

PHYTOSOCIOLOGICAL STUDIES ON CALCAREOUS SCREES FROM MERIDIONAL CARPATHIANS (ROMANIA)

Monica Angela Neblea^{1,*}, Mădălina Cristina Marian¹

¹University of Pitesti, Targu din Vale Street, no. 1, Pitesti, Romania



Abstract

The calcareous screes are very well represented in Meridional Carpathians, especially in Piatra Craiului Mountains. The paper analyzes the vegetation of these natural habitats from phytosociological point of view. There are 11 plant associations characteristic for calcareous screes in this region, as follows: *Cerastio lichenfeldiani-Papaveretum Boşcaiu, Täuber et Coldea 1977, Cardaminopsis neglectae-Papaveretum Coldea et Pânzaru 1986, Acino-Galietum anisophylli Beldie 1967, Doronico columnae-Rumicetum scutati Boşcaiu et al. 1977, Saxifragetum moschatae-aizoidis Boşcaiu 1971, Cerastio transsilvanici-Galietum lucidi M. Boşcaiu et al. 1998, Achnatheretum calamagrostis Br.- Bl. 1918, Gymnocarpietum robertianae (Kaiser 1926) Tx. 1937, Sedo fabariae-Geranietum macrorrhizi Boşcaiu et Täuber 1977, Thymetum comosi Pop et Hodişan 1963, Parietarietum officinalis Csűrös 1958. The plant associations were characterized and the Relative Euclidean distance was calculated on the basis of the Ward method. The hierarchical analysis revealed the distribution of the plant associations in two clusters corresponding to the *Papavero-Thymion pulcherrimi I. Pop 1968* and *Stipion calamagrostis Jenny-Lips ex Br.-Bl. 1950* alliances.*

Keywords: calcareous screes, Meridional Carpathians, plant associations, Romania

1. INTRODUCTION

„The most representative screes of the Southern Carpathians are found in Piatra Craiului Mountains, especially on the western slope, in the central area known as the Grand Grohotiş.” (Doniţă et al., 1992)

The screes from Piatra Craiului Mountains are in different phases of fixation, starting with the mobile ones, with a poorly developed or even absent grassy layer up to screes covered by plant associations of forest, hay, meadows, depending on the local climatic conditions and the solification stage (Beldie, 1952).

As the process of pedogenesis and stabilization of the substrate evolves, the screes from Piatra Craiului Mountains going through a series of successive phases with syntaxonomically well-defined plant associations or more difficult to affiliate them (*Cerastio transsilvanici-Galietum lucidi, Gymnocarpietum robertianae, Saxifrago-Poëtum nemoralis, Carici polyphyllae-Arrhenatheretum bulbosae*) in typical communities for the stabilization (*Seslerio haynaldianae-Caricetum sempervirentis, Rhododendro-Pinetum mugo, Viola declinatae-Nardetum*) and climax stage (*Hieracio rotundati-Piceetum*) (Pop, 2009).

The majority of plant communities of the calcareous screes from Bucegi Mountains are those characteristic of the habitat 8120 Calcareous and calcashist screes of the montane to alpine levels (*Thlaspietea rotundifolii*). The coenoses on the limestone screes are arranged mosaically. In a first stage, the substrate is colonized by phytocoenoses of the *Cerastio lerchenfeldiani-Papaveretum*, *Cardaminopsio neglectae-Papaveretum*, *Acino-Galietum anisophylli*. Subsequently, as the organic matter accumulates and the soil is formed, cormophytes stabilize the scree, such as: *Vaccinium myrtillus*, *V. vitis-idaea*, *Juniperus communis* subsp. *alpina*, *Rhododendron myrtifolium*, *Pinus mugo* (<http://www.bucegipark.ro/>).

There are two types of plant communities for Leaota Mountains, either on unfixed, sunny and wet screes (*Gymnocarpietum robertianae*) or on semi-fixed screes (*Thymetum comosi*) (figure 1, 2).

Csürös (1953) indicates the directions of the screes evolution in the Făgăraș Mountains. Coenoses with *Papaver alpinum* subsp. *corona-sancti-stephani* can evolve either to shrubs with *Salix reticulata*, *Dryas octopetala* (in mesophilic conditions), or to those with *Salix retusa* in hygrophilous conditions. Shrubs with *Salix* spp. offer favorable conditions for groups of *Rhododendron myrtifolium*. The stabilization of screes is achieved by the phytocoenoses of the *Luzuletum obscurae* (Szafer et al. 1927) Dúbracová 2000.

