

## THE SIMILARITIES OF THE SAXICOLOUS VEGETATION FROM LEAOTA MASSIF WITH THE OTHER MOUNTAINOUS MASSIFS FROM ROMANIAN CARPATHIAN

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**Abstract:** In this paper is presented a comprehensive analysis of the saxicolous vegetation on the calcareous substratum of the Leaota Mountains, in comparison with the other calcareous massifs of the Romanian Carpathian. This comparison was done on base of calculation of the Jaccard qualitative index.

The saxicolous vegetation is represented by the next associations, fixed on the calcareous substratum: *Asplenio-Cystopteridetum fragilis* Oberd. (1939) 1949, *Asplenio quadrivalens-Poëtum nemoralis* Soó ex Gergely et al. 1966, *Thymo comosi-Galietum albi* Sanda, Popescu 1999 and *Asperulo capitatae-Seslerietum rigidae* (Zólyomi 1939) Coldea 1991.

### Introduction

Leaota Massif is situated at the southern limit of the western flank of Bucegi Mountains, being the oldest nucleus of the mountainous complex of Bucegi, which belongs: Leaota, Bucegi, Piatra Craiului Mountains, Rucăr-Bran-Dragoslavele Passage and Prahova Passage.

Majority of peaks are sculptured on the Leaota crystalline series, corresponding to facies with green schists. The north-west part of Leaota is constituted by titonic limestone of the jurasic age beginning with the Dragoslavele Stone (1437 m) and the gorges around Ghimbav Mountain. The relief is represented by jurasic limestone in the south-east part of this mountainous edifice, to the Ialomița river (Brătei and Rătei Gorges).

### Materials and Methods

In order to determine the manner in which the saxicolous vegetation of Leaota Massif is integrated within the general aspect of the rocks vegetation, from the calcareous massifs of the Romanian Carpathian, we considered data from the next mountainous area, for to be pursued the differences and similitudes:

- Oriental Carpathian (Rodna Mountain);
- Meridional Carpathian (Bucegi Mountains – Tătaru and Zănoaga Gorges, Piatra Craiului, Făgăraș);
- Apuseni Mountains (Scărița-Belioara Mountains, Gilău - Runcu Gorges, Trascău – Rîmeț Gorges).

The comparison which took into consideration similarities of the rocks vegetation from Leaota Massif, with the other calcareous region from Carpathian space depends on the calculation of Jaccard qualitative index ( $Q_J$ ).

We were taken into consideration presence/absence of the species from the analysed surveys, for to calculate Jaccard index.

The surveys from Leaota and Bucegi were taken during the investigation on the ground (2002-2004 period). On the other hand, it was used surveys from the speciality literature, which broached problems of vegetation from the studied calcareous massifs. The characteristic grouping of the saxicolous vegetation was taken depending on the altitude spreading, beginning with mountainous level and finishing with subalpine level.

The studied surveys present next characteristics, for each associations in part:

*Asplenio-Cystopteridetum fragilis* Oberd. (1939) 1949

Leaota Mountains [8 surveys](Table 1)

Rodnei Mountains by Coldea Gh. [3 surveys]:

- 1RD, Piatra Rea (26.07.1979) – altitude 840, exposure S, slope 80°, cover 75%, surface 4 m<sup>2</sup>,
- 2RD, Valea Rebrei, Valea Gușatu (10.06.1981) – altitude 960, exposure N, slope 80°, cover 90%, surface 4 m<sup>2</sup>,
- 3RD, Piatra Rea (26.07.1979) – altitude 1200, exposure N, slope 40°, cover 60%, surface 4 m<sup>2</sup>.

Piatra Craiului Mountains by Mihăilescu Simona [4 surveys]:

- 4PC, Șaua Curmăturii (14.09.1995) – altitude 1520, exposure N, slope 90°, cover 60%, 9 m<sup>2</sup>,
- 5PC, Șaua Curmăturii (14.09.1995) – altitude 1540, exposure N, slope 80°, cover 50%, 4 m<sup>2</sup>,
- 6PC, Șaua Curmăturii (14.09.1995) – altitude 1580, exposure V, slope 80°, cover 60%, 4 m<sup>2</sup>,
- 7PC, Șaua Curmăturii (14.09.1995) – altitude 1600, exposure V, slope 70°, cover 70%, 9 m<sup>2</sup>.

Făgăraș Mountains by Stancu Daniela Ileana [5 surveys]:

- 16FG, Valea Buda (1999) - altitude 850, exposure NE, slope 90°, cover 55%, surface 4 m<sup>2</sup>,
- 17FG, Valea Buda (1999) - altitude 900, exposure NE, slope 50°, cover 75%, surface 9 m<sup>2</sup>,
- 18FG, Valea Buda (1999) - altitude 900, exposure N, slope 50°, cover 15%, surface 4 m<sup>2</sup>,
- 19FG, Muntele Râiosu (2000) - altitude 1500, exposure E, slope 90°, cover 55%, surface 25 m<sup>2</sup>,
- 20FG, Muntele Râiosu (2000) - altitude 1500, exposure NE, slope 45°, cover 45%, surface 4 m<sup>2</sup>.

*Asplenio quadrivalens-Poëtum nemoralis* Soó ex Gergely et al. 1966

Leaota Mountains [7 surveys](Table 2)

Piatra Craiului Mountains by Mihăilescu Simona [6 surveys]:

- 8PC, Vlădușca-Prăpăștiile Zărneștilor (9.07.1994) – altitude 820, exposure S, slope 65°, cover 90%, surface 25 m<sup>2</sup>,
- 9PC, Vlădușca-Prăpăștiile Zărneștilor (9.07.1994) – altitude 820, exposure SV, slope 70°, cover 75%, surface 25 m<sup>2</sup>,
- 10PC, Vlădușca-Prăpăștiile Zărneștilor (9.07.1994) – altitude 810, exposure N, slope 80°, cover 70%, surface 16 m<sup>2</sup>,
- 11PC, Cheile Prăpăștiile Zărneștilor (9.07.1994) – altitude 800, exposure NE, slope 80°, cover 90%, surface 4 m<sup>2</sup>,
- 12PC, Cheile Prăpăștiile Zărneștilor (9.07.1994) – altitude 800, exposure NE, slope 75°, cover 90%, surface 4 m<sup>2</sup>,
- 13PC, Cheile Prăpăștiile Zărneștilor (9.07.1994) – altitude 900, exposure NE, slope 85°, cover 80%, surface 16 m<sup>2</sup>.

