# CONTRIBUTION TO THE BRYOFLORA OF CĂLIMANI MOUNTAINS IN THE EASTERN CARPATHIANS, ROMANIA, I.

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Bryoflora of Călimani Mts.

Liverworts, Mosses, Carpathians, Transylvania, Romania, conservation

**Abstract**. The authors visited the spruce, subalpine and alpine belts of Călimani Mts. in July 2011. From the collected 144 bryophyte taxa *Marsupella apiculata, Pohlia nutans* ssp. *schimperi* and maybe *Ditrichum lineare* are new to the Romanian bryoflora. Further 37 taxa are new to the Călimani Mountains, among them rare Arctic-Alpine species, like *Pleurocladula albescens, Arctoa fulvella, Dicranum brevifolium, Grimmia donniana* and *Racomitrium microcarpon*. An account on the environmental conditions of the mountains is given in the introduction.

**Abstract**: Autorii acestui studiu au vizitat zona boreală, subalpină si alpină a Munţilor Călimani în iulie anului 2011. Printre cele 144 specii de briofite colectate *Marsupella apiculata, Pohlia nutans* ssp. *schimperi* şi probabil *Ditrichum lineare* sunt taxoni noi pentru brioflora României. 37 taxoni sunt semnalaţi pentru prima dată in flora Călimanului, printre acestea elemente arcto-alpine rare, cum sunt *Pleurocladula albescens, Arctoa fulvella, Dicranum brevifolium, Grimmia donniana* şi *Racomitrium microcarpon*. In introducere este redată şi o sumarizare a condiţiilor de mediu din zona Munţilor Călimani.

## Introduction

As part of the Călimani-Ghiughiu-Harghita volcanic chain the Călimani Mountains (Kelemen Havasok) is one of the highest and the youngest volcanic massif of the Eastern Carpathians. Its formation is a result of the repeated volcanic activity during the Pliocene. It is assumed that with its 10km diameter the Călimani volcanic crater is one of the largest among Europe's inactive volcanos. This famous geological structure preserved until the present, by the collapse of the inner part and by erosion formed a widely opened caldera facing towards the North. The highest peaks are the Pietrosul Călimani (2100 m), Negoiul Unguresc (2081m), the Răchiţiş (2021m), Călimani Izvor (2032m).

Altogether the Călimani Mountains cover an area of about 2000 $km^2$, extending west to east for 60 km. This immense andesite barrier between Moldavia and Transylvania is bordered on the North by the Bârgăului Mountains and the Vatra Dornei Depression, and on the South by the Gurghiului Mountains from which it is separated by the strait Mures river defile. The Eastern border is lined out mainly by the intermontaneous depressions Bilbor and Borsec that delimit Călimani from the Bistriţa and Giurgeului Mountains.

The dominant bedrocks are andesite, andesite with amphibole, or amphibole-pyroxenes, very rarely andesite with basaltic content. Dacites originate from the late volcanic activity.

The surface of the mountain can be divided into three main parts; the central part with the caldera (1600-2100m), the volcanic plateau (1300-1600m) that remained from the cooling lava flow, thirdly the rich interfluvial network (400-800m) that is incised deeply into the plateau and in the deposited volcanic material at the bottom of the mountain. Brook valleys are narrow, mostly with steep, abrupt slopes, oriented straight to the North and to the South. The northern part is characteristic for its large glacier cirques (Naum 1972).

## Climate

The climate of the mountain is quite severe with long winters and strong snowfalls. Average annual temperature on the lower elevations is 4-6 °C, on the upper alpine subalpine region around 0 or -2°C. Summer temperatures are rising to 8-15° C in the upper regions and to 14-18 °C in the lower mountains sites. Dominant winds bring large amounts of precipitation from the west, watering strongly the western slopes, while eastern slopes are less humid. Summer air humidity in the deep valleys can exceed 88%. Annual average precipitation is 1000-1400 mm; these values are the highest in the whole region. The snow cover lasts 180-200 days beginning from early October. Not more than 40 days are sunny in one year. The continental character of the climate is strengthened by the fast coming cold weather fronts that produce rapid decrease in the daily temperature even in the summer period. Almost every month of the year, night

temperature can decrease below 0°C. Moreover the summer foehn activity can produce drought on the local scale.

## Soils

According to the cool wet climatic conditions and the volcanic bedrock, the soil cover of the Călimani Mountains, on the whole, is predominantly acidic. The deep, medium deep soils have good water supply and are rich in humus. The most characteristic soil types are the so called andosols, podzols and skeletic leptosols.

Andosols and podzols are quite frequent at the height of 1000-1800m above sea level where they can cover the medium steep slopes and the plateaus built mainly of lava flows. Those andosols that are located in special microtopographic positions with stronger water percolation tend to evolve towards podzols. Compared to the andosols, podzolic soils have less clay minerals and their structure is more compact with a higher raw humus layer on the surface. At lower elevations, mostly where the volcanic material has accumulated in form of pyroclastits and breccias the predominant soil types are luvisols and cambisols. Grasslands and pastures maintained by human activity can be characterized by different soil types. In many places within the mountain area the pastures are overgrazed and therefore these soils become hard with less oxygen supply. On the steep slopes and along the brook sites skeletic soils are very common. Skeletic leptosols and rock cliffs cover large surfaces on high elevations, mainly on the northern part of the mountain. Microbiological activity of the soils is generally high in the summer period, while in the rest of the year it becomes insignificant.

## Vegetation

The territory of the Călimani Mountains has luxuriant vegetation, as large forests belts were maintained despite of intensive forestry and mining in some parts of the mountain. Mixed broad leaf forests dominated by *Carpinus betulus* and *Fagus sylvatica* occur just around 600-700m, while the most widespread deciduous forests are Carpathian beech forests (*as*. *Symphyto-Fagetum*). Typical for the Eastern Carpathians, the herb layer of these forests is rich in Carpathian endemic species and dacic elements like *Dentaria glandulosa* and *Symphytum cordatum*. Beech woods are subsequently followed by fir mixed beech spruce forests (*as. Pulmonario rubrae –Abieti- Fagetum*) considered to be the most threatened forest communities, since the sensible population equilibrium of the three tree species cannot be maintained following intensive forestry works. Deciduous forests are limited on higher elevations by homogenous spruce forests. The latter, with a strong boreal character are the most widespread forests within the Călimani Mountains and are represented by several plant associations,

depending on the slope, substrate and exposition. Spruce forests cover more than 10000ha. Subalpine shrub communities are also well-represented. At about 1700-1900m above the sea level dwarf mountain pine is widely distributed with spots of green alder. The high mountain ecotone is also characterised by the distribution of the *Pinus cembra*, glacial relict species of Europe.

