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Research article

## BRYOFLORESTICAL DATA FROM THE APUSENI MOUNTAINS (ROMANIAN WESTERN CARPATHIANS, TRANSILVANIA) 2.

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**Abstract:** The main aim of this study was to explore the bryophyte diversity and distribution patterns in the Apuseni Mountains. From our collections hitherto 94 bryophyte species were identified. The 25 Marchantiophyta and 69 Bryophyta species belong to 73 genera of 42 families. *Syntrichia norvegica* are new for the whole Apuseni Mountains. Among them the endangered *Campylium protensum*, the near threatened *Barbula crocea*, *Platydictya jungermannioides* and the very rare *Abietinella abietina* var. *hystricosa* are worth to be mentioned.

**Keywords:** bryoflora, rare species, Apuseni Mts., Romania

**Rezumat:** Lucrarea prezintă distribuția speciilor de briofite din cadrul Munților Apuseni. Din colecția recentă fost identificate 94 de specii de briofite. Cele 25 specii de Marchantiophyta și 69 de specii de Bryophyta aparțin în 73 de genuri și 42 de familii. *Syntrichia norvegica* este semnalare nouă pentru Munții Apuseni. *Campylium protensum* este specie periclitată, *Barbula crocea* și *Platydictya jungermannioides* specii amenințate iar *Abietinella abietina* var. *hystricosa* specie rară care merită să fie menționată.

**Cuvinte cheie:** brioflora, specii rare, Apuseni, România

### INTRODUCTION

The first bryological records of the climatologically and geologically very variable and biologically very rich Apuseni Mountains were published at the end of XIX<sup>th</sup> century (Csató 1885), but its intensive investigation started only in the XX<sup>th</sup> century, which till now is far from complete (Győrffy 1903; Péterfi 1908, 1910; Boros 1942a, 1942b, 1951; Páll 1960, 1962, 1963; Rațiu *et al.* 1966; Boros and Vajda 1967, 1974; Ștefureac 1975, 1977; Plămadă and Goia 1994). Investigations have continued intensively in the past twenty years

(Goia 2001, 2005; Goia and Mătase 2001; Jakab 1999, 2000; Goia and Schumacker 2000, 2002, 2003a, 2003b, 2004; Goia and Ștefănuț 2004; Plămadă *et al.* 2000; Lüth 2002, and others). Csűrös (1981) gave a wide overview of the natural conditions and of Apuseni Mountains and its flora and fauna. A preliminary report on the Bihor mountains was published by Simon (1960) and a very detailed vegetation study is given by Pop *et al.* (2000) from its part in Cluj County. We started our bryological exploration in 2002 and published a series of papers from this area, some of them as result of the fruitful cooperation with Irina Goia, bryologist at the Babeș-Bolyai University (Pócs 2005, Sass-Gyarmati *et al.* 2005a, 2005b, Sass-Gyarmati *et al.* 2008a, 2008b, Sass-Gyarmati and Pócs 2017).

### **Study area**

Muntele Mare and Gilăului Mountains form a distinct geomorphological unit, known as *Gilău – Muntele Mare*. The massif is covered with beech and spruce forests. The crystalline schists gave rise to a massive landscape, with wide interfluves separated by narrow and deep valleys. Reserve includes "Șesul Craiului" located on a limestone plateau above 1350 m altitude, the forest on the mountain scale and spectacular cliffs guard Belioara Valley (tributary of Poșaga Valley), with vertical walls, tanks, gully and sharp increases. It has an area of 47.7 hectares and houses many rare species of plants and animals. Initiative put under protection of the area had Alexandru Borza, since the early 20's of the twentieth century. Here have found their place those floral rarities and a relic forest of conifers (scotch pine and larch) for which in 1935 it was declared a botanical reservation. Csűrös (1958) presents in details vegetational studies made in Scărișoara-Belioara (Bélavár) Massif and published several more studies, partly together with Csűrös-Káptalan.