There are characteristic plant associations for mobile or semi-fixed calcareous screes (*Doronico columnae-Rumicetum scutati*, *Thymetum comosi*, *Gymnocarpietum robertianae*, *Parietarietum officinalis*) in the central group of the Southern Carpathians (Căpățâni Mountains, Buila-Vânturarița Mountains, Cindrel Mountains, Parâng Mountains).

In the Retezat Mountains, large areas with calcareous screes are located above the area occupied by mountain pine. Piatra Iorgovanului Mount offers favorable ecological conditions for the communities like *Cerastio lerchenfeldiani-Papaveretum*, *Acino-Galietum anisophylli*, *Doronico columnae-Rumicetum scutati* and *Saxifragetum moschatae-aizoidis*, installed on both mobile and semi-fixed, sunny or wet screes.



Figure 1. Calcareous screes in Leaota Mountains – Colțul Surpat



Figure 2. *Thymetum comosi* Pop et Hodişan 1963 *teucrietosum montani* (Csűrös 1985) Coldea 1991 in Leaota Mountains – Colţii Ghimbavului

Csűrös et al. (1956a) highlights the directions of evolution of the screes in the Retezat Mountains. Thus, on the mobile screes, the communities with *Papaver alpinum* subsp. *corona-sancti-stephani* can evolve either to sesleriets or to associations with *Dryas octopetala*. With the lying fallow of the substrate, the groups with *Sesleria* spp. can continue the ecological succession to tall-herbs and meadows with *Festuca rubra*. Finally, under anaerobic conditions, the stations are populated by mountain pine.

The coenoses of the *Thlaspietalia rotundifolii* at the base of the Cretaceous and Jurassic limestone rocks are characteristic for Godeanu Mountains (Boşcaiu, 1971).

Muică (1995) identifies five plant associations from *Thlaspietalia rotundifolii* developed both on mobile and fixed screes in the Vâlcan Mountains. *Rumex scutatus* is an important species of mobile screes in the Sohodol Gorges, while in sunny or even shady stations *Geranium macrorrhizum* is distinguished. On the thicked screes appear phytocoenoses with *Parietaria officinalis* at the base of the slopes and communities of the *Acino-Galietum anisophylli* in the subalpine level.

Maloş (1977) cites four plant associations of the limestone screes from the upper basin of the Motru River, respectively: *Gymnocarpietum robertianae*, *Sedo fabariae-Geranietum macrorrhizi*, *Thymetum comosi* and *Parietarietum officinalis*.

Regarding the syntaxonomic diversity, the most numerous plant associations of the calcareous screes were identified in the Piatra Craiului Mountains and the Bucegi Mountains (6) while in the Vâlcan Mountains are 5 and 4 for Retezat, Ţarcu Godeanu, Cernei, Făgăraş (table 1).

In terms of frequency, the most common plant associations on calcareous screes in the Meridional Carpathians are: *Gymnocarpietum robertianae* (7 mountain massifs), *Acino-Galietum anisophylli* (7 mountain massifs), *Doronicum columnae-Rumicetum scutati* (6 mountain massifs), *Thymetum comosi* (6 mountain massifs), *Sedo fabariae-Geranietum macrorrhizi* (6 mountain massifs), *Saxifragetum moschatae-aizoidis* (5 mountain massifs) (table 1).