*Thymo comosi-Galietum albi* Sanda, Popescu 1999

Leaota Mountains [7 surveys](Table 3)

Scărița – Belioara Mountains by Csürös I. [5 surveys]:

- 1SB, altitude 750, exposure S, slope 45°, cover 60%, surface 9 m<sup>2</sup>,
- 2SB, altitude 800, exposure S, slope 50°, cover 40%, surface 9 m<sup>2</sup>,
- 3SB, altitude 820, exposure SV, slope 55°, cover 35%, surface 9 m<sup>2</sup>,
- 4SB, altitude 800, exposure SV, slope 45°, cover 40%, surface 12 m<sup>2</sup>,
- 5SB, altitude 850, exposure S, slope 25°, cover 65%, surface 9 m<sup>2</sup>.

Runcu Gorges by Pop I., Csürös Șt. [2 surveys]:

- 6RC, altitude 600, exposure S, slope 45°,
- 7RC, altitude 600, exposure S, slope 45°.

Rîmeț Gorges by Șuteu, Șt. [7 surveys]:

- 8 RM, Uzmezău la Peșteră și Curtea Mare (27.06.1967) - altitude 850, exposure S, slope 50°, cover 80%, surface 25 m<sup>2</sup>,
- 9RM, Uzmezău la Peșteră și Curtea Mare (27.06.1967) - altitude 800, exposure S, slope 45°, cover 85%, surface 25 m<sup>2</sup>,
- 10RM, Curtea Mică (28.07.1967) - altitude 800, exposure S, slope 30°, cover 70%, surface 25 m<sup>2</sup>,
- 11RM, Fundoi, Muietoare (11.06.1967) - altitude 850, exposure S, slope 60°, cover 70%, surface 25 m<sup>2</sup>,

- 12 RM, Uzmezău, Curtea Mare (12.06.1967) - altitude 700, exposure S, slope 45°, cover 60%, surface 25 m<sup>2</sup>,  
 13RM, Gruitul Trufaș (22.07.1967) - altitude 650, exposure SE, slope 40°, cover 60%, surface 25 m<sup>2</sup>,  
 14RM, Gruitul Trufaș (22.07.1967) - altitude 650, exposure S, slope 50°, cover 70%, surface 25 m<sup>2</sup>.

*Asperulo capitatae-Seslerietum rigidae* (Zólyomi 1939) Coldea 1991

Leaota Mountains [5 surveys](Table 4)

Bucegi Mountains by Neblea Monica [6 surveys]:

- 1BC, Cheile Zănoagei (9.09.2004) - altitude 1300, exposure NE, slope 80°, cover 85%, surface 16 m<sup>2</sup>,  
 2BC, Cheile Zănoagei (9.09.2004) - altitude 1300, exposure NE, slope 80°, cover 70%, surface 16 m<sup>2</sup>,  
 3BC, Cheile Zănoagei (9.09.2004) - altitude 1300, exposure NE, slope 70°, cover 85%, surface 16 m<sup>2</sup>,  
 4BC, Cheile Tătarului (10.09.2004) - altitude 1500, exposure E, slope 90°, cover 95%, surface 25 m<sup>2</sup>,  
 5BC, Cheile Tătarului (10.09.2004) - altitude 1500, exposure V, slope 90°, cover 55%, surface 25 m<sup>2</sup>,  
 6BC, Cheile Tătarului (10.09.2004) - altitude 1500, exposure V, slope 90°, cover 65%, surface 25 m<sup>2</sup>.

Piatra Craiului Mountains by Mihăilescu Simona [6 surveys]:

- 7PC, Prăpăștiile Zărneștilor (10.09.1996) - altitude 900, exposure NE, slope 80°, cover 90%, surface 16 m<sup>2</sup>,  
 8PC, Prăpăștiile Zărneștilor (10.09.1996) - altitude 910, exposure NE, slope 80°, cover 70%, surface 16 m<sup>2</sup>,  
 9PC, Prăpăștiile Zărneștilor (9.07.1994) - altitude 920, exposure E, slope 90°, cover 65%, surface 16 m<sup>2</sup>,  
 10PC, Prăpăștiile Zărneștilor (9.07.1994) - altitude 920, exposure E, slope 80°, cover 90%, surface 16 m<sup>2</sup>,  
 11PC, Valea Crăpăturii (20.09.1996) - altitude 1100, exposure N-NV, slope 90°, cover 65%, surface 16 m<sup>2</sup>,  
 12PC, Valea Crăpăturii (20.09.1996) - altitude 1150, exposure N-NV, slope 90°, cover 90%, surface 25 m<sup>2</sup>.

Scărița – Belioara Mountains by Csürös I. [6 surveys]:

- 13SB, altitude 1350, exposure SV, slope 30°, cover 75%, surface 25 m<sup>2</sup>,  
 14SB, altitude 1200, exposure SV, slope 30°, cover 90%, surface 25 m<sup>2</sup>,  
 15SB, altitude 1350, exposure SV, slope 30°, cover 90%, surface 9 m<sup>2</sup>,  
 16SB, altitude 1200, exposure SE, slope 50°, cover 50%, surface 25 m<sup>2</sup>,  
 17SB, altitude 1300, exposure V, slope 5°, cover 80%, surface 25 m<sup>2</sup>,  
 18SB, altitude 1300, exposure S, slope 15°, cover 80%, surface 25 m<sup>2</sup>.

### Results and Discussion

We took into account four saxicolous vegetal associations which are presented in the calcareous areas of Leaota Massif and they had correspondent phytocoenoses from the other massifs.

*Asplenio-Cystopteridetum fragilis* Oberd. (1939) 1949

Calculating the Jaccard index, in case of this association has been obtained a dendrogram, which illustrates the obvious grouping of the surveys around the individualized clusters for each massif in part. (Fig. 1)

This fact can be explained because of the different altitudes of the phytocoenoses in the analyzed massifs (Leaota: 460-900 m, Rodna: 840-1600 m, Piatra Craiului: 1500-1600 m, Făgăraș: 840-1600 m). Once with the increase of the altitude, as part as this association appears species, which are spread in the subalpine level and they are characteristic to *Seslerietalia* order, like in Piatra Craiului, Rodnei and Făgăraș Mountains.