The Bihor Mountains occupy a central position within the Apuseni mountains range. The characteristic karstic topography is widely developed, parallel to places with other sedimentary and volcanic bedrocks. The Bihar Massif is the highest part of the Apuseni Mountains. Here the general aspects of vegetation of Cheile Ordâncușa – a narrow, 2.5 km long limestone gorge – were studied by I. Pop and I. Hodișan (1967). The streamlet has the side-branch of Gârdei Seacă on the left part. The Ordâncușa gorge has 400 m high limestone walls, between which there is a road leading to the

Scărișoara Ice Cave. In the cliffs more than 70 caves, gates and smaller halls are present. Among them the most popular is Poarta lui Ionele cave with different species of protected bats. In the right wall can be found the Zgurăști sinkhole, with interesting vegetation inversion and with an underground lake (Sass-Gyarmati *et al.* 2005a). The characteristics of the landscape are crevices, extended karst zones (with almost 430 caves described) and the third largest underground ice cave of Europe after the Eisriesenwelt cave in Austria and Dobsinska cave in Slovakia (Strug *et al.* 2006), the „Ghețarul de la Scărișoara” – which is the largest in Romania, declared a natural monument and a speleological reserve. It is situated at 1165 m a.s.l., the entrance being located on the western wall of a circular shaft 60 m in diameter and 47 m deep. Beyond the entrance, the ice block with a volume of 100 000 m<sup>3</sup> and area extent of 3000 m<sup>2</sup> (Perșoiu *et al.* 2011).

## MATERIAL AND METHODS

The bryophytes enumerated below were collected from Apuseni Mountains between 22-25 October 2006 by Tamás Pócs, Irina Goia, Zoltán Tóth and identified by Tamás Pócs and Andrea Sass-Gyarmati. The collection was made in various vegetation types: bogs, meadows, beech and spruce forests and subalpine belts. The Romanian distribution of mosses was established from Plămadă (1998) and Mohan (1998), while that of the liverworts from Ștefănuț (2008). The nomenclature of liverworts follows Ștefănuț (2008) modified by Söderström *et al.* (2016), nomenclature of mosses follows Hill *et al.* (2006), except *Racomitrium affine* which was recently included to *Bucklandiella* (F. Weber & D. Mohr) Bednarek-Ochyra & Ochyra (Ochyra *et al.* 2003). The classification of liverworts (Marchantiophyta) follows Söderström *et al.* (2016), while the classification of mosses (Bryophyta) follows Goffinet and Shaw (2009). The species in each family are arranged in alphabetical order. Species names are followed by the collecting site number, and by the substrate on which they were grown. The collected specimens are deposited in the Herbarium of Eger (EGR). The collecting sites are listed in the Appendix.

## RESULTS

### List of species

During the field study, 94 bryophyte species were found in the investigated area. The 25 Marchantiophyta and 69 Bryophyta species belong to 73 genera of 42 families.

### Marchantiophyta

#### Conocephalaceae

*Conocephalum conicum* (L.) Dumort. – 13: on irrigated rocks

#### Marchantiaceae

*Preissia quadrata* (Scop.) Nees – 2: on limestone rocks

#### Aneuraceae

*Aneura pinguis* (L.) Dumort. – 2, 12: on limestone rocks

#### Anastrophyllaceae

*Barbilophozia barbata* (Schmidel ex Schreb.) Loeske – 9: on volcanic rocks

#### Lepidoziaceae

*Bazzania trilobata* (L.) Gray. – 5: lignicolous

*Lepidozia reptans* (L.) Dumort. – 5: on volcanic rocks; 10: lignicolous

#### Cephaloziaceae

*Cephalozia pleniceps* (Austin) Lindb. – 13: on vertical cliff

#### Lophoziaceae

*Lophozia ventricosa* (Dicks.) Dumort. – 5: on volcanic rocks.