Table 1. Distribution of plant associations of the calcareous screes

Mountainous Massif	Plant associations
Retezat	<i>Cerastio lerchenfeldiani-Papaveretum</i> Boşcaiu, Täuber et Coldea 1977; <i>Acino-Galietum anisophylli</i> Beldie 1967; <i>Doronico columnae-Rumicetum scutati</i> Boşcaiu et al. 1977; <i>Saxifragetum moschatae-aizoidis</i> Boşcaiu 1971
Țarcu	<i>Acino-Galietum anisophylli</i> Beldie 1967; <i>Doronico columnae-Rumicetum scutati</i> Boşcaiu et al. 1977; <i>Saxifragetum moschatae-aizoidis</i> Boşcaiu 1971; <i>Sedo fabariae-Geranium macrorrhizi</i> Boşcaiu et Täuber 1977
Godeanu	<i>Acino-Galietum anisophylli</i> Beldie 1967; <i>Saxifragetum moschatae-aizoidis</i> Boşcaiu 1971; <i>Gymnocarpietum robertianae</i> (Kaiser 1926) Tx. 1937; <i>Sedo fabariae-Geranium macrorrhizi</i> Boşcaiu et Täuber
Cernei	<i>Achnatheretum calamagrostis</i> Br.- Bl. 1918; <i>Gymnocarpietum robertianae</i> (Kaiser 1926) Tx. 1937; <i>Sedo fabariae-Geranium macrorrhizi</i> Boşcaiu et Täuber 1977; <i>Parietarietum officinalis</i> Csürös 1958
Mehedinți	<i>Achnatheretum calamagrostis</i> Br.- Bl. 1918; <i>Gymnocarpietum robertianae</i> (Kaiser 1926) Tx. 1937; <i>Sedo fabariae-Geranium macrorrhizi</i> Boşcaiu et Täuber 1977
Vâlcan	<i>Doronico columnae-Rumicetum scutati</i> Boşcaiu et al. 1977; <i>Thymetum comosi</i> Pop et Hodișan 1963; <i>Parietarietum officinalis</i> Csürös 1958; <i>Sedo fabariae-Geranium macrorrhizi</i> Boşcaiu et Täuber 1977; <i>Acino-Galietum anisophylli</i> Beldie 1967
Buila-Vânturarița	<i>Doronico columnae-Rumicetum scutati</i> Boşcaiu et al. 1977; <i>Thymetum comosi</i> Pop et Hodișan 1963; <i>Parietarietum officinalis</i> Csürös 1958
Căpățâni	<i>Gymnocarpietum robertianae</i> (Kaiser 1926) Tx. 1937; <i>Thymetum comosi</i> Pop et Hodișan 1963; <i>Parietarietum officinalis</i> Csürös 1958
Cindrel	<i>Doronico columnae-Rumicetum scutati</i> Boşcaiu et al. 1977
Leaota	<i>Gymnocarpietum robertianae</i> (Kaiser 1926) Tx. 1937; <i>Thymetum comosi</i> Pop et Hodișan 1963
Bucegi	<i>Cerastio lerchenfeldiani-Papaveretum</i> Boşcaiu, Täuber et Coldea 1977; <i>Cardaminopsis neglectae-Papaveretum</i> Coldea et Pânzaru 1986; <i>Acino-Galietum anisophylli</i> Beldie 1967; <i>Saxifragetum moschatae-aizoidis</i> Boşcaiu 1971; <i>Gymnocarpietum robertianae</i> (Kaiser 1926) Tx. 1937; <i>Thymetum comosi</i> Pop et Hodișan 1963
Făgăraș	<i>Cerastio lerchenfeldiani-Papaveretum</i> Boşcaiu, Täuber et Coldea 1977; <i>Acino-Galietum anisophylli</i> Beldie 1967; <i>Doronico columnae-Rumicetum scutati</i> Boşcaiu et al. 1977; <i>Saxifragetum moschatae-aizoidis</i> Boşcaiu 1971
Piatra Craiului	<i>Cerastio lerchenfeldiani-Papaveretum</i> Boşcaiu, Täuber et Coldea 1977; <i>Acino-Galietum anisophylli</i> Beldie 1967; <i>Cerastio transsilvanici-Galietum lucidi</i> M. Boşcaiu et al. 1998; <i>Gymnocarpietum robertianae</i> (Kaiser 1926) Tx. 1937; <i>Thymetum comosi</i> Pop et Hodișan 1963; <i>Sedo fabariae-Geranium macrorrhizi</i> Boşcaiu et Täuber 1977

2. MATERIALS AND METHODS

The Meridional Carpathians are located between Cerna-Timiș-Bistra-Hațeg-Ștei-Orăștie Pass and Prahova Valley and are known as Transylvanian Alps.