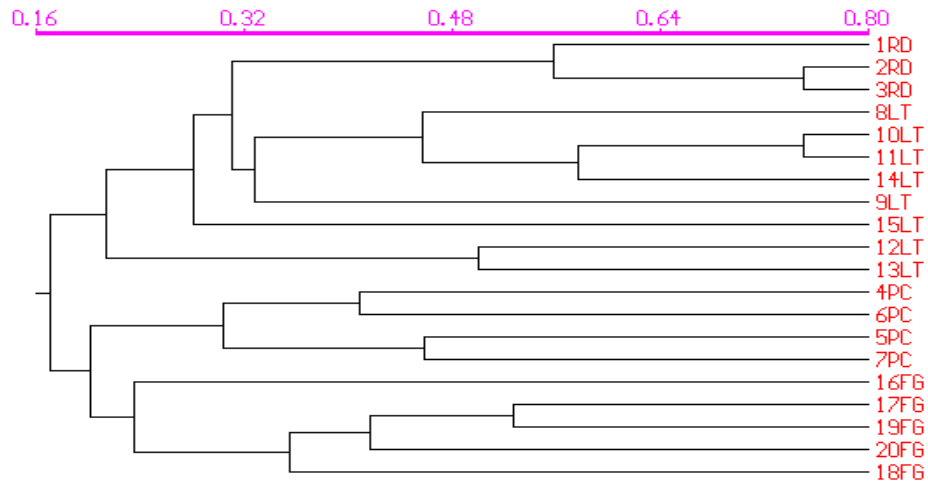


Fig. 1: The dendrogram of the *Asplenio-Cystopteridetum fragilis* Oberd. (1939) 1949 association

*Asplenio quadrivalens-Poëtum nemoralis* Soó ex Gergely et al. 1966

The analysis of dendrogram for *Asplenio-Poëtum nemoralis* association revealed the grouping of the surveys on the individual clusters for each massif in part (Leaota and Piatra Craiului). (Fig.2)

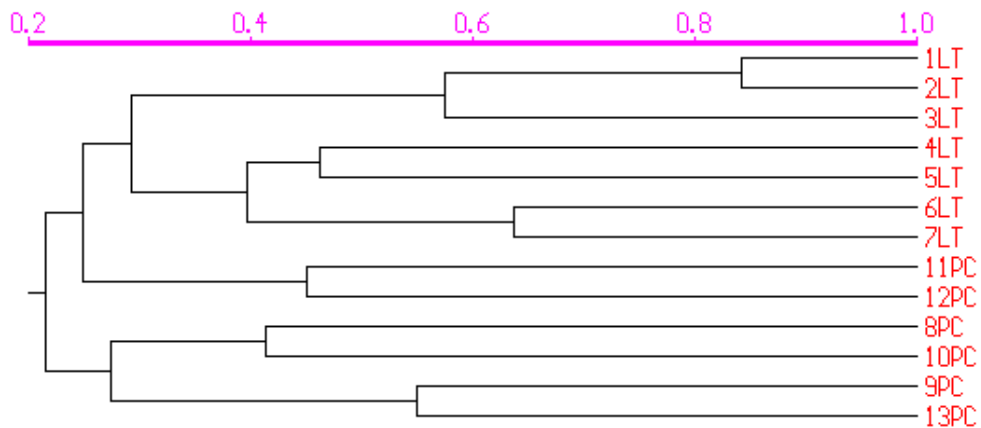


Fig. 2: The dendrogram of the *Asplenio quadrivalens-Poëtum nemoralis* Soó ex Gergely et al. 1966 association

The differences between the first and second surveys (Rudărița and Cheii Gorges), in comparison with the other from Leaota appears because of the advanced degree of covering of the rocks with herbaceous vegetation, in the coenoses of these stations. These coenoses evolutes to sesleriets because the presence of the characteristic species of *Seslerion* alliance and *Seslerietalia* order: *Bupleurum falcatum*, *Aconitum anthora*, *Cnidium silaifolium*, *Erysimum witmannii*.

It found that exists a near similarity of the surveys from Ghimbav Mountain (6-th and 7-th survey) with the other from Prăpăstiile Zărneștilor Gorges (11-th and 12-th). This situation is explained because of the existence of the characteristic vegetation for gorges, in accordance with the wet and cold topoclimate.

The similarity of the surveys from Leaota are less obviously with the 8-th, 9-th, 10-th and 13-th survey from Vlădușca – Piatra Craiului, because both of the floriferous composition with a numerous characteristic species of the *Seslerion* alliance and the presence of the carpathian – balkan, dacian species (like in Piatra Craiului).

Table 1: *Cystopteridetum fragilis* Oberd. (1939) 1949

			Survey	1	2	3	4	5	6	7	8	
			Altitude (mx10)	46	74	70	70	46	75	76	90	
			Exposure	N	SE	S	NE	N	SE	NE	E	
			Slope (degree)	90	85	90	85	90	85	85	80	
			Surface (m <sup>2</sup> )	9	9	9	9	9	4	4	9	
			Coverage (%)	20	50	30	50	60	35	25	50	
B.f.	F. e.	Cyt.										K
			<u>Char. ass.</u>									
H	Cp	P	<i>Asplenium viride</i>	-	-	+	+	-	-	1	3	III
Brr	Cp	P	<i>Ctenidium molluscum</i>	-	-	+	-	+	-	-	-	II
			<u>Diff. reg.</u>									
H	Carp(end)	D	<i>Campanula carpatica</i>	+	1	1	1	3	+	+	1	V
Ch	Ec(mont)	D	<i>Saxifraga cuneifolia</i>	+	-	+	+	1	-	-	-	III
H	Ec(mont)	P	<i>Valeriana montana</i>	-	-	-	-	-	-	+	+	II
H	Eua(mont)	D	<i>Cortusa matthioli</i>	-	-	-	1	-	-	-	-	I
			<u>Cystopteridion et Potentilletalia</u>									
H	Cm	P	<i>Cystopteris fragilis</i>	1	1	1	+	1	-	+	+	V
H	Cp	P	<i>Asplenium ruta-muraria</i>	+	+	-	-	-	+	-	-	II
H	Ec(mont)	D	<i>Moehringia muscosa</i>	-	-	-	-	-	-	-	2	I
			<u>Asplenetea</u>									
H	Cp	P	<i>Poa nemoralis</i>	+	1	1	+	1	1	-	+	V
H	Cm	D	<i>Asplenium trichomanes</i>	2	3	2	2	2	2	1	1	V
H	Ec	P	<i>Sedum maximum</i>	-	+	-	-	-	+	-	1	II
G	Cp	P	<i>Polypodium vulgare</i>	-	+	-	-	-	-	-	-	I
Th-THec		D	<i>Cardaminopsis arenosa</i>	-	-	-	-	-	-	+	-	I
Ch	Eua(arct.alp)	P	<i>Saxifraga paniculata</i>	-	-	-	-	-	+	-	-	I
			<u>Varia</u>									
H-G	Cp	D	<i>Oxalis acetosella</i>	+	-	+	+	-	-	+	+	IV
H	Ec(mont)	D	<i>Veronica urticifolia</i>	+	-	+	+	-	-	+	+	IV
H	Eua	D	<i>Fragaria vesca</i>	-	+	-	-	-	-	+	+	II
H	Cp	D	<i>Solidago virgaurea</i>	-	-	-	-	-	-	+	+	II
Th	Cm	P	<i>Geranium robertianum</i>	-	-	+	-	+	-	-	+	II
H	Carp-Balc	-	<i>Aconitum toxicum</i>	-	-	-	+	+	-	+	-	II
H	E	D	<i>Mycelis muralis</i>	+	-	-	-	-	+	-	+	II
H	Eua(med)	D	<i>Valeriana officinalis</i>	-	-	-	+	1	-	-	-	II
Ch	Eua	D	<i>Selaginella helvetica</i>	-	-	-	3	-	-	+	-	II
H	Ec(mont)	P	<i>Doronicum austriacum</i>	-	-	-	+	-	-	-	-	I
nPh	Eua	D	<i>Sorbus aucuparia</i>	-	-	-	-	-	-	-	+	I
mPh	Eua	P	<i>Spiraea chamaedrifolia</i>	-	-	-	-	-	-	+	-	I
H	Ec	P	<i>Valeriana sambucifolia</i>	-	-	-	-	-	-	-	+	I
H	Ec(mont)	P	<i>Gentiana asclepiadea</i>	-	-	-	-	-	-	+	-	I
H	Eua	D	<i>Hypericum maculatum</i>	-	-	-	-	-	-	+	-	I
TH	Carp-Balc	P	<i>Campanula abietina</i>	-	-	-	-	-	-	+	-	I
H	E	P	<i>Digitalis grandiflora</i>	-	+	-	-	-	-	-	-	I
H	Cp(arct.alp.)	P	<i>Polystichum lonchitis</i>	-	+	-	-	-	-	-	-	I
H	Eua	P	<i>Senecio germanicus</i>	-	-	-	-	-	-	+	-	I
H	Eua(mont)	D	<i>Salvia glutinosa</i>	-	-	-	-	-	-	-	+	I
TH	Eua	D	<i>Cnidium dubium</i>	-	-	-	-	-	-	-	+	I
Ch	Eua	P	<i>Sedum album</i>	-	-	-	-	-	-	-	+	I
MPh	Ec	P	<i>Acer pseudoplatanus</i>	-	-	-	-	-	-	-	+	I
H	Carp-Balc	D	<i>Pulmonaria rubra</i>	-	-	-	-	-	-	-	+	I
H	E(mont)	P	<i>Polystichum aculeatum</i>	-	-	-	-	-	-	-	+	I
G	Cp	P	<i>Gymnocarpium robertianum</i>	-	-	-	-	-	-	+	-	I
H	Ec(mont)	D	<i>Cirsium erisithales</i>	-	-	-	-	-	-	+	-	I