#### Scapaniaceae

*Scapania aequiloba* (Schwagr.) Dumort. – 12: on vertical cliff

*Scapania calcicola* (S.W. Arnell & J. Perss.) Ingham – 13: on limestone rocks

*Scapania nemorea* (L.) Grolle – 5, 9: on volcanic rocks

#### Jubulaceae

*Frullania dilatata* (L.) Dumort. – 1, 3, 12, 13: on bark

Jungermanniaceae

*Jungermannia atrovirens* Dumort. – 12, 13: on limestone rocks

*Tritomaria exsecta* (Schmidel) Schiffn. ex Loeske – 5, 10:  
lignicolous

Blepharostomataceae

*Blepharostoma trichophyllum* (L.) Dumort – 5: on volcanic rocks;  
10: lignicolous

Lophocoleaceae

*Lophocolea heterophylla* (Schräd.) Dumort. – 8, 12: on decaying  
log

Plagiochilaceae

*Pedinophyllum interruptum* (Nees) Kaal. – 12: on limestone rocks

*Plagiochila porelloides* (Torr. ex Nees) Lindénb. – 12: on limestone  
rocks

Trichocoleaceae

*Trichocolea tomentella* (Ehrh.) Dumort. – 5: twigs of a dead spruce

Radulaceae

*Radula complanata* (L.) Dumort. – 12, 13: on bark

Ptilidiaceae

*Ptilidium pucherrimum* (Weber) Hampe – 10: on spruce roots

Metzgeriaceae

*Apometzgeria pubescens* (Schränk) Kuwah. – 12: on limestone  
rocks

*Metzgeria conjugata* Lindénb. – 12: on bark

Lejeuneaceae

*Cololejeunea calcarea* (Lib.) Schiffn. – 13: on limestone rocks

*Lejeunea cavifolia* (Ehrh.) Lindénb. – 13: on limestone rocks

**Bryophyta**

Sphagnaceae

*Sphagnum angustifolium* (C.E.O. Jensen ex Russow) C.E.O. Jensen –  
7: transition spring bog

*Sphagnum capillifolium* (Ehrh.) Hedw. – 5, 8: on raised bog

*Sphagnum fuscum* (Schimp.) Klinggr. – 8: on raised bog

*Sphagnum girgensohnii* Russ. – 5, 8: on turf

***Sphagnum magellanicum*** Brid. – 6, 8: on turf

***Sphagnum subsecundum*** Nees – 7: transition spring bog

Tetraphidaceae

***Tetraphis pellucida*** Hedw. – 10: lignicolous

Polytrichaceae

***Polytrichum strictum*** Menzies – 8: on raised bog

***Polytrichum longisetum*** Sw. ex Brid. – 5: on peaty soil

Encalyptaceae

***Encalypta streptocarpa*** Hedw. – 1: on limestone rocks

***Encalypta vulgaris*** Hedw. – 1: on limestone rocks

Grimmiaceae

***Grimmia hartmanii*** Schimp. – 9: on volcanic rocks.

***Bucklandiella affinis*** (F. Weber & D. Mohr) Bednarek-Ochyra & Ochyra, Syn.: *Racomitrium affine* (F. Web. et D. Mohr) Lindb. – 5: on soil