The study was based, mainly, on information from scientific literature (articles, books, monographs, doctoral thesis) related to calcareous screes (Alexiu, 1998; Bartók et Irimia, 2016; Beldie, 1952; Beldie, 1967; Boşcaiu, 1971; Boşcaiu et al., 1977; Csürös et al., 1956a; Csürös et al., 1956b; Diaconescu, 1973; Drăghici, 1994; Drăgulescu, 1995; Maloș, 1977; Mihăilescu, 2001; Neblea, 2007, 2012, 2016; Nicolae-Biță, 2005; Păun and Popescu, 1978; Pop, 2009; Popescu, 1974; Pușcaru-Soroceanu et al., 1981; Răduțoiu, 2008; Sanda and Popescu, 1976; Sanda et al., 1977; Sanda and Popescu, 1991; Sanda et al., 1996; Schneider-Binder, 1970; Stancu, 2005; Voik, 1976; Voik and Schneider-Binder, 1978).

Syntaxonomical classification elaborated by Coldea et al. (2017) was used.

In order to establish the degree of floristic similarity between the plant associations on the calcareous screes, a dendrogram was developed using the SYSTAT program version 10.2. The Relative Euclidean distance calculated on the basis of the Ward method was chosen as a similarity index (Neblea and Marian, 2020).

321 phytosociological surveys belonging to 11 plant associations recorded from Meridional Carpathians were analysed. Due to the large number of surveys analyzed for calcareous screes, SYSTAT version 10.2 did not allow a clear differentiation of clusters. In this case, the surveys were grouped by stations, resulting 104 units that were compared.

3. RESULTS AND DISCUSSIONS

The hierarchical analysis revealed the distribution of the plant associations in two clusters corresponding to two alliances *Papavero-Thymion pulcherrimi* I. Pop 1968 and *Stipion calamagrostis* Jenny-Lips ex Br.-Bl. 1950 (figure 3).

Cluster A is divided into two groups **A1** and **A2** which include especially phytocoenoses from the *Papavero-Thymion pulcherrimi* alliance belonging to the *Cerastio lerchenfeldiani-Papaveretum*, *Acino-Galietum anisophylli*, *Saxifragetum moschatae-aizoidis*, *Doronicum columnae-Rumicetum scutati*, *Cerastio transsilvanici-Galietum lucidi* (figure 3).

Group A1 includes phytocoenoses from Piatra Craiului Mountains, which belong to the *Cerastio lerchenfeldiani-Papaveretum* and *Cerastio transsilvanici-Galietum lucidi*. Groups with *Papaver alpinum* subsp. *corona sancti-stephani* (CLPPC9-Umerii Pietrei Craiului, CLPPC11-Marele Grohotiș, CLPPC12-Cerdacul Stanciului) present in the floristic composition a well-defined nucleus of characteristic taxa of the *Seslerietalia* order that indicate the evolution to phytocoenoses of the rocky meadows (*Biscutella laevigata*, *Achillea oxyloba* subsp. *schurii*, *Carex sempervirens*, *Androsace lactaea*, *Dianthus spiculifolius*, *Festuca stricta* subsp. *saxatilis*, *Minuartia verna*, *Ranunculus breyninus*, *Scabiosa lucida*, *Seseli libanotis*, *Sesleria rigida* subsp. *haynaldiana*).

The groups edified by *Galium lucidum* (CGPC45-Piatra Craiului Mică, CGPC46-Marele Grohotiș) form a separate cluster with *Gymnocarpium robertianae* (GRPC59-Marele Grohotiș and GRPC60-Cerdacul Stanciului). Although the communities with *Gymnocarpium robertianum* belong to the alliance *Stipion calamagrostis*, in the phytocoenoses of the Piatra Craiului Mountains *Gymnocarpium robertianum* and *Galium lucidum* are codominant. The floristic composition is outlined by species that indicate an early lying fallow of the substrate and are also present in *Cerastio-Galietum lucidi* (*Biscutella laevigata*, *Bupleurum falcatum* subsp. *cernuum*, *Carex sempervirens*, *Festuca stricta* subsp. *saxatilis*, *Geranium robertianum*, *Ranunculus breyninus*).

There are two subgroups in **group A2** (**A2.1** and **A2.2**):

A2.1 reunites the phytocoenoses of the *Acino-Galietum anisophylli* from Făgăraș Mountains (AGFG20-Buda, AGFG21-Râiosu), Piatra Craiului Mountains (AGPC16-Grindul Mare, AGPC17-Șaua Crăpăturii, AGPC18-Vârful Turnu, AGPC19-Vârful Ascuțit), Bucegi Mountains (AGBC22-Colții Morarului) and Godeanu Mountains (AGGO15-Valea Soarbelor) which tend to evolve to rocky meadows from *Elyno-Seslerietea* class due to the presence of many typical species of these habitats.