One of the most valorous aspects of the alpine vegetation is the wide distribution, covering around 1300 ha, of the alpine dwarf shrub heaths dominated by alpine rose, *Rhododendron myrtifolium*. Bordering rock cliffs and screes alpine heaths are rich in Arctic-Alpine floral elements and boreal mosses, being the most colourful stands in the high elevations of the Călimani Mountains. Large areas are covered also by alpine meadows and rock communities in some parts strongly modified, degraded by pasturing activity. Overgrazing favoured the spreading of *Nardus stricta*. Azonal vegetation along the wet habitats is represented mainly by grey alder woods and nitrophylous tall herb vegetation, that are limited in some flat sites, where the acid water tends to accumulate, by assemblages of mineral-poor fen communities. Peat bogs are mainly distributed in the upper boreal zone. One of the deepest peat substrate evolved around the lake Iezer at 1750m. The largest Romanian raised bog, Tinovul Mare at Poiana Stampei (Suceava County), is also situated at the northern foot of this mountain.

Since the 90th, the high mountain ecosystems of the Călimani Mountains were included within the administration of the Călimani National Parc, an area of 24.041 ha. However the landscape with the abandoned sulphur quarry and the nude peak of Negoiul Românesc in the vicinity of the protected area still provides an unusual aspect for the visitors.

Although detailed research was performed on the vascular flora and vegetation (Csürös 1951, Höhn 1996-1997), the moss flora of the Călimani Mts was not studied in details until the present. However, the bryophytes of certain localities have been investigated earlier, like the large peat bog "Tinovul Mare"of Poiana Stampei at the northern foothills (Pop 1960, Ştefureac 1965a, 1967) and the alpine vegetation of the main ridge (Mihai 1968, 1985, Stefureac 1965b, 1986, Ştefanuţ 2008). Our recent study focuses on the description of the bryophyte flora including zonal and edaphic communities of the boreal belt. We intend to continue this study at other sites in the future.

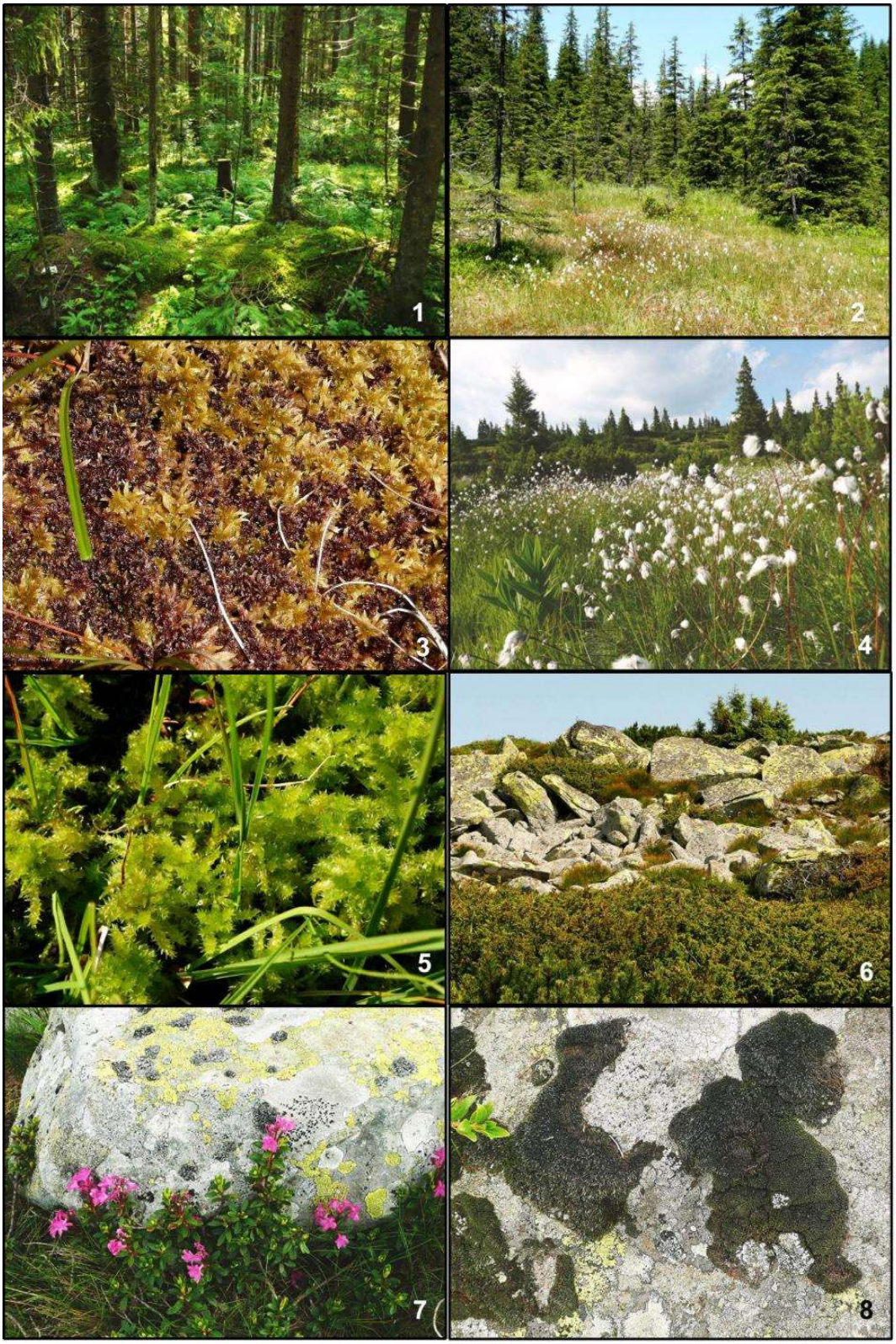
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Plate I. Fig. 1: Mesophilous spruce forest in Topliţa (Lomás) Valley, at 850 m alt. (Locality 4). Fig. 2: The „Puturosul" spring bog with *Eriophorum angustifolium,* at 1480 m alt. (Loc. 6). Fig. 3: *Sphagnum quinquefarium* and *Sph. acutifolium* ssp. *rubellum* on the „Puturosul" spring bog. Fig. 4: Peat bog complex with *Eriophorum vaginatum* near to the Mountain Rescue house, ENE from Iezer Lake, at 1725 m alt. (Loc. 8). Fig. 5: *Sphagnum squarrosum* in the transition bog at the margin of a raised bog in the above complex (Loc. 8). Fig. 6: Periglacial blocks on the main ridge, at 1880 m alt., surrounded by *Pinus mugo* and *Juniperus nana,* habitat of *Racomitrium microcarpon* and the three *Grimmia* species (Loc. 9). Fig. 7: Blocks with the lichen community *Rhizocarpetum alpicolae,* surrounded by *Rhododenron myrtifolium* bush on the S side of Răchiţiş summit, at 1950 m alt. (Loc. 10). Fig. 8: *Grimmia sessitana* and *G. incurva* in the same community (Loc. 10). (Photos made by T. Pócs. In the on-line version each picture can be magnified up to 500%, which corresponds to desktop size).


