# CONTRIBUTIONS TO THE STUDY OF *ASPLENIO RUTAE-MURARIAE-MELICETUM CILIATAE* ASSOCIATION IN THE VAŞCĂU PLATEAU (CODRU-MOMA MOUNTAINS)

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***Abstract***

*The work presents a phytocoenologic study of Asplenio rutae-murariae-Melicetum ciliatae association Soó 1962 in the Vaşcău Plateau in Bihor County. This association was reported in the Rasteţului Hill on Vaşcău Plateau, where a number of five phytocoenological relevées were carried out in 2011.*

*The phytocoenoses of this association were analyzed considering the floristic composition, life forms, floristic elements, karyotype and ecological indices.*

*The floristic composition of the association, totalizing 57 species is dominated by calcio-phillic elements with low preferences on soil moisture. An important coenotic role is played by xerophytes and xero-mesophytes species specific to the Seslerio-Festucion pallentis alliance, Stipio pulcherrimae-Festucetalia pallentis order and Festuco-Brometea class.*

*These phytocoenoses have low economic significance, having in their floristic composition some forage plants: Festuca valesiaca, Sanguisorba minor, Brachypodium pinnatum, Trifolium montanum and medicinal ones: Thymus comosus, Hypericum perforatum, Sedum acre.*

**Key words:** association, phytocoenoses, floristic elements, life forms, ecological indices, karyotype.

## INTRODUCTION

In Romania, the association is not well known, being cited in Transylvania (Pop et al., 2002) and Crişana (Pop, Hodişan, 1967; Coldea 1973; Groza, 2008). It is cited in Hungary Bakony areas, Vértes, Gerecse and Budai-hg. (Borhidi, 2003).

The Carstic Plateau of Vaşcău comprises a very wide and unitary chalcophile area in the east of the Codru-Moma Mountains. Vaşcău Plateau lies at an altitude of 600-700 m and includes the most spectacular country karst, due to the impressive number of sinkholes, which aligns most times, constituting sinkholes valleys. Many sinkholes are home to water stove called ”tăuri’’ formed due to sealing of slopes with descaling clay of a red-violet color (Cocean, Filip, 2008).

The edge of the plateau is made of impermeable rocks that form a higher landform, with the highest peak Momuţa (930 m). These Paleozoic rocks have a normal appearance of valleys bounded by rounded ridges.

The hydrography of Vaşcău Plateau is characterized by sinkholes, which captures the permanent waters. In the central-southern part three are three short rivers, with water that is lost in contact with dolomite: Ponoraşul, Recea and Ponorul, and in the south, the most important one considering rate and length is Ţarina River. The lower course of the Ţarina River penetrates the Câmpeneasca Cave, where it forms a waterfall. After an underground journey, the water comes out at Boiu Spring, near the town of Vaşcău. Near Vaşcău Plateau there are two springs to be mentioned: the one in Briheni Valley, at the

bottom of a gorge, and the other one Călugări, once famous for double intermittence (Bleahu, 1978).

The climate falls into moderate continental type. Climatic elements show a concentric setting with values ranging from outside to center. Thus, the annual average temperature decreases from 10 °C to 8 °C, the average temperature of the air decreases in January from -2° C to -4 °C, and in July, from 20 °C to 18 °C. Precipitation (annual average quantities) increases from 700 mm to 1000 mm.

Rendzine soil is specific to highlands. Soils are affected by erosion caused by grazing.

## MATERIAL AND METHODS

The study was conducted in 2008. The association was found in the Vaşcău Plateau on the limestone rocks of Rastețului Hill, near the town of Câmp, Bihor County.

Geographic coordinates of the plateau are 46°25'50'' North latitude and 22°26'49'' East longitude. It has a total area of 4983 ha which administratively belongs to Bihor and Arad Counties.


Fig. 1 Vaşcău Plateau (Bihor County)
(http://www.infobihor.ro/user_files/images/harta_administrativa.jpg)

In the study of the association, phyto-sociological research methods of the Central European School were used. The relevee technique and the quantitative and qualitative assessments were done according to the instructions provided by Cristea et al, 2004. The quantitative criterion considered in the research of the phytocoenoses was the abundance and dominance of individuals to establish consistency classes (K = IV).

In th field sheet data on the stationary and habitat conditions in which the phytocoenosis develop were recorder, namely: altitude, exposition, slope, covering the vegetation cover (%) as well a species list, place and date of the survey. The size of sample surfaces used was 25 m².