Similar groups from Bucegi Mountains (AGBC23-Caraiman, AGBC24-Coștila) and Godeanu Mountains (AGGO14-Curmătura Paltina) form a separate cluster within subgroup A2.2. The latter one have a lower floristic diversity, being less represented the characteristic species of the *Seslerietalia* order.

A2.2 includes different syntaxonomically plant coenoses, respectively *Cerastio lerchenfeldiani-Papaveretum*, *Doronico columnae-Rumicetum scutati* and *Acino-Galietum anisophylli*.

A large coverage realize both *Saxifraga moschata* and *Saxifraga aizoides* in the communities of the *Saxifragetum moschatae-aizoidis* from Avrigelului Valley (SAFG38-Ciortea, SAFG39-Șeaua Gârbova), along with other species (*Cardamine resedifolia*, *Carex sempervirens*, *Cortusa matthioli*, *Chrysosplenium oppositifolium*, *Cystopteris fragilis* subsp. *alpina*, *Lloydia serotina*, *Pedicularis oederi*, *P. verticillata*, *Poa laxa*, *Potentilla ternata*, *Primula minima*, *Soldanella pusilla*, *Taraxacum panalpinum*) that individualize these phytocoenoses from other similar ones of the Făgăraș Mountains.

The phytocoenoses with *Rumex scutatus* from Buila-Vânturarița Mountains (DRBV28-Muntele Albu, DRBV29-Muntele Ștevioara) are closer, as a floristic composition, to the *Cerastio-Papaveretum* (CLPFG2) on the Arpășel Valley.

The groups edified by *Rumex scutatus* from Țarcu Mountains (DRTA25-Groapa Bistrei) and Făgăraș Mountains (DRFG31-Valea Doamnei, DRFG32-Valea Arpășel) form another cluster. These phytocoenoses are individualized through a nucleus of characteristic species of the *Thlaspietalia rotundifolii* order (*Arabis alpina*, *Thymus pulcherrimus*, *Saxifraga aizoides*, *Galium anisophyllum*, *Acinos alpinus*).

The phytocoenoses of the *Saxifragetum moschatae-aizoidis* from Făgăraș Mountains (SAFG37-Valea Șerbotei, SAFG40-Scara) are more floristically homogeneous due to the coenotic combination of typical species for the *Thlaspietalia* order (*Arabis alpina*, *Galium anisophyllum*, *Thymus pulcherrimus*, *Doronicum carpaticum*, *Saxifraga oppositifolia*, *S. paniculata*). *Saxifraga moschata* is found sporadically in the floristic composition, while *Dianthus glacialis* has a large coverage which determines the existence of the *dianthetosum glacialis* Voik et Schneider 1978 subassociation.

The groups with *Saxifraga aizoides* and *S. moschata* from Țarcu Mountains (SATA33-Sadovanu Peak, SATA34-Groapa Bistrei, SATA35-Obârșia Hidegului), Godeanu Mountains (SAGO36-Curmătura Paltina) and Bucegi Mountains (SABC43-Colții Morarului) form a distinct cluster due to the heterogeneous floristic structure comprising species of the *Thlaspietalia rotundifolii* (*Arabis alpina*, *Cerastium arvense*, *C. lerchenfeldianum*, *Galium anisophyllum*, *Thymus pulcherrimus*, *Senecio squalidus* subsp. *rupestris*), *Seslerietalia* (*Minuartia verna*, *Ranunculus breyninus*, *Acinos alpinus*) and *Artemisietalia petrosae* orders (*Artemisia umbelliformis* subsp. *eriantha*, *Asplenium viride*, *Cystopteris fragilis*, *Saxifraga paniculata*).

Cluster B is divided into two groups **B1** and **B2** that reunite plant communities from the *Stipion calamagrostis* alliance of the *Sedo fabariae-Geranium macrorrhizi*, *Achnatheretum calamagrostis*, *Thymetum comosi*, *Gymnocarpium robertianae* (figure 3).