**Species only in a survey:** *Cortusa matthioli* (4): H, Eua(mont), D; *Moehringia muscosa* (8): H, Ec(mont), D; *Polypodium vulgare* (2): G, Cp, P; *Cardaminopsis arenosa* (7): Th-TH, Ec, D; *Saxifraga paniculata* (6): Ch, Eua(arct.alp.), P; *Doronicum austriacum* (4): H, Ec(mont), P; *Sorbus aucuparia* (8): nPh, Eua, D; *Spiraea chamaedrifolia* (7): mPh, Eua, P; *Valeriana sambucifolia* (8): H, Ec, P; *Gentiana asclepiadea* (7): H, Ec(mont), P; *Hypericum maculatum* (7): H, Eua, D; *Campanula abietina* (7): TH, Carp-Balc, P; *Digitalis grandiflora* (2): H, E, P; *Polystichum lonchitis* (2): H, Cp(arct.alp.), P; *Senecio germanicus* (6): H, Eua, P; *Salvia glutinosa* (8): H, Eua(mont), D; *Cnidium dubium* (8): TH, Eua, D; *Sedum album* (8): Ch, Eua, P; *Acer pseudoplatanus* (8): MPh, Ec, P; *Pulmonaria rubra* (8): H, Carp-Balc, D; *Polystichum aculeatum* (8): H, E(mont), P; *Gymnocarpium robertianum* (7): G, Cp, P; *Cirsium erisithales* (7): H, Ec(mont), D.

**Place and data of the record:** 1,2,3,4 – Cheile Ghimbavului (15.06. 2002); 5,6,7 – Cheile Cheii (16.06.2002); 8 – Cheile Brateiului (23.08.2004).

Table 2: *Asplenio quadrivalenti* – *Poëtum nemoralis* Soó ex Gergely et al. 1966

			Survey	1	2	3	4	5	6	7	8		
			Altitude (mx10)	80	80	85	82	100	98	47	70		
			Exposure	S	NV	N	N	S	NV	S	S		
			Slope (degree)	85	80	80	70	75	80	80	70		
			Surface (m <sup>2</sup> )	10	25	25	25	15	25	4	4		
			Coverage (%)	50	50	50	30	25	50	55	40		
B.f.	F. e.	Cyt.										K	
			<b>Char.ass.</b>										
H	Cm	P	<i>Asplenium trichomanes</i>	+	+	+	+	+	1	1	2	V	
H	Cp	P	<i>Poa nemoralis</i>	3	3	3	2	2	1	3	1	V	
			<b>Androsacion et Androsacetalia</b>										
H(G)	Eua(med)	-	<i>Sedum maximum</i>	+	+	-	-	-	+	-	-	II	
			<b>Asplenietea</b>										
H	Cm	P	<i>Cystopteris fragilis</i>	+	+	+	+	+	+	+	+	V	
H	Carp(end)	D	<i>Campanula carpatica</i>	+	+	+	+	+	-	+	1	V	
G	Cp	P	<i>Polypodium vulgare</i>	+	+	+	+	-	+	-	-	IV	
TH	Ec	P	<i>Cardaminopsis arenosa</i>	1	+	+	+	-	+	-	-	IV	
Ch	Ec(mont)	P	<i>Saxifraga cuneifolia</i>	+	-	-	-	-	-	-	+	II	
Ch	Carp(end)	P	<i>Thymus comosus</i>	-	-	-	-	+	2	-	-	II	
H	Carp(end)	D	<i>Silene nutans</i> ssp. <i>dubia</i>	-	-	-	-	+	2	-	-	II	
H	Ec(mont)	D	<i>Valeriana tripteris</i>	+	+	+	-	-	-	-	-	II	
			<b>Seslerion et Seslerietalia</b>										
H	E(cont)	P	<i>Aconitum anthora</i>	+	+	+	-	-	-	-	-	III	
TH	Carp(end)	D	<i>Erysimum witmannii</i>	+	+	-	-	-	-	-	-	II	
H	Alp-E	D	<i>Bupleurum falcatum</i>	+	+	-	-	-	-	-	-	II	
Th	Med	D	<i>Cnidium silaifolium</i>	-	-	-	-	+	-	-	-	I	
			<b>Varia</b>										
H	E	P	<i>Mycelis muralis</i>	+	+	+	+	+	-	-	-	IV	
Th-TH	Cm	P	<i>Geranium robertianum</i>	-	-	-	+	+	-	+	+	III	
H	Eua	P	<i>Senecio germanicus</i>	+	+	+	+	-	-	-	-	III	
Ch	Eua	P	<i>Sedum album</i>	+	+	-	-	-	-	-	-	II	
H	Eua(med)	D	<i>Valeriana officinalis</i>	+	-	-	-	-	-	+	-	II	
H-Ch	Eua	D	<i>Lamium maculatum</i>	+	+	+	-	-	-	-	-	II	
H(G)	Cp	P	<i>Adoxa moschatellina</i>	+	-	+	-	-	-	-	-	II	
nPh	Arct(alp)	D	<i>Clematis alpina</i>	+	+	+	-	-	-	-	-	II	
H	Ec(mont)	D	<i>Veronica urticifolia</i>	-	-	+	-	-	-	+	+	II	
H	Eua	D	<i>Galium molugo</i>	-	-	+	+	-	-	+	-	II	
H	Eua	D	<i>Chelidonium majus</i>	+	+	-	+	-	-	-	-	II	
H	Cp	P	<i>Asplenium viride</i>	-	-	-	-	-	-	-	+	I	
H	Cp	D	<i>Oxalis acetosella</i>	-	-	-	-	-	-	-	+	I	
Th(TH)	Eua(arct.alp)	D	<i>Sedum annuum</i>	-	-	-	-	-	+	-	-	I	
H	Eua	D	<i>Hypericum maculatum</i>	-	-	-	-	-	+	-	-	I	
TH	Eua	D	<i>Viola tricolor</i>	-	-	-	-	-	+	-	-	I	
Th	Eua(med)	D	<i>Geranium rotundifolium</i>	-	-	-	-	-	+	-	-	I	
G	Carp-Balc	D	<i>Scopolia carniolica</i>	-	-	-	-	-	-	+	-	I	

