil sites (alluvial soils) that are influenced by cold water, snowmelt runoff and ground frosts, seepage areas and springs are among the characteristic sites of this pioneer habitat and occur in the Rodna Mountains. They have also been recorded as *Carex bicolor* sites. The occurrence of further arctic-alpine plant species and their sites, all of them characteristic of this habitat type prove the existence of the latter, even though it occurs in fragments and on a small scale. Moreover, what comes along are the various beetle species, arctic-alpine species all the same, that are bound to this kind of pioneer sites. They emphasize also the habitat's relevance as glacial relict.

It may thus be concluded that the biological-ecological relevance of the habitat type altogether depends on its arctic-alpine plant and animal species, i.e. on glacial relicts of special bio-geographical interest. In this respect the Rodna Mountains play a major role as some species such as e.g. *Carex bicolor* or *Juncus castaneus* reach the southernmost point of their disjunct repartition here. Also some ground beetles are located only in these specific habitats in the Rodna Mountains (Hurka, 1997).

Even though the habitat type merely occurs on a small scale, or right therefore, its characteristic species and their repartition are of special relevance. The presence of characteristic species - even though not of all of them - constitutes the only and most important identifying feature of this habitat type (Pouchol, 2010).

Given that the Carpathians' alpine belt is not very broad (Ozenda, 1994), its sustainability and that of further alpine habitat types is threatened with extinction by global warming. This is why it deserves our special interest.

A comparative evaluation of the habitat type's occurrence data and its respective phytocoenosis' in the Alps and the Carpathians reveals clearly that fragmentary sites of the habitat type have been considered all the same and that its existence in an area may even be proven on the basis of such fragments, to which great value is attached (Ozenda, 1988; Ssymank et al., 1998; Ellmauer and Traxler, 2000; Ellmauer, 2005).

The whole complex of site factors, habitat structures and species, plants and animals, mainly macroinvertebrates such as spiders, beetles, butterflies and gastropods, is of major importance as for the identification and delimitation of the habitat type. It frequently reveals necessary to consider very small-scale, mosaic-like areas that are in close interaction with further habitats, e.g. springs, snowmelt depressions plant communities, wetland meadows and fens.

The dynamic factor, i.e. the hydrological dynamics and possible changes in the morphological condition as a consequence of hydrological changes after snowmelt as well as changing water courses, is of major importance for a long term sustainability of this habitat type.

Considering the biogeographical importance of the habitat, it reveals fundamental to study the characteristic sites in greater detail and make them undergo a long-term monitoring.

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TERRESTRIAL GASTROPOD FAUNA OF THE REPEDE RIVER VALLEY IN THE RODNA MOUNTAINS NATIONAL PARK (TRANSYLVANIA-MARAMUREŞ, ROMANIA)

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KEYWORDS: Romanian Carpathians, Rodna Mountains, Repede River valley, terrestrial gastropods, diversity, human impact.

ABSTRACT

In the frame of investigating the flora and fauna of Rodna Mountains National Park, this paper aims to supplement the data on the fauna of terrestrial gastropods of the area. The study analyzes the terrestrial gastropod fauna of Repede River Valley in the Northern area of Rodna Mountains National Park. Qualitative samples were taken from 7 locations between Vişeu River and the confluence of Repede River with Buhăescu. After analyzing the collected material, 33 species were identified. In each sampling station were identified 5 to 17 terrestrial gastropod species, the highest value was recorded in the town of Borşa. Among the species the more common are *Monachoides vicinus, Faustina faustina* and *Trichia bielzi.*

RĖSUMĖ: La faune de gastéropodes terrestres de la vallée de la rivière Repede du Parc National des Montagnes de Rodna (Transylvanie-Maramureş, Roumanie).

Dans le contexte de l'investigation de la flore et la faune du Parc National des Montagnes de Rodna, ce papier vise à compléter les données sur la faune de gastéropodes terrestres de la région mentionee. La présente étude analyse la faune de gastropodes terrestres de la vallée du Rivière Repede, dans le nord du Parc National. Des prélèvements qualitatifs ont été réalisés en 7 points entre la Rivière Vişeu et la confluence de la Rivière Repede avec Buhăescu. Apres l'analyse, 33 espèces de gastropodes terrestres ont été identifiées. Le nombre d'espèces dans chaque point de prélèvement varie entre 5 et 17, le plus élève étant identifie dans la ville de Borşa. Parmi les espèces le plus communes sont *Monachoides vicinus, Faustina faustina* et *Trichia bielzi.*

REZUMAT: Fauna de gastropode terestre din valea râului Repede în Parcul Național Munții Rodna (Transilvania-Maramureş, România).

În contextul investigării florei şi faunei Parcului Național Munții Rodnei, lucrarea de față își propune să completeze datele referitoare la fauna de gastropode terestre a zonei menționate. Lucrarea analizează fauna de gastropode terestre din Valea Râului Repede, în nordul Parcului Național Munții Rodna. Au fost colectate probe calitative din 7 stații amplasate de la vărsarea în Vişeu până la confluența cu pârâul Buhăescu. În urma analizei materialului colectat au fost identificate 33 de specii de gastropode terestre. Numărul de specii identificate în fiecare stație este cuprins între 5 şi 17, cel mai mare număr de specii fiind înregistrat în localitatea Borşa. Speciile cele mai comune în probele analizate sunt *Monachoides vicinus, Faustina faustina* şi *Trichia bielzi.*

INTRODUCTION

The study area (Fig. 1) is located in the northern part of the Rodna Mountains National Park, northern Transylvania and Maramureş areas.

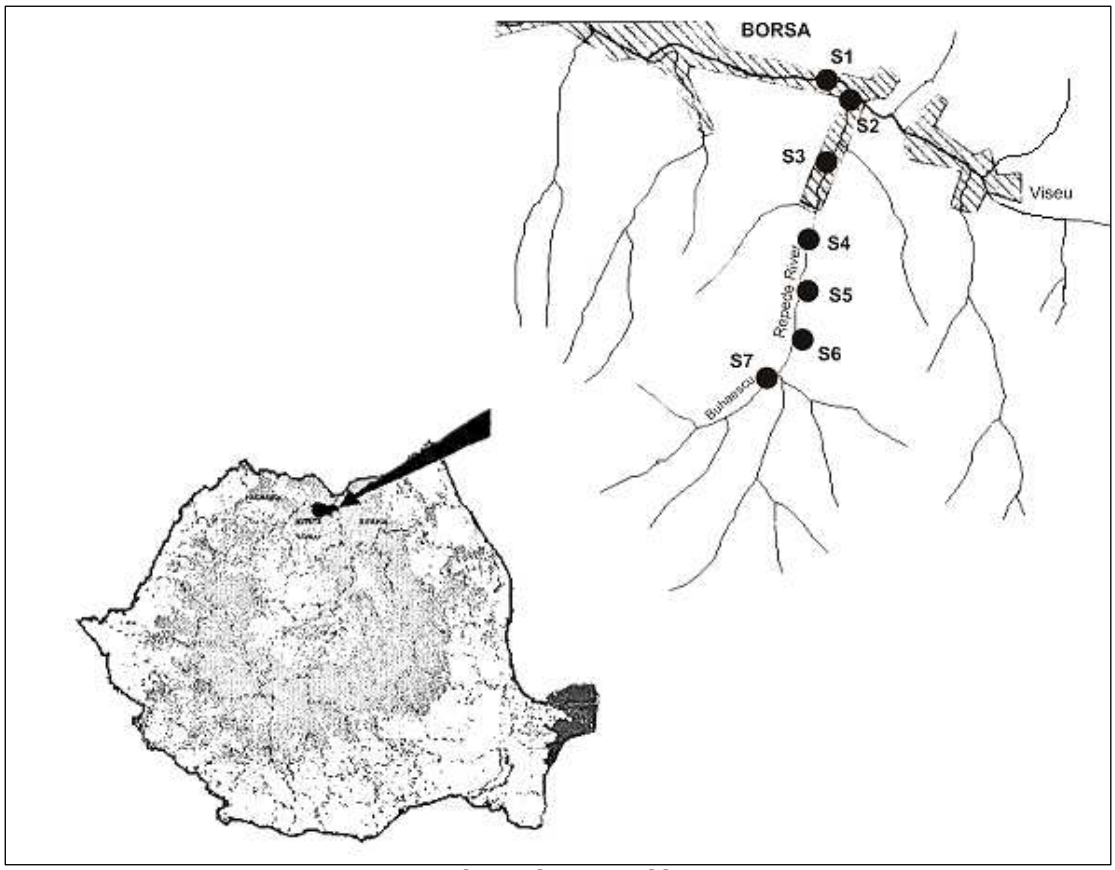

Figure 1: The study unit and location.
(Badea et al., 1983; http://www.parcrodna.ro/ - modified).

Concerning the geology, the studied area is localized on crystalline schists substrata, as is the most important part of the Rodna Mountains. The limestone substrata are present only in the south-western area of these mountains. Favored by heavy rainfalls, the natural grasslands are present here on extended surfaces, most of them being constantly overgrazed. This human activity (grazing) has lead in the most of the past decades to a high local and regional degradation, Repede River valley being one of the most affected from this point of view (Iacob, 1987). Spruce forests cover over 75% of the forested area.

The first data concerning gastropods of the Rodna Mountains area are known since the XIX Century (Bielz, 1867; Kimakowicz, 1883, 1890, 1894). Only after a long period, almost a century later, in his valuable and comprehensive work, Grossu (1981, 1983, 1987), presents new data regarding also about this area, but they are most often sporadic and incomplete. More recent studies are more or less directly related to this mountainous area. Some papers present the snail fauna of the neighboring Maramureş Mountains Nature Park (Fehér et al., 2008; Gheoca et al., 2008;

Sîrbu et al. 2008). Some recent papers concerning the Rodna Mountains where published by Andrei (1997) and Bába and Sárkány (1999), which presents aspects regarding the land snail fauna of the Someş River valley, three of the sampling points being located in the southern area of the Rodna Mountains, on Someşul Mare River, as well as Feher et al. (2008). The last one presents a synthesis of data from the scientific literature and some still unpublished material from the Wagner collection of Hungarian Nature History Museum, including some data from the Rodna Mountains area.

The present study aims to examine the terrestrial gastropods fauna of Repede Valley, in the northern area of Rodna Mountains National Park.

MATERIAL AND METHODS

In this study, qualitative samples were taken during one single campaign, in the month of June in 2009, in the Repede River valley. A total of seven sampling sites were chosen from the Vişeu River to Izvorul Repede - Buhăescu confluence, as shown in the figure 1.

The sampling sites are as follows:

S1 - Vişeu River downstream the confluence with Repede River; modified, with cut wood, and coarse woody debris; vegetation consisting of Salicetum fragilis with *Urtica dioica*, *Impatiens glandulifera* and *Petasites* sp.;

S2 - Repede River in Borşa, at the confluence with Vişeu River; vegetation - Salicetum fragilis with *Urtica dioica*, *Rubus idaeus*, *Dryopteryx filis-mas*;

S3 - Repede River in Borşa; Salicetum fragilis with *Urtica dioica* and *Impatiens glandulifera*; waste deposits on the side of the river;

S4 - 1 km upstream Borşa; rocks with mosses and ferns near the river,

S4 - 3 km upstream Borşa; *Picea abies*, rocks with mosses and ferns on a small side stream;

S5 - 4 km upstream Borşa, exposed rocks on the side of the river;

S6 - 5 km upstream Borşa; small stream with rocks and decomposing logs; wooden vegetation dominated by *Picea abies.*

S7 - 6 km upstream Borşa; Izvorul Repede - Buhăescu confluence; slope which is generally very steep and unstable with much bare ground; *Picea abies*, some damper patches with *Petasites* sp.

The sampling stations were chosen according to the valley's morphology, the habitat type and the type and degree of human impact, in order to highlight the diversity of terrestrial gastropods.

The biological material containing terrestrial gastropods was sorted and analyzed in the laboratory, preserved in 70% alcohol and included in the collections of the "Lucian Blaga" University of Sibiu, Faculty of Sciences, Department of Ecology and Environmental Protection, Zoology Laboratory.

The collected biological material was identified using Grossu (1981, 1983, 1987).

The nomenclature follows Fauna Europaea v. 2.3 (Bank, 2007).

RESULTS AND DISCUSSIONS

In the seven sampling points, we have found 33 terrestrial gastropod species, belonging to 20 families.

The following list presents the terrestrial gastropods taxa identified in the studied area; the taxonomy is based on Fauna Europaea (Bank, 2007); zoogeographical range and ecological preferences: H - hygrophilous; MH - mezohygrophilous; M - mezophilous; MX - mezoxerophilous), mentioning the collecting points.

Ordo Pulmonata Cuvier, 1814

Fam. Carychiidae Jeffreys, 1830

1. *Carychium tridentatum* (Risso, 1826)
   European; H. S2;

Fam. Succineidae

2. *Succinea putris* (Linnaeus, 1758)
   Eurosiberian; H. S2;
3. *Succinea oblonga* (Draparnaud, 1801)
   Eurosiberian; H. S2;

Fam. Cochlicopidae Pilsbry, 1900

4. *Cochlicopa lubrica* (O. F. Müller, 1774)
   Holarctic; H. S2;

Fam. Orculidae Pilsbry, 1913

5. *Sphyradium doliolum* (Bruguière, 1792)
   Central-South European; original data: S4;

Fam. Valloniidae Morse, 1864

6. *Acanthinula aculeata* (O. F. Müller, 1774)
   European; M. Original data: S4;

Fam. Enidae Woodward, 1903

7. *Ena montana* (Draparnaud, 1801)
   European; MH. original data: S6;

Fam. Punctidae Morse, 1864

8. *Punctum pygmaeum* (Draparnaud, 1801)
   European; M. Original data: S6;

Fam. Clausiliidae A. Schmidt, 1857

9. *Cochlodina orthostoma* (Menke, 1828)
   European; MH. Original data: S2, S4;
10. *Clausilia dubia* Draparnaud, 1805
    European; MH. Original data: S2, S4, S5;
11. *Ruthenica filograna* (Rossmässler, 1836)
    Central European; M. Original data: S4, S5;
12. *Macrogastra latestriata* (Schmidt, 1857)
    Carpathic; M. original data: S3;
13. *Alinda (Pseudalinda) fallax* (Rossmässler, 1836)
    Carpathic; MH. original data: S1;

Fam. Arionidae Gray, 1841

14. *Arion subfuscus* (Draparnaud, 1805)
    European, MH. original data: S6, S7;

15. *Arion circumscriptus* Johnston, 1828
    European; MH. Original data: S2, S7;
16. *Arion hortensis* (Férussac, 1819)
    European; MH. Original data: S1, S7;
    Fam. Vitrinidae Fitzinger, 1833
17. *Vitrina pellucida* (O. F. Müller, 1774)
    Holarctic; original data: S2;
18. *Semilimax semilimax* (Férussac, 1802)
    Alpino-Carpathic; original data: S2;
    Fam. Pristilomatidae Cockerell, 1891
19. *Vitrea transsylvanica* (Clessin, 1877)
    Central-East European; MH. original data: S2, S4, S5;
    Fam. Oxychilidae Hesse, 1927 (1879)
20. *Nesovitrea hammonis* (Ström, 1765)
    Palearctic; M. original data: S1, S3;
21. *Aegopinella pura* (Alder, 1830)
    European; M. original data: S3;
22. *Aegopinella epipedostoma* (Fagot, 1879)
    Central European; MH. original data: S7;
23. *Oxychilus orientalis* (Clessin, 1887)
    Carpathic; MH. original data: S3, S7;
    Fam. Daudebardiidae Hartmann, 1821
24. *Carpathica calophana* (Westerlund, 1881)
    Carpathic; MH. Original data: S2, S3;
    Fam. Limacidae Rafinesque, 1815
25. *Limax cinereoniger* (Wolf, 1803)
    European; MH. original data: S7;
26. *Bielzia coerulans* (M. Bielz, 1851)
    Central-East European; MH. original data: S7;
    Fam. Bradybaenidae Pilsbry, 1939
27. *Fruticicola fruticum* (O. F. Müller, 1774)
    Palearctic; MH. original data: S2;
    Fam. Hygromiidae Tryon 1866
28. *Perforatella dibothrion* (M. von Kimakowicz, 1884)
    Carpathic; MH. original data: S2;
29. *Monachoides vicinus* (Rossmässler, 1842)
    Central-European; M. original data:S1,S2 S3, S5, S6, S7;
30. *Trichia bielzi* (Schmid, 1860)
    Carpathic; M. original data: S4, S5, S7;
    Fam. Helicidae Rafinesque, 1815
31. *Isognomostoma isognomostomos* (Schröter, 1784)
    European; M. original data: S2, S3, S4, S7;
32. *Faustina faustina* (Rossmässler, 1835)
    Central-Eastern Europe; M. Original data: S1, S2, S3, S4, S6;
33. *Helix pomatia* Linnaeus, 1758
    European; M. Original data: S2;

The number of recorded species per stations varies between 5, for station number 1 and 5, and 17 for station number 2 (Fig. 2).

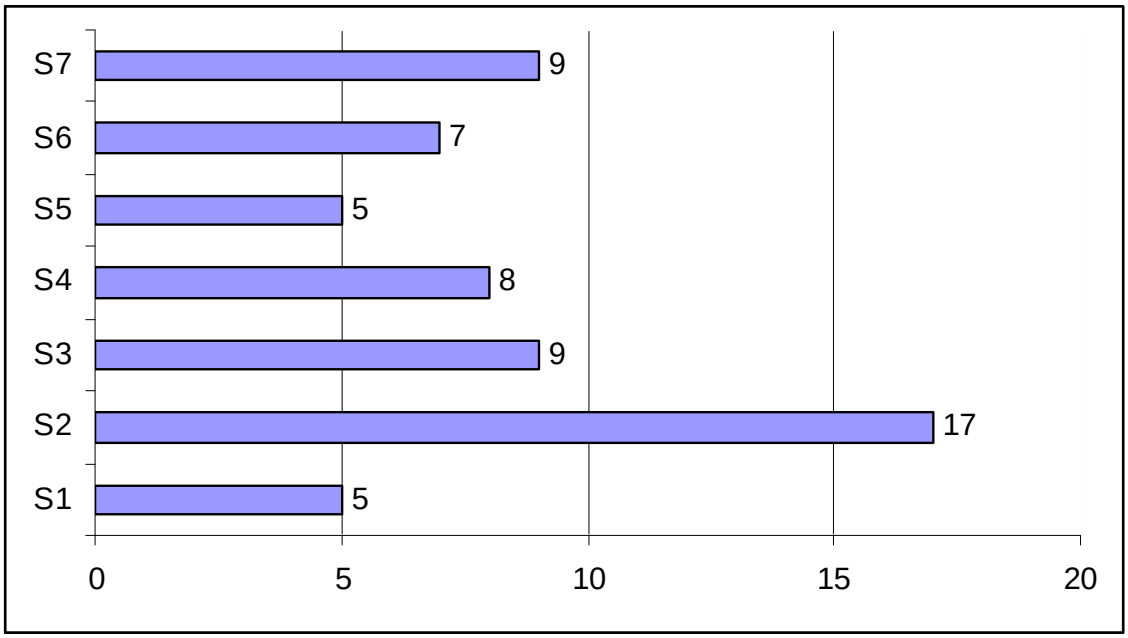

Figure 2: The number of species
in each sampling station (S1-S7).

In general, the diversity is rather low as compared to that reported in other mountainous areas.

The small number of species is probably due to the characteristics of the habitats. Thus, some authors such as Evans (1972), have suggested that soil characteristics are the principal determinants of gastropod species' distributions, while others consider the litter characteristics to be the most important factor, followed by soil characteristics and vegetation type (Bishop, 1977). Many subsequent studies have confirmed the importance of soil characteristics. It is known that lime-rich habitats often support abundant and diverse land-snail communities (Kerney and Cameron, 1979; Nekola, 1999). In fact, one of the most important global trends identified in land-snail ecology is the strong positive correlation between individual abundance, species richness and the pH of soil and organic litter (Hermida, Ondina and Rodreiguez, 2000; Pokryszko and Cameron, 2005).

So, the low diversity can be explained by soil characteristics (crystalline schist) and the presence of spruce forest. There are yet some gastropod species which tolerate well a low pH value. Mänd et al. (2002) find in a study concerning different types of forest in Estonia, that the most common species in pine and spruce forests are *Nesovitrea hammonis, Nesovitrea petronella,* and *Aegopinella pura.* Especially the first one has been found to tolerate lower pH values and calcium levels than other species (Wäreborn, 1970). The restrictive ecological factors as pH and vegetation have effect on terrestrial gastropod diversity outside the town of Borşa (S4-S7).

Although the land snail communities are generally considered to be among the most sensitive to anthropogenic and other disturbances (Frest and Johannes, 1995), frequently the anthropogenic habitats shelter a valuable high diversity of terrestrial snail communities.

Some anthropogenic habitats are characterized by rich herbaceous vegetation (in general with low diversity) - the effect of an anthropogenic contribution to soil fertility. This is completed by humidity conservation in the shelter of buildings and planted wooden vegetation. In these conditions in towns and villages are conserved patches of proper habitats with relatively diverse terrestrial snail communities. Station 2 with the 17 species is an example of such a case.

The other two stations located in the town are much more affected by anthropic impact: station 3 has a relatively rich vegetation but this is covering a layer of household waste, while the only five species present in station 1 are the prove of a more important human impact, the wooden debris present here generate restrictive conditions for the majority of land snails species.

Shirov (1984) considers that the expansion of croplands occurs simultaneously with the development of the human settlements and the anthropogenic mollusks communities are closely correlated with this specific evolution. Among the mollusks species able to successfully colonize agricultural and settlement habitats the author is mentioning *Carichium minimum, Succinea putris, S. oblonga, Oxyloma elegans, Cochlicopa lubrica, Vallonia costata, V. pulchella, Zonitoides nitidus, Nesovitrea petronella, N. hammonis, Deroceras leave* and *D. reticulatum.* Due to anthropogenic activity, many of these species have been able to expand their ranges as the case of *Carichium minimum* and *Succinea putris*.

In our study *N. hammonis* was found only in two of the three stations from Borşa locality, and *Carichium minimum, Succinea putris* and *S. obloga* in one (S2), also inside the town.

Concerning the frequency, the most common mollusk species are *Monachoides vicinus* (found in a total of six stations) and *Faustina faustina* (found in five stations). Less common are *Trichia bielzi* and *Isognomostoma isognomostomos* (found in three stations), while the rest of the mollusk species were found only in one or two points.

CONCLUSIONS

Relatively recent studies on the fauna of the terrestrial gastropods of the Rodna Mountains showed a low diversity compared to other mountains. Thus, Fehér et al, (2008) found 41 species of terrestrial gastropods in their work investigating the whole Maramureş County.

Concerning the diversity distribution along the studied Repede River valley, the highest level was recorded inside the small town of Borşa (17 species), while the sampling points located in natural habitats have a very low diversity (5-9 species/sampling station). This low diversity is due to the local specific soil and also vegetation characteristics. The presence of spruce on crystalline schist acts as a limitative factor on terrestrial gastropod communities. This action is diluted inside the town due to different human activities, which sometimes generate propitious microhabitats for these invertebrates.

The fact that 33 species have been identified in a relatively small area, namely one valley, makes us believe that, all the studies under valuated the terrestrial gastropod fauna diversity of the Rodna Mountains. We can assume a much higher diversity of the whole national park, considering that the most interesting habitat types (limestone) were not yet entirely evaluated.

The conservative importance of this mountainous area imposes in the future a global study of terrestrial snail communities.

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THE LEAF BEETLES FAUNA (COLEOPTERA, CHRYSOMELIDAE) OF THE RODNA MOUNTAINS (TRANSYLVANIA-MARAMUREŞ, ROMANIA)

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KEYWORDS: Romanian Carpathians, Rodna Mountains, Coleoptera, Chrysomelidae, diversity.

ABSTRACT

The paper presents data on the species diversity of the leaf beetles fauna from the Rodna Mountains on the basis of the previously published information and on the material collected from this area between 1995 and 2004. Taxonomical structure of the Chrysomelidae family consists of 43 genera and 138 species, representing about 64% from the total number of leaf beetles species known in the Maramureş region and 24% from the Romanian chrysomelid fauna. *Sclerophaedon carpathicus* Weise, *Chrysolina weisei* (Frivaldszky), *Psylliodes frivaldszkyi* Weise and *Neocrepidodera transsilvanica* (Fuss) are Carpathian endemic species.

RÉSUMÉ: La faune des chrysomelides (Coleoptera: Chrysomelidae) dans les Montagnes de Rodna (Transylvanie-Maramureş, Roumanie).

Ce travail présente des données sur la diversité de la faune de coléoptères chrysomelides dans le Montagnes de Rodna, sur la base de sources bibliographiques et de l'étude du matériel collecté au cours de la période 1995 et 2004. La structure taxonomique de la famille Chrysomelidae comprend 43 genres et 138 espèces, représentant presque 64% du total des espèces de crisomelides connues pour la région de Maramureş et 24% du total des espèces de crisomelides citées dans la faune de Roumanie. Les espèces *Sclerophaedon carpathicus* Weise, *Chrysolina weisei* (Frivaldszky), *Psylliodes frivaldszkyi* Weise and *Neocrepidodera transsilvanica* (Fuss) sont endémiques dans les Carpathes.

REZUMAT: Fauna de crisomelide (Coleoptera: Chrysomelidae) a Munților Rodna (Transilvania-Maramureş, România).

Lucrarea prezintă date, referitoare la diversitatea specifică a faunei de crisomelide, din Munții Rodna, pe baza informațiilor bibliografice şi a materialului colectat, în perioada 1995-2004. Structura taxonomică a familiei Chrysomelidae, include 43 genuri şi 138 specii, ceea ce reprezintă circa 64% din numărul speciilor semnalate în regiunea Maramureş şi 24% din totalul speciilor, citate în fauna României. Speciile *Sclerophaedon carpathicus* Weise, *Chrysolina weisei* (Frivaldszky), *Psylliodes frivaldszkyi* Weise şi *Neocrepidodera transsilvanica* (Fuss) sunt endemice în Munții Carpați.

INTRODUCTION

The first information concerning the coleopterans from the Rodna Mountains, situated in the northern part of the Romanian Eastern Carpathians, were published in the second half of the XIXth century by Frivaldszky (1871) and Bielz (1887). A number of beetle species recorded from this area are found in the catalogues of Petri (1912, 1925).

The Csiki's paper (1951) presents a list with 1343 taxa (collected by the author, together with previous records for this area) from 56 families, including the Chrysomelidae family. Most of the chrysomelid species mentioned here were found on the southern mountainous slopes, on the tributaries of the Someşul Mare River: Băilor Valley, Măriilor Valley, valley of Roşu Rivulet and Saca Valley. Szél et al. (1995) presents few leaf beetles species collected from Borşa. Latest, some papers concerning the coleopterans from Maramureş, also including the Rodna Mountains, were published by: Serafim (1997) - for Cerambycidae and Coccinellidae families; Procheş (1998) - for Curculionidea; Stan (2002) - for Staphylinidae; Maican and Serafim (2001, 2004) and Maican (2007) - for Chrysomelidae; Nitzu et al. (2008), Merkl (2008).

Investigations on the biodiversity of Maramureş region and the National Park "Pietrosul Rodnei" were performed since 1995, within the "Knowledge of the invertebrates of Maramureş" project, developed by the "Grigore Antipa" National Museum of Nature History of Bucharest. The objectives of this project were published by Găldean and Pârvu (1997). Beetwen 1995 and 2004 several collecting trips were performed in Maramureş area: the Maramureş Depression, the catchment areas of the Iza, Mara and Săpânța rivers, the Igniş Plateau, the Țibleş Mountains, the Maramureş Mountains. Two expeditions were carried out in 1995 in the Pietrosul Rodnei Nature Park and on the valley of Iza River.

MATERIALS AND METHODS

The paper presents data about the distribution of the chrysomelid species in the Rodna Mountains, based on the study of the material collected during the expeditions made by "Grigore Antipa" National Museum's team, in the period 1995-2004, and also on records from faunal papers published since 1887 up to 2008.

The subfamilies within Chrysomelidae family are listed in the phylogenetic order, according to Seeno and Wilcox (1982). For each recorded species, the collecting sites and localities, the general distribution and the literature cited are given. The geographic distribution, the nomenclature and systematics are presented after Warchałowski (2003). The zoogeographical classification of the taxa is presented in accordance with information from the Gruev's papers (2006 a, b).

Abbreviations:

S - Siberian complex (EAP - Euro Asiatic Palaearctic: SibE - Sibero-European; SsibE - Southsibero-European; TrPal - Transpalaearctic; Hpal - Holopalaearctic; H - Holarctic; EAAP - Euro-Asiatic-African Palaearctic).

E - European complex (CE - Central European; CEMount - Central European Mountain; Emount - European Mountain; SbM - Submediterranean; EsbM - Eastsubmediterranean);

M - Mediterranean complex (HM - Holomediterranean; EM - Eastmediterranean).

End - Endemic (CarpEnd - Endemic species to the Carpathians; AlpCarpEnd - Endemic species to the Alps and Carpathians).