***Schistidium apocarpum*** (Hedw.) Bruch & Schimp. – 10: on limestone rocks

Seligeriaceae

***Seligeria acutifolia*** Lindb. – 13: on vertical cliff

***Seligeria patula*** (Lindb.) I. Hagen – 13: on vertical cliff

Fissidentaceae

***Fissidens adianthoides*** Hedw. – 12: on limestone rocks

***Fissidens dubius*** P. Beauv. – 2: on limestone rocks

Dicranaceae

***Dicranella heteromalla*** (Hedw.) Schimp. – 10: lignicolous

***Dicranum scoparium*** Hedw. – 5: on bog; 10 on *Picea* roots; 11: on rotten spruce stumps

***Dicranum fuscescens*** Sm. – 8: on raised bog

***Dicranum montanum*** Hedw. – 10: on rotten spruce stumps

***Paraleucobryum longifolium*** (Ehrh. ex Hedw.) Loeske – 5: on volcanic rocks

Pottiaceae

***Barbula crocea*** (Brid.) F. Weber & D. Mohr – 2, 13: on limestone rocks

***Bryoerythrophyllum recurvirostrum*** (Hedw.) P.C.Chen – 9: on volcanic rocks

***Didymodon fallax*** (Hedw.) R. H. Zander – 2: on vertical cliff

***Didymodon ferrugineus*** (Schimp. ex Besch.) M.O.Hill – 2: on limestone rocks

***Gymnostomum aeruginosum*** Smith. – 13: on vertical cliff

***Syntrichia norvegica*** F. Weber – 10: on limestone rocks

***Tortella tortuosa*** (Hedw.) Limpr. – 1, 2: on soil; 10, 12: on limestone rocks

#### Orthotrichaceae

***Orthotrichum anomalum*** Hedw. – 4: bark of *Fagus*

***Orthotrichum speciosum*** Nees – 12, 13: bark of *Salix*

***Ulota crispa*** (Hedw.) Brid. – 4: bark of *Fagus*, 5: on *Picea* twigs, 12: bark of *Salix*

#### Hedwigiaceae

***Hedwigia ciliata*** (Hedw.) P. Beauv. var. ***ciliata*** – 9: on volcanic rocks

#### Bryaceae

***Bryum capillare*** Hedw. var. ***capillare*** – 13: on limestone rocks

***Bryum pseudotriquetrum*** (Hedw.) P. Gaertn. – 2, 9: on rocks

***Plagiobryum zieri*** (Hedw.) Lindb. – 13: on limestone rocks

#### Mniaceae

***Mnium marginatum*** (Dicks.) P. Beauv. – 12: on limestone rocks

***Plagiomnium undulatum*** (Hedw.) T. J. Kop. – 13: on earth covered rocks

***Pohlia nutans*** (Hedw.) Lindb. – 13: on earth covered rocks

***Pohlia wahlenbergii*** (F. Weber & D. Mohr.) A. L. Andrews – 13: on limestone rocks

***Rhizomnium punctatum*** (Hedw.) T. J. Kop. – 10: lignicolous; 13: on irrigated rocks

#### Aulacomniaceae

***Aulacomnium palustre*** (Hedw.) Schwaegr. – 7: transition bog

#### Amlystegiaceae

***Amblystegium serpens*** (Hedw.) Schimp. – 11: on bark

***Campylium chrysophyllum*** (Brid.) Lange – 2: on limestone rocks

***Campylium protensum*** (Brid.) Kindb. – 7: transition bog

***Campylium stellatum*** (Hedw.) Lange & C.E.O. Jensen – 7: transition bog

***Sanionia uncinata*** (Hedw.) Loeske – 5: twigs of a dead spruce; 6: on irrigated soil

Hylocomiaceae