Group B1 includes two subgroups (**B1.1** and **B1.2**):

B1.1 includes phytocoenoses of the *Thymetum comosi* from Buila-Vânturarița Mountains (TCBV95-Cheile Cheii), Leaota Mountains (TCLE87-Curmătura Ghimbavului, TCLE88-Culmea Zacotelor, TCLE91-Cheile Rudăriței, TCLE93-Cheile Mari ale Dâmboviței, TCLE97-Cetățeni), Făgăraș Mountains (TCFG98-Piatra Chiorului, TCFG99-Dealul La Piatră, TCFG100-Cetatea Tălmaciului, TCFG101-Rășinari, TCFG102-Defileul Turnu Roșu), Piatra Craiului Mountains (TCPC94-Cheile Mici ale Dâmboviței).

The communities with *Gymnocarpium robertianum* from Colțul Surpat (GRLE68) are more structurally similar to the coenoses of the *Thymetum comosi teucrietosum montani* from Curmătura Ghimbavului (TCLE87) and Culmea Zacotelor (TCLE88) due to the presence of the characteristic

species in which *Teucrium montanum* and *Dianthus spiculifolius*, *Cyanus triumfettii* as differentials species are distinguished.

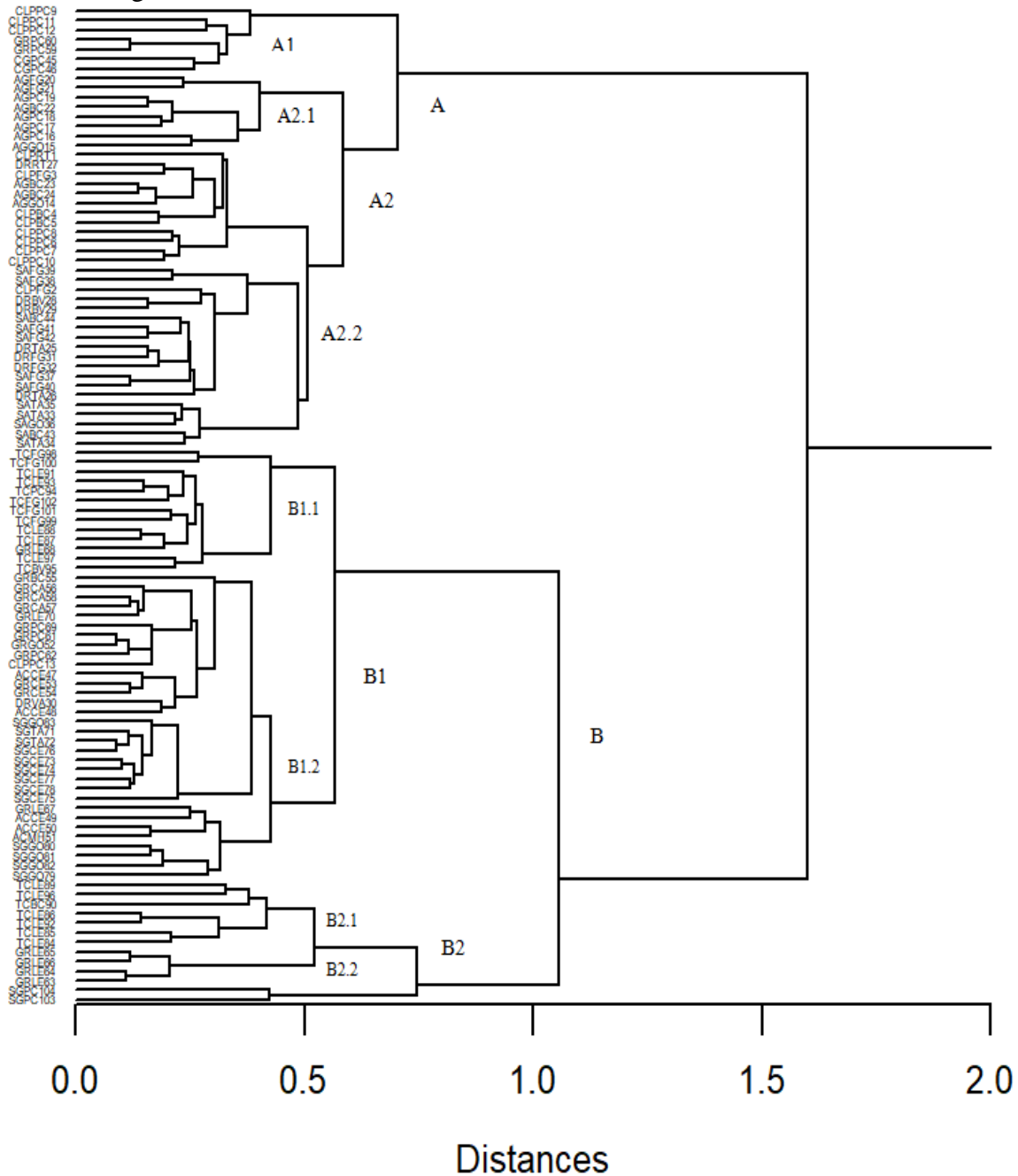


Figure 3. Similarity dendrogram of the surveys of plant associations on calcareous screes from Meridional Carpathians using Relative Euclidian Distance (Ward method) (GR-Gymnocarpietum robertianae; AC-Achnatheretum calamagrostis; TC-Thymetum comosi; SG-Sedo-Geranietum macrorrhizi; CG-Cerastio-Galietum lucidi; SA-Saxifragetum moschatae-aizoidis; DR-Doronico-Rumicetum scutati; CLP-Cerastio-Papaveretum; AG-Acino-Galietum anisophylli; RT-Retezat; FG-Făgăraș; TA-Țarcu; GO-Godeanu; CE-Cernei; MH-Mehedinți; VA-Vâlcan; CA-Căpățâni; BV-Buila-Vânturarița; PC-Piatra Craiului; LE-Leota; BC-Bucegi)