RESULTS AND DISCUSSION

On the basis of the information obtained until now, 138 chrysomelid species belonging to 11 subfamilies and 43 genera are reported from the Rodna Mountains, representing about 24.2% from the number of leaf beetles species mentioned in the Romanian fauna and 64.4% from the total species recorded in Maramureş region (Tab. 1). Among them, aproximatively 26% are mountainous species (e.g. *Chrysolina globipennis*, *C. hemisphaerica*, *C. carpathica*, *C. marcasitica*, *C. umbratilis*, *Oreina coerulea*, *O. intricata*, *O. Virgulata*, *O. viridis*, *Sclerophaedon carniolicus*, *S. carpathicus*, *Psylliodes glaber*, *Orestia aubei*).

According to the information from the coleopterological literature, the following European endemics of the Alticinae have been recorded in the fauna of the Rodna Mountains: *Orestia aubei*, *Minota carpathica*, *Longitarsus rubellus*, *Longitarsus pallidicornis*, *Neocrepidodera melanostoma* and *Phyllotreta christinae* - all of them being distributed in most part of the European mountains.

Neocrepidodera transsilvanica, *Psylliodes frivaldszkyi*, *Chrysolina weisei* and *Sclerophaedon carpathicus* are endemic species in the Carpathians. Also, *Neocrepidodera cyanescens* is endemic in the Alpine-Carpathian chain. Among the species mentioned in the older literature, *Chrysolina weisei* is a rare mountainous species, possible endemic to the Romanian Carpathians.

The *Minota obesa* presence (Petri, 1912; from the Rodna Mountains) in the Romanian fauna is questionable. According to Gruev et al. (1993), the records of this species in Romania were possible based on the misidentified specimens of *Minota halmae* or *M. carpathica*.

Table 1: The leaf beetles species recorded from the Rodna Mountains.

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Donaciinae Kirby, 1837			
Donacia semicuprea Panzer, 1796	Băilor Valley	Csiki, 1951	British Islands, Southern Scandinavia, Central Europe
Donacia thalassina Germar, 1811	Valley of Roşu Rivulet	Csiki, 1951	Europe, Siberia, North western China, Japan S/EAP/TrPal
Plateumaris sericea (Linnaeus, 1761)	Valley of Roşu Rivulet; Săcel, Izvorul Izei (1 sp., 6.VII.1995, P. C.)	Csiki, 1951; Maican and Serafim, 2004	Europe, Caucasus, Asia Minor, Transcaspia, Siberia, Japan S\EAP\TrPal
Plateumaris consimilis (Schrank, 1781)	Rodna Mts. (without other specifications); Săcel, Izvorul Albastru al Izei (3 sp., 6.VII.1995, P. C.); Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri, 1925; Maican and Serafim, 2001; Merkl, 2008	from Western Europe to Japan S\EAP\TrPal

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Orsodacninae Thomson, 1866			
Orsodacne cerasi (Linnaeus, 1758)	Rodna Mts., Vinului Valley, Valley of Saca Rivulet, Valley of Roşu Rivulet; National Park "Pietrosul Rodnei", Laboratory House 1370 m altitude (1 sp., 11.VII.1995, P. C.); Izvorul Izei (1 sp., 6.VII.1995, P. C.)	Csiki, 1951; Maican and Serafim, 2004	Europe, Caucasus, Asia Minor, Western Siberia S\EAP\SibE
Zeugophorinae Chûjô, 1952			
Zeugophora flavicollis (Marsham, 1802)	Rodna Mts.; Valley of Iza River, 6 km upstream Săcel (1 sp., VI.1998)	Csiki, 1951; Maican and Serafim, 2001	Central and Western Europe E/CE
Criocerinae Latreille, 1807			
Lilioceris merdigera (Linnaeus, 1758)	Rodna Mts.; Băilor Valley	Petri, 1925; Csiki, 1951	from Iberian Peninsula, France to Japan S/EAP/TrPal
Oulema erichsonii (Suffrian, 1841)	Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	Central and Northern Europe
Oulema gallaeciana (Heyden, 1870)	Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	Europe, Danube basin, western Siberia, European Russia S/EAP/SibE
Oulema melanopus (Linnaeus, 1758)	Borşa, Rodna Mts., Izvorul Bistriței, 1,700 m; Staţiunea Borşa, 1,544 m; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	from Ireland, southern Norway and Morocco to western Siberia and Mongolia S/EAP/SibE
Oulema septentrionis (Weise, 1880)	Borşa (Rodna Mts.), 1,200 m altitude	Szél et al., 1995	Central and Northern Europe, Volga basin
Clythrinae Kirby, 1837			
Labidostomis longimana (Linnaeus, 1761)	Măriilor Valley (Someşul Mare Basin)	Csiki, 1951	Europe, Asia Minor, Caucasus, Siberia, Mongolia S/EAP/SibE
Smaragdina flavicollis (Charpentier, 1825)	Vinului Valley (Someşul Mare Basin)	Csiki, 1951	from France and Northern Italy to Ukraine and Northern Turkey; Lithuania, Finland E\CE

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Cryptocephalinae Gyllenhal, 1813			
Cryptocephalus aureolus Suffrian, 1847	Rodna Mts., Ineu Peak, Roşu Mountain, Vinului Valley, Măriilor Valley, Băilor Valley	Petri, 1912; Csiki, 1951	Austria, Hungary, Romania, Balkan Peninsula, Slovenia E\SbM\ESbM
Cryptocephalus flavipes Fabricius, 1781	Corongiş Peak (Rodna Mts.)	Csiki, 1951	Europe, Asia Minor, Caucasus, Central Asia, Siberia S/EAP/SibE
Cryptocephalus frenatus Laicharting, 1781	Valley of Iza River, 6 km upstream Săcel (1 sp., VI.1998)	Maican and Serafim, 2001	Western France, Germany, Poland, Danube and Nistru basins E\CE
Cryptocephalus frontalis Marsham, 1802	Rodna Mts.; Corongiş Peak (Rodna Mts.)	Petri, 1912; Csiki, 1951; Roşca, 1973	Central Europe E/CE
Cryptocephalus hypochoeridis (Linnaeus, 1758)	Rodna Mts.; Saca Valley, Vinului Valley, MăriilorValley; Pietrosul Rodnei (1 sp., 12.VII.1995, S. A.); Săcel, Izvorul Izei (1 sp., 6.VII.1996, P. C.); Borşa, Rodna Mts. (2 sp., 21.VIII.1998, V. A.)	Petri, 1912; Csiki, 1951; Maican and Serafim, 2001	Europe, Asia Minor, Southern Siberia S\EAP\SSibE
Cryptocephalus moraei (Linnaeus, 1758)	Rodna Mts., Vinului Valey, valley of Roşu Rivulet; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri, 1912; Csiki, 1951; Roşca, 1973; Merkl, 2008	Europe (excepting Northern Scandinavia) E/CE
Cryptocephalus ocellatus Drapiez, 1819	Rodna (Someşul Mare Basin)	Csiki, 1951	Europe, Asia Minor, Iran, Kazakhstan, Western Siberia S/EAP/SibE
Cryptocephalus octopunctatus (Scopoli, 1763)	Izvorul Albastru al Izei (1 spec, 17.VI.1998)	Maican and Serafim, 2001	Europe, Kazakhstan, Western Siberia S\EAP\SibE
Cryptocephalus quadriguttatus Richter, 1820	Vinului Valley (Someşul Mare Basin)	Csiki, 1951	Mid, East and South Eastern Europe, Caucasus, Kazakhstan, Western Siberia S\EAP\SibE
Cryptocephalus quadripustulatus Gyllenhal, 1813	Rodna Mts.; Corongiş Peak (Rodna Mts.)	Petri, 1912; Csiki, 1951	Central, East and South Eastern Europe E/CE

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Cryptocephalus querceti Suffrian, 1848	Vinului Valley (Someşul Mare Basin)	Csiki, 1951	North and Central Europe, southwards to the Balkans E\CE
Cryptocephalus sericeus (Linnaeus, 1758)	Rodna Mts.; valley of Saca Rivulet (Someşul Mare Basin); Borşa (Rodna Mts.), 1,200 m altitude	Petri, 1912; Csiki, 1951; Szél et al., 1995	Europe, Asia Minor, Kazachstan, Siberia, North Western China S/EAP/SibE
Cryptocephalus transiens Franz, 1949	Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	Northern Italy, Alps, basin of Danube
Pachybrachis hieroglyphicus (Laicharting, 1781)	Rodna (Someşul Mare Basin)	Csiki, 1951	Europe, Asia Minor, Kazakhstan, Siberia S/EAP/SibE
Pachybrachis sinuatus (Mulsant and Rey, 1859)	Rodna Mts.	Petri, 1912, 1925; Csiki, 1951	Southern France, Central Europe, Balkans, Asia Minor E/CE
Eumolpinae Thomson, 1859			
Bromius obscurus (Linnaeus, 1758)	Săcel, Rodna Mts., Iza Valley, 850 m altitude	Merkl, 2008	Europe, Urals, Siberia, Kazakhstan, Central Asia, Mongolia, North China, Japan, North America S\H
Chrysomelinae Latreille, 1802			
Chrysolina carpathica (Fuss, 1856)	Rodna Mts.	Petri, 1912; Panin, 1944; Roşca, 1974	Carpathians, Sudetes, Stara Planina EMount
Chrysolina cerealis (Linnaeus, 1767)	Rodna Mts.	Panin, 1944	from Great Britain and Northern Spain to basins of Amur and Ussuri TrPal
Chrysolina coerulans (Scriba, 1791)	Borşa (Rodna Mts.), 1,600 m altitude	Szél et al., 1995	from Central France, Italy, Balkan to Asia Minor; E/CE
Chrysolina cuprina (Duftschmid, 1825)	Vinului Valley, valley of Saca Streamlet (Someşul Mare bBsin)	Csiki, 1951	in mountainous regions from Central Europe; E/CEMount
Chrysolina fastuosa (Scopoli, 1763)	Rodna Mts.; Vinului Valley, valley of Saca Rivulet, valley of Roşu Rivulet, Rodna; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri, 1912; Panin, 1944; Csiki, 1951; Merkl, 2008	Europe, Caucasus, Asia Minor, Central and Western Siberia S/EAP/SibE

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Chrysolina fimbrialis (Küster, 1845)	Rodna Mts.	Panin, 1944; Roşca, 1974	Northern Italy, Balkans, Danube River basin
Chrysolina geminata (Paykull, 1799)	Vinului Valley (Someşul Mare Basin)	Csiki, 1951	Europe, Caucasus, Asia Minor E\CE
Chrysolina globipennis (Suffrian, 1851)	Rodna Mts.; Vinului Valley; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri, 1912; Csiki, 1951; Roşca, 1974; Merkl, 2008	Western, Eastern and Southern Carpathians CarpEnd
Chrysolina hemisphaerica (Germar, 1817)	Rodna Mts.	Petri, 1912; Panin, 1944; Csiki, 1951	Alps, Sudetes, Carpathians, Balkans, EMount
Chrysolina herbacea (Duftschmid, 1825)	Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	Europe, Caucasus, Asia Minor, Iran, Afghanistan, Altai S/EAP/SSibE
Chrysolina lichenis (Richter, 1820)	Rodna Mts.; Ineu Peak (Rodna Mts.); Valley of Roşu Rivulet (Someşul Mare Basin)	Petri, 1912; Csiki, 1951	Alps, Sudetes, Carpathians EMount
Chrysolina marcasitica (Germar, 1824)	Rodna Mts.; Vinului Valley, Băilor Valley, Roşu Mountain, Corongiş Peak (Rodna Mts.)	Petri, 1912; Panin, 1944; Csiki, 1951	Slovenia, Alps, Sudetes, Carpathians EMount
Chrysolina marcasitica turgida (Weise, 1882)	Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	Sudetes, Carpathians EMount
Chrysolina olivieri (Bedel, 1892)	Rodna Mts.	Csiki, 1951	Alps, Carpathians, Dinaric Alps, Stara Planina EMount
Chrysolina polita (Linnaeus, 1758)	Rodna Mts., Rodna (Someşul Mare basin)	Csiki, 1951	Europe, Western Siberia, Mongolia S/EAP/TrPal
Chrysolina purpurascens (Germar, 1822)	Rodna Mts.	Petri, 1912	Alps, Tatra, Carpathians, Sudetes EMount
Chrysolina rufa crassicollis (Suffrian, 1851)	Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	Alps, Sudetes, Carpathians, Northern Balkans; EMount
Chrysolina staphylaea (Linnaeus, 1758)	Roşu Mountain (Rodna Mts.)	Csiki, 1951	from Ireland and Iceland to Kamchatka S/EAP/TrPal

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Chrysolina umbratilis (Weise, 1887)	Rodna Mts.; valley of Saca Rivulet; Borşa, Rodna Mts., 2,000 m; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri, 1912, Panin, 1944; Csiki, 1951; Roşca, 1974; Szél et al., 1995; Merkl, 2008	Carpathians, Sudetes, Alps, Dinaric Alps EMount
Chrysolina varians (Schaller, 1783)	Rodna Mts.; Vinului Valley, valley of Saca Streamlet, valley of Roşu Rivulet, Corongiş Peak, Ineu Peak, Băilor Valley, Pietrosul Rodnei (1 sp., VII.1995, M. I.); Borşa (Rodna Mts.), 1,200 m altitude; Săcel, Rodna Mts., Izvorul Izei, 850 m	Petri, 1912; Csiki, 1951; Szél et al., 1995; Maican and Serafim, 2001; Merkl, 2008	Europe, Asia Minor, Siberia S\EAP\SibE
Chrysolina weisei (Frivaldszky, 1883)	Rodna Mts. (without other specifications)	Panin, 1944; Roşca, 1974	Southern Carpathians CarpEnd
Chrysomela collaris Linnaeus, 1758	Rodna Mts.	Csiki, 1951	from eastern France to Siberia, Mongolia, North Eastern China S/EAP/TrPal
Chrysomela cuprea Fabricius, 1775	Rodna; Săcel, Izvorul Albastru al Izei (1 sp., VI.1998)	Csiki, 1951; Maican and Serafim, 2001	from eastern France to North-eastern Asia S/EAP/TrPal
Chrysomela populi Linnaeus, 1758	Rodna Mts.	Csiki, 1951	Palaearctic S/EAP/HPal
Chrysomela vigintipunctata (Scopoli, 1763)	Rodna, Vinului Valley	Csiki, 1951	From Eastern France to Japan S/EAP/TrPal
Gastrophysa polygoni (Linnaeus, 1758)	Borşa (Rodna Mts.), 1,600 m altitude	Szél et al., 1995	Europe, Caucasus, Asia Minor, Kazakhstan, Middle Asia, Siberia, Mongolia, China, Korea, North Africa. S\EAP\Hpal
Gonioctena decemnotata (Marsham, 1802)	Vinului Valley	Csiki, 1951	from the British Isles to Japan S/EAP/TrPal
Gonioctena pallida (Linnaeus, 1758)	Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	Western Palaearctic

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Gastrophysa viridula (De Geer, 1775)	Valley of Roşu Rivulet, Vinului Valley, Băilor Valley; Borşa (Rodna Mts.), 1,200-1,600 m; Pietrosul Rodnei, 800-1,300 m altitude (18 spec, 11.VII.1995, M. I.); Borşa (4 sp., 4.VIII.1995, P. S.); Izvorul Izei (9 sp., 9.IX.1995, P. C.); Lab. house "Pietrosul Rodnei", 1,370-1,400 m altitude (32 sp., 12.IX.1996, P. C.; 26 sp., 11.-13.VII.1995, P. C.; 4 sp., 14.IX.1995, P. C.); Săcel, Izvorul Izei	Csiki, 1951; Szél et al., 1995; Maican and Serafim, 2001, 2004; Merkl, 2008	Europe, Caucasus, Asia Minor, Kazakhstan, Mongolia, Kamchatka S\EAP\TrPal
Gonioctena linnaeana (Schrank, 1781)	Rodna	Csiki, 1951	Europe, Asia Minor, Kazakhstan, Siberia, Mongolia S/EAP/TrPal
Gonioctena quinquepunctata (Fabricius, 1787)	Pietrosul Rodnei, Vinului Valley, Băilor Valley, valley of Roşu Rivulet	Csiki, 1951	Northern, Central and Southern Europe
Hydrothassa glabra (Herbst, 1783)	Vinului Valley, Băilor Valley, valley of Roşu Rivulet; Săcel, Rodna Mts., Valea Izei, 850 m altitude	Csiki, 1951; Merkl, 2008	Europe, West Siberia, Morocco S\EAP\SibE
Leptinotarsa decemlineata (Say, 1824)	Borşa (Rodna Mts.), 1,200 m; Izvorul Albastru al Izei (1 sp., 6.VII.1995, P. C.); Săcel, Rodna Mts., Iza Valley, Izvorul Izei, 850 m altitude	Szél et al., 1995; Maican and Serafim, 2004; Merkl, 2008	introduced in Europe from North America
Oreina alpestris (Schumell, 1824)	Rodna Mts.; Vinului Valley, valley of Saca Rivulet, Băilor Valley, Corongiş Peak, Ineu Peak	Csiki, 1951	all mountains of Europe except Scandinavia and Iberian Peninsula EMount
Oreina alpestris banatica (Weise, 1884)	Săcel, Rodna Mts., Izvorul Izei, Iza Valley, 850 m altitude	Merkl, 2008	Romania, Poland, Ukraine EMount
Oreina bifrons decora (Richter, 1820)	Rodna Mts.	Csiki, 1951; Petri, 1912	Carpathians, Sudetes EMount

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Linaeidea aenea (Linnaeus, 1758)	Rodna Mts., Vinului Valley, Băilor Valley, valley of Roşu Rivulet, valley of Saca Rivulet; valley of Iza River, 6 km upstream Săcel (4 sp., VI.1998, M. I.); Izvorul Albastru al Izei (1 sp., 17.VI.1998); Izvorul Izei (1 sp., 6.VII.1995, P. C.); Borşa, Rodna Mts., Izvorul Bistriței, 1,665-1,710 m altitude	Csiki, 1951; Maican and Serafim, 2001, 2004; Merkl, 2008	Europe, Palaearctic Asia (including Japan) S\EAP\TrPal
Oreina cacaliae senecionis (Schummel, 1844)	Rodna Mts., Ineu Peak, Roşu Mountain (Rodna Mts.), valley of Saca Rivulet; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri 1912; Csiki, 1951; Merkl, 2008	Carpathians, Sudetes EMount
Oreina coerulea (Olivier, 1790)	Rodna Mts.; Vinului Valley, Ineu Peak, valley of Saca Rivulet; Pietrosul Rodnei, 1,600-2,050 m altitude (1 spec, 12.VII.1995, S. A.)	Petri 1912; Csiki, 1951; Maican and Serafim, 2001	mountains of Southern Germany Sudetes, Carpathians, Dinaric Alps, Bulgaria EMount
Oreina intricata (Germar, 1824)	Rodna Mts.; Ineu Peak, Roşu Mountain, Vinului Valley; Borşa (Rodna Mts.), 1,600 m altitude; Pietrosul Rodnei (1 sp., 13.VII.1995, P. C.); National Park "Pietrosul Rodnei", Laboratory House, 1,370 m altitude (1 sp., 12.IX.1996, P. C.); Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri, 1912; Csiki, 1951; Szél et al., 1995; Maican and Serafim, 2004; Merkl, 2008	Carpathians, Sudetes, Alps, Balkans EMount
Oreina plagiata (Suffrian, 1861)	Rodna Mts.; Corongiș Peak (Rodna Mts.)	Petri, 1912; Csiki, 1951	Apennines, Alps, Balkans, Carpathians EMount
Oreina speciosissima (Scopoli, 1763)	Rodna Mts.; Ineu Peak, Roşu Mountain, Vinului Valley, valley of Saca Rivulet	Petri, 1912; Csiki, 1951	Carpathians, Sudetes, Alps, Pyrenees, Balkans Emount

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Oreina virgulata (Germar, 1824)	Ineu Peak, valley of Saca Rivulet, valley of Roşu Rivulet, Vinului Valley	Csiki, 1951	Carpathians, Sudetes, Alps, Apennines, Balkans; EMount
Oreina virgulata ab. *praefica* (Weise, 1884)	Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	EMount
Oreina viridis (Duftschmid, 1825)	Pietrosul Rodnei; Borşa (Rodna Mts.), 2,000 m altitude	Csiki, 1951; Szél et al., 1995	Alps, Vosges, Carpathians EMount
Phaedon cochleariae (Fabricius, 1792)	Rodna Mts.; valley of Roşu Rivulet, Vinului Valley; Izvorul Izei, Săcel (1 sp., 6.VII.1995, P. C.); Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri, 1912; Csiki, 1951; Maican and Serafim, 2001; Merkl, 2008	Europe, Palaearctic Asia S/EAP/TrPal
Phaedon laevigatus (Duftschmid, 1825)	Rodna Mts.	Petri, 1912; Csiki, 1951	Central, South and East Europe; E\CE
Phaedon segnis Weise, 1884	Pietrosul Rodnei (Rodna Mts.); Ineu Peak (Rodna Mts.); Izvorul Izei (1 sp., 6.VII.1995, P. C.)	Petri, 1912; Csiki, 1951; Maican and Serafim, 2001	Carpathians, Alps, Dinaric Alps EMount
Phratora atrovirens (Cornelius, 1857)	Rodna Mts.	Petri, 1912; Csiki, 1951	Alps, Fennoscandia, Germany, Poland, Russia, North Eastern Asia
Phratora tibialis (Suffrian, 1851)	Borşa (Rodna Mts.); Pietrosul Rodnei, 1,500-2,050 m altitude (2 sp., 12.VII.1995, M. I.); Izvorul Albastru al Izei (2 sp., 9.IX.1995, P. C.)	Csiki, 1951; Maican and Serafim, 2001	Europe, Asia Minor E\CE
Phratora vitellinae (Linnaeus, 1758)	Rodna, Vinului Valley, Borşa, Ineu Peak (Rodna Mts.); Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Csiki, 1951; Merkl, 2008	Europe, Palaearctic Asia (excl. Japan) S\EAP\TrPal
Plagiodera versicolora (Laicharting, 1781)	Rodna; valley of Iza River, 1 km upstream Săcel (1 sp., VI.1995, M. I.); Vadul Izei (2 sp., 9.VII.1995, M. I.); valley of Iza River, 6 km upstream Săcel (2 sp., VI.1998)	Csiki, 1951; Maican and Serafim, 2001	Palaearctic, India, Taiwan S/EAP/HPal

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Sclerophaedon carniolicus (Germar, 1824)	Rodna Mts.; Vinului Valley, valley of Roşu Rivulet, Corongiş Peak; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri, 1912; Csiki, 1951; Merkl, 2008	Carpathians, Dinaric Alps, Alps, Sudetes EMount
Sclerophaedon carpathicus (Weise, 1875)	Rodna Mts.; Vinului Valley (Someşul Mare basin)	Petri, 1912; Csiki, 1951	Eastern Carpathians CarpEnd
Timarcha metallica (Laicharting, 1781)	Ineu Peak (Rodna Mts.); "Pietrosul Mare" Scientific Reserve, 1755 m altitude	Csiki, 1951; Nitzu et al., 2008	mountains of Central Europe and Balkans E/CEMount
Timarcha rugulosa Herrich-Schäffer, 1838	Rodna Mts.; Săcel, Rodna Mts., Valea Izei, 850 m altitude	Csiki, 1951; Merkl, 2008	Southern Poland, Moldavia, Southern Carpathians, Slovakia, Ukrainian Carpathians, Romania
Galerucinae Latreille, 1802			
Agelastica alni (Linnaeus, 1758)	Valley of Roşu Rivulet, Vinului Valley, valley of Saca Rivulet, Corongiş Peak (Rodna Mts.); Săcel, Izvorul Albastru al Izei (1 sp., VI.1998)	Csiki, 1951; Maican and Serafim, 2001	Europe, from Ireland to Southern Finland and from the Pyrenees to Caucasus, Asia Minor E\CE
Galeruca tanaceti (Linnaeus, 1758)	Valley of Saca Rivulet; Borşa, Rodna Mts., Pasul Prislop, 1,014 m a.s.l.; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude; Borşa, Rodna Mts., Pasul Prislop	Csiki, 1951; Merkl, 2008	from Ireland and Portugal to Korea; introduced in North America S/EAP/TrPal
Galerucella lineola (Fabricius, 1781)	Vinului Valley (Someşul Mare Basin)	Csiki, 1951	from Ireland to Japan S/EAP/TrPal
Lochmaea caprea (Linnaeus, 1758)	Vinului Valley, valley of Saca Rivulet; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Csiki, 1951; Merkl, 2008	from Spain and Ireland to Southern Norway and Japan S/EAP/TrPal
Luperus viridipennis Germar, 1824	Borşa (Rodna Mts.), 1,600 m altitude	Szél et al., 1995	Alps, Carpathians, Balkans, Ural, Centr. Asia S\EAP\SibE
Alticinae Newman, 1834			
Altica helianthemi (Allard, 1859)	Pietrosul Rodnei, 1,400-1,900 m altitude (1 sp., 14.IX.1995, P. C.)	Maican and Serafim, 2004	Europe, Asia S/EAP/SibE

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Altica lythri Aubé, 1843	Rodna Mts.	Gruev et al., 1993	Europe, Turkey E/CE
Altica oleracea (Linnaeus, 1758)	Rodna Mts.	Csiki, 1951	Europe, Palaearctic Asia; S/EAP/TrPal
Altica tamaricis Schrank, 1785	Vinului Valley, valley of Saca Rivulet	Csiki, 1951	Europe, Palaearctic Asia S/EAP/TrPal
Aphtona atrocaerulea (Stephens, 1831)	Pietrosul Rodnei	Gruev et al., 1993	Northern and Central Europe, South to Northern Italy and Romania
Aphtona ovata Foudras, 1860	Valley of Saca Rivulet	Csiki, 1951	Central and Southern Europe, Caucasus, Asia Minor E/CE
Aphtona violacea (Koch, 1803)	Săcel, Izvorul Albastru al Izei (2 sp., 6.VII.1995, P. C.)	Maican and Serafim, 2001	Europe, Siberia, Caucasus S/EAP/SibE
Batophila rubi (Paykull, 1799)	Rodna Mts.; Vinului Valley; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri, 1912; Csiki, 1951; Konnerth, 1963; Merkl, 2008	Europe, Caucasus, Western Siberia S\EAP\SibE
Chaetocnema concinna (Marsham, 1802)	Rodna Mts.	Csiki, 1951	Europe, Palaearctic Asia, North Western Africa; S/EAAP/HPal
Chaetocnema hortensis (Geoffroy, 1785)	Rodna Mts.	Petri, 1912; Csiki, 1951	Europe, Sudan, Palaearctic Asia, Madeira, North Western Africa S/EAP/HPal
Chaetocnema tibialis (Illiger, 1807)	Rodna Mts.; Ineu Peak	Petri, 1912; Csiki, 1951; Konnerth-Ionescu, 1963	Europe, Palaearctic Asia, Northern Africa S/EAP/SibE
Crepidodera aurata (Marsham, 1802)	Pietrosul Rodnei; Rodna Mts.	Csiki, 1951	Europe, Palaearctic Asia (except Japan), Morocco S/EAAP/HPal
Dibolia occultans (Koch, 1803)	Baia Borşa	Gruev et al., 1993	Europe, Caucasus, Asia Minor, North Western Africa; E/CE
Longitarsus aeneicollis (Faldermann, 1837)	Măriilor Valley (Someşul Mare Basin)	Csiki, 1951	Europe, Caucasus, Asia Minor, Iran, Iraq, Syria, Central Asia, North Western Africa; E/CE

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Longitarsus brunneus (Duftschmid, 1825)	Pietrosul Rodnei	Csiki, 1951	Europe, Palaearctic Asia (excluding Japan); S\EAP\TrPal
Longitarsus exsoletus Linnaeus, 1758	Rodna (Someşul Mare basin)	Csiki, 1951	Europe, Caucasus, Asia Minor, Iran, Syria, Cyprus E/CE
Longitarsus longiseta Weise, 1889	Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	Europe, Siberia, Japan and Northern China
Longitarsus lycopi (Foudras, 1860)	Pietrosul Rodnei, 1,400-1,900 m altitude (1 sp. 14.IX.1995, P. C.)	Maican and Serafim, 2004	Europe, Caucasus, Asia Minor, Iran, Central Asia, Northern Africa; E/CE
Longitarsus pallidicornis Kutschera, 1863	Pietrosul Rodnei	Csiki, 1951	Alps, Pyrénées, Carpathians, Dinaric Alps; EMount
Longitarsus parvulus (Paykull, 1799)	Borşa (Rodna Mts.), 1,600 m altitude	Szél et al., 1995	Europe, Caucasus, Asia Minor, Israel, Siberia; S/EAP/SibE
Longitarsus pinguis Weise, 1888	Rodna Mts.	Petri, 1912, 1925	Northern Italy, Danube River basin, Balkan Peninsula, Ukraine; E/CE
Longitarsus rubellus (Foudras, 1860)	Pietrosul Rodnei	Csiki, 1951	Alps, Sudetes, Carpathians EMount
Longitarsus suturellus (Duftschmid, 1825)	Pietrosul Rodnei, Rodna Mts., Vinului Valley, Rodna Veche; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Petri, 1912; Csiki, 1951; Konnerth-I., 1963; Gruev et al., 1993; Merkl, 2008	Europe, Palaearctic Asia S/EAP/TrPal
Minota carpathica Heikertinger, 1911	Rodna Mts., Pietrosul Rodnei, Ineu Peak, Corongiş Peak, Roşu Mountain, Valley of Saca Rivulet; Borşa (Rodna Mts.), 1,600 m altitude	Petri, 1912; Csiki, 1951; Szél et al., 1995	Carpathians Sudetes, Alps EMount
Minota obesa (Waltl, 1839)	Pietrosul Rodnei, Rodna Mts.	Konnerth-Ionescu, 1963 (with older data)	mountains and submountains areas of Western and Central Europe excepting Pyrenees; EMount