***Hylocomium splendens*** (Hedw.) Schimp. – 5, 12, 13: on limestone rocks

***Pleurozium schreberi*** (Willd. ex Brid.) Mitt. – 13: on soil

***Rhytidiadelphus triquetrus*** (Hedw.) Warnst. – 13: on limestone rocks

Rhytidiaceae

***Rhytidium rugosum*** (Hedw.) Kindb. – 1: on soil

Thuidiaceae

***Abietinella abietina*** (Hedw.) M. Fleisch. – 3: on soil

***Abietinella abietina*** (Hedw.) M. Fleisch. var. ***hystricosa*** (Mitt.) Sakurai – 3: on limestone rocks

Brachytheciaceae

***Brachythecium rutabulum*** (Hedw.) Schimp. – 12: on limestone rocks

***Homalothecium sericeum*** (Hedw.) Schimp. – 12: on limestone rocks

***Eurhynchium angustirete*** (Broth.) T.J. Kop. – 12: on limestone rocks

Plagiotheciaceae

***Plagiothecium denticulatum*** (Hedw.) Schimp. – 8: raised bog, on litter

***Platydictya jungermannioides*** (Brid.) Crum – 1: on earth covered soil

Hypnaceae

***Calliergonella cuspidata*** (Hedw.) Loeke – 5: on soil

***Ctenidium molluscum*** (Hedw.) Mitt. – 2, 12, 13: on limestone rocks

***Hypnum cupressiforme*** Hedw. – 11: on bark, 13: on limestone rocks

***Orthothecium rufescens*** (Dicks. ex Brid.) Schimp. – 12, 13: on limestone rocks

***Ptilium crista-castrensis*** (Hedw.) De Not. – 13: on limestone rocks

Calliergonaceae

***Straminergon stramineum*** (Dicks. ex Brid.) Hedenas – 6: on irrigated soil, 11: lignicolous



***Warnstorfia exannulata*** (Schimp.) Loeske – 8: raised bog, on litter

Neckeraceae

***Neckera crispa*** Hedw. – 12: on limestone rock

***Neckera complanata*** (Hedw.) Hüb. – 12, 13: on limestone rocks

Leskeaceae

***Leskeella nervosa*** (Brid.) Loeske – 12: on limestone rocks

## DISCUSSION

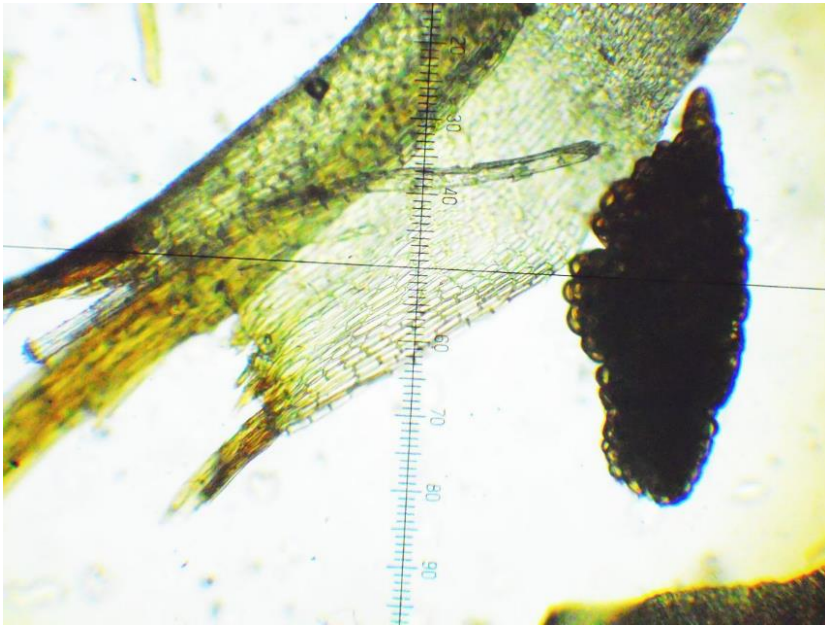
***Trichocolea tomentella*** (Ehrh.) Dumort. – it is reported only from two localities from the Bihor Mountains: Galbena Valley, 750 m alt., 08.1999 (Jakab 2000) and Cetățile Ponorului, AB 46°33'55"N / 22°42'15"E, 1050 m alt., 3.09.2007, leg. & det. Ștefănuț S. [BUCA B3827]. Based on Mohan (1998) it occurs sporadically in Retezat, Bucegi, Cibin, Arpașului Mountains, tinovul Poiana Ștampei, Băile Chirui, Valea Ialomiței, Cascada cu șapte scări, Piatra Mare Mountain, Iezer - Păpușa Mountains.

***Abietinella abietina*** (Hedw.) M. Fleisch. var. ***hystricosa*** (Mitt.) Sakurai – it is known only from one locality in Romania from Pângărați valley near Piatra Neamț (Mihai 1976), but missing from the checklist of Mohan (1998). It was collected by us on the limestone rocks of Scărița-Belioara. Another record was published by Pócs (2006) from Scărișoara. It is considered nowadays on molecular basis to be a separate species under the old name of *Abietinella hystricosa* (Mitt.) Broth.