Plate II. Fig. 9: Primaeval acidophilous spruce forest on the N slopes of the Neagra Şarului valley head, at 1610 m alt. (Loc. 16). Fig. 10: *Ptilium crista-castrensis* on the litter of acidophilous spruce forest of Puturosul valley, at 1100 m alt. (Loc. 5). Fig. 11: Typical habitat of *Schistostega pennata*, in the cavity under the root system of a spruce (Loc. 5). *Schistostega pennata* in the cavity.

## Materials and Methods

The authors visited the Călimani Mountains between 12 and 16 July 2011, accompanied by

Péter Ábrán and József Sulyok, along the Topliţa (Maroshéviz) – Vatra Dornei road and its surrounding area, crossing the main ridge between Răchiţiş (Răchitişu, Reţiţis) and Pietrosu summits. The collection was made in the spruce, subalpine and alpine belts. The specimens were collected by all authors and identified by P. Erzberger and by T. Pócs. The Romanian distribution of mosses was established from Mohan (1998) and Plămadă (1998), while that of the liverworts from Ştefănuţ (2008). The collected specimens are deposited in the herbaria B, CL and EGR.

Nomenclature of liverworts follows Ştefănuţ. (2008), except for *Marsupella apiculata,* where Váňa *et al.* (2010) is followed. The nomenclature of mosses follows Hill & al. (2006), except for *Grimmia sessitana* De Not., where Maier (2010) and for *Polytrichum perigoniale* Michx., where Meinunger & Schröder (2007) is followed.

## List of collecting sites from the Călimani Mts. (Kelemen Havasok).

4. Harghita county (Judeţul Harghita), 7 km N from Topliţa (Maroshéviz) town, along Topliţa (Lomás) streamlet. Mesophilous spruce forest (*Leucanthemo waldsteinii-Piceetum*) N 47°01’04.7”, E 25°21’57” at 850 m alt. 14.07.2011

5. Harghita county (Judeţul Harghita), ca. 12 km N from Topliţa (Maroshéviz) town, SE slopes of the Călimani Mts, along a forest trail leading upwards, from near the Poiana Puturosul (Büdös Tisztás), shady andesite cliff, towards the base of the Piciorul Mocearului (Mocsárláb) ridge, in the Puturosul (Büdös) valley. Acidophilous spruce forest (*Hieracio rotundati-Piceetum*), between N 47°02’41.6”, E 25°19’49.6” and N 47°03’55.7’’, E 25°17’52.7’’, at 950-1250m alt. 14.07.2011

6. Harghita county (Judeţul Harghita), „Puturosul” spring bog on the Piciorul Mocearului (Mocsárláb) ridge, N 47°04’41.9”, E 25°16’48.2” at 1500 m alt. 14.07.2011

7. Harghita county (Judeţul Harghita), along the forest trail from the „Puturosul” spring bog to the Mountain Rescue (Salvamont) house, 500 m ENE from Jezer Lake above the forest line, between N 47°05’00.2’’, E 25°16’44.2’’and N 47°05’50”, E 25°16’13”, at 1500-1700 m alt. 14.07.2011

8. Harghita county (Judeţul Harghita), SE ridge of the Călimani Mts. Peat bog complex of raised bog (*Eriophoro vaginati-Sphagnetum recurvi*) and transition bog (*Caricetum lasiocarpae*) near the Mountain Rescue (Salvamont) house, 500 m ENE from Jezer Lake, at the forest line, N 47°05’50”, E 25°16’13”, at 1725 m. alt. 14.07.2011

9. Harghita county (Judeţul Harghita), ridge of saddle between Vf. Ciunt (Csonthegy) and Vf. Răchiţiş (Rekettyés csúcs). *Pinus mugo* stand (*Rhododendro myrtifolii-Pinetum mugi*) N 47°06'0", E 25°15'40" at 1880 m alt. 15.07.2011

10. Harghita county (Judeţul Harghita), ridge of Călimani Mts. In a small depression on the S slope of Răchiţiş (Rekettyés) summit. *Rhododendro myrtifolii-Vaccinietum* N 47°05'45", E 25°15'15" at 1950 m alt. 15.07.2011

11. Maros county (Judeţul Mureş), NE slope of Vf. Negoiu, near waste piles of abandoned sulphur mine, surrounded by *Pinetum mugi*, N 47°06'30", E 25°13'35" at 1820 m alt. 15.07.2011

12. Harghita county (Judeţul Harghita), Negoi Saddle (Şaua Negoiul, Negoj Nyereg), W slope of Vf. Pietricelul. *Pinus mugo* stand (*Rhododendro myrtifolii-Pinetum mugi*) with a few *Pinus cembra* N 47°06'25", E 25°14'03" at 1750-1780 m alt. 15.07.2011