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Mniophila muscorum (Koch, 1803)	Rodna Mts.; Borşa (Rodna Mts.), 1,600 m; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude; "Pietrosul Mare" Scientific Reserve, 2,047 m altitude	Petri, 1912; Szél et al., 1995; Merkl, 2008; Nitzu et al., 2008	Europe, Caucasus E/CE
Neocrepidodera cyanescens (Duftschmid, 1825)	Pietrosul Rodnei	Frivaldszky, 1871	Alps, Carpathians AlpCarpEnd
Neocrepidodera femorata (Gyllenhal, 1813)	Rodna Mts.; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Csiki, 1951; Konnerth-Ionescu, 1963; Merkl, 2008	boreo-alpine species; mountainous areas of Europe and Siberia
Neocrepidodera melanostoma (Redtenbacher, 1849)	Pietrosul Rodnei (1 sp., 14.IX.1995, P. C.)	Maican and Serafim, 2001	Alps, Apeninnes, Carpathians, Dinaric, Vosges; EMount
Neocrepidodera transsilvanica (Fuss, 1864)	Pietrosul Rodnei; Ineu Peak (Rodna Mts.); valley of Saca Rivulet; Borşa (Rodna Mts.), 1,600 m altitude	Petri, 1912, Csiki, 1951; Konnerth-Ionescu, 1963; Szél et al., 1995	Endemic species to the Eastern and Southern Carpathians
Orestia aubei Allard, 1859	Pietrosul Rodnei, Rodna Mts.; valley of Saca Rivulet	Petri, 1912; Csiki, 1951; Konnerth-Ionescu, 1963	Carpathians, Transylvania, Dinaric Alps EMount
Phyllotreta atra (Fabricius, 1775)	Rodna Mts.; Ineu Peak, Valea Vinului, Valley of Saca rivulet; Borşa (Rodna Mts., 1,600 m altitude)	Petri, 1912; Csiki, 1951; Konnerth-Ionescu, 1963; Gruev et al., 1993; Szél et al., 1995	Europe, Palaearctic Asia, Morocco, Yemen S/EAAP/HPal
Phyllotreta christinae Heikertinger, 1941	Borşa (Rodna Mts.), 1,600 m altitude	Szél et al., 1995	mountains of Central Europe and Balkan Peninsula; E/Mount
Phyllotreta cruciferae (Goeze, 1777)	Rodna Mts.; Vinului Valley	Petri, 1912; Csiki, 1951; Konnerth-Ionescu, 1963; Gruev et al, 1993	Europe, Caucasus, Asia Minor, Central Asia, Siberia, Mongolia, Northern Africa; S/EAP/SibE

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Phyllotreta diademata Foudras, 1860	Rodna Mts.; Vinului Valley	Petri, 1912; Csiki, 1951; Konnerth-I., 1963; Gruev et al., 1993	Europe, Central Asia, India S/EAP/SibE
Phyllotreta flexuosa (Illiger, 1794)	Rodna Mts.; Vinului Valley	Petri, 1912; Csiki, 1951; Konnerth-I., 1963; Gruev et al., 1993	Boreal part of Palaearctic Region
Phyllotreta nemorum (Linnaeus, 1758)	Vinului Valley; Pietrosul Rodnei	Csiki, 1951; Gruev et al., 1993	Europe, Palaearctic Asia (excl. Japan) S/EAP/SibE
Phyllotreta striolata (Fabricius, 1803)	Pietrosul Rodnei (1 sp., 14.IX.1995, H. C.)	Gruev et al., 1993; Maican and Serafim, 2001	Europe, Asia, Indonesia S/EAP/TrPal
Phyllotreta undulata (Kutschera, 1860)	Rodna Mts., Vinului Valley, valley of Saca Rivulet, Pietrosul Rodnei, Săcel, Izvorul Izei (1 sp., 6.VII.1995, P. C.)	Petri, 1912; Konnerth-I., 1963; Gruev et al., 1993; Maican and Serafim, 2001	Europe, Palaearctic Asia S/EAP/TrPal Pausescu
Phyllotreta vittula (Redtenbacher, 1849)	Rodna Mts., Ineu Peak; valley of Saca Rivulet; Pietrosul Rodnei; Borşa (Rodna Mts.), 1,600 m altitude; Pietrosul Rodnei (1 sp., 14.IX.1995, H. C.)	Petri, 1912; Csiki, 1951; Konnerth-Ionescu, 1963; Gruev et al., 1993; Szél et al., 1995; Maican and Serafim, 2001	Europe, Palaearctic Asia (excluding Japan) S/EAP/TrPal
Psylliodes aereus Foudras, 1860 (probably ssp. *austriaca* Heikertinger, 1911)	Rodna Mts.	Gruev et al., 1993	Emount
Psylliodes affinis (Paykull, 1799)	Rodna Mts.; Rodna Veche; Vinului Valley	Csiki, 1951; Gruev et al., 1993	Europe, Kazakhstan, Caucasus, Siberia, Altai, Morocco S/EAP/SibE
Psylliodes attenuatus (Koch, 1803)	Rodna Mts.	Petri, 1912; Csiki, 1951; Konnerth-I., 1963; Gruev et al., 1993	Europe, Palaearctic Asia S/EAP/TrPal

Taxa	Collecting sites	Literature cited	Distribution/ Zoogeography
Psylliodes cucullatus (Illiger, 1807)	Pietrosul Rodnei	Gruev et al., 1993	TrPal
Psylliodes frivaldszkyi Weise, 1888	Rodna Mts.; Pietrosul Rodnei; Ineu Peak (Rodna Mts.); Rodna Veche; valley of Saca Rivulet	Petri, 1912; Csiki, 1951; Konnerth-I., 1963; Gruev et al., 1993	Carpathians CarpEnd
Psylliodes glaber (Duftschmid, 1825)	Pietrosul Rodnei	Csiki, 1951	Alps, Carpathians, Dinaric Alps EMount
Psylliodes napi (Fabricius, 1792)	Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Merkl, 2008	Europe, Palaearctic Asia (except Japan), North Western Africa S/EAAP/HPal
Psylliodes subaeneus Kutschera, 1867	Rodna Mts.	Petri, 1912; Csiki, 1951; Gruev et al., 1993	Alps, Eastern and Southern Carpathians, Slovenia EMount
Cassidinae Gyllenhal, 1813			
Cassida murraea Linnaeus, 1767	Vinului Valley	Csiki, 1951	Palaearctic (excluding northern Africa) S/EAP/TrPal
Cassida viridis Linnaeus, 1758	Vinului Valley, valley of Saca Rivulet; Săcel, Rodna Mts., Izvorul Izei, 850 m altitude	Csiki, 1951; Merkl, 2008	Palaearctic S/EAAP/HPal
Cassida vittata Villers, 1789	Rodna Mts.	Petri, 1912; Csiki, 1951	from Morocco and Portugal to Japan TrPal

CONCLUSIONS

Integrating the data obtained from the study of material preserved in the collections of "Grigore Antipa" National Musem of Nature History from Bucharest, with those from the available coleopterological literature, a synthesis concerning the diversity of the leaf beetles fauna in the Rodna Mountains (Maramureş, northern Romania) is given.

The chrysomelid fauna from this area is relatively well known, being represented by 138 species from 43 genera, belonging to 11 subfamilies.

Among them, *Neocrepidodera transsilvanica* (Fuss), *Psylliodes frivaldszkyi* Weise, *Chrysolina weisei* (Frivaldszky) and *Sclerophaedon carpathicus* Weise are endemic species to the Carpathian Mountains. From a zoogeographical point of view, the Siberian and European complexes are dominant in the Rodna Mountains.

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MAYFLY (INSECTA, EPHEMEROPTERA) ASSEMBLAGES IN THE IZA RIVER/TISA WATERSHED (EASTERN CARPATHIANS, ROMANIA)

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KEYWORDS: Romanian Carpathians, Rodna Mountains, Iza River, Tisa/Danube watersheds, Ephemeroptera, communities, structure.

ABSTRACT

This study presents the description of the structure and diversity analysis of the Ephemeroptera larvae communities of the Iza River. The paper is based on quantitative benthic macroinvertebrates and mayfly qualitative samples, sampled in 2008 (July-September), in 14 sampling stations.

In the reference zone, 21 mayfly species were identified, belonging to 10 genera and five families, representing 29.17% of the Romanian Ephemeroptera fauna.

The mayflies present the highest diversity (10 species) in the proximity of the Onceşti locality - here the specific microhabitats diversity is favourable for many species and the lowest diversity (four species) in the mountainous course, 250 m downstream from Izvorul Albastru al Izei - and 4 km upstream of Săcel Village.

In the upper course of the river the strictly rheophilic species (*Rhithrogena germanica*, *Rhithrogena semicolorata*, *Baetis alpinus*) are numerically dominant: downstream their weight is decreasing, numerically dominant here being the species of broader ecological tolerance (*Serratella ignita*, *Baetis rhodani*). In the river sectors with lenitic areas and sedimentary substratum, of the lower course, the species *Caenis luctuosa* presents high relative abundances.

The structure of the ephemeropteran larval communities reveals that the Iza River is in a good ecological state, the aquatic habitats are not significantly affected by human impact, that is why we recommend a management of the river for biodiversity conservation.

RÉSUMÉ: Communautés des larves d'éphéméroptères (Insecta, Ephemeroptera) de la rivière d' Iza/Bassin de Tisa (Carpates Orientales, Roumanie).

L'article décrit la structure des communautés des larves d'éphéméroptères de la rivière d' Iza et l'analyse de la diversité de ces communautés. Les données présentées sont basées sur des échantillons quantitatifs de benthos et qualitatifs d'éphéméroptères, collectés durant l'année 2008 (juillet-septembre) sur 14 stations de prélèvement

Dans la zone de référence 21 espèces d'éphéméroptères ont été identifiées, appartenant à 10 genres et cinq familles, celles-ci représentant 29,17% des espèces d'éphéméroptères signalées sur le territoire roumain.

Les éphéméroptères présentent la plus grande diversité (10 espèces) au niveau de la localité de Onceşti - ici la diversité des micro habitats spécifiques étant favorable pour des nombreuses espèces. La moindre diversité (4 espèces) est enregistrée dans le secteur supérieur de la rivière, 250 m en aval de Izvorul Albastru al Izei (La Source Bleue de Iza) et 4 km en amont du village de Săcel.

Dans le secteur supérieur de la rivière, dominent de point de vue numérique les espèces strictes rhéophiles (*Rhithrogena germanica*, *Rhithrogena semicolorata*, *Baetis alpinus*), en aval leurs pourcentages baissent, le secteur étant dominé de point de vue numérique par les espèces qui possèdent une valence écologique plus large (*Serratella ignita*, *Baetis rhodani*). Dans les secteurs présentant des zones lentiques et un substrat sédimentaire dans le cours inferieur de la rivière, l'espèce *Caenis luctuosa* présente des grandes abondances relatives.

La structure des communautés des larves d'éphéméroptères indique le fait que la rivière d' Iza se trouve dans un état écologique bon, les habitats aquatiques n'étant pas affectés de manière significative par les activités anthropiques, d'où notre recommandation pour une gestion de la rivière dans le sens de la conservation de sa biodiversité.

REZUMAT: Comunităţi ale larvelor de efemeroptere (Insecta, Ephemeroptera) din râul Iza, bazinul hidrografic Tisa/Dunăre (Carpaţii Orientali, România).

Lucrarea prezintă descrierea structurii comunităţilor larvelor de efemeroptere din râul Iza şi analiza diversităţii acestor comunităţi. Datele prezentate în lucrare se bazează pe probe cantitative de bentos şi calitative de efemeroptere, colectate în anul 2008 (iulie-septembrie), din 14 staţii de prelevare.

În zona studiată, au fost identificate 21 specii de efemeroptere, aparţinând la 10 genuri şi 5 familii, acestea reprezintă 29,17% din speciile de efemeroptere, semnalate în România.

Efemeropterele prezintă cea mai mare diversitate (10 specii) în dreptul localităţii Onceşti - aici diversitatea microhabitatelor specifice este favorabilă mai multor specii. Cea mai mică diversitate (4 specii) se înregistrează în sectorul montan al râului, 250 m aval de Izvorul Albastru al Izei şi 4 km amonte de satul Săcel.

În cursul superior al râului, dominante numeric sunt speciile strict reofile (*Rhithrogena germanica*, *Rhithrogena semicolorata*, *Baetis alpinus*), în aval, ponderea acestora scade, dominante numeric, fiind speciile cu valenţă ecologică mai largă (*Serratella ignita*, *Baetis rhodani*). În sectoarele de râu, cu zone lenitice şi substrat sedimentar, din cursul inferior, specia *Caenis luctuosa* prezintă abundenţe relative mari.

Structura comunităţilor larvelor de efemeroptere indică faptul că Iza se află într-o stare ecologică bună, habitatele acvatice nefiind afectate semnificativ de activităţile antropice, de aceea recomandăm ca managementul râului, să se facă în sensul conservării biodiversiăţii.

INTRODUCTION

This study presents the description of the structure and diversity analyse of Ephemeroptera larvae communities of the Iza River/Tisa River basin.

The Iza River is a second order tributary of the Danube, localized in the north part of the Romanian territory. The upper course of the Iza River was included in the Rodna Mountains National Park.

Iza River has its sources in the Rodna Mountains under Bătrâna Peak at a 1,380 m altitude, 83 km length, 1,303 km^2 basin, a multiannual average flow at the confluence with Tisa River of 16.3 m^3/s with which confluence at the west of Sighetu Marmaţiei locality at 268 m altitude, and collects streamlets from the west-western side of the Rodna Mountains the main of the left side tributaries being Mara, Baicu, Botiza, Slătioara and of the right side Ronişoara (Roşu, 1980; Badea et al., 1983; Posea et al., 1982).

Actual hydrobiological research related with the aquatic macroinvertebrates in this area are few, in this respect we have to mention the study concerning the benthic communities of the Iza River with special remarks on rheophilic mayfly species, realised by Găldean (1997).

MATERIAL AND METHODS

This paper is based on quantitative benthic macroinvertebrates and mayflies qualitative samples, sampled in 2008 (July-September), in 14 sampling stations (Fig. 1).

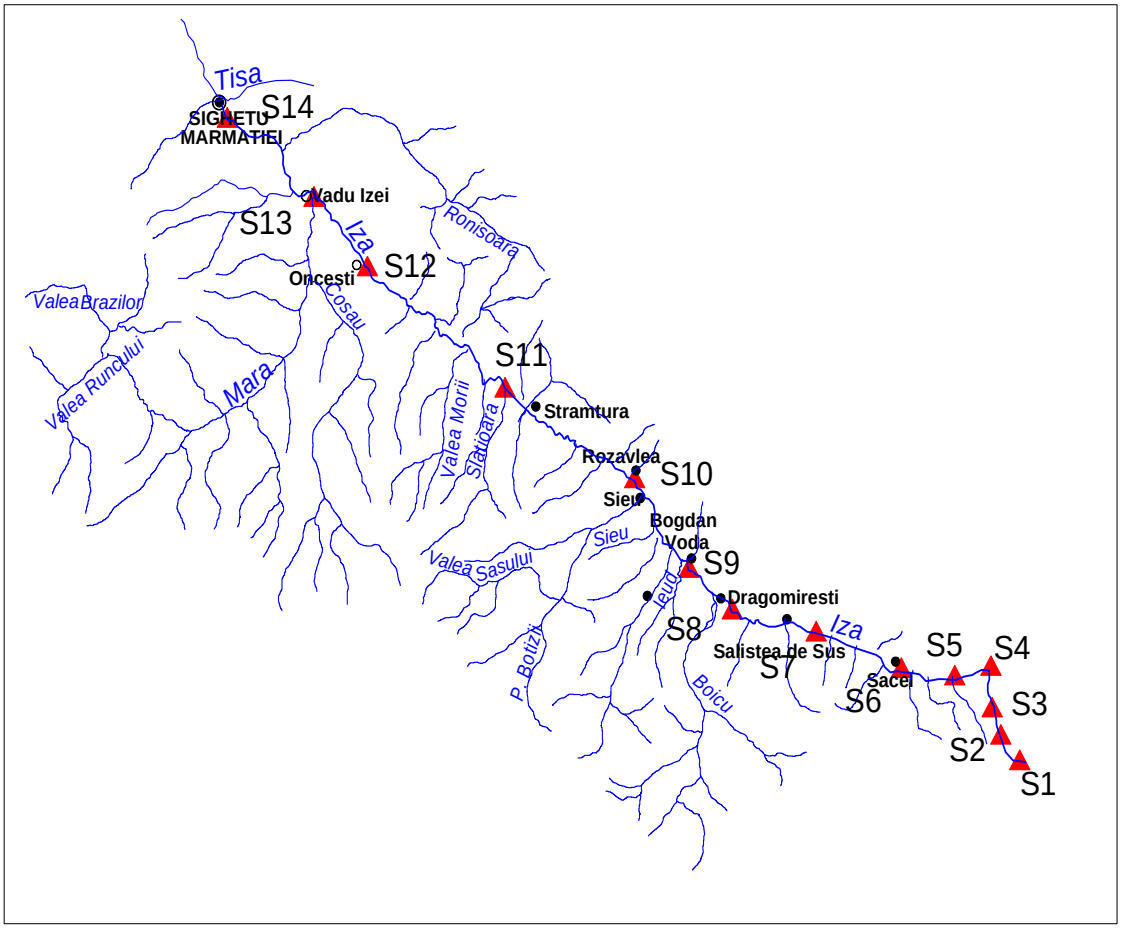

Figure 1: The Iza River sampling stations (S1 - S14) layout.

The sampling stations for this study were chosen according to the valley morphology, the confluence with the main tributaries and the human impact types and degrees on the river sectors - hydro-technical works, pollution sources, and overexploitation of the riverbed mineral resource and exploitation of riverine lands, in order to highlight the Ephemeroptera species diversity, and also the variation of the benthic macroinvertebrate communities structure.

At each site were sampled quantitative samples from five different points, in order to highlight the micro-habitats specific diversity. In the study period 140 quantitative benthic macroinvertebrates samples were sampled and analysed. The benthic macroinvertebrates quantitative samples were carried out with an 887 cm^2 surface Surber Sampler, with a 250 µm mesh net. The sampled biological material was fixed in 4% formaldehyde solution at which $NaHCO_3$ was added.

The biological material included 1773 Ephemeroptera larvae in life cycle periods which allowed their identification to species level. Another 32% of the quantitatively sampled individuals were in life cycle periods which did not allowed identification to species level.

For the quantitative structure description of the mayfly communities we have used the relative abundance (A%). For the mayfly communities' diversity quantifying, the heterogeneity index Simpson (Gomoiu and Skolka, 2001; Krebs, 1989) were determined, based on the quantitative samples.

RESULTS AND DISCUSSION

In the studied zone 21 species were found, belonging to 10 genera and 5 families.

The identified mayfly species list of the Iza River, with the specific sampling sites (S1 - S14 - sampling stations):

Fam. Ephemerellidae

Serratella ignita (Poda 1761) - S6, S7, S8, S9, S10, S11, S12, S13, S14
Ephemerella notata (Eaton 1887) - S8, S9, S10

Fam. Caenidae

Caenis luctuosa (Burmeister 1839) - S11, S12, S13, S14
Caenis macrura Stephens 1835 - S13

Fam. Baetidae

Baetis alpinus (Pictet 1843) - S1, S2, S3, S4, S5, S6
Baetis melanonys (Pictet 1843) - S2, S3,
Baetis rhodani (Pictet 1843) - S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12, S13, S14
Baetis vernus Curtis, 1834 - S7, S8, S9, S10, S11, S12
Baetis lutheri Müller-Liebenau 1967 - S6, S7
Baetis fuscatus (Linnaeus 1761) - S5, S6
Baetis muticus (Linnaeus 1758) - S5, S6
Centroptilum luteolum (Muller 1776) - S6, S7
Procloeon bifidum (Bengtsson 1912) - S13, S14

Fam. Oligoneuriidae

Oligoneuriella rhenana (Imhoff 1852) - S8, S12, S14

Fam. Heptageniidae

Ecdyonurus insignis (Eaton 1870) - S11, S12
Ecdyonurus venosus (Fabricius 1775) - S1, S3, S5, S6, S9, S12, S13, S14
Ecdyonurus dispar (Curtis 1834) - S4, S8, S12, S13, S14
Ecdyonurus submontanus Landa 1969 - S10
Epeorus sylvicola (Pictet 1865) - S12
Rhithrogena germanica Eaton 1885 - S1, S2, S3
Rhithrogena semicolorata (Curtis 1834) - S1, S3, S4, S6, S11, S12

In the Iza River, the mayflies had the highest species diversity (10 species) in the proximity of the Onceşti locality (S12) (Tab. 1) - here the diversity of the specific microhabitats is favourable for many species, and the lowest species diversity (four species) in the montainous course at 250 m downstream Izvorul Albastru al Izei (S2) and four km upstream Săcel Village (S4) (Tab. 1).

According to the Simpson Index, the Ephemeroptera larvae communities present a high heterogeneity on the entire Iza River course (Tab. 1), with a maximum at 0.5 km upstream Săcel locality (S6).

The mayfly species with the widest distribution in the Iza River is *Baetis rhodani* - present in all the fourteen studied lotic sectors. The species with the most restricted distributions are *Caenis macrura*, *Epeorus sylvicola* and *Ecdyonurus submontanus* - sampled only in the one of the fourteen studied lotic sectors.

In the studied area, the numerical weight of the mayfly larvae in the benthic macroinvertebrate communities vary, between 75.0%m four km upstream Săcel Village (S4) and 16.2%, upstream the confluence with the Tisa River (S14) (Tab. 1).

Table 1: The structure of mayfly communities present in the 14 lotic sectors analysed in the Iza River and the numerical weight of this systematic group in the benthic macroinvertebrate communities (P - Ephemeroptera numerical weight in the benthic macroinvertebrate communities structure, A% - relative abundance of each species).

Sampling station	P (%)	Inverted Simpson index (1-l)	The specific structure of the Ephemeroptera larvae community	A (%)
S1	67.68	0.668	*Baetis alpinus* *Baetis rhodani* *Ecdyonurus venosus* *Rhithrogena germanica* *Rhithrogena semicolorata*	52.5 10.0 5.0 22.5 10.0
S2	41.94	0.546	*Baetis alpinus* *Baetis melanonyx* *Baetis rhodani* *Rhithrogena germanica*	25.71 8.57 2.86 62.86
S3	42.63	0.812	*Baetis alpinus* *Baetis melanonyx* *Baetis rhodani* *Ecdyonurus venosus* *Rhithrogena germanica* *Rhithrogena semicolorata*	30.0 22.0 10.0 14.0 18.0 6.0
S4	75.0	0.687	*Baetis alpinus* *Baetis rhodani* *Ecdyonurus dispar* *Rhithrogena semicolorata*	16.0 48.0 8.0 28.0
S5	49.68	0.699	*Baetis alpinus* *Baetis rhodani* *Baetis fuscatus* *Baetis muticus* *Ecdyonurus venosus*	50.0 20.83 4.17 8.33 16.67
S6	41.23	0.837	*Serratella ignita* *Baetis alpinus* *Baetis rhodani* *Baetis lutheri* *Baetis fuscatus* *Baetis muticus* *Centroptilum luteolum* *Ecdyonurus venosus* *Rhithrogena semicolorata*	21.88 1.56 7.81 18.75 3.13 4.69 14.06 3.12 25.0
S7	29.57	0.792	*Serratella ignita* *Baetis rhodani* *Baetis vernus* *Baetis lutheri* *Centroptilum luteolum*	27.91 6.98 18.6 20.93 25.58

Sampling station	P (%)	Inverted Simpson index (1-l)	The specific structure of the Ephemeroptera larvae community	A (%)
S8	57.70	0.774	*Serratella ignita* *Ephemerella notata* *Baetis rhodani* *Baetis vernus* *Oligoneuriella rhenana* *Ecdyonurus dispar*	32.76 8.62 15.52 29.31 1.72 12.07
S9	64.67	0.756	*Serratella ignita* *Ephemerella notata* *Baetis rhodani* *Baetis vernus* *Ecdyonurus venosus*	38.18 5.45 14.55 20.0 21.82
S10	31.19	0.768	*Serratella ignita* *Ephemerella notata* *Baetis rhodani* *Baetis vernus* *Ecdyonurus submontanus*	36.36 11.36 25.0 9.09 18.19
S11	57.4	0.776	*Serratella ignita* *Caenis luctuosa* *Baetis rhodani* *Baetis vernus* *Ecdyonurus insignis* *Rhithrogena semicolorata*	8.82 35.29 25.0 2.94 16.18 11.74
S12	48.51	0.828	*Serratella ignita* *Caenis luctuosa* *Baetis rhodani* *Baetis vernus* *Oligoneuriella rhenana* *Ecdyonurus insignis* *Ecdyonurus venosus* *Ecdyonurus dispar* *Epeorus sylvicola* *Rhithrogena semicolorata*	15.71 17.14 32.86 7.14 2.86 4.29 1.43 10.0 5.71 2.86
S13	40.69	0.795	*Serratella ignita* *Caenis luctuosa* *Caenis macrura* *Baetis rhodani* *Procloeon bifidum* *Ecdyonurus venosus* *Ecdyonurus dispar*	30.43 15.94 5.8 27.54 2.9 4.35 13.04
S14	16.2	0.779	*Serratella ignita* *Caenis luctuosa* *Baetis rhodani* *Procloeon bifidum* *Oligoneuriella rhenana* *Ecdyonurus venosus* *Ecdyonurus dispar*	33.34 29.82 8.77 5.26 5.26 3.51 14.04

Analysing the similarity of the mayfly larvae communities in the 14 sampled lotic sectors, on the basis of the species relative abundance (Tab. 1), allows these communities to be grouped in six classes (Fig. 2):

I. community where the species *Rhithrogena germanica* is numerically dominant, situation which was found in S2 sampling station;

II. communities where the species of genus Baetis are numerically codominant, situations wich were found in S1, S3, S4 and S5 sampling stations;

III. communities builded up by *Serratella ignita*, *Baetis lutheri* and *Centroptilum luteolum* situations wich were found in S6 and S7 sampling stations;

IV. communities where the species *Serratella ignita* is numerically codominant, situations which were found in S8, S9 and S10 sampling stations;

V. communities builded up by *Serratella ignita*, *Caenis luctuosa* and *Baetis rhodani* situations which were found in S12, S13 and S14 sampling stations;

VI. community where the species *Caenis luctuosa* and *Baetis rhodani* are numerically codominant, situation wich were founded in S11 sampling station.

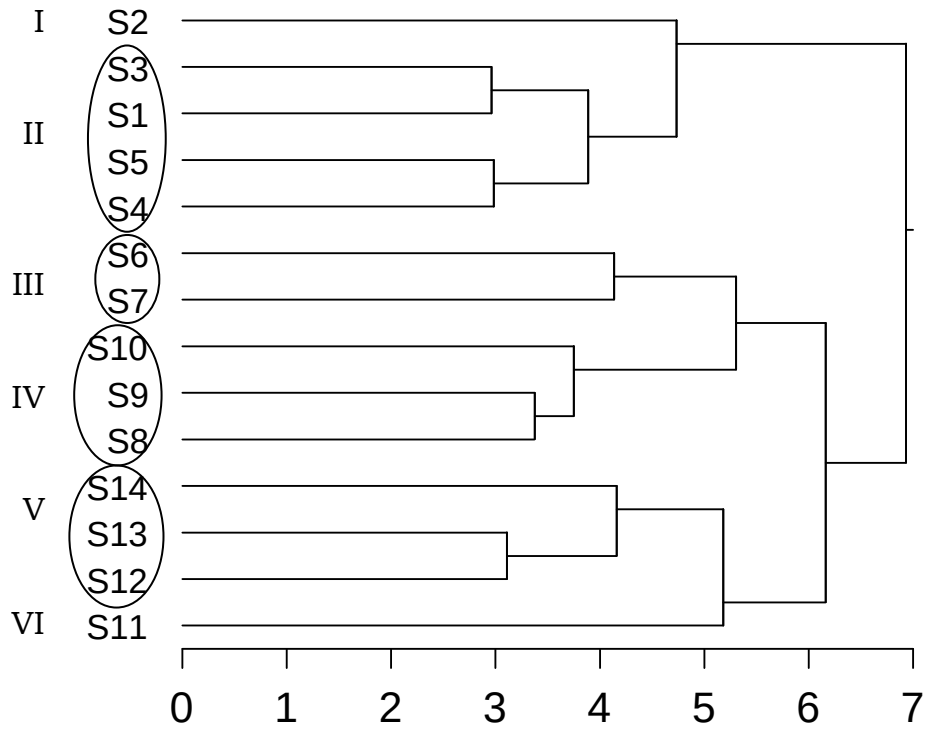

Figure 2: Tree diagram based on the mayfly species relative abundance (A%), of the 14 analysed lotic sectors (Euclidean distances, S1 - S14 sampling stations).