**Species only in a survey:** *Cnidium silaifolium* (5): Th, Med, D; *Asplenium viride* (8): H, Cp, P; *Oxalis acetosella* (8): H, Cp, D; *Sedum annuum* (6): Th(TH), Eua(arct.alp), D; *Hypericum maculatum* (6): H, Eua, D; *Viola tricolor* (6): TH, Eua, D; *Geranium rotundifolium* (6): Th, Eua (med), D; *Scopolia carniolica* (7): G, Carp-Balc, D.

**Place and data of the record:** 1,3,4 – Cheile Cheii (16.06.2002); 2 – Cheile Rudăriței (16.06.2002); 5 – Cheile Crovului (17.06.2002); 6 – Secări (11.07.2003); 7,8 – Cheile Ghimbavului (15.06.2002).

#### *Thymo comosi-Galietum albi* Sanda, Popescu 1999

The dendrogram of the *Thymo comosi-Galietum albi* association emphasizes a reduced similarity between the phytocoenoses from calcareous gorges of Leaota with the other from Apuseni Mountains (Scărița-Belioara, Rîmeț Gorges and Runcu Gorges). (Fig. 3)

Depending on the stational factors (humidity) and the growth of the altitude in phytocoenoses with *Thymus comosus* and *Galium album* from Leaota appear a numerous characteristic species of the *Seslerietalia* order and *Seslerio-Festucion pallentis* alliance. This

fact indicates the direction of the evolution of these coenoses, either to sesleriets or to xerophylic lawns of the *Seslerio-Festucion pallentis*, as next stage in series on the limestone.

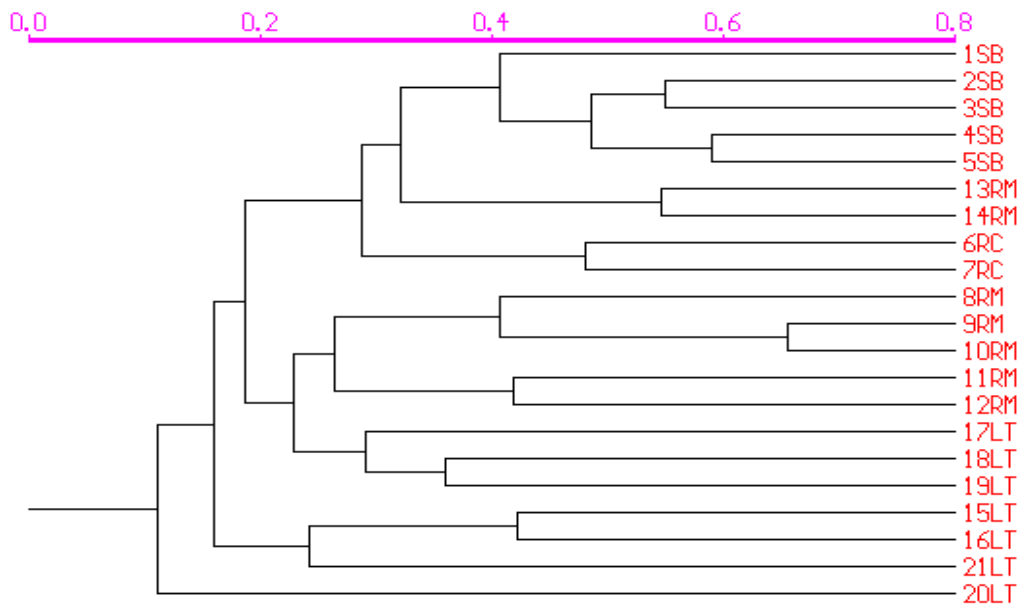


Fig. 3. The dendrogram of the *Thymo comosi-Galietum albi* Sanda, Popescu 1999 association

Once with the advance of the lying fallow process, corresponding coenoses from Apuseni Mountains evaluate to associations of the *Bromo-Festucion pallentis* alliance.

As part of this vegetal grouping from Leaota, one can find characteristic species of the *Asplenieta* class (*Asplenium ruta-muraria*, *Asplenium viride*, *Campanula carpatica*, *Silene nutans* ssp. *dubia*, *Asplenium trichomanes*, *Cystopteris fragilis*, *Saxifraga paniculata*), which has a reduced constancy in the corresponding phytocoenoses from Apuseni Mountains.

#### *Asperulo capitatae-Seslerietum rigidae* (Zólyomi 1939) Coldea 1991

The concentration of the surveys in cluster diagrams emphasizes the similitudes between the Leaota and Bucegi Massifs, less than Piatra Craiului, concerning floriferous composition. (Fig. 4)

A branch of the cluster emphasizes the near similarity of the surveys from Brătei Gorges (19-th, 20-th survey) with the Zănoaga Gorges from Bucegi (1-st, 2-nd survey), because of the geographical position of these stations (near to Bucegi).