13. Maros county (Judeţul Mureş), NW slope of Răchiţiş (Rekettyés) summit. *Pinus mugo* stand (*Rhododendro myrtifolii-Pinetum mugi*) with many groups of *Pinus cembra* N 47°06'25", E 25°14'03" at 1780-1850 m alt. 15.07.2011

14. Harghita county (Judeţul Harghita), Vf. Răchiţiş (Rekettyés). *Potentillo chrysocraspedae-Festucetum airoidis* on the flat summit with many *Juncus trifidus* tussocks and *Rhododenro myrtifolii-Vaccinietum* in the upper part of north facing glacial valley, N 47°05'53", E 25°14'48" at 2000-2020 m alt. 16.07.2011

15. Suceava county (Judeţul Suceava), N side of the ridge of Călimani Mts., NE slope of Vf. Negoiu, in a ditch with seeping water in the abandoned sulphur mine, surrounded by *Pinetum mugi*, N 47°07'08", E 25°13'41", at 1720 m alt. 16.07.2011

16. Suceava county (Judeţul Suceava), N side, head of Neagra Şarului (Fekete Sáros) valley. Acidophilous montane spruce forest (*Hieracio rotundati-Piceetum*) N 47°07'20", E 25°13'24" at 1610 m alt. 16.07.2011

17 N foot of Călimani Mts. (Kelemen Havasok), Suceava county (Judeţul Suceava), 2.4 km SW of Poiana Stampei, at Căsoi village. „Tinovul Mare",1.5 x 0.5 km large continental type raised bog (*Vaccinio- Pinetum sylvestris*), with *Sphagno-Piceetum* at the edges. N 47°17'54", E 25°06'57" at 920 m alt. 16.07.2011

## Results and Discussion

39 Liverwort taxa and 105 mosses, altogether 144 bryophyte taxa were found. The liverwort records were checked against the „Hornwort and Liverwort Atlas of Romania" (Ştefănuţ. 2008). The moss records were checked against

Dihoru (1994), Mohan (1998) and Plămadă (1998). Taxa that represent new records to the Călimani Mts., are marked by an asterisk *, and taxa new to Romania are marked by a double asterisk **.

## List of collected liverworts:

*Anthelia juratzkana* – 14: on soil over siliceous rock
*Blepharostoma trichophyllum* subsp. *trichophyllum* –4, 7: on decaying wood
*Calypogeia azurea* – 5, 7: on soil
**Calypogeia muelleriana* – 17: on decaying wood
*Cephalozia bicuspidata* – 5, 6, 7: on soil
*Cephalozia hampeana* – 12: on soil
**Cephaloziella rubella* – 8, 14, 16: on soil
*Chiloscyphus pallescens* – 5: on soil
*Conocephalum conicum* –5: on siliceous rock
*Diplophyllum albicans* –13: on soil
*Diplophyllum obtusifolium* – 5, 12: on soil
*Diplophyllum taxifolium* – 14: on soil over siliceous rock
**Frullania fragilifolia* – 5: on bark of *Alnus*
**Jungermannia gracillima* – 7, 14: on soil over siliceous rock
**Lejeunea cavifolia* – 5: on siliceous rock
*Lepidozia reptans* – 4, 5, 17: on soil and on rotting wood
*Lophocolea heterophylla* – 4, 7: on (decaying) wood
**Lophozia ascendens* – 16: on rotting wood
*Lophozia bicrenata* – 9, 11, 12: on soil
*Lophozia excisa* – 5: on soil
*Lophozia incisa* – 7: on rotting wood
*Lophozia sudetica* – 14: on soil among siliceous rocks
*Lophozia ventricosa* – 5, 7, 11, 12: on soil
***Marsupella apiculata* Schiffn. (Syn.: *Gymnomitrium apiculatum* (Schiffn.) Müll. Frib.) – 14: on soil over siliceous rock
**Metzgeria conjugata* – 5: on siliceous rock
**Nardia geoscyphus* – 14: on soil over siliceous rock
*Nardia scalaris* – 14: on soil over siliceous rock
*Pellia epiphylla* – 4, 5: on soil and stones near running water
*Plagiochila asplenioides* – 4, 5: on soil
*Plagiochila porelloides* – 4, 5: on soil
**Pleurocladula albescens* – 14: on soil over siliceous rocks
*Ptilidium pulcherrimum* – 5, 16: on bark of spruce (*Picea abies*)
*Radula complanata* –5: on the bark of *Alnus*
*Riccardia palmata* – 4: on decaying wood
**Scapania irrigua* – 5, 8, 16: on soil

**Scapania scandica* – 11, 16: on soil
*Scapania undulata* – 5, 6, 8: on siliceous boulders near water and moist peat
*Tritomaria exsecta* – 4, 5, 7: on decaying wood
*Tritomaria quinquedentata* – 5: on soil

## List of collected mosses:

**Amphidium mougeotii* – 5: on siliceous rock
**Andreaea rupestris* var. *rupestris* – 8, 9, 13, 14: on siliceous rock
**Arctoa fulvella* – 14: on soil over siliceous rock.
*Atrichum undulatum* – 4, 11: on soil over siliceous rock
*Aulacomnium palustre* – 8, 17: on peat
*Bartramia halleriana* – 5: on siliceous rock
**Blindia acuta* – 11: on siliceous rock
**Brachythecium glareosum* – 5: on soil
*Brachythecium rutabulum* – 4: on soil
*Brachythecium salebrosum* – 4: on spruce (*Picea abies*) bark
*Bryum caespiticium* – 11: on soil
*Bryum elegans* – 4, 5: on soil
*Bryum moravicum* –5: on the bark of *Alnus*
*Calliergonella cuspidata* – 4, 5: on soil
**Calliergonella lindbergii* – 5: on path with limestone gravel
*Ceratodon purpureus* – 4, 5, 8, 16: on soil
*Climacium dendroides* – 4: on soil
*Cratoneuron filicinum* – 4: on soil
*Cynodontium polycarpon* – 15: on siliceous rock
**Dichodontium pellucidum* – 5: on moist siliceous rock and on moist limestone
*Dicranella heteromalla* – 7, 16: on soil
**Dicranella humilis* – 5: on soil.
*Dicranodontium denudatum* – 8: on soil and on rotting wood
*Dicranoweisia crispula* – 5, 8, 9, 14: on siliceous rock
**Dicranum brevifolium* – 17: on peat (det. M. Sauer).
**Dicranum flexicaule* – 14: on soil (rev. M. Sauer); 17: on peat (det. M. Sauer)
*Dicranum montanum* – 4, 5, 7, 11, 12, 16: on bark and decaying wood
*Dicranum scoparium* – 4, 5, 7, 9, 11, 16: on soil; 17: on peat
*Diphyscium foliosum* – 14: on soil over siliceous rock
*Ditrichum heteromallum* – 5, 8, 14: on soil
**Ditrichum lineare* – 7, 12: on soil
**Eurhynchium angustirete* – 4: on soil
*Funaria hygrometrica* – 8: on soil
**Grimmia donniana* – 9: on siliceous rock (conf. E. Maier)