CONCLUSIONS

The Ephemeroptera fauna of the Iza River presents a relative high species diversity. In the studied area 21 mayfly species were found, belonging to 10 genera and five families were identified, representing 29.17% of the Romanian Ephemeroptera fauna.

In the Iza River, the mayflies present the highest diversity in the proximity of the Onceşti locality - here the specific microhabitats diversity is favourable for many species, and the lowest diversity is in the mountainous course at 250 m downstream Izvorul Albastru al Izei and at four km upstream Săcel Village.

In the upper course of the river numerical dominants are the strictly rheophilic species (*Rhithrogena germanica*, *Rhithrogena semicolorata*, *Baetis alpinus*), downstream their weight decrease, numerical dominant here being the species with a large ecological valence (*Serratella ignita*, *Baetis rhodani*). In the river sectors with slow flowing water and sedimentary substrata of the lower course, the species *Caenis luctuosa* present relatively high abundances.

The structure of the Ephemeroptera larvae communities show the fact that Iza River in spite of its long therm use by the local human settlements it is in a good ecological state, its aquatic habitats being not significantly affected by the local human impact, that is why it is recommended for this river a management which should target mainly the biodiversity conservation.

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INFLUENCE OF ANTHROPIC IMPACT ON AQUATIC AND SEMI-AQUATIC HETEROPTERA DISTRIBUTION FROM REPEDE RIVER IN THE RODNA MOUNTAINS NATIONAL PARK (TRANSYLVANIA-MARAMUREŞ, ROMANIA)

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KEYWORDS: Romanian Carpathians, Repede River, anthropic impact, biodiversity.

ABSTRACT

This paper is part of a study made in order to establish the quality of water resources within the Rodna Mountains National Park. The aim was to make an inventory of the habitats of aquatic and semi-aquatic Heteroptera, the connection between those habitats and the degree of anthropic impact, and to establish the biodiversity degree, using Lou Jost's number equivalents. In order to achieve this, we chose Repede River as a reference. Samples were collected from the river's floodplains, from 16 sampling stations belonging to three sectors along the valley, with different degrees of anthropic impact. Three eurivalent species of the group were collected. Obvious differences were observed between the three sectors analyzed, the one with a medium degree of anthropization being preferred. The biodiversity analysis showed values similar to other analogous basins studied by the authors.

ZUSAMMENFASSUNG: Der Einfluss des Menschen auf die Verteilung der aquatischen und semiaquatischen Heteropteren des Repede Flusses/Nationalpark Rodna-Gebirge (Transylvanien-Maramuresch/Rumänien).

Die vorliegende Arbeit ist Teil einer Studie, zur Bewertung der Güte der Wasserressourcen im Nationalpark Rodna Gebirge. Das Ziel war die Erfassung der von den aquatischen und semiaquatischen Heteropteren bevorzugten Habitaten, die Feststellung der Beziehung zwischen ihrer Anzahl und dem Grad ihrer Beeinflussung durch menschliche Tätigkeiten sowie die Ermittlung der Biodiversitätswerte mit Hilfe der Methode der numerischen Äquivalenz von Lou Post. Um dieses Ziel zu erreichen, wurde der Repede-Fluss als Referenzgewässer ausgewählt. Die Proben wurden an 16 ausgewählten Stellen der Aue im Bereich von drei unterschiedlich stark vom Menschen beeinflussten Flussabschnitten entnommen. Die untersuchte Gruppe war mit drei eurivalenten Arten vertreten. Es wurden klare Unterschiede zwischen den drei im Hochwasserbett analysierten Abschnitten festgestellt, wobei sich derjenige mit einem moderaten Einfluss menschlicher Tätigkeit als bevorzugt erwies. Die Biodiversitätsanalyse zeigte Werte, die denen ähnlicher, von den Autoren untersuchter Einzugsgebiete nahe standen.

REZUMAT: Influența impactului uman asupra distribuției heteropterelor semiacvatice şi acvatice din râul Repede în Parcul Național Munții Rodna (Transilvania-Maramureş, România).

Lucrarea face parte dintr-un studiu realizat pentru evaluarea calității resurselor de apă, din Parcul Național Munții Rodna. Obiectivul a fost inventarierea habitatelor preferate de Heteropterele acvatice şi semiacvatice, legătura dintre numărul lor şi gradul de impact antropic, şi stabilirea valorilor biodiversității, cu ajutorul metodei echivalenților numerici a lui Lou Jost. Pentru atingerea scopului, a fost aleasă ca arie de referință Râul Repede. Probele au fost colectate din albia majoră a râului, din 16 puncte aparținând la trei sectoare din lungul văii, cu grade diferite de impact, trei specii eurivalente, fiind colectate. Diferențe evidente au fost observate între cele trei zone analizate, cea cu un grad moderat de antropizare fiind preferată. Analiza de biodiversitate a arătat valori apropiate cu cele ale altor bazine hidrografice, similare, studiate de autori.

INTRODUCTION

The Rodna Mountains National Park is the largest natural reserve from northern Romania, spreading across 46.339 hectares of forests and meadows. The area contains valuable species of plants and animals, alongside important geological and geomorphological assets. Human activities are reduced to minimum inside the park's boundaries, only rational forestry and grazing being aloud. This paper is part of a larger study made in order to asses quality of habitats and the influence of human activities in the area. From the target group, aquatic Heteroptera belong to Infrasuborder *Nepomorpha* Popov 1968, while the semi-aquatic ones belong to Infrasuborder *Gerromorpha* Popov 1971 (Gaby Viskens, 2005, on www.earthlife.net), being insects associated, more or less, to water surfaces, forming, along other groups, the nekton and the epineuston. They inhabit a large variety of micro biotopes, from those lacking in vegetation, to those completely covered (Andersen, 1982; Davideanu, 1999), the typical habitats for the group representing ponds, lakeshores, slow flowing creeks or little bays formed at the shore of rivers. Most species are not sensible to moderate human impact in the habitat, as well to the presence of vegetation (Andersen, 1982; Jansson, 1986). Repede River was chosen as a case study on the group, due to the gradual anthropic impact present, from completely pristine habitats, in the upper basin, to river banking and all that comes from the presence of a locality, in its the lower basin.

MATERIAL AND METHODS

The study took place in June 2009, with the goal of taking qualitative samples. A total of 16 stations were taken in concern, from three different areas of the floodplains: four stations in the lower basin (intense anthropic impact), eight stations in the middle basin (medium anthropic impact) and another four station in the upper basin (with no anthropic impact). From each station, we took one sample, of 7 to 10 m, covering as much of the habitat possible (water surface and interior, aquatic vegetation if present, bottom); the samples were collected with an entomological net with 60 cm^2 opening and 2 mm mesh.

The identification of the species was made by the morphological features of the insects, studying them at the stereo binocular, using data from other specialists (Jansson, 1986; Davideanu, 1999). The larvae found were not identified at species' level, due to difficulties regarding that operation, and they will not be considered in the biodiversity analysis.

The results obtained from the sampling points were analyzed from the biodiversity point of view, using Jost's number equivalent. For our case, in which community weights are different, we used Shannon Entropy ($-\Sigma p_i * \ln(p_i)$), with the number equivalent of $\exp(-\Sigma p_i * \ln(p_i))$, for which the β value is obtained by dividing γ to α (Jost, 2007).

RESULTS AND DISCUSSIONS

As stated before, three different river sectors were studied.

Sector 1 (Fig. 1) was chosen in a small ward of Borşa locality, between the following river sectors: 47°37’35” northern latitude, 24°42’08” eastern longitude downstream (753 m a.s.l.) and 47°37’27” northern latitude, 24°41’59” eastern longitude upstream (765 m a.s.l.). Four sampling station were evaluated from this area, encoded S11 to S14, from the lowest to the highest altitude.

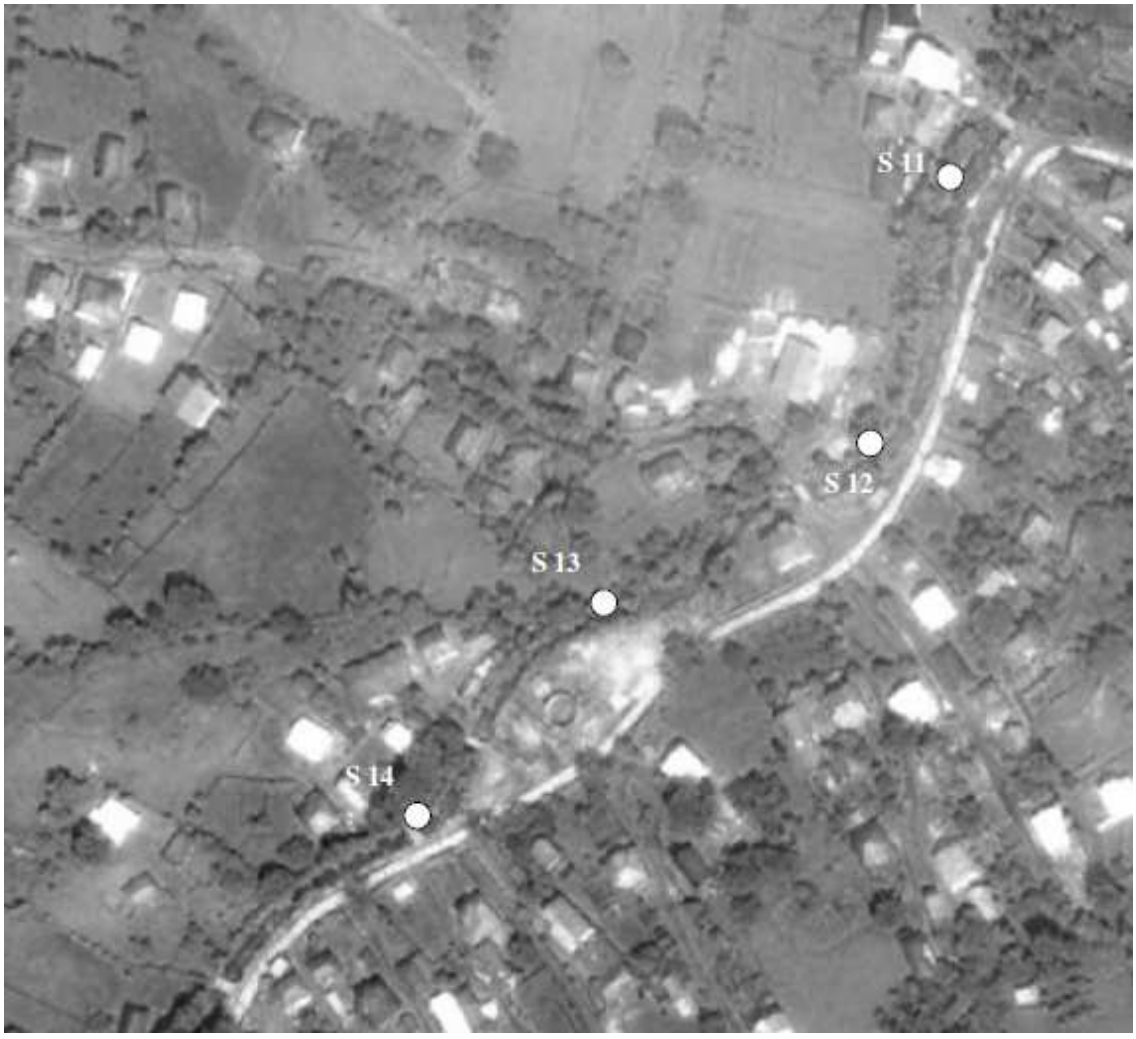

Figure 1: Sampling sector 1 - lower Repede River basin
(personal representation from googleearth.com basis)

The geographical status of the stations is as follows: S11 is located at 47°37’33” northern latitude, 24°42’07” eastern longitude and an elevation of 754 m a.s.l., S12, at 47°37’31” northern latitude, 24°42’06” eastern longitude and 756 m a.s.l. elevation, S13, at 47°37’30” northern latitude, 24°42’02” eastern longitude and an elevation of 760 m a.s.l., and, finally, S14 was chosen at 47°37’28” northern latitude, 24°42’00” eastern longitude and 764 m a.s.l. elevation.

All the stations are largely similar, being river shores with a relatively slow stream (altitude difference is 10 m at 500 m long sector), the river bottom is rocky and has small amounts of sediment, water depth is under 40 cm, aquatic vegetation is missing and the water is clear. All along the sector the river is partially banked, and urban wastes are a habit (plastic bags, garbage, oil spills), due to the proximity of inhabited space (the river runs between individual households). Samples were taken from about 5-6 m long and one m wide sectors of the river.

Neither aquatic nor semi aquatic Heteroptera was found in either of the sampling stations, and very few other inhabitants were sampled (Trichoptera and Odonata larvae, small worms). The most probable cause is the lack of vegetation and low quantity of organic sediment, both favourable conditions for the group. Another problem is regarding the river's territorial improvement, which leads to the absence of stagnant water, both on the main course and flood plains, stagnant water where most target group species are found. The mild pollution must not be seen as a problem, since previous works showed the contrary (Olosutean and Ilie, 2008; Ilie and Olosutean, 2009).

Sector 2 (Fig. 2) was chosen between the following points from the river course: 47°37'05" northern latitude, 24°41'48" eastern longitude (at an 819 m a.s.l.) and 47°36'41" northern latitude, 24°41'43" eastern longitude (elevation 834 m a.s.l.). The sector has suffered a recent transformation, drills being made in the flood plains and river bed, for drinkable water captures, to be used by the people in the nearby Borşa locality.

We took samples from eight different stations, chronologically encoded S21 to S28.

S 21 (47°37'04" northern latitude, 24°41'49" eastern longitude, elevation 825 m a.s.l.) is a river sector with slow stream flow, hygrophilous vegetation present in a small amount at the shore and a muddy bottom. The sampling was made from about 10 m in length and 60-70 cm in width.

S 22 (47°37'02" northern latitude, 24°41'49" eastern longitude, elevation 825 m a.s.l.) is again a river sector with hygrophilous vegetation present in a small amount at the shore and muddy bottom, about 100 m upstream S21. The water was almost still, and the amount of vegetation a little larger than the previous station. The sampling was again made from about 10 m in length and 60-70 cm width.

S 23 (47°36'55" northern latitude, 24°41'49" eastern longitude, elevation 831 m a.s.l.) is a small puddle of about 5 m long and 3 m wide, formed at the side of the road. Hygrophilous vegetation was heavily present, the bottom was muddy, and the depth of the water was less than 20 cm.

S 24 (47°36'58" northern latitude, 24°41'50" eastern longitude, elevation 826 m) was another small puddle formed in an excavation on the river floodplain, 2 m long and a half meter wide, with a small amount of semi aquatic vegetation, rocky bottom and signs of anthropic intervention (metal pieces, wood). The water was deeper than the previous station, measuring up to 50 cm.

S 25 (47°36'53" northern latitude, 24°41'54" eastern longitude, elevation 843 m) is a small creek, tributary to Repede, with a step-like course, rocky bottom and no vegetation. The samples were made from about 10-12 m in length and 30 cm in width.

S 26 (47°36'52" northern latitude, 24°41'53" eastern longitude, elevation 843 m) is again a small tributary of Repede River, but with a different course, imposed by a road gap, with hygrophilous vegetation present and a very slow flow. Samples were taken from about 10 m in length and 20 cm in width.

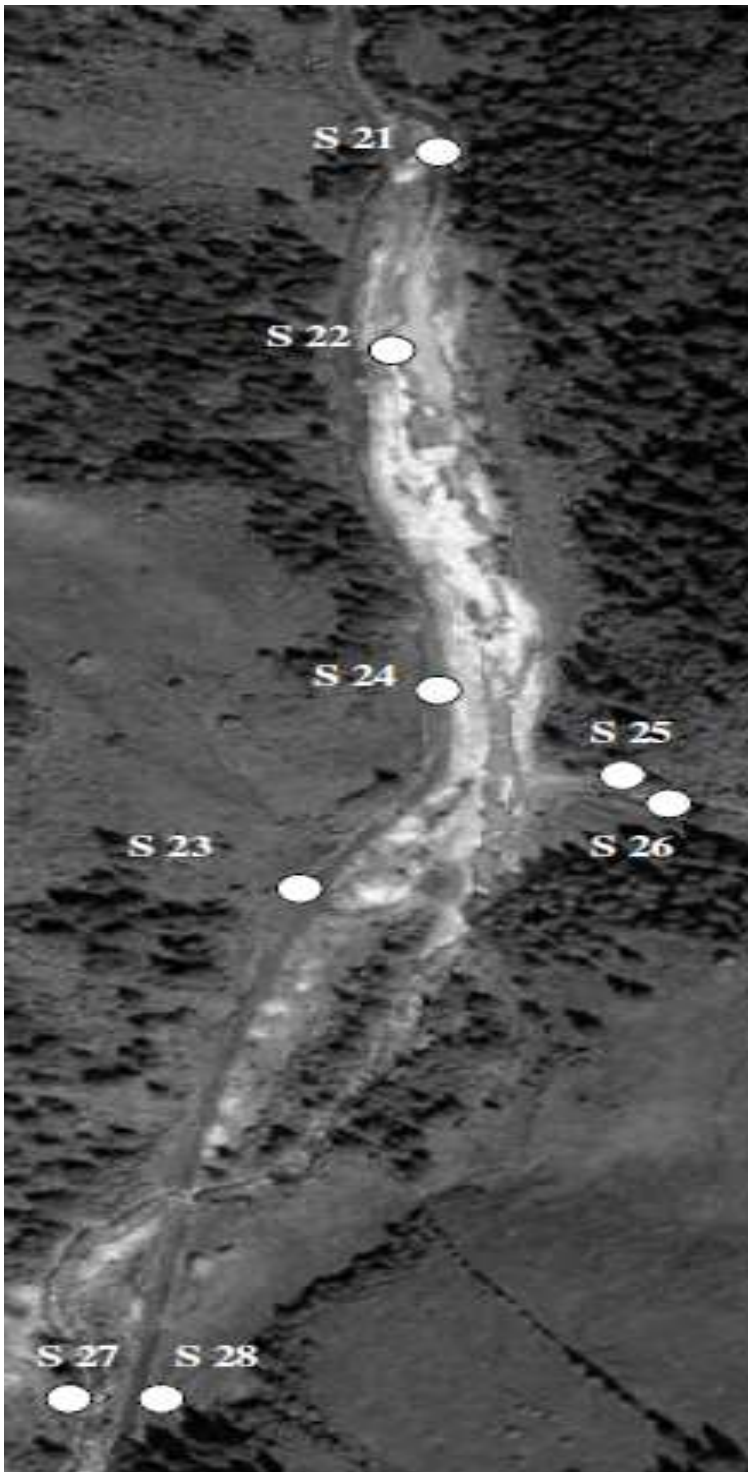

Figure 2: Sampling sector 2 - middle Repede River basin (personal representation from googleearth.com basis).

S 27 (47°36'43" northern latitude, 24°41'45" eastern longitude, elevation 833 m) consists of two communicating small puddles formed in an excavation near the road, measuring each about 2 m in both length and width. The puddles had rocky bottom, no vegetation and small depth (around 10-15 cm). Spruce branches from forest exploitation were in a large amount inside both puddles.

S 28 (47°36'43" northern latitude, 24°41'44" eastern longitude, elevation 830 m) was a swamp sector formed by a spring dammed by the construction of the road. The station was about 20 m long and 10 m wide, of mixed underwater and dry sectors, with abundant vegetation and stagnant water, no deeper than 10 cm.

Six out of eight sampling stations show the presence of the target group (Tab. 1). Only three species were sampled as imago: *Gerris lacustris* Lineé 1758, *Gerris costae* Herrich-Schäffer 1853 and *Notonecta glauca glauca* Linné, 1758, as well as 13 larvae belonging to the group, impossible to identify at species' level (therefore, not taken into account in a further analysis). Biodiversity values calculated using Jost's number equivalents were 1.207 for average α-biodiversity, 0.878 for β-biodiversity and 2.085 for γ-biodiversity.

Table 1: List of aquatic and semi-aquatic Heteroptera sampled in the Rodna Mountains National Park.

No.	Species	Stations					
		S21	S22	S23	S24	S27	S28
1.	*N. glauca glauca*	-	-	1	-	-	-
2.	*G. lacustris*	4	1	-	1	-	-
3.	*G. costae*	-	1	1	1	4	9
Total		4	2	2	2	4	9

We compared those values with similar sectors sampled in previous campaigns: the upper Arieş River basin from the Apuseni Mountains (Ilie and Olosutean, 2009), Ruscova and Frumuşeaua rivers from the Maramureş Mountains (recalculation for Jost's method using data from Olosutean and Ilie, 2008). The comparison is depicted in the table 2.

Table 2: Biodiversity values of the four rivers.

No.	river	no. of species /no. of stations	average α	β	γ
1.	Repede (Rodna Mountains)	3/6	1.207	0.878	2.085
2.	Ruscova (Maramureş Mountains)	4/6	1.16	0.99	2.15
3.	Frumuşeaua (Maramureş Mountains)	4/5	1.88	1.14	3.02
4.	Arieş (Apuseni Mountains)	7/6	1.53	2.317	3.545

The highest similarity is with Ruscova Valley, where the degree of anthropic impact was very much alike: habitats appear from small creeks dammed by roads, road gaps, canals at the side of roads. Frumuşeaua Valley shows higher α diversity, being a much pristine area, although anthropic impact is familiar. Upper Arieş River has higher β values, pursuant to a much larger distance between consecutive stations (about 2 km between stations, opposed to a 2 km entire area for Repede River), resulting in a higher variety of geological and geomorphological conditions, reflected in larger differences between community compositions. In conclusion, similar values occur at similar impact (in intensity and type), but a general conclusion needs further investigation.

Sector 3 (Fig. 3) was chosen between 47°35'57" northern latitude, 24°41'31" eastern longitude downstream, at an elevation of 936 m, and 47°35'48" northern latitude, 24°41'28" eastern longitude upstream, at 971 m a.s.l.

Four sampling stations were taken into account, encoded S31 to S33 from the lowest to the highest in altitude.

S31 (47°35'56" northern latitude, 24°41'31" eastern longitude, elevation 942 m) was a curved river sector, with slower than average stream speed. No hygrophilous vegetation was present, the bottom was rocky, the water clear and rapid enough, with a depth of about 50 cm. The sample was taken from a 5 m per 1 m area.

S32 (47°35'52" northern latitude, 24°41'29" eastern longitude, elevation 952 m) is the confluence of Repede with a large tributary. The samples were taken at shores, under a bridge, for about 10 m in length, and 50 cm in width, where the stream speed was slower, the bottom was rocky, the water depth around 70-80 cm, and no vegetation was present.

S33 (47°35'50" northern latitude, 24°41'29" eastern longitude, elevation 966 m) and S34 (47°37'49" northern latitude, 24°41'30" eastern, elevation 966 m) are small creeks, tributary to Repede River, flowing in parallel with the main river. They both had a fast flow, around 10 cm depth, a small amount of hygrophilous vegetation, muddy bottom and relatively clear water.

No individual of the target group was found in this sector, but the causes are, most likely, very different than the ones in sector 1. Pristine habitats from the upper basin are not very favourable to our group, who needs small ponds, slow flow or semi aquatic vegetation, none present on the area. Fast flowing streams, characteristic of mountain rivers are not preferred by aquatic and semi aquatic species of Heteroptera, and also to hygrophilous vegetation, another important condition for most species.

Geomorphological conditions, with a crystalline substratum, favour rapid rainwater infiltration, leaving small room for puddle formation, another specific habitat for the group. Last, but not least, harsh climatic conditions might be a problem for some higher temperature preferring species, concurring, along with the other conditions mentioned, to the complete lack of aquatic and semi aquatic Heteropterans from this area.

As a personal comment, we must not exclude the presence of the group from the entire upper basin, since we didn't have access to the river's springs, where the presence of vegetation and slow flowing water could offer good conditions for some species (especially *G. lacustris* and *Velia (Plesiovelia) rivulorum* Fabricius 1794), as previous work from the authors revealed (Olosutean and Ilie, 2008; Ilie and Olosutean, 2009; Ilie, personal observation).

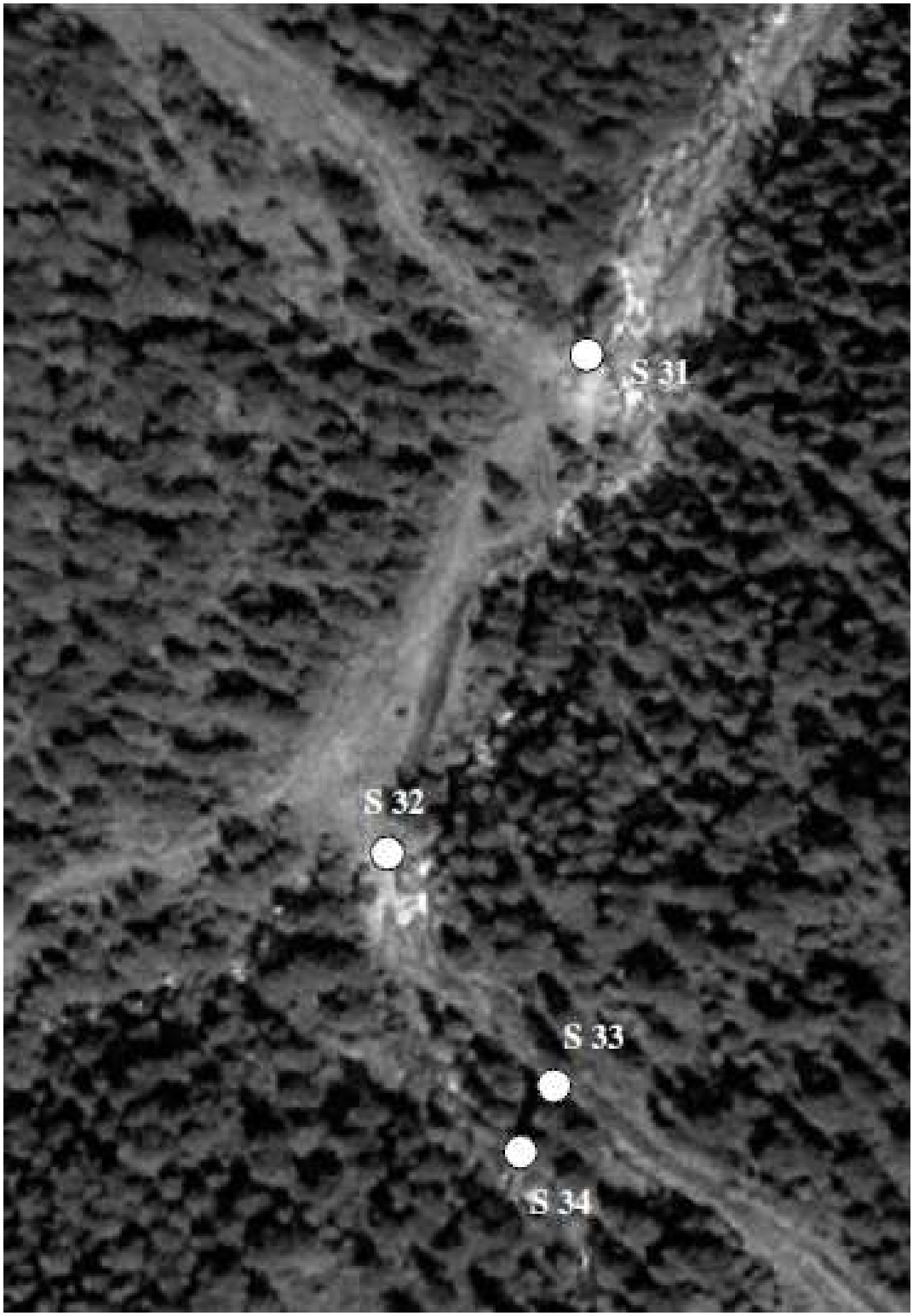

Figure 3: Sampling sector 3 - upper Repede River basin
(googleearth.com basis modified by author).

CONCLUSIONS

Aquatic and semi-aquatic Heteroptera are represented in the Repede River valley by only 3 species (with 23 imago and 17 larvae), all common ones for the group in Romania. All three species are new to the area, probably as a result to the lack of studies made in the area, but two of them were sampled to the nearby regions: *G. lacustris* in several locations from Maramureş Mountains (Olosutean and Ilie, 2008) and *G. costae* at Tihuţa from the Bârgău Mountains (Paina, 1975) and on Bardi Creek from the Maramureş Mountains (Olosutean and Ilie, 2008).