Framing of the association in corresponding cenotaxonomic units alliance, order, class was made in accordance with ecological and floristic systems developed by Sanda et al, 2008. The values shown in the table of associations +, 1, 2, 3, 4, 5, which is abundance-dominance of each species, have the following percentage values: + = 0.5%, 1 = 5%, 2 = 17.5% 3 = 37.5%, 4 = 62.5%, 5 = 87.5% (Ivan, Doniță, 1975).

To identify the taxa I used the specialty literature: Illustrated Flora of Romania (Ciocârlan, 2000, 2009) and Vascular plants in Romania (Sarbu et al, 2013). Key terms used to characterize organic plants (life forms, floristic elements, ecological indices) were determined according to the literature produced by Sanda et al, 2003; Cristea et al, 2004. Chromosome number and karyotypes of different species were considered after studying some data provided by Flora Europaea (1964-1980), as well as some reference works (Löve, Löve 1974; Májovsky, Murin, 1987; Pignatti, 1995 a,b; Ciocârlan, 2000).

## RESULTS AND DISCUSSION

The largest covering of phytocoenoses is that of *Melica ciliata*, edifying dominant species that occupies the space between the limestone blocks from ground surface. On calcareous rocks the species characteristic of the *Asplenium ruta-muraria* association develops, having less coverage (table 1).

Association *Asplenio rutae-murariae-Melicetum ciliatae* Soó 1962, fall in syntaxonomical terms as follows (after Sanda et al, 2008):

***Festuco-Brometea*** **class** Br.-Bl. et R. Tüxen in Br.-Bl. 1949

***Stipio pulcherrimae-Festucetalia pallentis*** **order** I. Pop 1968

***Seslerio-Festucion pallentis*** **alliance** Klika 1931

Life forms spectrum (Figure 2) shows that hemicryptophytes species (54.39%) had the largest share, followed by annual terophytes (15.79%) and camaephytes (10.53%). Of floristic elements (Figure 3), the most are Eurasian species (36.84%), followed by European species (26.32%), Central Europeans (15.79%) and Mediterranean ones (8.77%).

Analyzing the diagram of ecological indices (Figure 4), depending on moisture, most species are xero-mesophytes (68.42%) and xerophytes (19.3%). Compared to the temperature factor, the weight is held by micro-mesothermophylous (61.41%), followed by moderately thermophylous (17.54%). The chemical reaction of the soil indicates the predominance in the association of the phytocoenosis of the weak acid-neutrophylous species (52.63%), followed by amphitolerant species (21.05%) and acid-neutrophylous ones (17.54%).

The karyotype spectrum (Figure 5) reveals a large share of polyploid species (50.88%), followed by diploid species (35.09%) and diplo-polyploid ones (14.03%).