*Grimmia incurva* – 9, 10, 14: on siliceous rock, conf./rev. E. Maier
*Grimmia sessitana* – 9, 10: on siliceous rock, conf./rev. E. Maier
**Herzogiella seligeri* – 4: on decaying wood
*Hylocomium splendens* – 4, 5, 16, 17: on soil
*Hypnum cupressiforme* var. c*upressiforme* – 4: on soil
*Leucodon sciuroides* – 5: on tree bark
*Mnium marginatum* – 5: on soil
*Mnium stellare* – 5: on siliceous rock
*Oligotrichum hercynicum* – 8, 11, 12, 14: on soil among siliceous rock
*Orthotrichum affine* – 4: on spruce (*Picea abies*) bark
**Orthotrichum stramineum* – 4: on spruce bark
**Orthotrichum striatum* – 4: on spruce bark
*Paraleucobryum enerve* – 14: on soil over siliceous rock
*Philonotis fontana* – 7: on soil
*Philonotis seriata* – 5, 8: on soil
*Plagiomnium affine* – 4: on soil
*Plagiomnium elatum* – 4: on soil
*Plagiomnium rostratum* – 5: on silicous soil
*Plagiomnium undulatum* – 4, 5: on soil
**Plagiothecium curvifolium* – 4, 16: on soil
*Plagiothecium laetum* – 5, 7: on soil
**Platygyrium repens* – 17: on bark of spruce
*Pleurozium schreberi* – 4, 5, 6, 9, 16, 17 on soil and decaying litter
*Pogonatum aloides* – 5, 7: on soil
**Pogonatum nanum* – 5: on soil
*Pogonatum urnigerum* – 5, 16: on soil
*Pohlia annotina* – 5: on soil
*Pohlia cruda* – 5, 11: on soil
**Pohlia elongata* – 5, 7, 11, 13: on soil
*Pohlia nutans* ssp. *nutans* – 4, 5, 7, 8, 11, 14, 15, 16: on soil
***Pohlia nutans* ssp. *schimperi* – 14: on soil over siliceous rock
**Pohlia proligera* – 5, 11: on soil
*Polytrichastrum alpinum* – 7, 11, 14: on soil
*Polytrichastrum formosum* – 5, 16: on soil
**Polytrichastrum pallidisetum* – 9: on siliceous rock
*Polytrichum commune* – 5, 8: on soil; 6, 17: on peat
*Polytrichum juniperinum* – 7, 8, 11, 15, 16: on soil
*Polytrichum longisetum* – 8: on peat; 14: on soil over siliceous rock. In Călimani Mts. known only from Poiana Stampei (Plămadă 1998).
*Polytrichum perigoniale* – 8: on peat
*Polytrichum piliferum* – 7, 9, 11: on soil

**Polytrichum strictum* – 8, 17: on peat ; 9, 11, 14: on soil among siliceous rocks
*Pseudoleskea incurvata* – 5: on siliceous rock
*Ptilium crista-castrensis* – 5: on spruce litter
**Racomitrium microcarpon* – 8, 9, 10, 11,12, 14: on siliceous rock and boulders
*Rhizomnium punctatum* – 4: on soil
*Rhodobryum roseum* – 8: on soil
**Rhynchostegium megapolitanum* – 16: on soil
*Rhytidiadelphus squarrosus* – 4, 5, 8. 16: on soil and on peat
*Rhytidiadelphus triquetrus* – 4: on soil
*Sanionia uncinata* – 4, 5, 7, 16: on soil
*Schistidium apocarpum* – 5: on siliceous boulders
*Schistidium papillosum* – 5: on siliceous rock
*Schistostega pennata* – 7: on soil
**Sphagnum angustifolium* – 17: on peat
*Sphagnum capillifolium* – 5, 8, 9: on peat
*Sphagnum fallax* – 6, 8, 17: on peat. In Călimani Mts. known only from Poiana Stampei.
*Sphagnum girgensohnii* – 5, 6, 8, 11, 14: on soil and on peat
*Sphagnum magellanicum* – 6, 17: on peat
*Sphagnum palustre* – 5: on peat
*Sphagnum quinquefarium* – 5, 8: on soil and on peat
*Sphagnum russowii* – 6, 8, 11: on peat. In Călimani Mts. known only from Poiana Stampei.
*Sphagnum rubellum* – 9, 13, 17: on siliceous rock and on peat
*Sphagnum squarrosum* – 4, 5, 8: on soil and on peat
*Sphagnum subsecundum* – 8: on peat. In Călimani Mts. known only from Poiana Stampei.
*Sphagnum warnstorfii* – 8: on peat
*Straminergon stramineum* – 6, 8: on peat. In Călimani Mts. known only from Poiana Stampei.
*Tetraphis pellucida* – 4, 5, 7, 17: on decaying wood
*Thuidium assimile* – 4: on soil
*Thuidium tamariscinum* – 4: on soil
**Tortula schimperi* – 4: on soil
*Warnstorfia exannulata* – 8: on peat

There are 11 liverwort and 27 moss records which are new to the Călimani Mts.

One liverwort and four of the moss taxa recorded by us appear to be new to the bryoflora of Romania compared to Ştefănuţ (2008), Sabovljević & al.