However, it has been ascertained that the group of surveys 5,6,7 from Tătaru Gorges presents a better similarity with the 8-th, 9-th from Piatra Craiului and less than the other from Leaota, because of the phytogeographical structure of these coenoses (the presence of the considerable number of circumpolar and carpathian-endemic species).

The surveys from Scărița-Belioara are even more detached, in comparison with the grouping from Meridional Carpathian. In these phytocoenoses, *Sesleria rigida* presents a big adaptability, being associated with species of the alpine plants, making different facies with *Arctostaphylos uva-ursi*, *Anthyllis alpestris*. Under the floriferous aspect, the corresponding phytocoenoses from Scărița-Belioara are characterized by the big frequency of these species: *Dianthus spiculifolius*, *Leontodon asper*, *Sempervivum marmoreum*, *Seseli rigidum*, *Taraxacum hoppeanum*, *Centaurea triumfetti*, *Carex humilis*, which have a reduced constancy or are absent in the phytocoenoses of this association from Leaota.

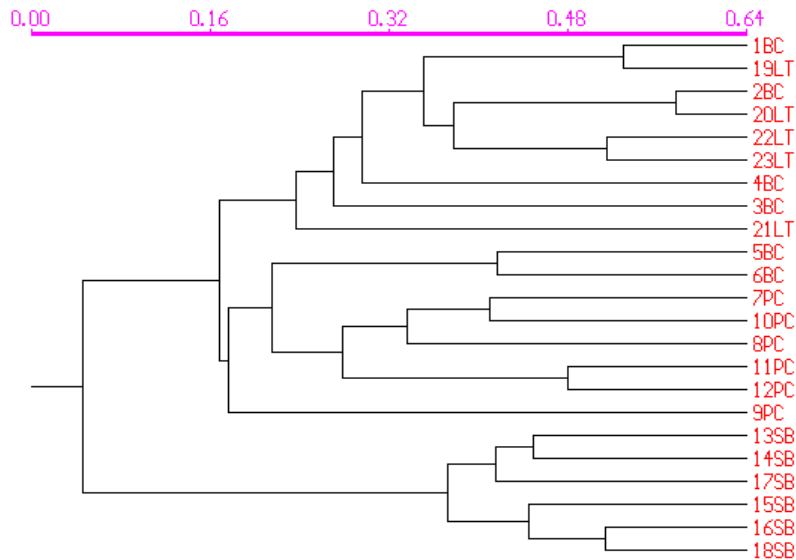


Fig. 4. The dendrogram of the *Asperulo capitatae-Seslerietum rigidae* (Zólyomi 1939) Coldea 1991 association

Table 3: *Thymo comosi – Galietum albi* Sanda et Popescu 1999

			Survey	1	2	3	4	5	6	7		
			Altitude (mx10)	100	145	85	100	100	100	90		
			Exposure	V	S	S	S	V	SV	N		
			Slope (degree)	60	30	10	45	45	60	80		
			Surface (m <sup>2</sup> )	5	5	10	20	15	10	6		
			Coverage (%)	20	20	25	15	15	35	30		
B.f.	F. e.	Cyt.									K	
			<b>Char.ass.</b>									
H	E	P	<i>Galium album</i>	+	+	+	2	+	-	+	V	
Ch	Carp(end)	D	<i>Thymus comosus</i>	+	+	+	+	1	2	2	V	
Ch	Ec-Med	P	<i>Teucrium montanum</i>	3	2	2	-	+	-	-	III	
G	Cp	P	<i>Gymnocarpium robertianum</i>	+	-	+	-	-	-	-	II	
			<b>Diff. reg.</b>									
H	Carp(end)	D	<i>Dianthus spiculifolius</i>	+	+	-	-	-	-	+	III	
nPh	Ec	P	<i>Lembotropis nigricans</i>	-	+	-	-	-	-	+	II	
TH	Pont	P	<i>Erysimum odoratum</i>	-	-	-	+	-	-	-	I	
			<b>Stipion et Thlaspietalia</b>									
H	Ec-Balc	D	<i>Melica ciliata</i>	+	-	+	+	+	-	-	III	
Th-TH	Alp-Carp	-	<i>Senecio squalidus</i>	-	-	-	+	+	+	-	III	
Th-TH	Ec	P	<i>Cardaminopsis arenosa</i>	-	-	-	+	-	+	-	II	
H	Ec(mont)	D	<i>Moehringia muscosa</i>	+	-	+	-	-	-	-	II	
H	E(med)	D	<i>Vincetoxicum hirundinaria</i>	-	-	+	-	-	-	+	II	
			<b>Asplenieta</b>									
H	Cm	P	<i>Asplenium trichomanes</i>	-	-	-	+	+	-	1	III	
H	Cp	P	<i>Poa nemoralis</i>	+	-	+	-	+	+	-	III	
Ch	Eua	P	<i>Saxifraga paniculata</i>	+	+	-	-	-	-	+	III	
H	Carp(end)	D	<i>Campanula carpatica</i>	-	-	+	+	+	-	-	III	
H	Carp(end)	D	<i>Silene nutans ssp. dubia</i>	-	-	-	+	-	-	+	II	
H	Cp	P	<i>Asplenium ruta-muraria</i>	-	+	-	-	-	-	1	II	
Ch	Eua(arct.alp.)P		<i>Asplenium viride</i>	-	-	-	-	-	+	-	I	
H	Cm	P	<i>Cystopteris fragilis</i>	-	-	-	-	-	-	+	I	
			<b>Seslerion rigidae et Seslerietalia</b>									
H	Carp-Balc	D	<i>Festuca pallens</i>	-	+	-	+	+	+	-	III	
Th	Med	D	<i>Cnidium silaifolium</i>	+	+	-	+	-	-	+	III	
H	Carp-Balc	P	<i>Sesleria rigida</i>	+	+	-	-	-	-	-	II	
H	Carp-Balc	P	<i>Asperula capitata</i>	-	-	-	+	+	-	-	II	
H	Ec(mont)	-	<i>Pedicularis comosa</i>	-	-	-	+	+	-	-	II	
H	Carp(end)	-	<i>Centaurea pinnatifida</i>	+	-	-	-	-	-	-	I	
H(Ch)	Carp(end)	-	<i>Dianthus tenuifolius</i>	-	-	-	-	+	-	-	I	
Ch-nPh	Ec-Med	D	<i>Helianthemum nummularium</i>	-	+	-	-	-	-	-	I	