All the individuals were sampled in only one of the three sectors chosen, respectively the one with medium anthropic impact. The specific activities from the area (drilling the river bed and meadows, road construction, river damming) produced habitat conditions for the group (puddles, marshes, slow flow), therefore the results were obtained. The biodiversity analysis revealed more or less similar values with suchlike rivers from previous campaigns.

The upper basin (with no anthropic impact) and the lower basin (with intense anthropization) showed no presence of the group, but the reasons are completely different. Due to access problems, we were unable to sample the river springs, where usually appear habitats for the studied group.

As a general conclusion, it seems that mild anthropic impact suites aquatic and semi aquatic Heteroptera, creating better habitat conditions for the group, but the discussion is still open and needs further research.

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NOTES ON THE ANT FAUNA (HYMENOPTERA, FORMICIDAE) OF THE RODNA MOUNTAINS NATIONAL PARK AND IT'S SURROUNDINGS (TRANSYLVANIA-MARAMUREŞ, ROMANIA)

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KEYWORDS: Romanian Carpathians, myrmecofauna, diversity.

ABSTRACT

Faunistic investigation of the Rodna Mountains National Park and its surroundings (NW Romania) yielded records for 16 ant species. Based upon these results the number of known species reaches 22 in this region. Nine species are new for this region: *Camponotus ligniperdus, Formica lemani, Formica clara, Formica sanguinea, Leptothorax acervorum, Myrmica lobicornis, Myrmica rubra, Myrmica ruginodis* and *Polyergus rufescens*. Three main habitat types were studied: meadows, spruce forests and grasslands. The highest number of species was recorded in grasslands. The majority of the species are common in Romania. Data regarding the species' biology and ecology are given.

ZUSAMMENFASSUNG: Anmerkungen zur Ameisenfauna (Hymenoptera: Formicidae) des Nationalparks Rodna-Gebirge und seiner Umgebung (Transylvanien-Maramuresch, Rumänien).

Auf Grund faunistischer Untersuchungen im Nationalpark Rodna-Gebirge und seiner Umgebung (NW Rumänien) wurden 16 Ameisenarten festgestellt. Mit diesen Ergebnissen weist die Ameisenfauna des Gebietes nun 22 Arten auf, davon sind neun Arten *Camponotus ligniperdus, Formica lemani, Formica clara, Formica sanguinea, Leptothorax acervorum, Myrmica lobicornis, Myrmica rubra, Myrmica ruginodis* und *Polyergus rufescens* neu für das Gebiet. Es wurden drei Haupttypen von Lebensräumen untersucht und zwar: Wiesen, Fichtenwald und Weiden. Die höchste Artenzahl fand sich im Weideland. Die meisten sind in Rumänien weit verbreitete Arten. Angaben betreffend Biologie und Ökologie der Arten werden auch angeführt.

REZUMAT: Date privind fauna de furnici (Hymenoptera: Formicidae) din Parcul Național Munții Rodna şi împrejurimi (Transilvania-Maramureş, România).

Investigațiile faunistice în Parcul Național Munții Rodna au dus la înregistrarea a 16 specii de furnici. Cu aceste date, numărul speciilor cunoscute din această zonă se ridică la 22 de specii. Nouă specii sunt noi, pentru această regiune: *Camponotus ligniperdus, Formica lemani, Formica clara, Formica sanguinea, Leptothorax acervorum, Myrmica lobicornis, Myrmica rubra, Myrmica ruginodis* and *Polyergus rufescens*. Trei tipuri de habitate au fost studiate: lunca, pădurea de molid şi pajiştea. Cea mai mare diversitatea a fost înregistrată în pajişti. Majoritatea speciilor sunt comune în România. Sunt prezentate date privind biologia şi ecologia speciilor identificate.

INTRODUCTION

Although in the last decade faunistic studies were carried out in different regions of Romania (Csősz et al., 2001; Kiss and Fetykó, 2008; Markó, 2008; Tăuşan and Markó, 2009), there are still areas from where no data or few species are known.

The ant fauna of Rodna Mountains was rather poorly studied, only scarce data are known. Ten species are known from Rodna Veche (Bistriţa Năsăud County): *Formica cinerea* Mayr, 1853, *Formica cunicularia* Latreille, 1798, *Formica pratensis* Retzius, 1783, *Formica rufibarbis* Fabricius, 1793, *Lasius brunneus* (Latreille, 1798), *Lasius flavus* (Fabricius, 1781), *Lasius niger* (Linnaeus, 1758), *Lasius plathytorax* Seifert, 1992, *Solenopsis fugax* (Latreille, 1798) and *Tetramorium* cf. *caespitum* (Paraschivescu, 1978; Markó, 1999). An additional two species, *Myrmecina graminicola* (Latreille, 1802), from Pasul Prislop (Rodna Mountains) (Markó and Csősz, 2002) and *Camponotus herculeanus* (Linnaeus, 1758) from Rodna Mountains are recorded so far (Csősz and Markó, 2005).

This study offers the first data to the knowledge of the myrmecofauna of the Rodna Mountains National Park. Biology and ecology data concerning the recorded ant species from the protected area and its surroundings are also given.

STUDY AREA, MATERIAL AND METHODS

The Rodna Mountains National Park is located in the northern part of the Romanian Eastern Carpathians and it is the northernmost national park of our country. It covers an area of 46,400 ha.

The collections took place in June, 2009. Ant species from different habitats were sampled from the Rodna Mountains National Park and its surrounding (Tab. 1, Fig. 1).

Table 1: Sampling points in the Rodna Mountains National Park and its surroundings.

Location	Altitude (m)	Coordinates	Vegetation
Rodna Mountains National Park	850	47°36'67" N 24°41'19" E	spruce forest
	810	47°36'34" N 24°41'96" E	grassland
	808	47°37'67" N 24°41'32" E	rock crevices with moss
Borşa Town	442	47°38'78" N 24°42'42" E	meadow
Vişeu Valley downstream Borşa	613	46°27'11" N 22°51'36" E	meadow

Ants were collected by hand mainly from nests; the collected specimens were preserved in 70% ethanol.

The identification of ant species was carried out on the basis of several available identification keys (Czechowski et al., 2002; Markó et al., 2009; Seifert, 1988, 1992, 1996 and 2007).

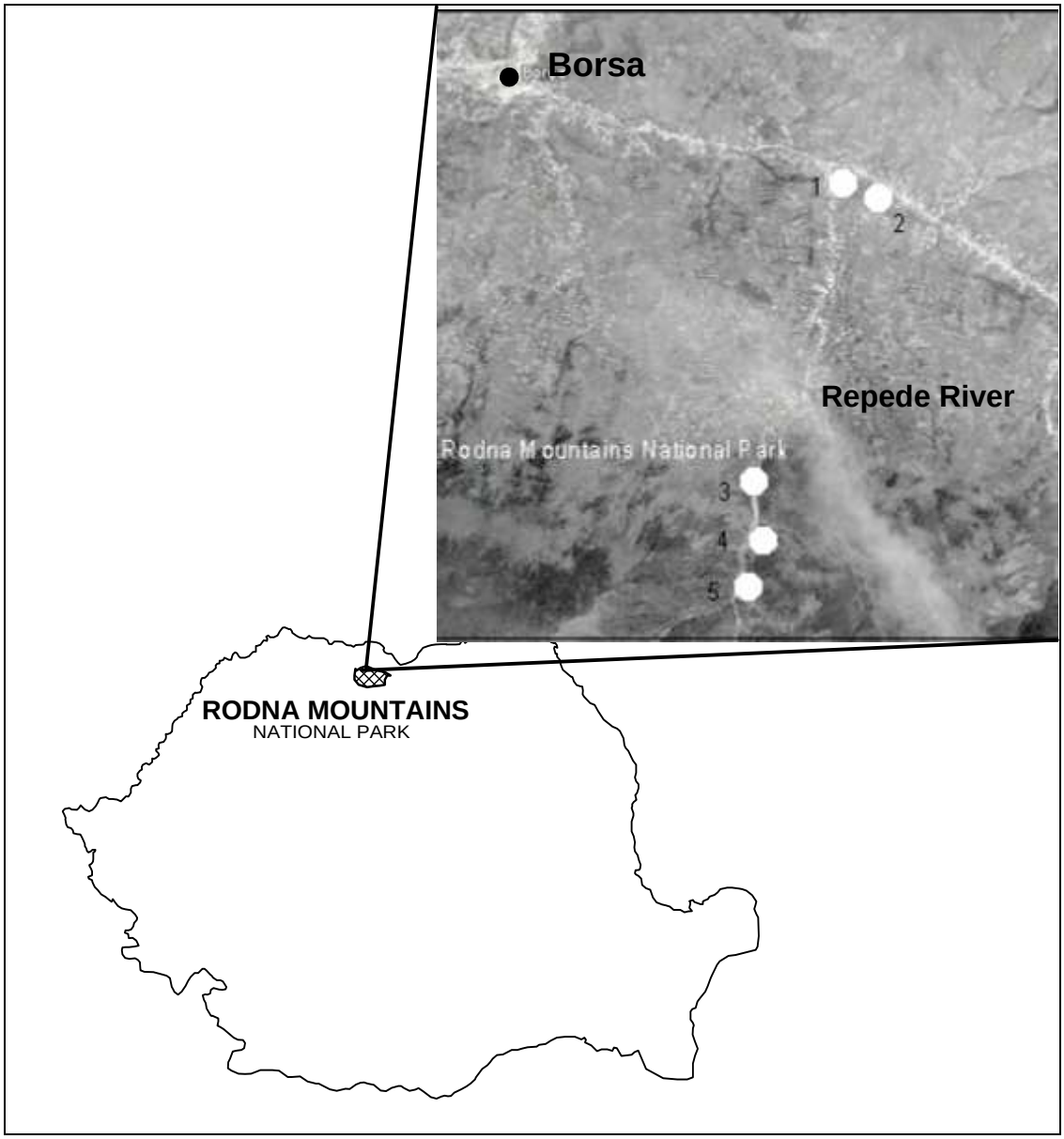

Figure 1: Studied habitats in the Rodna Mountains; (1 - Borşa - meadow, 2 - Vişeu Valley - meadow; Rodna Mountains Park; 3 - rock crevices with moss, 4 - grassland, 5 - spruce forest).

RESULTS

Altogether 16 species belonging to two subfamilies were collected from the Rodna Mountains National Park during this study (Tab. 2). The majority of the species are common for the myrmecofauna of Romania (Markó et al., 2006).

The presence of *Myrmica ruginodis* Nylander, 1846, a polytopic species of moist forests, in grassland habitats isn't unusual, because in mountains, above 1,000 m altitude, it also inhabits open habitats (Czechowski et al., 2002).

Table 2: Species collected from The Rodna Mountains National Park and its surroundings (* species published by other authors, but not collected during the present study).

Species	Borşa	Rodna Mountains National Park			Vişeu Valley
Type of habitat	meadow	rock crevices with moss	grassland	forest	meadow
Formicinae Lepeletier, 1836					
Camponotus ligniperdus (Latreille 1802)			**X**	**X**	
Camponotus herculeanus (Linnaeus, 1758)*					
Formica cinerea Mayr 1853	**X**				**X**
Formica clara Forel 1886			**X**		
Formica cunicularia Latreille 1798			**X**		
Formica lemani Bondroit 1917		**X**	**X**	**X**	
Formica pratensis Retzius 1783*					
Formica rufibarbis Fabricius 1793*					
Formica sanguinea Latreille 1798				**X**	
Lasius brunneus (Latreille 1798)*					
Lasius flavus (Fabricius 1781)			**X**		
Lasius niger (Linnaeus 1758)	**X**				
Lasius plathytorax Seifert 1992	**X**		**X**		
Myrmicinae Lepeletier, 1836					
Leptothorax acervorum (Fabricius 1793)	**X**				
Manica rubida (Latreille 1802)		**X**	**X**	**X**	
Myrmecina graminicola (Latreille 1802)*					
Myrmica lobicornis Nylander 1846		**X**			
Myrmica rubra (Latreille 1867)	**X**				
Myrmica ruginodis Nylander 1846		**X**	**X**	**X**	
Solenopsis fugax (Latreille 1798)*					
Tetramorium cf. *caespitum*		**X**	**X**	**X**	
Total no. of species: 22	5	5	9	6	2

Myrmica rubra (Latreille, 1867), a eurytope, the most hygrophilous and yet the most tolerant species of all Central-European *Myrmica*, one of the commonest in the Palearctic, it was collected from Borşa town meadows, a highly anthropogenized habitat.

Myrmica lobicornis Nylander, 1846, an oligotope of coniferous forests (but enters mixed ones, too), was also recorded from meadows and pastures, nowhere very abundant. Nests in the ground, litter, moss, under stones, in crevices (Czechowski et al., 2002). It was found in rock crevices with moss.

Manica rubida (Latreille, 1802) is a typical mountain species occurring at 500-2,000 m (usually above 700-800 m). It inhabits sunlit stony areas overgrown with low xerophilous vegetation - mainly riverside terraces, meadows and pastures. Nests are built in the ground, often under big stones (Czechowski et al., 2002). The species was collected from moss, from under stones and from grasslands.

Leptothorax acervorum (Fabricius, 1793) is mostly found in dry and light coniferous (mainly pine) forests, with poor undergrowth. It is also met in open habitats, ranging from moist peat bogs to xerothermal grasslands. In the mountains, it reaches the subalpine meadow

and the tundra zones. Nest are built, depending on habitat, in rotten logs or stumps, in fallen branches, under bark and, more rarely, under stones or in rock crevices, also under moss; in bogs they are found in peat (Czechowski et al., 2002). The species was collected from open habitats like meadows.

Formica lemani Bondroit, 1917, a boreo-montane species, mainly inhabits open area, mid-forest glades and mountain meadows, both dry and wet. Occasionally it is found in peat bogs or even in shaded humid forests (Czechowski et al., 2002). It was recorded from moss, grassland and spruce forest habitats.

Formica cinerea occurs exclusively in sunny sandy habitats, from sea and inland dunes to sparse light pine forests. They build deep and widely-spread underground nests (Czechowski et al., 2002). *Formica cinerea* is the typical species of open habitats (Seifert, 1998). The species was recorded from meadow habitats.

Formica cunicularia, a polytopic species of open areas from sandy dunes, limestone slopes and gypseous hills through (Czechowski et al., 2002). It was sampled from meadows.

Formica sanguinea Latreille 1798 is considered to be a forest species, but in fact it is more of a polytope of dry habitats. It occurs both in woodlands and in open areas of different kinds, on different types of soil. This species prefers sunny places, especially clearings and forest edges. It nests more readily in rotting tree stumps which it covers with dry plant material (Czechowski et al., 2002). It was collected from the edge of spruce forests.

Camponotus ligniperdus (Latreille 1802) is a forest species that inhabits mainly mixed and deciduous forests, met also in open habitats sparsely overgrown with shrubs or single trees. It is more thermophilous than *C. herculeanus*; the most typical places of these ants are stony banks and sun exposed borders of woodlands. They nest in dry stumps, in the wood's underground, stones or tree roots, but rarely mine in living trees. The species was recorded from spruce forests and grassland habitats.

Polyergus rufescens (Latreille 1798) is an obligatory social parasite (slave-maker) totally dependent on their hosts which are ants of the subgenus *Serviformica* (e.g. *Formica cunicularia, Formica cinerea*) (Czechowski et al., 2002). It was recorded from open habitats. Due to its abundance in a wide variety of habitats, *L. niger* is one of the commonest Palaearctic ant species. It was considered to be a eurytope species with an unusually wide ecological flexibility and a great biological plasticity (Czechowski et al., 2002). It has a strong synanthropic trend being one of most abundant *Lasius*, alongside *L. paralienus*, in cities, parks, gardens and arable land. It avoids shaded woodland and undisturbed bogs and fens, where it is competed out by *L. platythorax* (Seifert, 1992). It was collected from meadows.

L. platythorax in comparison with *L. niger*, clearly prefers more humid sites. It inhabits all types of forest as well as bogs and fens, and avoids open sites, especially anthropogenized ones. This species usually builds its nests in organic substrate, most frequently in dead wood (particularly in rotten stumps), but also in vegetation pads, in grass tussocks with a humus root layer; it makes no above-ground mineral construction (Czechowski et al., 2002). *L. platythorax* was recorded from grassland and meadow. Its frequent association with species likes *Leptothorax acervorum* and *Myrmica ruginodis* (Seifert, 1992).

L. flavus is an ubiquistic (eurytopic) species preferring open and sunny habitats. The species occurs in great densities in meadows and pastures where its nests with big soil mounds render cultivation and mowing difficult. The mounds are overgrown with moss, thyme, grasses. The species also nests under stones, particularly in rocky areas (Czechowski et al., 2002). The species was recorded from grassland habitats.

CONCLUSIONS

On the basis of this study the number of known ant species from the Rodna Mountains and its surroundings sums up to 22. There are nine new species for this region: *Camponotus ligniperdus, Formica lemani, F. clara, F. sanguinea, Leptothorax acervorum, Myrmica lobicornis, Myrmica rubra, Myrmica ruginodis* and *Polyergus rufescens*. As expected, the highest number of species was recorded in the grassland.

Similar studies undertaken from different mountain habitats revealed 21 species in Retezat Mountains (Paraschivescu, 1972), 19 species in Semenic Mountains (Paraschivescu, 1975), 31 species in Bucegi Mountains (Paraschivescu, 1976) and 29 species in Apuseni Mountains (Paraschivescu, 1982). Recently, Moscaliuc (2008) recorded 20 species from Rarău Mountains.

We can conclude that the recorded ant diversity from Rodna Mountains is quite low, although new species for the Romania ant fauna have been discovered from mountain habitats (Markó and Csősz, 2002).

Using other sampling methods and further investigation of other habitats, the real number of ant species could be higher than the one registered in the frame of the present study. Further researches could yield important additional data to the fauna of protected areas.

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ORTHOPTERA FAUNA OF THE RODNA MOUNTAINS NATIONAL PARK - BIOSPHERE RESERVE (TRANSYLVANIA-MARAMUREŞ, ROMANIA)

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KEYWORDS: Romanian Carpathians, Biosphere Reserve, Orthoptera, distribution, endemic species.

ABSTRACT

This paper is a part of an extensive study regarding the taxonomy and ecology of Orthoptera fauna in Rodna Mountains National Park/Eastern Carpathians, drawing the final conclusions of our investigations.

In the period 2004-2008, 52 Orthoptera species were identified; the majority of them are: chortobiont life forms (44.23%), eurosiberian elements (36.53%), occurring under 1,800 m altitude and prefer mezophilous meadows (48.07%).

A high number of Carpathians endemic species are present: *Isophya brevipennis, Isophya pienensis, Miramella ebneri carpathica, Odontopodisma carpathica* and *Pholidoptera transsylvanica.*

RÉSUMÉ: La faune d'orthoptères du Parc National des Montagnes de Rodna (Transylvanie-Maramureş, Roumanie).

L'article ci-dessous est partie d'une ample étude concernant la taxonomie et l'écologie de la faune des orthoptères du Parc National des Montagnes de Rodna/Carpates Orientaux, et en tire les conclusions des nos recherches.

Durant la période 2004-2008, 52 espèces d'orthoptères ont été identifiées la plupart d'entre elles étant des formes de vie chortobiontes (44,23%), des éléments sibériens (36,53%), répandues à moins de 1.800 m d'altitude et préférant des prairies mésophiles (48,07%).

Un grand nombre des espèces endémiques pour les Carpates y sont présentes: *Isophya brevipennis, Isophya pienensis, Miramella ebneri carpathica, Odontopodisma carpathica* et *Pholidoptera transsylvanica*.

REZUMAT: Fauna de ortoptere din Parcul Național al Munților Rodnei (Transilvania-Maramureş, România).

Prezentul articol este o parte a unui studiu mai amplu cu privire la taxonomia şi ecologia faunei de ortoptere din Parcul Național al Munților Rodnei din Carpații Orientali, conținând concluziile finale ale cercetărilor noastre.

În perioada 2004-2008, au fost identificate 52 de specii de ortoptere majoritatea fiind: forme chorobionte (44,23%), elemente eurosiberiene (36,53%), trăind sub 1.800 m altitudine şi ocupând cu precădere pajişti mezofile (48,07%).

Sunt prezente numeroase endemisme carpatice: *Isophya brevipennis, Isophya pienensis, Miramella ebneri carpathica, Odontopodisma carpathica* şi *Pholidoptera transsylvanica.*

INTRODUCTION

The Orthoptera insects are known under the common names as grasshoppers, crickets, locusts that play a very important role in natural ecosystems and, except for some species which can bring some damages, include many species considered as scientific treasures and consequently protected. Presently in Romania, there are 183 Orthoptera species and subspecies, 9 species are protected by Law 462/2001, one species by 13/1993 Law on Bern Convention adhesion and 7 species by the Habitats Directive 92/43/CEE.

Rodna Mountains National Park (Biosphere Reserve), placed in the Eastern Romanian Carpathians, was declared a Biosphere Reserve in 1979 and was established as a national park in 1990, covering a surface of 46,399 ha and including the highest peak from Northern Romania - Pietrosu Mare (2,303 m).

Our research were carried out in the period 2004-2009 in the Rodna Mountains National Park and in its neighboring areas, covering a surface of 50,000 ha, between latitude 47°25'54" and 47°37'28" north and longitude 24°31'30" - 25°01'30" east. (APNMR, 2007) (Fig. 1).

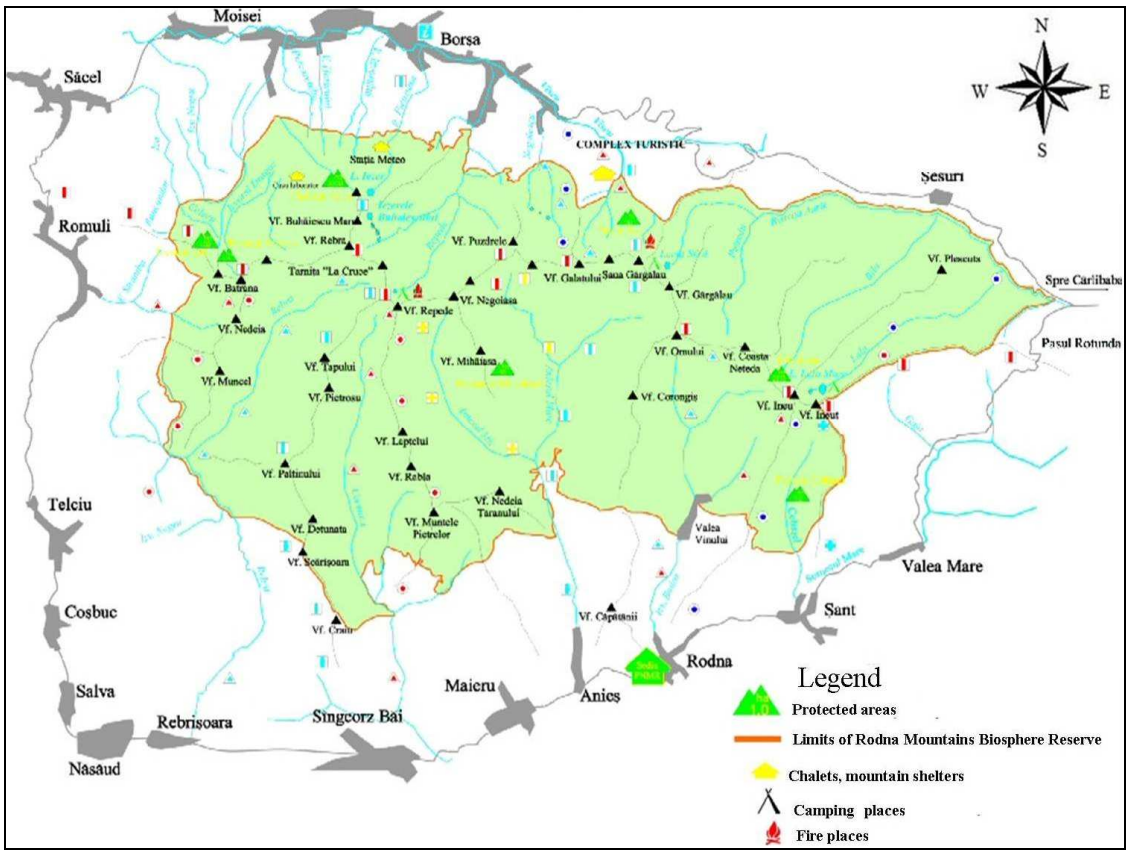

Figure 1: Rodna Mountains National Park map - study area.

MATERIAL AND METHODS

There were collected 959 quantitative samples of Orthoptera species from all types of habitats from Rodna Mountains (Fig. 2), between 500 and 2,303 m altitude. The main types of habitats are: xerophilous, mezophilous, hygrophilous meadows, pastures and hayfields, edge of coniferous, deciduous and mixt forests, forest clearings, swamps, screes, bushes, riparian habitats, orchards, ant hillocks.

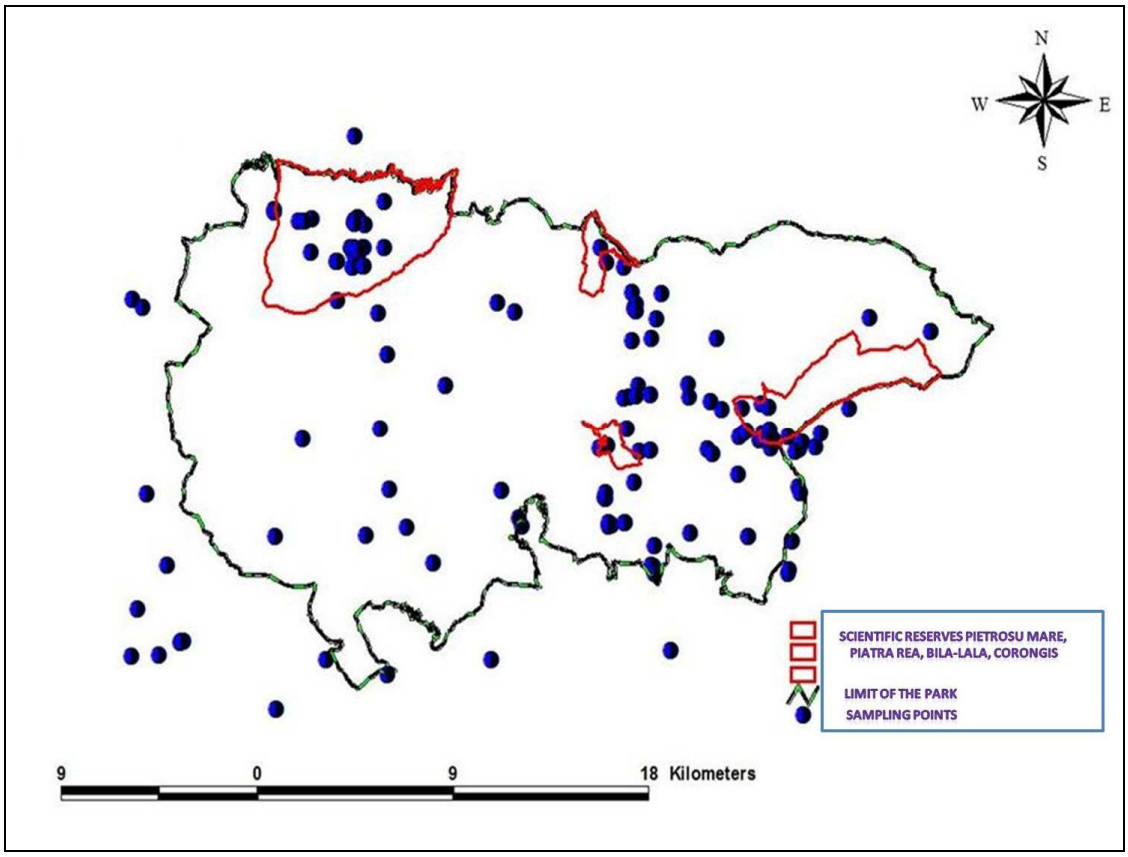

Figure 2: Distribution map of colleting points.

From each site 7 quantitative samples were collected using 50 mowing strokes with an entomological net (30 cm diameter and 70 cm length). Each point was marked by GPS unit (Garmin Etrex Summit). Some species were identified in the field using morphologic characters or calling songs and other species in laboratory by using the binocular and field guides (Harz, 1969, 1975, 1976).

More detailed studies were undertaken in scientific reserves from Rodna Mountains (Pietrosu Mare, Bila-Lala, Corongiş, Piatra Rea) because of high ecosystems diversity and high level of conservation status.

RESULTS AND DISCUSSIONS

In more than 100 field campaigns organized in Rodna Mountains National Park (2004-2008) were identified 52 Orthoptera species (Fig. 3). According to the old studies undertook in Rodna Mountains (Szilady, 1922; Kis, 1967), in this area were found initially only 5 species in (1922) and only 39 species (1954).