(2008), of which three were published already by Mohan (1998) under other combinations. The following species among them deserve special attention:

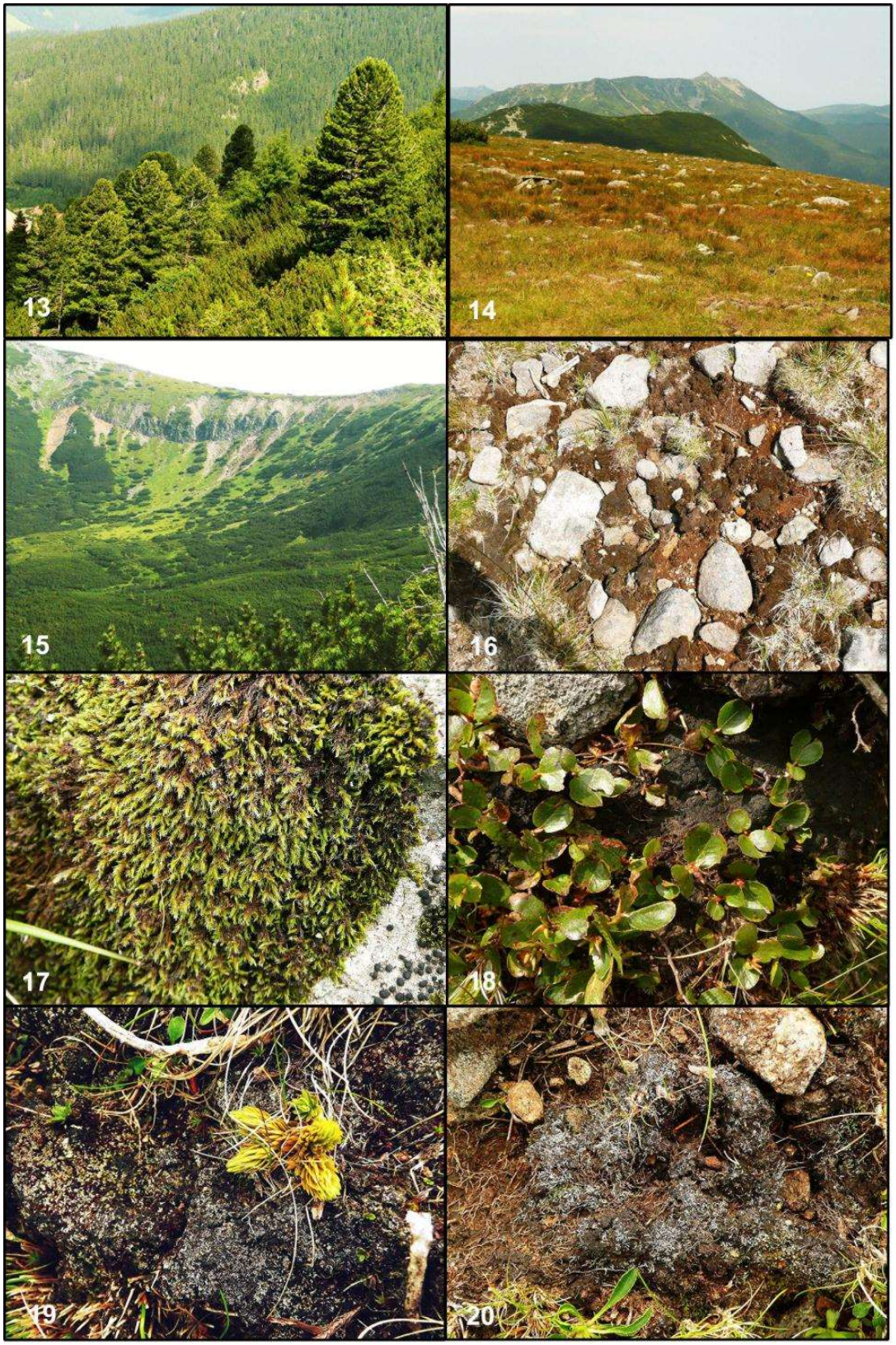
**Lophozia ascendens* (Warnst.) R.M. Schust.

A circumboreal element in the forested „Tinovul Mare" bog near Poiana Stampei, at 920 m alt. on rotting log. According to the European Red Data Book of Bryophytes (ECCB ) this species is considered rare. It grows on well decayed logs in constantly humid sites and is therefore considered an indicator of old forest stands (Goia & Schumacker 2000). In Romania it is known from nine mountain regions and four counties (Ştefanuţ 2008), but not from the Călimani Mts.

** *Marsupella apiculata* Schiffn. (Syn.: *Gymnomitrium apiculatum* (Schiffn.) Müll. Frib.)

It is a rare circumboreal Arctic-Alpine species known from Alaska, Greenland, Novaya Zemlya, northern Siberia, Mt. Ontake in Japan, only Scotland in Britain, Fennoscandia, Spitzbergen, NW Russia and in the Alps (Schuster 1974). Hitherto known in the Carpathians only from the Polish and Slovakian side of Tatra Mountains at 1700–2380 m (Sweykowski & Koźlicka 1977), on the Muran Plateau in Slovakia at 1384 m (Peciar 1984) and in the Ukrainian Carpathians near Tatul, at 1700 m altitudes (Zerov 1964), always on siliciferous substrate. It is new for Romania. We collected nice fertile wefts of this small liverwort on the volcanic rocks covered by a thin humus layer, in *Rhododendro myrtifolii-Vaccinietum*, at the upper part of north facing glacial valley of Vf. Răchiţiş (Rekettyés csúcs), at 2000-2020 m alt.16.07.2011. The species resembles *Gymnomitrion concinnatum* with its julaceous habit, living in the same habitat with long laying snow cover, but differs by its acuminate leaf lobes with hyaline margin and smooth, epapillose cuticle.