Phytocoenoses with *Thymus comosus* from Făgăraș Mountains (TCFG98-Piatra Chiorului, TCFG100-Cetatea Tălmaciului) are more floristically homogeneous, representing successive stages that indicate the evolution to xerophilous meadows due to the presence in the floristic composition of a large number of species from *Festuco-Brometea* class (*Asperula cynanchica*, *Allium flavum*, *Stachys recta*, *Carex humilis*, *Bothriochloa ischaemum*, *Teucrium montanum*, *Dorycnium pentaphyllum* subsp. *herbaceum*, *Medicago falcata*, *Centaurea stoebe* subsp. *australis*, *Pimpinella saxifraga*, *Euphorbia cyparissias*, *Anthericum ramosum*).

Mostly, **B1.2** reunite the communities of the *Sedo fabariae-Geranium macrorrhizi*, *Achnatherum calamagrostis*, *Gymnocarpium robertianae*.

The coenoses of the *Sedo fabariae-Geranium macrorrhizi* from Godeanu Mountains (SGGO79-Cheile Corcoaiei, SGG080-Ciuceava Ilie Drăgan, SGG081-Ciuceava Frasin, SGG082-Ciuceava Mare) differ from those homologous of the Cerna Mountains (SGCE72-78) and Țarcu Mountains (SGTA71-72), through a greater floristic diversity, in which species from *Asplenietea trichomanis* class (*Aurinia petraea*, *Asplenium ruta-muraria*, *A. trichomanes*, *A. viride*, *Cystopteris fragilis*, *Dianthus petraeus*, *Poa nemoralis*, *Polypodium vulgare*, *Sedum album*, *Selaginella helvetica*, *Veronica bachofenii*) are frequently.

The communities with *Achnatherum calamagrostis* from Prisăcinei Gorges (ACCE50) are floristically similar to those from Prolazului Gorges (ACMH51) having common species as: *Arabis procurrens*, *Aurinia petraea*, *Ceterach officinarum*, *Dianthus petraeus*, *Festuca xanthina*, *Asperula purpurea*, *Parietaria officinalis*, *Sedum album*.

The floristic similarities between phytocoenoses with *Achnatherum calamagrostis* (ACCE47-Cheile Bedinei, ACCE48- Stâncăria Irișor) and those of the *Gymnocarpium robertianae* (GRCE53-Cheile Prisăcinei, GRCE54-Cheile Bedinei) from Cerna Mountains are explained by the ecological ambiance favourable for heliophilous, xero-thermophilic and eurithermophilic species.