***Barbula crocea*** (Brid.) F. Weber & D. Mohr – European-mediterranean species and is treated as near threatened (NT) in Romania (Ștefănuț & Goia, 2012). It is known from few localities in the Apuseni Mountains: Vl. Seacă, Băița and Șuncuiș, here collected from Ordâncușa gorge and Cheile Posăgii gorge (Figure 1, 2). Also known just from few localities in the country: Borsec, Piatra Craiului, Bucegi and Ciucaș Mountains, Cristianul Mare and Piatra Mare Mountain (Mohan 1998).



**Figure 1.** *Barbula crocea* (Brid.) F. Weber & D. Mohr, habit (photo: T. Pócs).



**Figure 2.** *Barbula crocea* (Brid.) F. Weber & D. Mohr, leaf and gemma (scale by 8  $\mu$ m) (photo: T. Pócs).

***Seligeria acutifolia*** (Lindb.) Broth. – is mainly sub-mediterranean and montane taxon (Düll 1984), widely scattered throughout Europe. Besides on Sicily it has also been found on the Italian mainland, in Belgium, (former) Czechoslovakia, France, Germany, Great Britain and Greece, on Ireland, in Norway, Poland, Romania, Sweden and former Yugoslavia (Düll 1985). It occurs in limestone rock crevices, data deficient (DD) in Romania (Ștefănuț & Goia 2012). We have found it on a shaded limestone rocks at the narrowest part of Cheile Ordâncușei gorge at 850 m alt.

***Seligeria patula*** (Lindb.) Broth. – is an Alpine-Carpathian species, it was observed at several other places in the Bihor Mts., as in Ordâncușa Valley, Galbena gorge, at Barsa ice cave and from Boghii Valley, near the Oșelu waterfall (Pócs 2006). *Seligeria patula*, similarly to *S. tristicha*, is always embedded in a thin or thick layer of cryptobiotic crust dominated by cyanobacteria.

***Campylium protensum*** (Brid.) Kindb. – is an endangered species in Romania, many bryofloristical works did not separated it from its

very close relative and more frequent *C. stellatum*. The high red list category of *C. protensum* should be reevaluated after taxonomical revision of herbarium specimens and future fieldworks, to provide the reliable distribution.

***Platydictya jungermannioides*** (Brid.) Crum – the species is treated as near threatened (NT) in Romania (Ștefănuț & Goia 2012). Distribution based on Mohan (1998): Piatra Craiului Mountains, Cristianul Mare Mountains, Cluj cemetery, Cărpiniș forest, Retezat Mountains, Laptelui Mountains, Puzdra Mountains, Neamț county: Măgura-Petricica, Bucegi Mountains, Făgăraș Mountains, Ouzoru Mountains.

***Syntrichia norvegica*** F. Weber – this species is treated as vulnerable in Romania (Ștefănuț & Goia 2012). New to the Apuseni Mountains communicated in the country only from Retezat, Făgăraș Mountains and from Schitul Obârșia Ialomiței (Mohan 1998). Circumpolar, Arctic-montane, strongly calcicolous element. Montane and northern Europe north to Svalbard, Iceland, Caucasus, Turkey, Cyprus, Asia, Madeira, N. Africa, N. America, Greenland and Mexico (Smith 2004).

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## APPENDIX

List of collecting sites from the Apuseni Mts. (Nyugati Szigethegység):