Plate III. Fig. 13: *Pinus cembra* group in the *Pinus mugo* stand on the NW slope of Răchiţiş summit, at 1780-1850 m alt. (Loc. 13). Fig. 14: Alpine grassland on the Răchiţiş summit at 220 m alt., dominated by *Juncus trifidus* and *Festuca airoides* (Loc. 14). Fig. 15: The glacial valley at the NW slope of Răchiţiş summit (1700–1980 m), as seen from locality 13. Fig. 16: Open grassland of Negoi saddle, with the occurrence of *Oligotrichum herynicum, Cephaloziella hampeana* and of *Ditrichum lineare* (Loc. 12). Fig. 17: *Racomitrium microcarpon* on the open rocks of Răchiţiş summit (Loc. 14). Fig. 18: *Salicetum herbaceae* on the N facing cliffs of Răchiţiş summit, at 2000 m alt. (Loc. 14). Fig. 19. *Anthelia juratzkana* on the soil of the same habitat, with *Huperzia selago* var. *alpina*. Fig. 20: *Pleurocladula albescens* in the same community (Loc. 14).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**Pleurocladula albescens* (Hook.) Grolle var. *albescens*

It is also a typical circumboreal Arctic-Alpine element of snow valleys, growing often together with *Anthelia* species. Worldwide it is known from the northern part of North America and Asia, in Iceland, Scotland, northern Fennoscandia, Spitzbergen, in the Alps, Tatra Mountains and in the Apennines (Schuster 1974), Pyrenees, Krkonose and Balkan Mts. In central Europe its localities lie between 2000 and 2900 m in areas of long lasting snow cover (Frey *et al.* 2006). In Romania it is known only from the Rodna, Făgăraş and Retezat Mts. (Ştefănuţ 2008).

**Scapania scandica* (S.W. Arnell & H. Buch) Macvicar

A circumboreal-montane species with oceanic character, rare in central Europe. In Romania known only from the higher mountain ranges, as Rodna, Piatra Mare, Bucegi, Piatra Craiului, Făgăraş and Bihor Mts. New to Călimani Mts.: On soil in the N facing Neagra Şarului valley, at the edge of montane spruce forest, 1610 m alt. and on the NE slope of Vf. Negoiu, near the waste piles of abandoned sulphur mine, surrounded by *Pinetum mugi*, at 1820 m alt.

**Arctoa fulvella* (Dicks) Bruch & Schimp.

A circumboreal Arctic-Alpine species distributed from the northernmost parts of North America, Europe and Asia. In Central Europe it occurs in the mountain ranges of the Alps, Sudety and the Carpathians.We collected it in the upper part of north facing glacial valley of Răchiţiş summit, on soil covered andesite rocks with *Rhododendro myrtifolii-Vaccinietum*, at 2000-2020 m alt. 16.07.2011. In Romania it was known only from Rodna and Retezat Mountains before (Mohan 1998),and does not occur further Southeast in Europe (Sabovljević *et al.* 2008).

**Blindia acuta* (Hedw.) Bruch & Schimp.

A circumboreal-montane species, occurring in all major mountain ranges of the Romanian Carpathians, but unknown from Călimani Mts., where we have found it on volcanic rocks of the NE slope of Vf. Negoiu, near the waste piles of abandoned sulphur mine, surrounded by *Pinetum mugi*, at 1820 m alt.

**Ditrichum lineare* (Sw.) Lindb.

It is a circumboreal-montane species, occurring northwards in Europe rarely also on lowland but in the Carpathians only above or near the treeline. Our collections from the Călimani Mts. are from the forest trail from the „Puturosul" spring bog to the Mountain Rescue (Salvamont) house, near the forest line, at 1500–1600 m alt. and from Negoi Saddle (Şaua Negoiul, Negoj Nyereg), W slope of Vf. Pietricelul. On bare soil in *Pinus mugo* stand (*Rhododendro myrtifolii-Pinetum mugi*) with a few *Pinus cembra* at 1750-1780 m alt. It is a

tiny species growing scattered on open soil surface and is easy to overlook, but its narrow and abruptly pointed leaf apex is quite characteristic.

The only Romanian record of this rare species is from the 300-350 m high, forested Repedea hills (Masivul Bârnova-Repedea) S of Iaşi town, 47°05'N, 27°38'E (Papp & Eftimie 1967), which might be an error from such habitat.

**Dicranella humilis* R. Ruthe

An Eurasian species occurring scattered throughout from Central Europe to East Asia. This species is listed as "rare" in the European Red List (ECCB 1995) and occurs only scattered in SE Europe. We collected it on soil along a forest trail leading upwards in Puturosul valley between 950 and 1250 m. In Romania it is known only from two localities in Neamţ County.

**Dicranum brevifolium* (Lindb.) Lindb. is a circumboreal Arctic-Alpine species occurring in North America, Northern Asia, Fennoscandia and in the high mountains of Central Europe. According to Sabovljević *et al.* (2008) in Southeast Europe it occurs in the alpine habitats of Bulgaria, Bosnia-Hercegovina, Romania and Slovenia. According to Mohan (1998), under the name of *D. muehlenbeckii* var. *brevifolium* Limpr,. it is known in Romania only from the Ceahlău Mts. Its occurrence on the peat bog of Tinovul Mare bog near Poiana Stampei, at 920 m altitude seems to be an interesting relic occurrence.

**Dicranum flexicaule* Brid. A circumboreal montane species scattered all over the northern part of North America and Asia. In Europe it is widespread in the northern parts of Fennoscandia and Britain and occurs sporadically in all higher central and SE European monutains. We collected it on soil with many *Juncus trifidus* tussocks of the flat summit of Răchiţiş at 2020 m and on peat of Tinovul Mare bog, at 920 m alt. In Romania known from the Giumalău Mts. in the Bucovina part of Suceava County (Ştefureac & Pascal 1981, under the name of *D. fuscescens* var. *flexicaule*) and in several parts of Transylvania (Mohan 1998, under the name of *D. congestum* Brid.).

**Grimmia donniana* Smith.

A circumboreal montane species according to Greven (1995), occurring also in the Antarctic, but according to Ochyra *et al.* (2008) all the Antarctic records proved to be *G. sessitana*. *Grimmia donniana* was collected on andesite boulders surrounded by *Pinus mugo* stand at the ridge between Ciunt and Răchiţiş summits. In Romania it was known from practically all mountain ranges reaching the alpine belt, except for the Călimani Mts.