The coenoses of the *Doronico columnae-Rumicetum scutati* from Sohodolului Gorges (DRVA30) are floristically closer with *Achnatherum calamagrostis* from Cernei Valley (ACCE48-Stâncăria Irișor), separating from similar phytocoenoses of the Țarcu Mountains (DRTA25-Groapa Bistrei, DRTA26-Custura Căleanului), Buila-Vânturarița Mountains (DRBV28-Muntele Albu, DRBV29-Muntele Ștevioara) and Făgăraș Mountains (DRFG31-Valea Doamnei, DRFG32-Valea Arpășelului). The plant communities with *Rumex scutatus* from Sohodol Gorges vegetate at lower altitudes in a climate with thermophilic influences like the groups edified by *Achnatherum calamagrostis*.

The survey from Piatra Craiului Mountains (CLPPC13-Hornul Găinii) belong to the *Papavero-Thymion pulcherrimi* alliance and form a separate cluster with phytocoenoses of the *Stipion calamagrostis* alliance (Piatra Craiului Mountains: GRPC61-Hornul Găinii, GRPC62-Vlădușca; Godeanu Mountains: GRGO52-Curmătura Paltina), differing from similar groups of the Piatra Craiului Mountains. The explanation would be that the floristic composition is reduced in the CLPPC13 survey, compared with other similar coenoses from Piatra Craiului Mountains, presenting common species with the coenoses of the *Gymnocarpium robertianae* from Hornul Găinii (GRPC61) and Vlădușca (GRPC62). Also, *Papaver alpinum* subsp. *corona sancti-stephani* is missing in the CLPPC13 survey.

There are two subgroups in **group B2 (B2.1 and B2.2)**:

B2.1 consist of plant communities of the *Thymetum comosi* and *Gymnocarpium robertianae* from Leaota and Bucegi Mountains.

Phytocoenoses of the *Thymetum comosi* Pop et Hodişan 1963 *galietosum albi* (Pop et Hodişan 1964) Coldea 1991 from Bucegi Mountains (TCBC90- stâncile Sfânta Ana) and Leaota Mountains (TCLE84-Colţii lui Dumitru, TCLE85-Cheile Crovului, TCLE86-Valea Cheii, TCLE89-Colţii Ghimbavului, TCLE92-Cheile Cheii, TCLE96-Colţul Surpat) outlines a cluster in which *Galium album* has a large coverage and *Melica ciliata*, *Erysimum odoratum* appear as differential species.

Cluster B2.2 include phytocoenoses of the *Sedo fabariae-Geranium macrorrhizi* from Piatra Craiului Mountains (SGPC103-Valea Seacă and SGPC104-Valea Crăpăturii) that are separated from the homologous groups from Țarcu Mountains (SGTA71-72), Godeanu Mountains (SGGO79-8) and Cerna Mountains (SGCE73-78). This differentiation is due to the fact that, in the stations from Piatra Craiului Mountains, the groups with *Geranium macrorrhizum* are closer to beech habitats, so that many species typically for *Symphyto-Fagion* alliance, *Fagetalia* order (*Luzula luzuloides*, *Myosotis sylvatica*, *Sanicula europaea*, *Scrophularia nodosa*, *Veronica urticifolia*, *Cardamine impatiens*, *Daphne mezereum*, *Epilobium montanum*, *Fagus sylvatica*, *Gentiana asclepiadea*, *Lonicera xylosteum*, *Isopyrum thalictroides*, *Euphorbia carniolica*, *Heracleum sphondylium*, *Lapsana communis*, *Ribes uva-crispa*) and *Querco-Fagetea* class can be found (*Acer pseudoplatanus*, *Athyrium filix-femina*, *Impatiens noli-tangere*, *Tanacetum corymbosum*, *Glechoma hirsuta*, *Galium schultesii*, *Geum urbanum*, *Milium effusum*).

4. CONCLUSIONS

The hierarchical analysis highlights the floristic similarities between plant associations of the calcareous screes from different massifs of the Meridional Carpathians. Generally, the plant communities were grouped in two main clusters according to their affiliation at the *Papavero-Thymion pulcherrimi* I. Pop 1968 and *Stipion calamagrostis* Jenny-Lips ex Br.-Bl. 1950 alliances. Due to the specific stational conditions, some communities (CLPPC13, DRVA30, GRPC59, GRPC60) present floristic similarities with groupings belonging to another alliance than the characteristic one.

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