Table 1: List of Orthoptera species identified in the Rodna Mountains National Park.

No.	The species and the taxonomic position
	Order Orthoptera Suborder Ensifera Superfamily Tettigonoidea Family Phaneropteridae Subfamily Phaneropterinae Tribe Phaneropterini
1.	*Phaneroptera falcata* (Poda, 1761)
	Family Phaneropteridae Subfamily Barbitistinae Tribe Barbitistini
2.	*Leptophyes albovittata* (Kollar, 1833)
3.	*Isophya brevipennis* (Brunner, 1878)
4.	*Isophya pienensis* (Maran, 1954)
5.	*Barbitistes constrictus* (Brunner, 1878)
6.	*Poecilimon schmidti* (Fieber, 1853)
7.	*Polysarcus denticaudus* (Charpentier, 1825)
	Family Chonocephalidae Subfamily Conocephalinae Tribe Conocephalini
8.	*Conocephalus dorsalis* (Latreille, 1804)
9.	*Conocephalus fuscus* (Fabricius, 1793)
	Family Meconemidae Tribe Meconematini
10.	*Meconema thalassina* (De Geer, 1771)
	Family Tettigoniidae Subfamily Tetigoniinae Tribe Tettigoniini
11.	*Tettigonia cantans* (Fuessly, 1775)
12.	*Tettigonia viridissima* (Linne, 1758)
	Subfamily Decticinae Tribe Decticini
13.	*Decticus verrucivorus* (Linne, 1758)
	Tribe Platycleidini
14.	*Platycleis grisea* (Fabricius, 1781)
15.	*Metrioptera brachyptera* (Linne, 1761)
16.	*Metrioptera bicolor* (Phiippi, 1830)
17.	*Metrioptera roeseli* (Hagenbach, 1822)
18.	*Pholidoptera griseoaptera* (De Geer, 1773)
19.	*Pholidoptera fallax* (Fischer, 1853)

20.	*Pholidoptera transsylvanica* (Fischer, 1853)
21.	*Pholidoptera aptera* (Fabricius, 1793)
22.	*Pachytrachis gracilis* (Brunner, 1861)
	Superfamily Grylloidea Family Gryllidae Subfamily Gryllinae Tribe Gryllini
23.	*Gryllus campestris* (Linne, 1758)
	Family Gryllotalpidae Subfamily Gryllotalpinae Tribe Gryllotalpini
24.	*Gryllotalpa gryllotalpa* (Linne, 1758)
	Suborder Caelifera Suprafamily Tetrigoidea Family Tetrigidae Subfamiya Tetriginae Tribe Tetrigini
25.	*Tetrix subulata* (Linne, 1761)
26.	*Tetrix nutans* (Hagenbach, 1822)
27.	*Tetrix bipunctata* (Linne, 1758)
	Superfamily Acridoidea Family Catantopidae Subfamiya Podisminae Tribe Podismini
28.	*Miramella ebneri carpathica* (Galvagni, 1953)
29.	*Pseudopodisma fieberi* (Scuder, 1897)
30.	*Odontopodisma carpathica* (Kis, 1961)
	Subfamily Calliptaminae Tribe Calliptamini
31.	*Calliptamus italicus* (Linne, 1758)
	Family Acrididae Subfamily Acridinae Tribe Parapleurini
32.	*Mecostethus grossus* (Linne, 1758)
	Tribe Chrysochraontini
33.	*Chrysochraon dispar* (Germar, 1834)
34.	*Euthystira brachyptera* (Ocskay, 1826)
	Subfamily Oedipodinae Tribe Locustini
35.	*Psophus stridulus* (Linne, 1758)
	Tribe Oedipodini
36.	*Oedipoda coerulescens* (Linne, 1758)
	Subfamiy Gomphocerinae Tribe Arcypterini
37.	*Arcyptera fusca* (Pallas, 1773)
	Tribe Stenobothrini
38.	*Stenobothrus stigmaticus* (Rambur, 1839)

39.	*Stenobothrus lineatus* (Panzer, 1796)
40.	*Omocestus viridulus* (Linne, 1758)
41.	*Omocestus ventralis* (Zetterstedt, 1821)
42.	*Omocestus haemorrhoidalis* (Charpentier, 1825)
	Tribe Gomphocerini
43.	*Myrmeleotettix maculatus* (Thunberg, 1815)
44.	*Gomphocerus rufus* (Linne, 1758)
45.	*Chorthippus stauroderus scalaris* (Fischer, 1846)
46.	*Chorthippus biguttulus* (Linne, 1758)
47.	*Chorthippus brunneus* (Thunberg, 1815)
48.	*Chorthippus pullus* (Philippi, 1830)
49.	*Chorthippus albomarginatus* (De Geer, 1773)
50.	*Chorthippus dorsatus* (Zetterstedt, 1821)
51.	*Chorthippus montanus* (Charpentier, 1825)
52.	*Chorthippus parallelus* (Zetterstedt, 1821)

According to these data, Rodna Mountains is a rich area in Orthoptera species (52), being on the first place in eastern Carpathians, after Vrancei Mountains (39) (Iuşan and Oltean, 2002), Călimani Mountains (36) (Mihuț, 1997) and Țibleş Mountains (29) (Iuşan, 2008).

From an ecological point of view, Orthoptera fauna from Rodna Mountains is composed by 44.23% chortobiont life forms (Fig. 3) which are developing on meadows and 17.30% thamnobiont life forms which are developing on wooden vegetation (shrubs, bushes, forest edges, forest cuttings). A high number of chortobiont and thamnobiont species can be explain by the species preferences for meadows and forest habitats, prevalent in the Rodna Mountains.

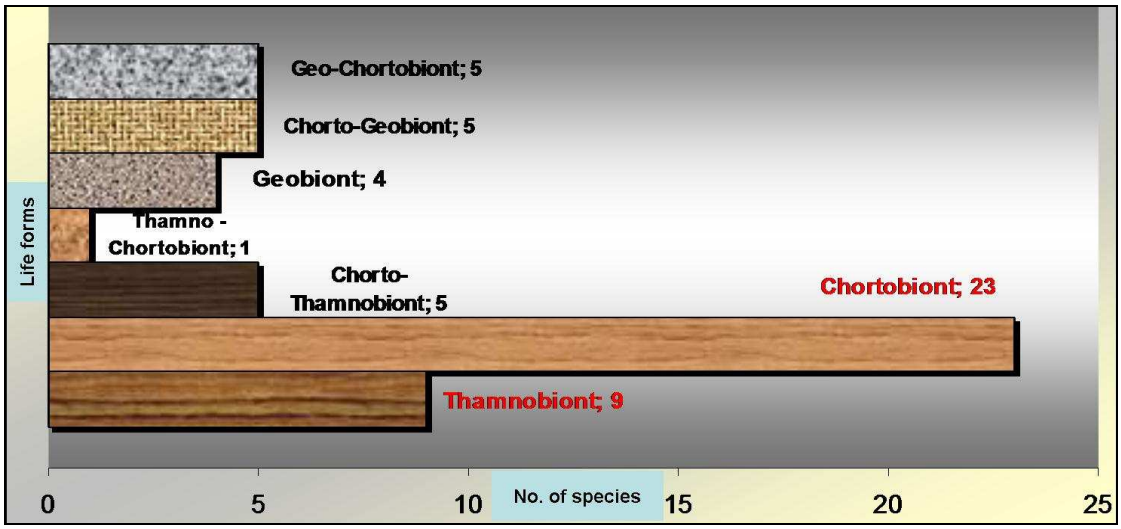

Figure 3: Life forms spectrum of Orthoptera species.

The majority of species (48.07%) prefer mezophilous meadows (Fig. 4), followed by species characteristic for bushes, edge of forests (19.38%), hygrophilous meadows (11.53%), by mezo-hygrophilous species (9.61%), mezo-xerophilous species (9.62%), xerophilous species (3.84%) and rock dwelling species (1.92%).

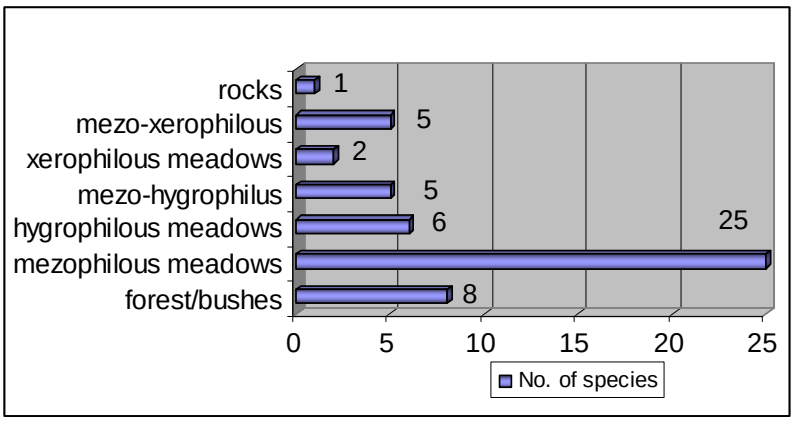

Figure 4: Orthoptera species distribution by habitats.

The altitude is a very important factor for the Orthoptera species distribution, also demonstrated in Rodna Mountains area, since most of the species are found lower than 1,800 m altitude. Between 1,800 m and 2,000 m four species were founded: *Myrmeleotettix maculatus, Psophus stridulus, Tettigonia cantans* and *Barbitistes constrictus*. Above 2000 m eight species can be found: *Omocestus viridulus, Polysarcus denticaudus, Chorthippus parallelus, Stenobothrus lineatus, Miramella ebneri carpathica, Pholidoptera transsylvanica, Metrioptera brachyptera* and *Isophya brevipennis*, which are very common in the area (Fig. 5).

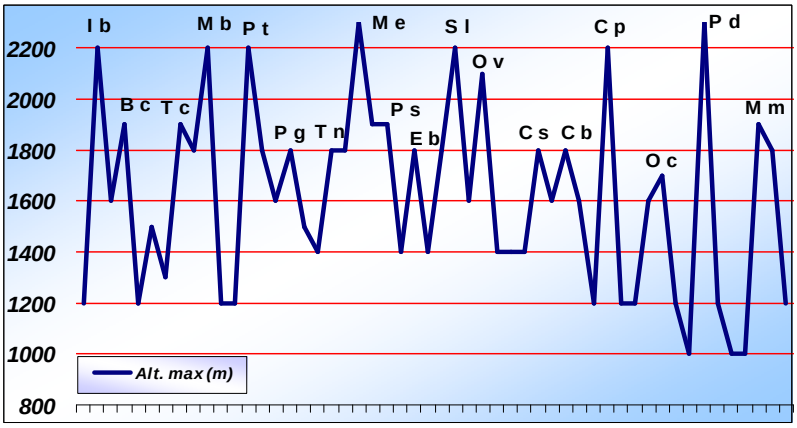

Figure 5: Orthoptera species distribution by altitude.

From zoogeographical point of view (Fig. 6), the Orthoptera fauna of Rodna Mountains consists of the following elements: eurosiberian species (36.53%), very common and wide spread: *Conocephalus dorsalis, Tettigonia cantans, Decticus verrucivorus, Metrioptera brachyptera, Psophus stridulus, Chryschraon dispar* etc.; holopalearctic species (23.07%) such as: *Conocephalus fuscus, Tettigonia viridissima, Tetrix nutans, Oedipoda coerulescens, Omocestus ventralis, Chorthippus brunneus* etc.

We identified an important group of Carpathians endemic species of five species (9.61%), of great importance for the Rodna Mountains protected status: *Isophya brevipennis, Isophya pienensis, Miramella ebneri carpathica, Odontopodisma carpathica* and *Pholidoptera transsylvanica*.

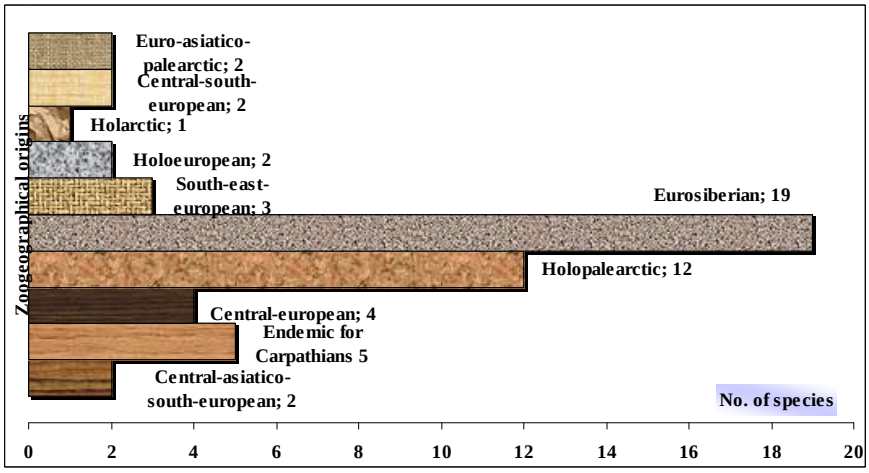

Figure 6: Orthoptera species distribution by zoogeographical origin.

CONCLUSIONS

Rodna Mountains National Park, a very important protected area from the Eastern Carpathians and a biodiversity hotspot in Romania, shelter a high number of Orthoptera species (52).

44.23% are chortobiont life forms living on meadows and 17.30% are thamnobiont life forms living on wooden vegetation (shrubs, bushes, forest edges and cuttings).

Most of the species which prefer mezophilous meadows (48.07%) are mostly encountered below 1,800 m and are eurosiberian elements (36.53%).

A group of endemic species for Carpathians (9.61%) offers grounds for site protection. A species of communitary importance was found (*Pholidoptera transsylvanica*) in many sites of the Rodna Mountains and should be a key species for future biodiversity monitoring strategies.

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HYDROTECHNICAL WORKS IMPACT ON CYCLOSTOMATA AND COTTIDAE SPECIES IN THE RODNA MOUNTAINS AND MARAMUREŞ MOUNTAINS NATURA 2000 SITES (EASTERN CARPATHIANS, ROMANIA), REPEDE RIVER - A STUDY CASE

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KEYWORDS: Romanian Carpathians, Natura 2000 Site ROSCI0125 Munții Rodna, Natura 2000 Site ROSCI0124 Maramureş Mountains, *Cottus gobio*, *Eudontomyzon danfordy*, human impact, conservation watershed management.

ABSTRACT

One of the main drivers of degradation of lotic ecosystems is the hydrological regime alteration, including water abstraction and regulation by different types of embankments and dams. Such a human impact is also present in the Repede River. Between 1997 and 2009 the populations of the species *Cottus gobio* and *Eudontomyzon danfordi* of the Repede River were assessed. Both these species are in an accentuated decrease of their ecological state. The key to real conservation of the river's biodiversity is the use of professional know-how in the cases of: local and regional impact studies, qualitative and quantitative permanent monitoring and correct administrative decisions regardless of the existing economic pressures. In this lotic system example, water abstraction quantity should be in relation to the ecological requirements of local species in all the river sectors and the river continuum should exist for all the species of conservative interest.

ZUSAMMENFASSUNG: Die Auswirkungen wasserbaulicher Maßnahmen auf die Cyclostomata und Cottidae Arten im Nationalpark und Biosphärenreservat Rodna Gebirge - (Ostkarpaten/Rumänien), der Repede Fluss - eine Fallstudie.

Eine der Hauptursachen der Verschlechterung des lotischen Ökosystems sind hydrologische Veränderungen, Wasserentnahme sowie die Regulierung durch verschiedene Arten von Eindeichungen, Uferbefestigungen und Dammbauten. Ein solcher menschlicher Eingriff besteht auch am Repede Fluss. Zwischen 1997 und 2009 wurden die Populationen von *Cottus gobio* und *Eudontomyzon danfordi* im Repede Fluss erfasst und bewertet. Bei beiden Arten ist eine verstärkte Verschlechterung des ökologischen Zustandes festzustellen. Der Schlüssel zu einem reellen Erhaltung der Artenvielfalt des Flusses ist die Anwendung fachlichen Wissens im Falle lokaler und regionaler Verträglichkeitsstudien, bei ständigem qualitativen und quantitativen Monitoring sowie korrekte Verwaltungsentscheidungen unabhängig des vorhandenen wirtschaftlichen Drucks. Im Falle des lotischen Systems im Repede Fluss muss die Menge des entnommenen Wassers im Verhältnis stehen zu den ökologischen Ansprüchen der lokalen Arten und die Durchgängigkeit für alle Arten von naturschutzfachlichem Interesse gewährleistet sein.

REZUMAT: Impactul amenajărilor hidrotehnice asupra speciilor de Cyclostomata şi Cottidae în siturile Natura 2000 din Munții Rodna şi Munții Maramureşului (Carpații Orientali, România), studiu de caz - râul Repede.

Una dintre principalele cauze ale degradării sistemelor lotice este modificarea regimului hidrologic, datorită captărilor de apă şi regularizării cursului prin diferite tipuri de diguri şi baraje. Un astfel de impact antropic este prezent şi în râul Repede. Între anii 1997 şi 2009 au fost evaluate populațiile speciilor *Cottus gobio* şi *Eudontomyzon danfordi* din râul Repede. Starea ecologică a acestor populații este într-un declin accentuat. Cheia pentru conservarea biodiversității râului este: utilizarea de know-how profesional în cazurile studiilor de impact locale şi regionale, monitoring calitativ şi cantitativ permanent şi decizii administrative corecte indiferent de presiunile economice existente. În cazul râului Repede, cantitatea de apă extrasă trebuie să fie în corelație cu cerințele ecologice ale speciilor şi comunităților acvatice locale în toate sectoarele râului, de asemenea trebuie păstrată diversitatea habitatelor specifice şi continuumul lotic.

INTRODUCTION

One of the main drivers of degradation of the lotic ecosystems is the hydrological alteration, including water abstraction and regulation by different types of embankments and dams. Water flow strongly influences the dynamics of streams and rivers, from the populations to the ecosystem level. Humans have profoundly altered the natural flow regime of most rivers and streams and freshwater fish are one of the most threatened taxon affected by these alterations. (Bănăduc, 1999, 2005; 2006; Benejam et. al, 2010; Baron at al., 2002; Marchetti, Moyle, 2001; Nilsson, et al., 2005; Bunn and Arthington, 2002)

This paper goal is to highlight the human impact effects on two fish species of conservative interest, protected by the European Habitats Directive: *Eudontomyzon danfordy* and *Cottus gobio* in the Repede River.

The Repede River watershed is located in the northern Romanian Carpathians, partialy in the Natura 2000 Munții Rodna/Rodna Mountains Site ROSCI0125 and partialy in the Munții Maramureș/Maramureș Mountans Site RO SCI 0124.

The Repede River spring in the Rodna Mountains, is formed on the northern slope of the Negoiasa Mare Peak, at an altitude of 1,560 m a.s.l. altitude, has a length of 10 km and has its confluence with the Vişeu River (Tisa Basin/Danube Basin) in the proximity of locality of Borşa (Buta, 1979).

The Munții Rodna Natura 2000 Site ROSCI0125 was designated by the Romanian Order 1964 of 13 December 2007 regarding the establishment of a system of protected natural areas of Community interest, as part of the European ecological network Natura 2000 in Romania (Monitorul Oficial, 2008). This European Community interest protected area of 47,975 ha was designated in the Alpine biogeographical region, at 47°31'47" North latitude and 24°46'30" East longitude, and has a minimum altitude of 595 m a.s.l. and a maximum one of 2,284 m a.s.l. (Natura 2000 official standard form).

The Maramureş Mountains Natura 2000 Site RO SCI 0124 was designated also by the Romanian Order 1964 of 13 December 2007 regarding the establishment of a system of protected natural areas of Community interest, as part of the European ecological network Natura 2000 in Romania (2008, Monitor Oficial). This European Community interest protected area of 103.391 ha was designated in the Alpine biogeographical region, at 47°46'60" North latitude and 24°33'53" East longitude, and has a minimum altitude of 330 m a.s.l. and a maximum one of 1,146 m a.s.l. (Natura 2000 official standard form; Curtean-Bănăduc et al., 2008).

The proper management for the species and habitats for which these Natura 2000 sites were designated is an obligation assumed by the Romanian authorities, and the failing of this management will definitively induce financial penalities for this country to the EU!

The very close proximity of the Borşa locality (27,000 inhabitants, 47,482 ha) induced the idea that constant human pressure on the Repede lotic system should be present there and its effects on fish diversity may also be present.

Due to the fact that more hydropower developments are planned to be allowed here, the necessity of new studies regarding the species of conservation concern raised in the last few years. In this respect, this study tries to respond if these economically desired hydropower developments added at the actual significant human impact on this ara can be acceptable from the local protected areas point of view, and if they are in concordance with the level of the conservation status of these two fish species of interest for which these two European Community interest areas were also designated, *Eudontomyzon danfordi* (Natura 2000 code - 9903) and *Cottus gobio* (Natura 2000 code - 1163).

The management plans of these protected areas are under construction now by the Rodna Mountains National Park Administration and Maramureş Mountains Nature Park Administration, and management actions for the river ichthyofauna of conservation concern will be required as well.

Eudontomyzon danfordi (Regan, 1911) - Natura 2000 code 4123

Ord. Petromyzontiformes; Fam. Petromyzontiae.

English-Carpathian lamprey; Romanian-Chişcar, Cicar; Serbian-Dunavska paklara; Bulgarian-Dunavska minoga; Ukrainian-Karpatskaja minoga; Hungarian-Tiszai ingola.

In Romania there were registered reductions in range due to the human impact. The presence of this fish in river sectors is unequal due to its relation with slow moving muddy areas in which the larvae stay. In Romania it is considered as a species with a medium vulnerability. The species is protected by: Law 13/1993, Bern Convention, European Directive 92/43, IUCN Red List (Ref. 84930) and OUG 57/2007. *Eudontomyzon danfordy* is considered an endangered species on the Romanian territory (Bănăduc, 2008; Bănărescu, 1969).

Cottus gobio Linnaeus, 1758 - Natura 2000 code 1163

Ord. Scorpaeniformes; Fam. Cottidae.

English-Bullhead; Romanian-Zglăvoc, Zglăvoacă; Serbian-Pes; Bulgarian-Glavoch; Ukrainian-Podkamenshchik; Hungarian-Botos kölönte.

It lives exclusively in warm, mountainous lotic freshwater, rarely in lakes. Usually stays under rocks, in the sectors with shallow and relatively slow-moving water. Sexual maturity is reached at two years of age. Its reproduction takes place in March - April. Its diet consists of insect larvae, amphipods, roes and alevines. The species is protected by: Law 13 of 1993 through which Romania is a part of the Bern Convention. It can be threatened by pollution and habitat destruction. (Bănărescu and Bănăduc, 2007)

MATERIAL AND METHODS

Two fishing techniques were used between 1997 and 2009 to monitor the Carpahtian lamprey and Bullhead species individuals: hand nets fishing and electro fishing (IG 1300 - 470 V DC, 2.6 kW device). The fishing was done in time and efforts unit from 1 km in 1 km for all the Repede River length. The sampled biological material was released immediately after its identification in situ for conservative reasons.

RESULTS AND DISCUSSIONS

Habitat changing threats for *Cottus gobio*

The author found the Bullhead for the first time in the Repede River in a field campaign organised by the "Grigore Antipa" National Museum in the Maramureş area in 1997 (unpublished data). The results of this study were published regarding the ichtiofauna of the Vişeu River and its main tributaries (Staicu et al., 1998) excluding the relatively small tributaries like Repede River. This species presence was confirmed in this area also by A. Iftime and V. Oţel in the Natura 2000 official standard data form, for the two Natura 2000 sites through which the Repede River passes.

In 2008, 2009 and 2010 the Bullhead was monitored along the Repede River entire course. In spite of the fact that it was found abundantly before this period along its entire course (excepting the salmonids upper river sector), presently it is found only in a 2.5 km sector. The average abundance in this sector remains the same all these years, respectively 8-9 individuals per 100 m river length sector. This species abundance in the Vişeu River at its confluence with Repede River was the same as more than a decade ago!

This critical situation that exists in the middle sector of the river is due to the presence of an important water catchment and inlet pipeline (Fig. 1) for the downstream city of Borşa, which also induced effects of habitat destruction (Fig. 2) mainly in terms of reduction of liquid flow and radical modification of the substrate; the only Bullhead characteristic habitat remaining at present is upstream of this significantly human impacted area (Fig. 3).

Figure 1: Water transport pipeline for Borşa locality.

Although this fish species is still common in this stretch of 2.5 km from the upper Repede River, this population may not extend upstream just because there are favorable conditions for salmonids only (Fig. 4) which strongly compete the Cottidae and eliminate them.

This still present population of Bullhead is isolated from the whole downstream Vişeu River basin where it was considered a relatively common species (Staicu et al., 1998) due to the following reasons: the dam at the confluence with the River Vişeu (Fig. 6), the Bullhead characteristic habitat destruction downstream the water diversion and culvert area for Borşa town and the impact of Borşa households and existing impoundments. (Fig. 5).

The single Bullhead populational nucleus which remained in this river can be destroyed by any changes/decreasing in water flow in the upper river sector if new technical projects are accepted by the Natura 2000 sites administrations.

The local protected areas management plans should include this ichthyofauna situation and require a permanent integrated monitoring system.

Figure 2: Destroyed *Cottus gobio* habitat
by the water diversion and culvert area for Borşa locality.

Figure 3: Bullhead characteristic habitat upstream the inlet for Borşa locality.

Figure 4: Upstream Repede River sector - Salmonid characteristic habitat.

Figure 5: Impoundments and waste pollution.

Habitat changing threats for *Eudontomyzon danfordi*

The author also found the Carpathian lamprey for the first time in the Repede River in the 1997 field campaign (Staicu et al., 1998); this river ichthyofauna was unpublished till now. This species presence was confirmed in this area also by A. Iftime and V. Oțel in the Natura 2000 official standard form for the two Natura 2000 sites through which the Repede River passes.

In 2008 and 2009 the Carpathian lamprey was recorded in the same confluence area where it was found abundantly in 1997, at the Repede River confluence with Vişeu River and was still found in the Repede River but at an only 10-5% abundance in comparison with 1997. The abundance in the Vişeu River at its confluence with Repede River was the same.

This situation can be explained due to the presence there of a hydrotechnical work - a low level dam (Fig. 6) which has a water apron and water intake role function for a fish farm from this confluence proximity in the conditions in which the upstream water deviation (for Borşa locality) through pipe lines makes an already significant reduction in the Repede River water flow. If this species is still common in the near (10 m) Vişeu River sector, the Repede River accentuated decrease in abundance in respect of this cyclostomata species can be explained due to the effect of the two existing hydrotechnical works on the river.

The absence of a fish ladder for cyclostomata species will probably induce in the near future the total local disappearance of this species from Repede River!

The Natura 2000 sites management plan should include this situation monitoring and remediation.

Figure 6: The low level dam from the confluence
of the Repede River and the Vişeu River.

CONCLUSIONS

In the Repede River case two species of major conservation concern *Cottus gobio* and *Eudontomyzon danfordi* populations are in an accentuated decrease of their ecological state in the last decade alone.

The biodiversity management of large river basins included in protected areas belonging to various types of protected areas/various types of protection can only be achieved by targeting all species and habitats of conservative interest and through an integrated management of the majority of the existing sub-basins (including relatively small rivers) and of the majority if not all of the lotic sectors (of the relatively big rivers).

This presented case study showed how in just a very short period of time, as a result of human impact unnoticed by the control factors, an entire river basin can no longer have a conservation value due to the drastic reduction of two protected species populations, which, if they continue to decrease without a proper management plan, will be locally extinct.

Scientific studies are usually done, due to constraints of time and materials, all too often only for the big lotic systems of a studied watershed; in this context the question that arises is: how many of the relatively small basins of these protected areas could be in the same worrisome situation?

Rising administrative, political and economic effects on these protected areas is growing, and any apparent environmentally-friendly investment that has not undergone professional impact studies will have a negative effect, increasingly emphasized in the protected areas until these areas dissolution due to the missing of the ... protected species and habitats, for which these areas were proposed!

The key to real conservation of the rivers biodiversity is the use of professional know-how in the cases of: the local and regional impact studies, qualitative and quantitative permanent monitoring and correct administrative decisions regardless of the existing economic pressures.

Especially in this lotic system case, the water abstraction quantity should be in relation with the local species ecological requirements in all the river sectors and the river continuum should exist for all the species of conservation concern.

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BAT SPECIES (CHIROPTERA) IDENTIFIED IN THE RODNA MOUNTAINS NATIONAL PARK AND IN ADJACENT AREAS (EASTERN CARPATHIANS, ROMANIA)

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KEYWORDS: Romanian Carpathians, Rodna Mountains, bats.

ABSTRACT

This paper presents the bat species identified in the course of time by different scientists and by the author of this paper in the Rodna Mountains.

Nine bat species have been identified in the Rodna Mountains from field research and specialists literature: *Rhinolophus ferrumequinum, Rhinolophus hipposideros, Myotis myotis, Myotis blythii, Pipistrellus pipistrellus, Plecotus auritus, Vespertilio murinus, Nyctalus noctula* and *Barbastella barbastellus*.