1. Munții Gilăului (Gyalui Havasok), Rezervația Șesu Craiului – Scărița Belioara (Bélavár). Șesu Craiului ridge, 2.5 km N of Poșaga de Sus (Felsőpodsága). 1350-1370 m alt. N 46°29'46.1", E 23°21'56.9" Hab.: Dry *Festuco-Caricetum humilis* sward on the steep (45°) S slope above the limestone cliffs. Date: 22. Oct. 2006 Coll.: T. Pócs, I. Goia & Z. Tóth. No. 06090
2. Munții Gilăului (Gyalui Havasok), Cheile Poșegii, 500 m, N of Mănăstirea Poșaga in the gorge. N 46°27'30.5", E 23°23'53.1" Hab.: N facing, shady limestone rocks with scattered *Sesleria rigida* and abundant *Selaginella helvetica*. Date: 23. Oct. 2006 Coll.: T. Pócs & Z. Tóth. No. 06093
3. Munții Gilăului (Gyalui Havasok), Rezervația Șesu Craiului – Scărița Belioara (Bélavár). Belioara Valley below the huge, SSE facing cliffs at 710-720 m alt. N 46°29.143', E 23°22.229' Hab.: Limestone scree covered by *Corylus* bush. Date: 23. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06095
4. Munții Gilăului (Gyalui Havasok), Rezervat Șesu Craiului – Scărița Belioara (Bélavár). Belioara Valley below the huge, SSE facing cliffs at 920-1000 m alt. N 46°29.502', E 23°22.954'. Hab.: Beech (*Fagus sylvatica*) forest. Date: 23. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06096
5. Munții Gilăului (Gyalui Havasok), complex of Muntele Mare (Öreghavas). Valea Mare NE of Bistra below Cheleteni village, at 920 m alt. N 46°26'40", E 23°07'44.5". Hab.: Acidiphilous spruce forest on volcanic rocks and scree. Date: 24. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06097
6. Munții Gilăului (Gyalui Havasok). W end of the plateau of Muntele Mare (Öreghavas) near the saddle to Vf. Prislop, at 1685 m alt. N 46°29'30.9", E 23°12'31.4". Hab.: Complex of transition, spring and raised peat bog. Date: 24. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06098
7. Munții Gilăului (Gyalui Havasok). NW part of the plateau of Muntele Mare (Öreghavas), W from the mean summit, at 1715-1725 m alt. N 46°29'36.4", E 23°12'50.2". Hab.: Transition spring bog with *Carex hartmanii*. Date: 24. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06099



8. Munții Gilăului (Gyalui Havasok). NW part of the plateau of Muntele Mare (Öreghavas), 1.5 km W from the mean summit, near the springs of Iara River, place called "Gemenele Țiganului" at 1716-1725 m alt. N 46°29'51.7", E 23°13'09.0". Hab.: Big, raised bog (*Eriophoro vaginatae*- *Sphagnetum*). Date: 24. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06100
9. Munții Gilăului (Gyalui Havasok), complex of Muntele Mare (Öreghavas). Valea Mare NE of Bistra at 716 m alt. N 46°24'37.5", E 23°06'34.1". Hab.: Spruce forest on volcanic ground with open lava rocks. Date: 24. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06101
10. Munții Bihorului (Bihar Hegység), S ridge of Dealu Bocului 1 km NW of Scărișoara Ice Cave, at 1200-1290 m alt. N 46°29'39.9", E 22°48'19.3". Hab.: Mixed *Fagus-Abies-Picea* forest on limestone ground, alternating with openings. Date: 25. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06102
11. Munții Bihorului (Bihar Hegység), 200-700 m N of Scărișoara Ice Cave near the Avenul din Șesuri sinkhole, at 1200 m alt. N 46°29'27.6", E 22°48'22.7". Hab.: Mixed *Fagus-Abies-Picea* forest on limestone ground. Date: 25. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06103
12. Munții Bihorului (Bihar Hegység), Cheile Ordâncușei gorge NE of Gârda de Sus village, near the Poarta lui Ionele cave, at 775 m alt. N 46°27'59.8", E 22°50'17.55". Hab.: Shady limestone cliffs with *Seslerietum rigidae*. Date: 25. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06104
13. Munții Bihorului (Bihar Hegység), northern, very narrow part of Cheile Ordâncușei gorge ("*Seligeria* Canyon") NE of Gârda de Sus village, at 850 m alt. N 46°28'30", E 22°50'30". Hab.: Shady, vertical limestone cliffs, almost no phanerogams. Date: 25. Oct. 2006. Coll.: T. Pócs & Z. Tóth. No. 06105