TH	Carp(end)	D	<i>Erysimum witmannii</i>	-	-	+	-	-	-	-	I
Th	E(Alp)	P	<i>Euphrasia salisburgensis</i>	-	-	-	-	-	+	-	I
H	End-Carp	P	<i>Festuca rupicola</i> ssp. <i>saxatilis</i>	-	-	-	-	-	-	+	I
H	End(Carp-Rom)	D	<i>Scabiosa lucida</i>	-	-	-	-	-	-	+	I
H	Eua(cont)	D	<i>Seseli libanotis</i>	-	-	-	-	-	-	+	I
<b>Seslerio – Festucion pallentis</b>											
H	Eua(mont)	D	<i>Campanula sibirica</i>	+	+	-	+	-	-	-	III
H	Ec(med)	D	<i>Coronilla varia</i>	+	-	+	+	-	-	-	III
G	Pont-Med	D	<i>Allium flavum</i>	-	-	-	-	-	+	-	I
H	Carp-Balc	P	<i>Phleum montanum</i>	-	-	-	-	-	+	-	I
Ch	Carp-Balc	D	<i>Jovibarba heuffelii</i>	-	-	-	-	-	-	+	I
Ch	Carp-Balc	D	<i>Sempervivum marmoreum</i>	-	-	-	-	-	-	+	I
<b>Varia</b>											
Th-TH	Cm	P	<i>Geranium robertianum</i>	-	-	+	+	-	+	-	III
H	Eua(cont)	P	<i>Aster amellus</i>	-	-	-	-	-	+	+	II
Th-TH	E(med)	D	<i>Acinos arvensis</i>	-	-	+	+	-	-	-	II
H	Pont(med)	P	<i>Stachys recta</i>	-	-	+	+	-	-	-	II
H	Eua	P	<i>Hypericum perforatum</i>	-	-	-	+	-	+	-	II
H	E(cont)	D	<i>Fragaria viridis</i>	-	-	-	+	-	-	-	I
Th(TH)	Med	P	<i>Sedum hispanicum</i>	-	-	+	-	-	-	-	I
H	Eua(cont)	D	<i>Anthemis tinctoria</i>	-	-	-	-	-	+	-	I
Ch	Ec-Med	P	<i>Teucrium chamaedrys</i>	-	-	-	-	-	+	-	I
Ch	Eua	D	<i>Selaginella helvetica</i>	-	-	-	-	-	-	+	I

**Species only in a survey:** *Asplenium viride* (6): Ch, Eua(arct.alp), P; *Cystopteris fragilis* (7): H, Cm, P; *Centaurea pinnatifida* (1): H, Carp(end); *Dianthus tenuifolius* (5): H(Ch), Carp(end); *Helianthemum nummularium* (2): Ch-nPh, Ec-Med, D; *Erysimum witmannii* (3); TH, Carp(end), D; *Euphrasia salisburgensis* (6); Th, E(Alp), P; *Festuca rupicola* ssp. *saxatilis* (7): H, End-Carp, P; *Scabiosa lucida* (7): H, End(Carp-Rom), D; *Seseli libanotis* (7): H, Eua(cont), D; *Allium flavum* (6): G, Pont-Med, D; *Phleum montanum* (6): H, Carp-Balc, P; *Jovibarba heuffelii* (7): Ch, Carp-Balc, D; *Sempervivum marmoreum* (7): Ch, Carp-Balc, D; *Fragaria viridis* (4): H, E(cont), D; *Sedum hispanicum* (3): Th(TH), Med, P; *Anthemis tinctoria* (6): H, Eua(cont), D; *Teucrium chamaedrys* (6): Ch, Ec-Med, P; *Selaginella helvetica* (7): Ch, Eua, D.

**Place and data of the record:** 1,5,6 - Cheile Crovului (17.06.2002); 2,3,4 - Cheile Cheii (16.06.2002); 7 - Cetățeni (12.07.2003).

**Table 4: *Asperulo capitatae* – *Seslerietum rigidae* (Zoly. 1939) Coldea 1991**

			Survey	1	2	3	4	5			
			Altitude (mx10)	80	70	75	75	80			
			Exposure	E	V	E	SV	N			
			Slope (grade)	90	70	80	90	80			
			Surface (m <sup>2</sup> )	25	25	25	25	25			
			Coverage (%)	60	40	50	50	60			
B. f.	F..e.	Cyt.							K		
<b>Char. ass.</b>											
H	Carp-Balc	D	<i>Sesleria rigida</i>	3	+	3	3	3	V		
H	Carp-Balc	D	<i>Asperula capitata</i>	1	1	-	1	+	IV		
<b>Seslerion rigidae</b>											
H	Carp(end)	P	<i>Dianthus spiculifolius</i>	+	+	+	+	+	V		
Ch	Carp(end)	P	<i>Thymus comosus</i>	+	1	1	+	+	V		
H	E(cont)	P	<i>Aconitum anthora</i>	-	-	+	+	+	III		
Ch	Carp-Balc	-	<i>Saxifraga luteo-viridis</i>	-	+	-	+	-	II		
H	Med	D	<i>Primula columnae</i>	-	+	-	+	-	II		
H	Alp-E	D	<i>Bupleurum falcatum</i>	+	-	-	+	-	II		
<b>Seslerietalia</b>											
Ch-H	Alp-E	D	<i>Helianthemum nummularium</i>	1	+	+	+	-	IV		
H	Alp-Carp-Balc	D	<i>Ranunculus oreophilus</i>	-	-	+	+	+	III		
H	Cp(arct.alp)	P	<i>Polygonum viviparum</i>	-	-	-	+	+	II		
Th	E(Alp.)	P	<i>Euphrasia salisburgensis</i>	+	+	-	-	-	II		
H	End(Carp-Rom)	D	<i>Scabiosa lucida</i>	-	-	+	-	-	I		
H	E(alp.)	P	<i>Carex sempervirens</i>	2	-	-	-	-	I		
H	Alp-Sudet-Carp	D	<i>Festuca versicolor</i>	+	-	-	-	-	I		
<b>Seslerio – Festucion pallentis</b>											
Th	Med	D	<i>Cnidium silaifolium</i>	+	+	-	+	-	III		
H	Ec-Balc	D	<i>Melica ciliata</i>	-	+	-	+	-	II		
H	Eua(cont)	D	<i>Anthemis tinctoria</i>	-	+	-	-	-	I		