The analysis made in this paper shows that these bat species have been little studied in the Rodna Mountains.

Almost all the data about bats refer to sites from the northern part of the Rodna Mountains, from the administrative territory of Maramureş County.

The research and the better understanding of the needs of the species and their habitats, the quantitative and qualitative inventory and the monitoring of over 80 caves would ensure the development of such conservation and management measures for these species and their environment.

This information would allow the drafting of a snapshot situation which monitored, allows the comparison of the areas of distribution, thus observing the evolution of colonies or isolated individuals.

ZUSAMMENFASSUNG: Im Rodna-Gebirge/Nationalpark Munții Rodnei (Ostkarpaten/Rumänien) und angrenzenden Gebieten festgestellte Fledermausarten (Chiroptera).

Die Arbeit stellt die im Rodna-Gebirge vom Verfasser und anderen Forschern vorgefundenen Fledermausarten vor. Dabei wurden während eigener Geländeuntersuchungen und auf Grund von Angaben in der Fachliteratur im Rodna-Gebirge bisher neun Fledermausarten festgestellt: *Rhinolophus ferrumequinum, Rhinolophus hipposideros, Myotis myotis, Myotis blythii, Pipistrellus pipistrellus, Plecotus auritus, Vespertilio murinus, Nyctalus noctula* und *Barbastella barbastellus*. Nach einer Analyse aller Daten geht hervor, dass die Fledermäuse im Rodna-Gebirge sehr wenig untersucht wurden. Die meisten Angaben stammen aus dem nördlichen Teil des Rodna-Gebirges, der zum Verwaltungskreis Maramuresch gehört.

Forschungen sowie eine bessere Kenntnis der Ansprüche der Arten und ihrer Lebensräume, eine zahlenmäßige und qualitative Erfassung sowie ein Monitoring der über 80 Höhlen würde die Entwicklung von Schutz- und Pflegemaßnahmen der Arten und ihrer Umwelt sichern.

Die Informationen würden im gegebenen Moment auch eine Zustandserfassung und bei weiterem Monitoring einen Vergleich der Verbreitungsgebiete der Arten, der Größe der untersuchten Populationen ermöglichen, so dass die Entwicklung von Kolonien und isolierten Individuen besser verfolgt werden kann.

REZUMAT: Specii de lilieci (Chiroptera) identificate în Munții Rodna - Parcul Național Munții Rodna şi în zone limitrofe (Carpații Orientali, România).

Lucrarea prezintă speciile de lilieci identificate de diferiți cercetători în decursul timpului, precum şi de autorul prezentei lucrări în Munții Rodnei.

În urma cercetărilor de teren şi din bibliografia de specialitate, în Munții Rodnei, au fost identificate, până la această dată, 9 specii de lilieci: *Rhinolophus ferrumequinum, Rhinolophus hipposideros, Myotis myotis, Myotis blythii, Pipistrellus pipistrellus, Plecotus auritus, Vespertilio murinus, Nyctalus noctula* şi *Barbastella barbastellus*.

În urma analizei acestei lucrări, reiese faptul că speciile de lilieci au fost puțin studiate în Munții Rodnei.

Aproape toate datele despre lilieci provin din partea nordică a Munților Rodnei, de pe teritoriul administrativ al județului Maramureş.

Cercetarea şi o mai bună cunoaştere a cerințelor speciei şi a habitatelor lor, o inventariere atât cantitativă, cât şi calitativă şi monitorizarea celor peste 80 de peşteri ar asigura dezvoltarea unor acțiuni de tipul conservare - gestionare a speciilor şi a mediului.

Aceste informații ar permite întocmirea unei situații-bilanț la un moment dat, care, monitorizate, dau posibilitatea de a compara ariile de răspândire, efectivele populațiilor studiate, observând astfel evoluția unor colonii sau indivizi izolați.

MATERIALS AND METHODS

The research was carried out between 2002 and 2010.

In order to catch the bats we used chiropterological mist-nets and for bats identification in feeding habitats we used the ultrasound detector Pettersson D 200.

Species determination was made according to Schober and Grimmberger (1991) and Gheorghiu et al. (1999). The captured individuals were released after their identification.

Alongside the species identified in the field research, we published the species mentioned by other authors, in order to reproduce the present day situation of the species number and their habitats from the Rodna Mountains.

INTRODUCTION

The latest study regarding the Chiroptera group in the neighbouring Maramureş Mountains Nature Park (Jére, 2008) raise the idea of a similar study for the Rodna Mountains National Park.

This paper presents synthetically an overall picture about the bat species identified in the Rodna Mountains.

The data on these studied species comes from personal observations and scientific literature.

RESULTS AND DISCUSSIONS

During the research conducted by different scientists and the author in the Rodna Mountains, the following bat species were identified:

Family: Rhinolophidae Bell. 1836

Genus*: Rhinolophus* Lacépède, 1799

1. *Rhinolophus ferrumequinum* (Schreber, 1774)

Greater horseshoe bat

In the Rodna Mountains the species was identified on 13.X.2002 inside the Obcina Cave, code 1029/13, Săcel Village (Maramureş County), at 942 m altitude (Chiş and Manole, 2002, 2003), in the area of the Rodna Mountains National Park, near the Forest District Cabin, from the Dragoş Spring, and near the Cabin Laboratory, on the slope of Pietrosu, Moisei Village, Maramureş County (Murariu, 2009).

2. *Rhinolophus hipposideros* (Bechstein, 1800)

Lesser horseshoe bat

In the Rodna Mountains the species was identified on 13.X.2002 inside the Obcina Cave, Săcel Village, at 942 m altitude (Chiş and Manole, 2002, 2003, 2005), in the area of the Rodna Mountains National Park, near the Cabin Laboratory on the slope of Pietrosu, at about 1,700 m altitude, Moisei Village (Murariu, 2009) and in the Tăuşoare Cave (Natura 2000 data base).

Family: Vespertilionidae (Gray, 1821)

Genus: *Myotis* Kaup, 1829

3. *Myotis myotis* (Borkhausen, 1797)

Greater mouse-eared bat

In the Rodna Mountains the species was identified in LN 27 Borşa, Maramureş County (Valenciuc, 1993; Gheorghiu et al., 2001) and in the area of the Rodna Mountains National Park, near the Cabin Laboratory on the slope of Pietrosu, at about 1,700 m altitude, Moisei Village and south of the Iezer Lake, Borşa town (Murariu, 2009).

4. *Myotis blythii* (Tomes, 1857)

Lesser mouse-eared bat

Species mentioned at Borşa LN27/28/37, Maramureş County, (Mehely, 1900; Dumitrescu et al., 1963; Răduleț, 1997; Murariu and Răduleț, 1998; Gheorghiu et al., 2001; Murariu, 2005).

Genus: *Pipistrellus* Kaup, 1829

5. *Pipistrellus pipistrellus* (Schreber, 1774)

Common pipistrelle

It is a frequent species in the Rodna Mountains National Park (Murariu, 2009), identified on the field research on 25.VII.2010 in the attic of Iza Cabin from the Iza's Blue Spring.

Genus*: Plecotus* Geoffroy, 1818

6. *Plecotus auritus* (Linnaeus, 1758)

Common long-eared bat

In the Rodna Mountains the species was identified inside the Obcina Cave, Săcel Village, code 1029/13, at 942 m altitude. The cave is developed in Eocene limestone, over 26 m deep and with an oscillation level of -5.5 m (Chiş and Manole, 2002, 2003).

Genus: *Vespertilio* Linnaeus, 1758

7. *Vespertilio murinus* (Linnaeus, 1758)

Parti-coloured bat

In the Rodna Mountains the species was identified in the area of the Rodna Mountains National Park on the slope of Pietrosu, at about 1,700 m of altitude, Moisei Village (Murariu, 2009).

Genus: *Nyctalus* Bodwich, 1825

8. *Nyctalus noctula* (Schreber, 1774)

Common Noctule

In the Rodna Mountains the species were identified in the area of the Rodna Mountains National Park on the slope of Pietrosu, the Dragoş Spring, the Bătrâna Valley, the Negoiescu Valley, and on the territories of Moisei and Borşa localities (Murariu, 2009).

Genus: *Barbastella* Gray, 1821

9. *Barbastella barbastellus* (Schreber, 1774)

Western barbastelle

In the Rodna Mountains the species were identified in the area of the Rodna Mountains National Park inside Iza's Cave, situated at an altitude of 1,250 m, on the territory of Săcel Village. Inside the cave we observed on the 22.I.2010 and 28.II.2010, five bats in the access gallery, at about 250 m from the entrance, and two individuals in the Speleotheme Gallery.

The status of the bat species from the Rodna Mountains (Tab. 1), according to the international treaties, Habitat Directive, the IUCN red list and national protection status, is shown in the table 2.

Table 1: Bat species from the Rodna Mountains.

No.	Species	Northern part of Rodna Mountains (Maramureş County)	Southern part of Rodna Mountains (Bistriţa Năsăud County)	Species identified by other authors	Species identified in the present study
1.	*Rhinolophus ferrumequinum* (Schreber, 1774) Greater horseshoe bat	x		x	x
2.	*Rhinolophus hipposideros* (Bechstein, 1800) Lesser horseshoe bat	x	x	x	x
3.	*Myotis myotis* (Borkhausen, 1797) Greater mouse-eared bat	x		x	
4.	*Myotis blythii* (Tomes, 1857) Lesser mouse-eared bat	x		x	
5.	*Pipistrellus pipistrellus* (Schreber, 1774) Common pipistrelle	x		x	x

No.	Species	Northern part of Rodna Mountains (Maramureş County)	Southern part of Rodna Mountains (Bistriţa Năsăud County)	Species identified by other authors	Species identified in the present study
6.	*Plecotus auritus* (Linnaeus, 1758) Brown long-eared bat	x			x
7.	*Vespertilio murinus* (Linnaeus, 1758) Parti-coloured bat	x		x	
8.	*Nyctalus noctula* (Schreber, 1774) Common Noctule	x		x	
9.	*Barbastella barbastellus* (Schreber, 1774) Western barbastella	x			x

Table 2: The status of the bat species from the Rodna Mountains area according to some international treaties, Habitat Directive, the IUCN red list and the national protection status.

No.	Species	Council Dire-ctive 92/43/ EEC	Bonn Con-vention	Bern Con-vention	R. L. IUCN	Law no. 90/ 2000	Red Book of Roma-nia Verte-brates	RGEO no. 57/ 2007
1.	*Rhinolophus ferrumequinum* (Schreber, 1774) Greater horseshoe bat	Annex2 Annex4	Annex 2	Annex 2	LR; nt	Protec-ted	VU	Annex 3 Annex 4
2.	*Rhinolophus hipposideros* (Bechstein, 1800) Lesser horseshoe bat	Annex 2 Annex 4	Annex 2	Annex 2	VU	Protec-ted	VU	Annex 3 Annex 4
3.	*Myotis myotis* (Borkhausen, 1797) Greater mouse-eared bat	Annex 2 Annex 4	Annex 2	Annex 2	LR; nt	Protec-ted	EN	Annex 3 Annex 4
4.	*Myotis blythii* (Tomes, 1857) Lesser mouse-eared bat	Annex 2 Annex 4	Annex 2	Annex 2	LR; Ic	Protec-ted	EN	Annex 3 Annex 4

No.	Species	Council Directive 92/43/ EEC	Bonn Convention	Bern Convention	R. L. IUCN	Law no. 90/ 2000	Red Book of Romania Vertebrates	RGEO n0. 57/ 2007
5.	*Pipistrellus pipistrellus* (Schreber, 1774) Common pipistrelle	Annex 4	Annex 2	Annex 3	LR; Ic	Protected	-	Annex 4
6.	*Plecotus auritus* (Linnaeus, 1758) Brown long-eared bat	Annex 4	Annex 2	Annex 2	LR; Ic	Protected	VU	Annex 4
7.	*Vespertilio murinus* (Linnaeus, 1758) Parti-coloured bat	Annex 4	Annex 2	Annex 2	LR; Ic	Protected	EN	Annex 4
8.	*Nyctalus noctula* (Schreber, 1774) Common Noctule	Annex 4	Annex 2	Annex 2	LR; Ic	Protected	-	Annex 4
9.	*Barbastella barbastellus* (Schreber, 1774) Western barbastella	Annex 2 Annex 4	Annex 2	Annex 2	VU	Protected	VU	Annex 3 Annex 4

From previous researches points out that all the identifications, excepting a sigle species, come from the northern part of the Rodna Mountains (the Maramureş County area).

CONCLUSIONS

Nine bat species have been identified in the Rodna Mountains from the field research and speciality literature.

The analysis made by this paper shows that the bat species have been partially studied in the Rodna Mountains.

Almost all the data about bats comes from the northern part of the Rodna Mountains, meaning the administrative territory of Maramureş County.

A monitoring program of the over 80 charted and uncharted caves would identify and help protecting the maternity and the hibernation colonies of the nine bat species, by preventing the tourists from visiting these caves during certain well established periods of time.

The research and the better understanding of the needs of the species and their habitats, as well as a quantitative and qualitative inventory would ensure the development of the bat species and the management of the environment conservation measures.

This information would allow the drafting of a snapshot situation which monitored, allows the comparison of the areas of distribution, thus observing the evolution of colonies or isolated individuals.

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NEW DATA CONCERNING THE SMALL MAMMAL FAUNA (INSECTIVORA, RODENTIA) OM THE RODNA MOUNTAINS NATIONAL PARK (EASTERN CARPATHIANS, ROMANIA),

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KEYWORDS: Romanian Carpathians, Rodna Mountains National Park, small mammals, capture-mark-recapture, *Apodemus*, *Microtus*.

ABSTRACT

During the years 2006, 2008, and 2009 five trapping sessions for an inventory of small mammal species took place on the territory of Rodna Mountains National Park at Pietrosu Mare Scientific Reserve, Bila-Lala Nature Reserve and the Anieşul River valley. The research aimed to establish the species diversity for a future monitoring plan for protected species, and hoped to reconfirm the presence of *Sicista betulina* (Pallas, 1779) in these mountains. The method used for the species inventory was capture-mark-recapture. A total of eight species of rodents and insectivores were identified.

RÉSUMÉ: Nouvelles données sur la faune de petits mammifères (Ord. Insectivora, Ord. Rodentia) du Parc National des Montagnes de Rodna (Carpates Orientales, Roumanie).

Pendant les années 2006, 2008 et 2009 nous avons entrepris cinq sessions d´inventaire faunistique pour les petits mammifères du Parc National Rodna Montagnes, dans la Réserve Scientifique Pietrosu Mare, Bila-Lala Réserve Naturelle et Vallée de l' Anieş. L'étude a visé la diversité spécifique pour la réalisation du plan de surveillance d'espèces protégées et pour la reconfirmation de l'existence de l'espèce *Sicista betulina* (Pallas, 1779) dans ces montagnes. La méthode utilisée dans les études est capture-marquage-recapture. Nous avons identifié huit espèces de petits mammifères, insectivores et rongeurs.

REZUMAT: Noi date asupra faunei de mamifere mici (Ord. Insectivora, Ord. Rodentia) din Parcul Național Munții Rodna (Carpații Orientali, România).

Pe parcursul anilor 2006, 2008 şi 2009, am desfăşurat cinci invetarieri ale faunei de micromamifere în Parcul Național Munții Rodna din Rezervația Ştiinţifică Pietrosu Mare, Rezervația Naturală Bila-Lala şi Valea Anieşului. Scopul studiului a fost stabilirea diversității specifice pentru realizarea unui plan de monitorizare a speciilor protejate şi reconfirmarea prezenței speciei *Sicista betulina* Pallas (1779), în aceşti munți. Metoda folosită în cadrul studiilor a fost capturare-marcare-recapturare. Au fost identificate un număr de opt specii de mamifere mici atât rozătoare, cât şi insectivore.

INTRODUCTION

The researches concerning small mammal fauna from Rodna Mountains started in 1974 (Wagner) when 21 species were identified. Among these, we have the first and only citation for *Arvicola terrestris* and the confirmation for the presence of the species *Microtus nivalis* and *Sorex minutus.* After Wagner, only a few studies on small mammal's communities have been carried out in the area and we can observe the total lack of information until 1989 when Béres published his article about the importance of Pietrosul Rodnei Reservation for the conservation of native vertebrates. Data can also be found in the Maramureş Vertebrate Fauna (Ardelean and Béres, 2000).

The newest data concerning the small mammals from Pietrosu Mare Scientific Reserve are from an article of Murariu (1997). In his article, he mentions the species *Sicista betulina* (Pallas, 1779) (Rodentia, Zapodidae) that his team had captured near Fața Pietrosului Rodnei Laboratory House (Fig. 1) and also a few other small mammal species.

The small mammal species inventory for Pietrosu Mare Scientific Reserve was included as an action in the Darwin Project: "Implication of young in the management of Rodna Mountains National Park", while the second nature reserve was included in the project: "Participatory Protected Area Management of Bila - Lala Nature Reserve from Rodna Mountains", KNIP Matra, financed by the Ministry of Agriculture, Nature and Food Quality from Holland, with the purpose of declaring the area as a Scientific Reserve. The session from the year 2009 at Lake Lala was financed by "Young in Action Program, Action 1.2, Young Initiative" - Little Curators - a model of interactive participation, and Little Curators of Rodna Mountains National Park as part of the same project, for Anieşului Valley.

MATERIAL AND METHODS

Pietrosul Mare Scientific Reserve

The Pietrosul Mare Reserve (Fig. 2) was established in 1932 and in 1962 it was extended to 2,700 ha. A new development took place in 1997, when it gained another 600 ha. More then half of the surface is represented by forests and the rest by alpine pastures and rocky habitats. The types of habitats from Pietrosu Mare Reserve according to "Habitats from Romania" (Doniță et al., 2005) are: alpine *Larix decidua* and/or *Pinus cembra* forests, acidophilous *Picea* forests of the mountain to alpine levels, siliceous alpine and boreal grassland, Dacian beech forest (*Symphyto-Fagion*), siliceous screes of the montane to snow level, alpine and boreal heaths.

The laboratory house lies at 1,370 m in Pietrosului Rodnei mountain area. It is surrounded by spruce forest and pastures that were used in the past for grazing. An old sheep and cattle barn was placed in the area for several years and the pastures are now covered with typical degraded pasture vegetation with species of *Urtica*, *Rumex* and *Arctium*.

The inventory of small mammal fauna started in 2006. Between 23rd and 27th of September we used 50 box traps which were placed in the area near the Laboratory House in the Scientific Reserve. The fifty traps were divided according to the different types of habitats that surrounded the house: spruce forest, an old grassland, wood side and a marsh. The traps were laid in linear transects surrounding the laboratory house, at different distances one from another. Transect 1 had twenty traps, and the other three transects had ten traps each. The fourth transect was placed on 25th of September on the mountain track to Pietrosul Rodnei Peak, in a humid pasture, rich in moss, situated on the limit of the spruce forest. All transects meet in different points along their way.

Transects and types of habitats:

Transect 1 - spruce forest, with species of ferns (*Dryopteris* sp.), berries (*Rubus* sp.*)* and post grazing pastures (*Rumex* sp.), including other species of mountain plants (*Oxalis acetosella, Poaceae*). N 47°96'51.9", E 24°30'05.2". Altitude: between 1,297 m and 1,441 m a.s.l.

Transect 2 - grazed pasture with species of *Rumex, Arctium, Urtica*. N 47°36'07,5", E 24°36'07,5". Altitude: between 1,302 m and 1,336 m.

Figure 1: Fața Pietrosului Rodnei Laboratory House (photo by C. Iuşan).

Transect 3 - spruce forest wood side. N 47°36'07.7", E 24°36'13.5". Altitude: between 1,337 m and 1,382 m.

Transect 4 - sub alpine pasture and spruce forest wood side, along the marked tourist path to Pietrosul Rodnei Peak.

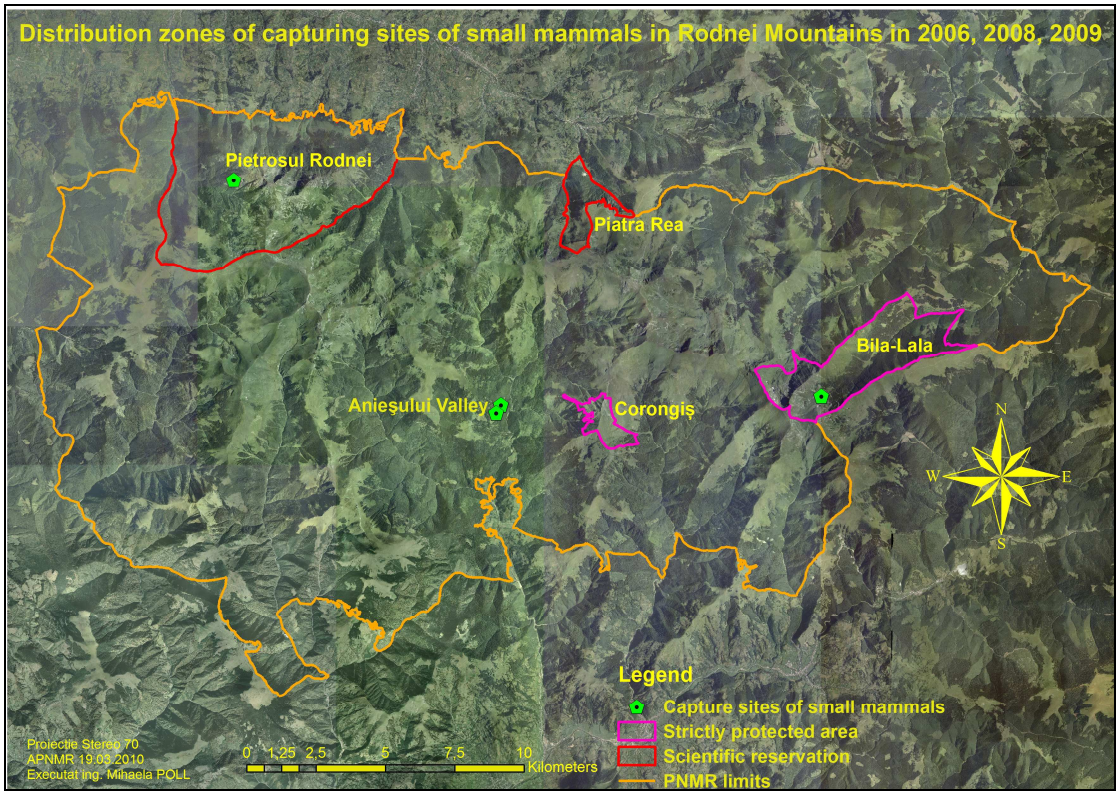

Figure 2: Pietrosu Mare Scientific Reserve; distribution zones of capturing sites of small mammals in Rodnei Mountains in 2006, 2008 and 2009.

Bila - Lala Nature Reserve

Founded in 1973, the Reserve contains the Bila bottom and the superior half of the Lala basinet. The Lala basinet contains two lakes at the basis of the Ineu Peak (2,279 m) - Lake Lala Mică and Lake Lala Mare (Fig. 3) where *Pinus mugo*, *Juniperus communis* and *Rhododendron myrtifolium* prevail. As habitats, the alpine gaps and pastures occupy the largest area, followed by mountain forests. According to "Habitats of Romania" (Doniță et al., 2005) the types of habitats found here are: alpine and boreal heaths, bushes with *Pinus mugo* and *Rhododendron myrtifolium*, siliceous alpine and boreal grassland, hydrophilous tall herb fringe communities of plain and of the montane to alpine levels, alpine cottonsedge lake girdles, alpic acid moss snow-patch communities.

The first inventory took place between 29 July - 2 August, 2008. We used 32 box traps, placed in two linear transects of 15 and 17 traps.

Transect 1: alpine pasture with *Pinus mugo*.

Transect 2: scree with *Pinus mugo* bushes, along Lake Lala`s side. N47°31´77´´, E24°53´95´´. Altitude: 1,810 m.

The second inventory started on the 8th of July and ended on 12th of July 2009. A number of 20 box traps were used, placed in a zigzag transect into a crystalline scree covered with *Pinus mugo* bushes near Lake Lala Mare (47˚31,986' N; 24˚54,569' E, altitude 1,777 m). The distance between traps was of 10 m.

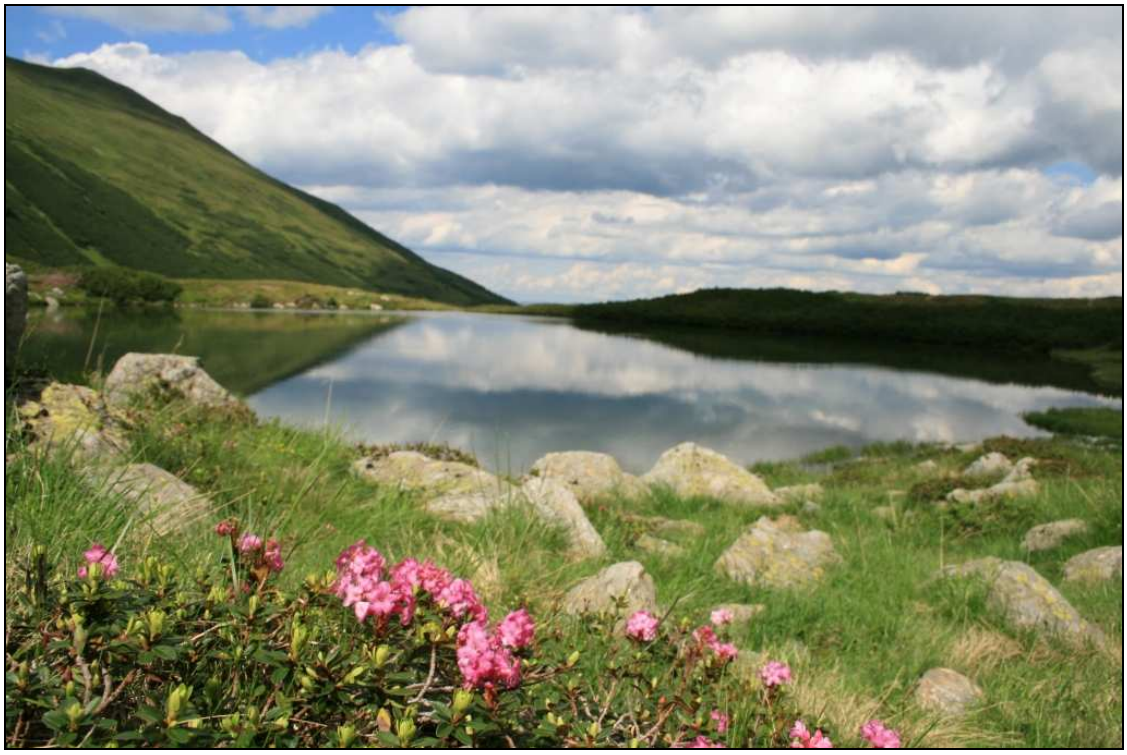

Figure 3: View over Lala Lake (photo by I. Cobzaru).

Anieşului Valley

Anieşului Valley is situated downstream from the streams rising from the Izvoarele Mihăiesei Reserve. Types of habitats (Doniță et al., 2005): petrifying springs with tufa formations (*Cratoneurion*), alpine and boreal heaths. The traps were set an an altitude of 700 m on a steep hill across the Anieş River from the Valea Secii cabin and a few private vacation houses. Close to the trapping sites there were private gardens and an old, unused house. The vegetation has been modified due to human use of the surrounding territories, therefore, apart from the mixture of vegetation specific for that altitude there were *Malus domestica* trees and pasture grass.

Two trapping sessions were carried out on the valley, the first one between 25-30 July 2009 and the second one from 31 July to 3 August, same year. In the first period, 20 box traps were placed as a quadrate, in a small glade, at a distance of 10 m one from another (Quadrate 1). 47˚29.162'N; 24˚44.371'E. In the second period, the same number of traps was placed at the outskirts of a mixed habitat of *Betula pendula, Corylus avellena, Sorbus aucuparia* and *Fraxinus excelsior*, as linear transect (Transect 1). 47˚29,470'N; 29˚44,028'E.

Box traps are made of wood, glass and wire and allows the capture of living animals without a high degree of stress. As working method, we used capture-mark-recapture. All animals were measured with a caliper; we took their weight with a Pesola scale, observed the reproductive state of each individual and determined their sex and approximate age. Each new captured individual was marked with blue permanent dye or parts of fur from the back side were cut by scissors. According to age and reproductive stage, we established two categories of individuals: juveniles and adults, respectively, breeding males and lactating females.

As bait we used pieces of fat bacon, nuts, sunflower and pumpkin seeds, cheese and raisins. The traps were verified each morning, at 7 o'clock. Not all the rodents that entered the traps could be determined. For the representatives of *Apodemus* genus, we made the determination according to the excrements that were left in the traps (the method was used only at Pietrosu Mare Scientific Reserve).

The body measurements taken with the caliper are:

- total body length (head and body), taken from the tip of the nose to the anal orifice;
- tail length, taken from the anal orifice to the end of the tail, without the fur tuft;
- length of the posterior foot, taken from the extremity of the calcaneum (the heel) to the tip of the longest finger, without the claw;
- length of the ear, taken from the opening of the pavilion to it's tip, without the hairs.