****Pohlia nutans** (Hedw.) Lindb. ssp. *schimperi* (Müll.Hal.) Nyholm

This taxon was long neglected and thought to be in Europe confined to Fennoscandia, but recent finds in the Alps, Sudetes and Carpathians (Köckinger & al., 2005) brought it to the attention of bryologists. It has subsequently been found also in the Stara Planina Mts. in Serbia (Erzberger, 2007), and even in predominantly montane areas of Germany (Meinunger & Schröder, 2007) and Hungary (Papp, 2009). Its occurrence in the Romanian Carpathians therefore was to be expected. We found this taxon in the Călimani Mts. (loc. 14), on the top of Vf. Răchiţiş (Rekettyés), on thin layers of soil in fissures of siliceous rock in N exposition, growing in close association with *Pleurcladula albescens* and *Nardia scalaris*. Köckinger & al. (2005) consider the Central European occurrences to be glacial relicts resulting from migratory events in the pleistocene. The new location fits well into this concept.

One reason for the apparent neglection of the taxon is the fact that some authors (e.g. Corley & al., 1981, Koperski & al., 2000) placed it in synonymy of *Pohlia nutans*. However, ssp. *schimperi* (treated at species rank by Limpricht, 1895, Mönkemeyer, 1927 and Nyholm, 1993) is distinguished from the typical subspecies by the purple coloration of the leaves and sometimes a different sexual condition (Köckinger & al., 2005). It is missing from Dihoru (1994), Mohan (1998) and from Sabovljević & al. (2008) and therefore believed to be a new record for the bryoflora of Romania.

***** *Pohlia proligera* (Kindb.) Lindb. ex Broth.

A circumboreal montane species known in Romania only from Rodna, Bucegi and Sibin Mts. and from Mera near Cluj-Napoca (Mohan 1998). Our collection was made from soil along the forest trail leading upwards in Puturosul valley between 950 and 1250 m and on the NE slope of Vf. Negoiu, near waste piles of abandoned sulphur mine, surrounded by *Pinetum mugi*, at 1820 m.

*******Polytrichastrum pallidisetum*

Distributed in the eastern part of North America and in eastern Europe, does not occur in western and in southern Europe. Known from several places in the Romanian Western and East Carpathians, under the name of *Polytrichum pallidisetum* Funck (Mohan 1998, Plămadă 1998), but new to Călimani Mts.: saddle between Ciunt and Răchiţiş summits, on volcanic rocks surrounded by *Pinus mugo* stand at 1880 m alt.

*******Racomitrium microcarpon* (Hedw.) Brid. = *Bucklandiella microcarpa* (Hedw.) Bedn.-Ochyra & Ochyra in Ochyra, Żarnowiec & Bedn.-Ochyra

A circumboreal-montane species new to Călimani Mts. Known from the Northern Carpathians from 600–2550 m altitude, in the Eastern and Southern

Carpathians only above 1900 m, from the Czarnahora, Rodnei, Făgăraş and Retezat Mountains (Rehmann 1878, Boros & Vajda 1969, Bednarek-Ochyra 1995, Mohan 1998). We collected it at several localities on volcanic rocks and boulders, between 1700 and 2000 m altitude.

**Rhynchostegium megapolitanum* (Blandow ex F. Weber & D. Mohr) Schimp.

An Atlantic-Submediterranean species, more widespread in the drier, southern parts of Europe, like in Hungary and in Balkan Peninsula (Sabovljecić *et al.* 2008), relatively rare in Romania and new to Călimani Mts.: On soil in the N facing Neagra Şarului valley. At the edge of montane spruce forest, at 1610 m alt.

**Tortula schimperi* M.J.Cano, O. Werner & J. Guerra (syn. *T. subulata* var. *angustata* (Schimp.) Limpr.)

We found this taxon in the Călimani Mts. (loc. 4), 7 km N from Topliţa (Maroshéviz) town, along Topliţa (Lomás) streamlet, growing on soil in mesophilous spruce forest (*Leucanthemo waldsteinii-Piceetum*) N 47°01'05", E 25°21'57" at 850 m a.s.l., 14 July 2011, *leg*. P. Erzberger, T. Pócs & M. Höhn, *det*. P. Erzberger (B Erzberger 14778).

According to Sabovljević & al. (2008), *T. schimperi* has been recorded in SE Europe in Greece, Montenegro and Serbia, but not in Romania, but Mohan (1998) records it from Romania based on the publications of several authors, under the name of *Tortula subulata* Hedw. var. *angustata* (Wils.) Schimp. It has perhaps been overlooked many times up to now, which might also result from the fact that it has been treated for a long time at infraspecific level within the common *T. subulata*, and only recently been elevated to species rank.

## Other interesting record

*Polytrichum perigoniale* Michx. (syn. *P. commune* var. *perigoniale* (Michx.) Hampe)

This taxon was found on the SE ridge of the Călimani Mts. (loc. 8), in a peat bog complex of raised bog (*Eriophoro vaginati-Sphagnetum recurvi*) and transition bog (*Caricetum lasiocarpae*) near the Mountain Rescue (Salvamont) house, 500 m ENE from Jezer Lake, at the forest line, growing on peat together with *P. strictum, Oligotrichum hercynicum*, *Sphagnum girgensohnii*, and *Scapania irrigua.*

Some authors place this species as a variety in *P. commune*, or fail to recognize it as specifically distinct from the latter (e.g. Hill & al., 2006, Sabovljević & al., 2008), with the result that it is a neglected taxon, and it is much more difficult to obtain information on its occurrences. It is published by

several authors from a number of places in the Eastern and Southern Carpathians, incl. the Tinovul Mare of Poiana Stampei at the N foot of Călimani Mts., under the name of var. *perigoniale* (Mohan 1998, Plămadă 1998), but missing from Sabovljević & al. (2008).

*P. perigoniale* is easily identified when leaf cross-sections are studied. The uppermost cells of costal lamellae are variable in shape within the same leaf, some are furrowed (especially in median part of costa), and some are rounded (especially in marginal part of costa). In *P. commune* s.str. all end cells are uniformly furrowed, and in *P. pallidisetum* they are usually uniformly truncate or with a very flat furrow (see fig.50c in Plămadă 1998: 151). The latter species is also characterized by a cylindrical capsule without constriction at the hypophysis, whereas the capsule in *P. perigoniale* is shortly cylindrical and strongly constricted at the neck (Schoepe 2000).

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