		<u>Potentilletalia caulescentis et Asplenietea</u>							
H	Cp	P	<i>Poa nemoralis</i>	1	2	-	+	+	IV
H	Carp(end)	D	<i>Campanula carpatica</i>	-	+	-	+	+	III
H	Cm	P	<i>Asplenium trichomanes</i>	+	-	-	+	+	III
Ch	Eua(arct.alp)	P	<i>Saxifraga paniculata</i>	+	-	+	-	+	III
Th	E	P	<i>Cardaminopsis arenosa</i>	+	-	+	-	-	II
H	Cm	P	<i>Cystopteris fragilis</i>	-	+	-	-	-	I
		<u>Geranium sanguinei</u>							
H	Med	P	<i>Galium lucidum</i>	+	+	-	+	-	III
H	E	P	<i>Digitalis grandiflora</i>	-	+	-	+	+	III
H	Eua(med)	P	<i>Campanula rapunculoides</i>	+	-	-	-	+	II
		<u>Festucetalia et Festuco-Brometea</u>							
H	Eua(cont)	D	<i>Campanula sibirica</i>	+	-	+	+	+	IV
H	Eua	P	<i>Pimpinella saxifraga</i>	+	+	-	-	-	II
		<u>Varia</u>							
H	Eua	D	<i>Angelica sylvestris</i>	+	+	+	-	+	IV
H	Pont-Med	D	<i>Scrophularia scopoli</i>	+	+	-	+	+	IV
H	Ec(mont)	D	<i>Cirsium erisithales</i>	-	+	-	+	+	III
H	Ec(mont)	P	<i>Astrantia major</i>	-	+	-	+	+	III
H	Cp	D	<i>Solidago virgaurea ssp. minuta-</i>	-	-	+	+	+	III
mPh	Eua(cont)	P	<i>Spiraea chamaedrifolia</i>	+	+	-	+	-	III
G	Ec	P	<i>Galium schultesii</i>	+	-	+	+	-	III
H	E	D	<i>Mycelis muralis</i>	-	-	-	+	+	II
H	Pont-Pan	D	<i>Inula ensifolia</i>	-	+	-	-	+	II
Ch	Med-Ec	D	<i>Teucrium montanum</i>	+	-	+	-	-	II
H	Carp(end)	-	<i>Aconitum moldavicum</i>	-	+	+	-	-	II
H	Eua	P	<i>Phleum phleoides</i>	-	-	+	+	-	II
nPh	Arct(alp.)	D	<i>Clematis alpina</i>	-	+	-	-	-	I
TH	Carp-Balc	P	<i>Campanula abietina</i>	+	-	-	-	-	I
H	E	P	<i>Valeriana sambucifolia</i>	-	+	-	-	-	I
H	E	D	<i>Luzula luzuloides</i>	-	-	-	-	+	I
Ch	Ec-Med	P	<i>Teucrium chamaedrys</i>	-	+	-	-	-	I
H	Eua	D	<i>Fragaria vesca</i>	-	+	-	-	-	I
H	Eua(Med)	D	<i>Valeriana officinalis</i>	-	-	-	+	-	I
Ch	Ec(mont)	D	<i>Saxifraga cuneifolia</i>	-	-	-	+	-	I

**Species only in a survey:** *Scabiosa lucida* (3): H, End(Carp-Rom), D; *Carex sempervirens* (1): H, E, (alp.), P; *Festuca versicolor* (1): H, Alp-Sudet-Carp, D; *Anthemis tinctoria* (2): H, Eua (cont), D; *Cystopteris fragilis* (2): H, Cm, P; *Clematis alpina* (2): nPh, Arct(alp.), D; *Campanula abietina* (1): TH, Carp-Balc, P; *Valeriana sambucifolia* (2): H, E, P; *Luzula luzuloides* (5): H, E, D; *Teucrium chamaedrys* (2): Ch, Ec-Med, P; *Fragaria vesca* (2): H, Eua, D; *Valeriana officinalis* (4): H, Eua (Med), D; *Saxifraga cuneifolia* (4): Ch, Ec(mont), D.

**Place and data of the record:** 1,2 – Cheile Brateiului (23.08.2004); 3,4,5 – Cheile Ghimbavului (15.06. 2002).

## Conclusions

In order to establish the similarities of the saxicolous vegetation from Leaota Massif with the other calcareous massifs of the Romanian Carpathian has been realized a comparison of the associations from gorges and the phytocoenoses on the rocks from mountainous level, using Jaccard qualitative index.

The dendrograms obtained for each of saxicolous vegetal associations reveal a cohesive grouping of the surveys from the studied massifs.

The highest similarities were observed in the surveys of closely situated massif (Piatra Craiului, Bucegi, Leaota).

The differences which determine the individualization of the surveys from Leaota in the separated clusters beside of the corresponding coenoses from the other mountainous massifs, results for the next aspects:

- The different altitude of the phytocoenoses from the studied massifs (increase of the altitude, in case of *Aspleno-Cystopteridetum fragilis* association determines the appearance of the characteristic species of *Seslerietalia* order, like in Piatra Craiului and Rodna, spreading in the subalpine level.

- The different syndinamic of the *Thymo comosi-Galietum albi* association: once with the advance of the lying fallow process, these phytocoenoses evaluate to the associations of the *Seslerio-Festucion pallentis* alliance, in Leaota Mountains, while in the gorges of the Apuseni evaluate to the grouping of the *Bromo-Festucion pallentis* alliance.
- The different geographical position of the stations which is reflected in the floriferous composition of the phytocoenoses.

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#### SIMILARITĂȚI ALE VEGETAȚIEI SAXICOLE DIN MASIVUL LEAOTA CU ALTE MASIVE MUNTOASE DIN CARPAȚII ROMÂNIEI

##### (Rezumat)

Masivul Leaota are o poziție anticlinală între sinclinalul Bucegilor și cele al Pietrei Craiului, reprezentând o regiune muntoasă de tranziție între Carpații Orientali și Meridionali.

Majoritatea culmilor sunt sculptate în masa cristalinului de Leaota, corespunzător faciesului de șisturi verzi, dar în partea de nord-vest (cheile din jurul muntelui Ghimbav) și cea de sud-est (Cheile Brăteului, Cheile Răteului) se întâlnesc calcare titonice de vârstă jurasică.

În lucrarea de față este prezentată o analiză comparativă a vegetației de stâncărie de pe substrat calcaros din Munții Leaota cu cea din alte masive calcaroase ale Carpaților românești. Această comparație se bazează pe calculul indicelui calitativ Jaccard ( $Q_j$ ) și ia în considerare prezența/absența speciilor din releveele studiate.

Vegetația saxicolă este reprezentată de următoarele asociații vegetale instalate pe substrat calcaros: *Asplenio-Cystopteridetum fragilis* Oberd. (1939) 1949, *Asplenio quadrivalens-Poëtum nemoralis* Soó ex Gergely et al. 1966, *Thymo comosi-Galietum albi* Sanda, Popescu 1999 and *Asperulo capitatae-Seslerietum rigidae* (Zólyomi 1939) Coldea 1991.