All inventories were carried with the help of the biologist of Rodna Mountains National Park, Mr. C. Iuşan.

RESULTS AND DISCUSSIONS

Pietrosu Mare Scientific Reserve

As a result of the investigation, 38 individuals belonging to Insectivora and Rodentia Orders were captured (Fig. 4)

Class Mammalia Linnaeus, 1758
Order Rodentia Bodwich, 1821
Family Muridae Gray, 1821
Genus *Apodemus* Kaup, 1829
- *Apodemus* sp. → 9 individuals
- *Apodemus flavicollis* (Melchior, 1834) - Yellow-necked Mouse → 10 individuals
- *Apodemus sylvaticus* (Linnaeus, 1758) - Wood mouse → 2 individuals
Family Arvicolidae Gray, 1821 (Microtidae Cope, 1821)
Genus *Clethrionomys* Tilesius, 1850
- *Clethrionomys glareolus* (Schreber, 1780) - Bank Vole → 15 individuals
Order Insectivora Bowdich, 1821
Family Soricidae Gray, 1821
Genus *Sorex* Linnaeus, 1758
- *Sorex minutus* Linnaeus, 1766 - Pygmy Shrew → 2 individuals.

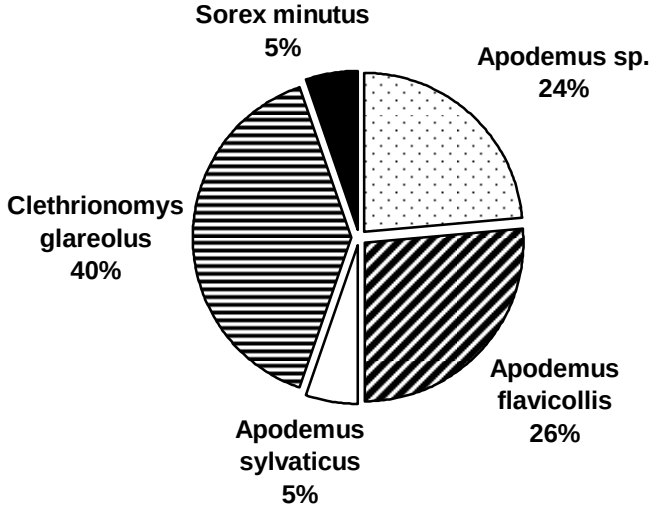

Figure 4: Absolute abundance of small mammal species at Pietrosul Rodnei.

The dominant species are also the most common for the types of habitats investigated during our study, *Apodemus flavicollis* and *Clethrionomys glareolus*. As number of captures, Transect 3 was the richest, but the dominant species are the same. Transect 1 which had the largest number of traps, had fewer captures. Transect 2, the one from the grazed pasture, had the poorest results, only one captured individual, an *Apodemus flavicollis*, which was probably just passing through. This is evidence that the exaggerated grazing of that pasture and the plants that are now growing there do not represent a suitable habitat to maintain and develop a small mammal population. Because it is situated between two sectors of spruce forest, it may be used as passage for some species. All other species are considered as specific for the zone that was investigated.

In the case of *Apodemus* genus, we observed the separated presence of the two captured species. *Apodemus flavicollis* was present only in the lower habitats, in all 3 transects, but *Apodemus sylvaticus* was captured on Transect 4, located at the highest altitude. We also observed the differences in the color of the fur, *A. sylvaticus* having a grayish shade, and A. *flavicollis* a brownish one. The proportions of the neck collar were likewise typical for each species and the determination of the juveniles could be made without doubt. The two species are known for their cohabitation.

If we take the two dominant species and compare the age structure and sex ratio, we can observe that in the case of *C. glareolus* the adults prevail and the number of males is higher, while for *A. flavicollis* juveniles were more often recorded and also the number of males was higher. For both species a number of six juveniles were recorded but their sex could not be identified correctly. That is why this number was not included in the sex ratio index.

Because of its status of scientific reserve, Fața Pietrosului Rodnei could have offered a better site for small mammal populations, with a higher number of species and individuals. If we make a comparison with Murariu's list of species, identified in 1995, we can see some significant differences. The author captured *Sorex alpinus*, which is the rarest species of shrew from Romanian fauna, *Microtus arvalis* and *Mus musculus*, which during our investigations were not found. We can explain these results by the differences in the types of traps used for study, and also in the type of baits. Because the data are scarce for this region, we could not make any other estimation of the state of development of the small mammal fauna.

Bila - Lala Nature Reserve

The species captured during the inventory are (Figs. 5 and 6):

Class Mammalia Linnaeus, 1758

Order Rodentia Bodwich, 1821

Family Muridae Gray, 1821

Genus *Apodemus* Kaup, 1829

- *Apodemus sylvaticus* (Linnaeus, 1758) - Wood mouse → 8 individuals (seven in 2008 and one in 2009)

- *Apodemus flavicollis* (Melchior, 1834) - Yellow-necked Mouse → 6 individuals (four in 2008 and two in 2009)

Family Arvicolidae Gray, 1821 (Microtidae Cope, 1821)

Genus *Clethrionomys* Tilesius, 1850

- *Clethrionomys glareolus* (Schreber, 1780) - Bank Vole → 4 individuals (in 2008)

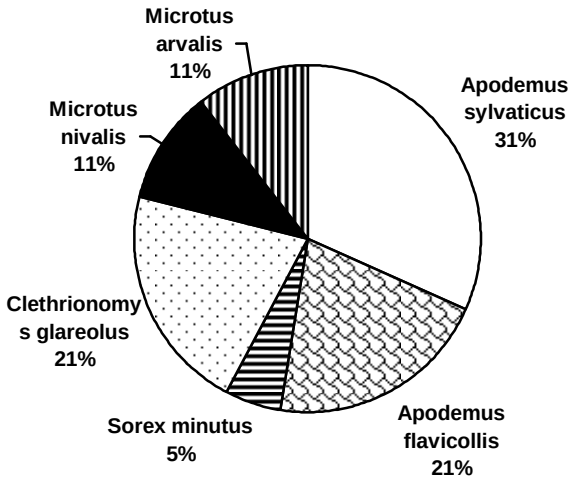

Figure 5: Absolute abundance of small mammal species from Lala Lake in 2008.

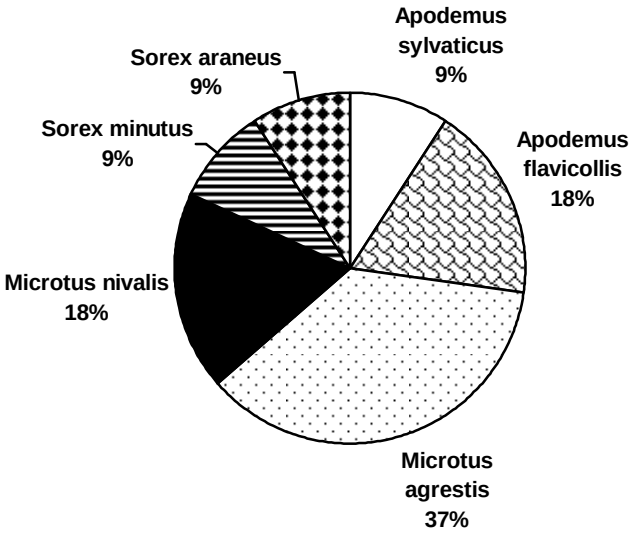

Figure 6: Absolute abundance of small mammal species from Lala Lake in 2009.

Genus *Microtus* Schrank, 1798

- *Microtus arvalis* (Pallas, 1779) - Common Vole → 2 individuals (in 2008)
- *Microtus nivalis* Martins, 1842 - Snow Vole → 4 individuals (two in 2008, and other two in 2009) (Fig. 7)
- *Microtus agrestis* (Linnaeus, 1761) - Field Vole → 4 individuals (in 2009)

Order Insectivora Bowdich, 1821

Family Soricidae Gray, 1821

Genus *Sorex* Linnaeus, 1758

- *Sorex minutus* Linnaeus, 1766 - Pygmy Shrew → 2 individuals (one in 2008, one in 2009)

- *Sorex aranues* Linnaeus, 1758 - Common Shrew → 1 individual (in 2009)

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Figure 7: *Microtus nivalis* (photo by I. Cobzaru).

Among the species captured in Bila-Lala Nature Reserve we highlight the presence of *Microtus nivalis*, the snow vole, which in Romania has been citied from a small number of localities and is a protected species. *M. nivalis* had been found both years, in the same area. In 2009, the two specimens were captured in the same trap, the first was a juvenile, while the second, an adult. The other four species collected in 2008, *A. sylvaticus*, *A. flavicollis*, *C. glareolus* and *M. arvalis* are common and the first one has the highest density. During the second campaign, in 2009, *C. glareolus* was not present, but we found *M. agrestis*. This species had the highest relative abundance index for this region, although the number of specimens captured was only four. The other species captured have relatively similar abundance indexes.

The sex ratio for the year 2008 shows that the males were dominant for all species, while the females captured, although in a small number, were lactating.

In 2009, at Lala Mare Lake the adults were dominant. The only juvenile specimens captured were two *M. nivalis* and *M. agrestis* females. Also a high dominance can be observed regarding the gender distribution of the species. From the entire number of individuals captured, only two were males. But considering the small number of individuals captured from each species, the age and gender variations may not be representative neither for the area, nor for the time of year when the trapping session took place.

Anieşului Valley

During the inventory the following species were captured (Fig. 8):

Class Mammalia Linnaeus, 1758

Order Rodentia Bodwich, 1821

Family Muridae Gray, 1821

Genus *Apodemus* Kaup, 1829

- *Apodemus sylvaticus* (Linnaeus, 1758) - Wood mouse → 3 individuals (two in Quadtrat 1, one in Transect 1)

- *Apodemus flavicollis* (Melchior, 1834) - Yellow-necked Mouse → 15 individuals (six in Quadrate 1, nine in Transect 1)

Family Arvicolidae Gray, 1821 (Microtidae Cope, 1821)

Genus *Clethrionomys* Tilesius, 1850

- *Clethrionomys glareolus* (Schreber, 1780) - Bank Vole → 2 individuals (Transect 1)

In both campaigns on Anieşului Valley *A. flavicollis* was the dominant species. A small number of *A. sylvaticus* individuals were found in both habitats, but in the second studied area *Clethrionomys glareolus* had a relative abundance index slightly higher than *A. sylvaticus*.

Although four of the traps were placed near a small stream than ran along the forest at one of the glade's edges, no species of *Neomys* was captured, despite the fact that they had been mentioned in the literature. Also no species of *Sorex* was captured. It is known from the literature that shrews encounter a high decrease in number in the years when *A. flavicollis* has a very high abundance. The complete absence of *Sorex* species and also the very high percentage of *A. flavicollis* specimens could lead us to conclude that 2009 was a year with a high population density for the latter species. But the small number of individuals captured in all during these two campaigns could be a setback in our assertion

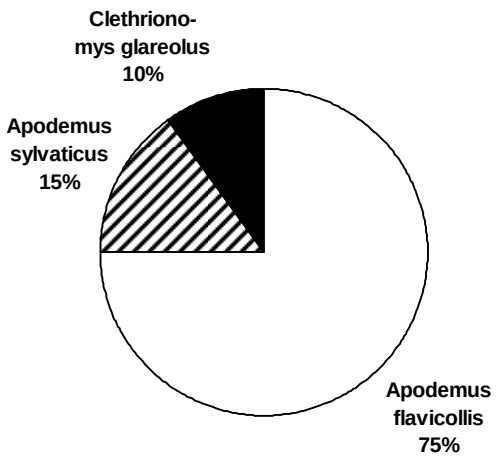

Figure 8: Absolute abundance of small mammal species from Anieş Valley in 2009.

We could also consider that the population density of *C. glareolus* was influenced by *A. flavicollis* in the given habitats. By comparing the ratios of the two species, *C. glareolus* represented only 10% in comparison with the 75% ratio of *A. flavicollis*. Other researchers have come to conclude that *C. glareolus* was found in large numbers especially in the years when *A. flavicollis* encountered a population decrease (Benedek, 2008).

For the first site (Quadrate 1) sex ratio could not be determined due to the fact that for some *A. flavicollis* individuals gender was not determined. Even so, no sex seems to be clearly dominant. The comparison between adult and juvenile individuals however shows a clear dominance of the adults in the detriment of juveniles, of which only one was captured. The two *A. sylvaticus* captured were both adults, one male and one female.

For the second site (Transect 1) in the Anieş Valley all captured individuals belonging to *C. glareolus* and *A. sylvaticus* species were females, whereas *A. flavicollis* had almost equal sex ratios. The age differences vary more because, while the only *A. sylvaticus* individual captured was a juvenile, for *C. glareolus*, even if only two individuals were captured, the age ratio was of 1:1. *A. flavicollis* also noted an adult dominance of 2:1.

As a conclusion, for Anieş Valley a clear dominance of *A. flavicollis* could be noted, having significantly high relative abundance index in comparison with the only two other species captured in the area, *A. sylvaticus* and *C. glareolus*. Also, the sex and age ratios in *A. flavicollis* are mainly balanced. *A. sylvaticus* was captured in all trapping sites studied, but in all cases their numbers were very small. Besides the two species of *Apodemus*, *C. glareolus* was only captured in the outskirts of a mixed forest in the Valley. One individual of *Sorex minutus* was found dead in Anieş Valley, but not in the areas were the traps were set.

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DATA ON THE DISTRIBUTION OF *MARMOTA MARMOTA* (RODENTIA, SCIURIDAE) FROM THE RODNA MOUNTAINS NATIONAL PARK (EASTERN CARPATHIANS, ROMANIA)

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KEYWORDS: Romanian Carpathians, Rodna Mountains, Alpine marmots, distribution, burrows.

ABSTRACT

Our study focuses on the spatial distribution of *Marmota marmota* in the Rodna Mountains, especially in the Pietrosul Rodnei National Park.

Marmota marmota is the largest rodent in the Romanian fauna. It was introduced in 1973 into the area of Pietrosu Peak. Since then we do not have reliable information about the monitoring of this colony.

We searched the area for galleries and we concluded that after the (re)colonization in 1973 the number of these galleries and also the population of marmots has increased.

RÉSUMÉ: Contributions regardant la distribution de l'espèce *Marmota marmota* (Rodentia, Sciuridae) dans la région du Parc National des Montagnes de Rodna (Carpates Orientales, Roumanie).

Cet étude a comme sujet la situation spatiale des marmottes, dans les Montagnes de Rodna, en particulière dans la région du Parc National Pietrosul Rodnei.

Les marmottes sont les plus grands rongeurs delà faune de Roumanie. Elles ont été réintroduites dans le Massif Pietrosul en 1973. Nous n`avons pas des informations certaines sur cette colonie.

En 2009 nous avons effectué le censés des terriers de marmotte dans la Reserve de Pietrosu Rodnei - Lacul Iezer.

REZUMAT: Date privind distribuția speciei *Marmota marmota* (Rodentia, Sciuridae) în aria Parcului Național Munții Rodnei (Carpații Orientali, România).

Această lucrare are ca subiect distribuția spațială a marmotelor (*Marmota marmota*) din masivul Munților Rodnei, în special, din arealul Parcului Național Pietrosul Rodnei.

Marmota (*Marmota marmota*) este cel mai mare rozător din fauna României. A fost reintrodusă în anul 1973, în zona vârfului Pietrosul Rodnei. De atunci, nu avem surse sigure despre existența unei monitorizări a coloniei.

S-au efectuat cercetări, amănunțite, în Rezervația Pietrosul Rodnei - Lacul Iezer, în vara anului 2009, în urma căruia s-au inventariat intrările marmotelor deasupra lacului glaciar.

INTRODUCTION

The alpine marmot (*Marmota marmota* ssp. *marmota*, Linnaeus, 1758) is the largest rodent mammal in the Carpathian Mountains.

The taxonomy of this mammal is the following: Order Rodentia, Family Sciuridae, and Subfamily Sciurinae (Spagnesi et al., 2000).

The marmots have the following measurements: head and body 50.3-57.7 cm, tail 13-16.6 cm, hind foot 8.7-9.5 cm, ear 2.5-3 cm. The weight of an adult specimen is between 5-7 kg (Pucek et al., 1981).

Today, *Marmota marmota marmota* live in alpine habitats in the highest mountains in Europe (French, Italian, Swiss and Austrian Alps, Pyrenees, Carpathians). In the High Tatra lives another subspecies, the *Marmota marmota latirostris*. This subspecies has a restricted range, small population and it is under protection (IUCN-red list, 2008).

There are many disputes between biologists about the past existence of this species in the Romanian Carpathian Mountains. Some of them back up the theory that they existed in the past as a native rodent, especially the *Marmota marmota latirostris* subspecies (Cortot et al., unpubl). On the other hand, we don't have information about fossils, the only piece of information regarding the status of this species, dated from the late 19th Century about the rarity of this rodent (Călinescu, 1956).

In 1973, 33 individuals of the *Marmota marmota* ssp. *marmota* from the French Alps were introduced in the Pietrosul Rodnei Reserve (Almăşan, 1981). Two years later they were dispersed in 10 colonies, 4 above the Lake Iezer (about 1,800 m) the rest settled under the Buhăescu Mare Peak (2,268 m) around the Buhăescu Lakes (on the South of the Iezer Lake).

In the present, the numbers of the marmots increase rapidly (Nădişan, 2000) and signs of their existence were observed along the principal massive of the Rodna Mountains (around the Laptelui Mare Peak (2,172 m), Roşu Peak (2,111 m a.s.l.), and near the Corongiş Peak (1,987 m a.s.l.).

The most part of the Rodna Mountains is part of Rodna Mountains National Park (Biosphere Reserve), which was founded in 1937 (Pietrosul Rodnei Reserve). Today the park has a larger surface, of 46,399 ha and the geographical limits are: 47°25`54" - 47°37`28" North latitude and 24°31`30" - 25°01`30" East longitude (Rodna Mountains National Park management plan).

Apart from the Pietrosul Rodnei Scientific Reserve, the park includes three more important areas which are under the highest protection: the Scientific Reserve of Piatra Rea, situated to North-East from the Pietrosul Rodnei; and the strictly protected areas of Bila-Lala in the East and Corongiş, in the South-East part of the Park (Fig. 1).

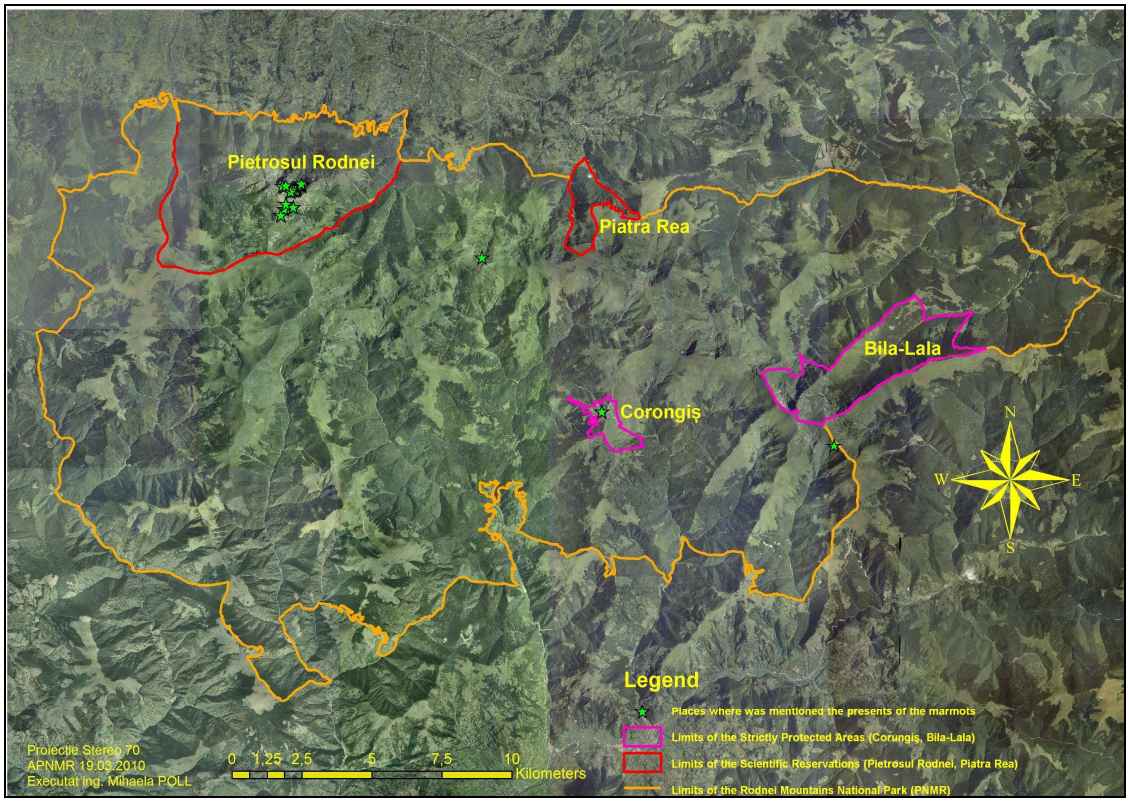

Figure 1: The Rodna Mountains National Park with the protected areas and the places where the existence of the marmots was mentioned.

MATERIAL AND METHODS

Our field-data was collected between 3rd and 5th of July 2009, from the Pietrosul Rodnei Scientific Reserve (Fig. 2), which is the ancient core of the Rodna Mountains National Park. The reserve was founded by the Journal no. 1149/1932 of the Ministry-Council in 1932, and today it has 3,300 ha (1,430 ha of the total surface is represented by the alpine meadows) (Rodna Mountains National Park management plan). In the centre of the Scientific Reserve is situated the glacial Lake Iezer. Above the lake we searched the signs of marmots' presence (gallery entrances, faecal remains). The space above the lake was divided in three zone (right (R) - general exposition is North-West, centre (C) - general exposition is North-North-East, left (L) - general exposition is East-South-East).

The search was effectuated every day between 6^{30}AM and 11^{30}AM.

On the first day (3.VII.2009) were located the burrows from the centre part above the lake, on the second day (4.VII.2009) the burrows from the right part, and on the third day (5.VII.2009) we discovered the entrances from the left side above the lake. We must mention that we observed the marmots mostly on the left side of the lake at about 1,850 m height.

The series of the entrances - which can constitute the access to the gallery-systems - were noted with A, B, C …. Each entry was noted in conformity to its position (centre, right or left), series number and the order of founding. For example, in the centre we found the first entry of the first burrow-system and we noted it with CA1, the second entry was noted with

CA2, etc. We found also single holes and we noted them with S1, S2 and S3. We consider them singles because their position is far away from the other entries.

For each entry was recorded the orientation, the distance between them, the "design" of the entrance (dug in soil or under rocks, the percentage of the vegetation, what kind of plants are around) and the functionality (for emergency, abandoned, actually used or for ventilation of the galleries).

RESULTS AND DISCUSSIONS

We found 37 entrances with the following classification: 14 were found both on the central and the right part (NE-NW) and 9 on the left part (E-SE) above the lake.

We identified in all 7 galleries above the Lake Iezer. In the central part we identified three galleries (two systems with three entrances and one system with seven entrances). In the right part we identified two galleries each with six entrances. On the left side we founded another two systems, one with three accesses and one with six.

Based on these data we can say that the majority (4 systems) of the galleries have 6 or 7 entrances and the rest have three.

The entries of the burrow systems are positioned in circular (4 galleries: 57.14%) or in linear (3 galleries: 42.85%) form. We must mention that all of the linear form galleries have only 3 entrances. Following is the synthetic table of the galleries (Tab. 1) and the satellite map of the Valley (Fig. 2).

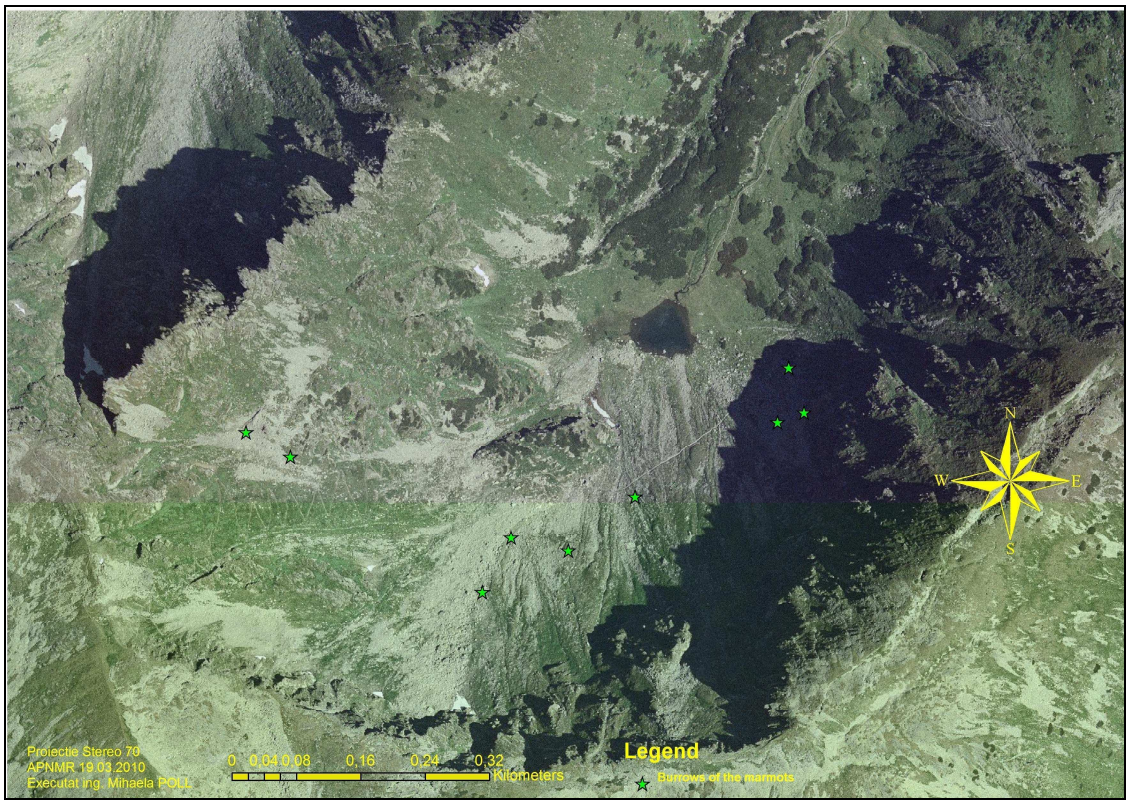

Figure 2: The distribution of the marmots' galleries in the valley of the glacial Iezer Lake, Pietrosul Rodnei Scientific Reservation, Rodna Mountains National Park.

Table 1: The synthetic table of the burrows above the Lake Iezer.

Gallery	Entrance	Expozition	Design	Function	% of vegetation-rock
1.	CA1	E	soil, inside grass		
	CA2	E	rock, inside grass		
	CA3	N	rock, in front of it is moss		
2.	CB1	E	soil		
	CB2	E	soil		
	CB3	E	soil		
3.	CC1	SE	soil		
	CC2	SE	soil, in front of it is a flower		
	CC3	SE	rock, covered by *Rhododendron myrthifolium*		
	CC4	SE	rock		
	CC5	E	rock		
	CC6	SE	rock, covered by *Rhododendron myrthifolium*		
	CC7	NE	rock		
	CS1	NE	rock, inside fecal		
4.	RA1	NV	soil, covered by grass		
	RA2	SV	rock, covered by *Rhododendron myrthifolium*		
	RA3	SV	soil		
	RA4	SV	soil, in front of it is a flower		
	RA5	NV	rock		
	RA6	NE	soil		
5.	RB1	SV	soil covered by a rock		
	RB2	NV	soil, inside grass		
	RB3	NV	soil covered by a rock, in front there is moss		
	RB4	NV	soil, inside grass		
	RB5	SV	soil, inside grass		
	RB6	NV	rock		
6.	RS1	SV	soil, covered by Rhododendron myrthifoliae		
	RS2	NE	soil		
7.	LA1	SE	soil, in front there is grass		
	LA2	SE	soil		
	LA3	S	rock		
8.	LB1	E	soil		
	LB2	E	soil		
	LB3	E	soil		
	LB4	E	rock		
	LB5	E	rock		
	LB6	E	soil		

CONCLUSIONS

If we take all of the information mentioned above, and if we consider every gallery as a home for one family, we can draw some conclusion.

1. Since 1975, the number of the colonies increased from 4 to 7 above the Iezer Lake.

2. We believe that all the smallest, linear burrow-systems were bigger once and we can't found the remains of the other entrances.

3. Marmots like the sunshine because the majority of the entrances (26-70.27%) are oriented to East, South, South-East and South-West, and the rest are oriented to North, North-East or North-West (11-29.73%).

4. Near the entrances the plant-carpet is abundant. This aspect is important because of the predators. For example if the marmots are too far from the entry, it's possible to easily become a prey.

In the future we want to search for other entrances from the Rodna Mountains, to prove that marmots are moving along the principal massif.

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