*Table 1*

***Asplenio rutae-murariae-Melicetum ciliatae*** Soó 1962

| L.f. | F.e. | U. | T. | R. | 2n | Number | 1 | 2 | 3 | 4 | 5 | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Altitude (m.s.m.) | 450 | 470 | 490 | 500 | 520 | |
| | | | | | | The grass layer (%) | 70 | 75 | 80 | 80 | 65 | |
| | | | | | | Exposition | V | SE | SV | V | S | |
| | | | | | | Slope (degree) (º) | 20 | 25 | 20 | 18 | 15 | |
| | | | | | | Area (m²) | 25 | 25 | 25 | 25 | 25 | |
| H | Cp-Bo | 1.5 | 3 | 5 | P | As. *Asplenium ruta-muraria* | 1 | + | 1 | 1 | 1 | V |
| H | Ec | 1.5 | 4 | 4 | D | As. *Melica ciliata* | 3 | 4 | 3 | 3 | 3 | V |
| | | | | | | ***Seslerio-Festucion pallentis, Stipio pulcherrimae-Festucetalia pallentis*** | | | | | | |
| Ch | End Carp | 2 | 3.5 | 4.5 | P | *Thymus comosus* | + | + | + | + | + | V |
| H | Ec | 2.5 | 3 | 0 | D | *Peucedanum oreoselinum* | + | · | + | · | + | III |
| H | E | 1.5 | 3 | 0 | P | *Poa compressa* | + | + | · | + | · | III |
| H | E | 2 | 4 | 4 | D | *Vincetoxicum hirundinaria* | + | · | + | · | + | III |
| H | E | 2 | 3.5 | 4.5 | D.P | *Potentilla arenaria* | · | · | + | · | + | II |
| H | Mp | 2 | 4 | 4.5 | D | *Stachys recta* | + | · | + | · | · | II |
| | | | | | | ***Festuco-Brometea*** | | | | | | |
| H | Eua-C | 1.5 | 4 | 4 | D | *Festuca valesiaca* | 1 | + | 1 | 1 | 1 | V |
| TH-H | E | 3 | 3 | 3 | P | *Centaurea biebersteinii* | · | + | + | + | + | IV |
| H | Eua | 2 | 3.5 | 4 | P | *Sanguisorba minor* | · | + | + | + | + | IV |
| Ch | Ec | 2 | 3.5 | 4 | P | *Teucrium chamaedrys* | 1 | + | 1 | 2 | · | IV |
| H | Eua | 2 | 3 | 4 | D.P | *Euphorbia cyparissias* | + | · | · | + | + | III |
| H | E | 2 | 4 | 3 | D | *Fragaria viridis* | · | + | 1 | · | 1 | III |
| Ch | Ec | 2 | 3 | 0 | P | *Sedum sexangulare* | + | · | + | · | 1 | III |
| H-TH | Mp | 2 | 4 | 4 | P | *Stachys germanica* | · | · | + | + | + | III |
| Ch | Eua-C | 1.5 | 3.5 | 4 | P | *Thymus pannonicus* ssp. *pannonicus* | · | · | + | + | + | III |
| H | Ec | 2 | 3 | 3 | P | *Achillea collina* | + | · | + | · | · | II |
| Th-TH | E | 1.5 | 3.5 | 4 | D | *Acinos arvensis* | + | + | · | · | · | II |
| H | Eua-C | 2.5 | 3 | 4 | P | *Ajuga genevensis* | · | + | · | + | · | II |
| Th-TH | E | 1 | 3 | 0 | P | *Alyssum alyssoides* | · | · | · | + | + | II |
| H | E | 2 | 0 | 4 | D | *Anthyllis vulneraria* | + | · | + | · | · | II |
| Th | M | 2 | 4.5 | 4.5 | D | *Arabis auriculata* | + | · | · | + | · | II |
| TH-H | Cp-Bo | 1.5 | 3 | 4 | P | *Arabis hirsuta* | · | + | · | + | · | II |
| Th | Cp-Bo | 2 | 2.5 | 0 | P | *Arenaria serpyllifolia* | + | · | · | + | · | II |
| H | Mp | 2 | 3.5 | 4.5 | D.P | *Asperula cynanchica* | + | · | · | + | · | II |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H | Eua | 2.5 | 4 | 4 | P | *Brachypodium pinnatum* | · | · | + | · | + | II |
| TH-Th | Eua | 1.5 | 0 | 4.5 | P | *Carduus nutans* | · | + | + | · | · | II |
| G | Eua | 2 | 2.5 | 0 | P | *Carex caryophyllea* | · | · | + | + | · | II |
| H | Ec | 2 | 3 | 4 | P | *Coronilla varia* | · | + | + | · | · | II |
| H | E | 2 | 5 | 5 | D | *Dianthus carthusianorum* | + | · | · | · | + | II |
| TH | Eua | 2 | 3 | 4 | D.P | *Echium vulgare* | + | · | + | · | · | II |
| H | P | 1 | 5 | 4 | D.P | *Eryngium campestre* | · | + | · | + | · | II |
| H | Eua | 2.5 | 2.5 | 0 | P | *Galium verum* | 1 | + | · | · | · | II |
| Th | E | 2.5 | 3 | 0 | D.P | *Geranium pusillum* | · | · | + | · | + | II |
| H | Eua | 3 | 3 | 0 | P | *Hypericum perforatum* | · | · | + | + | · | II |
| G-H | Eua-C | 2 | 3.5 | 4 | D.P | *Poa bulbosa* | · | · | · | + | + | II |
| H | Eua | 2 | 4 | 2 | D | *Potentilla argentea* | + | · | · | + | · | II |
| H | Eua-C | 1.5 | 3.5 | 4 | P | *Potentilla recta* | + | · | + | · | · | II |
| H | E | 2.5 | 3 | 4.5 | D | *Salvia pratensis* ssp. *pratensis* | + | · | · | · | + | II |
| H | Eua-C | 2.5 | 2 | 4 | D | *Trifolium montanum* | + | · | · | · | + | II |
| Th | Mp | 2 | 4 | 3 | D | *Xeranthemum annuum* | · | + | + | · | · | II |
| Ch-H | Ec | 2 | 5 | 4 | D | *Dorycnium pentaphyllum* ssp. *herbaceum* | · | · | 1 | · | · | I |
| Ch | Eua | 0 | 3 | 3 | P | *Sedum acre* | · | · | · | · | + | I |
| H | Ec | 2 | 3.5 | 4 | D | *Seseli peucedanoides* | · | · | · | · | + | I |
| Th-TH | Eua | 3 | 3 | 0 | D | *Trifolium aureum* | · | · | · | + | · | I |
| | | | | | | **Variae Syntaxa** | | | | | | |
| mPh | E | 2.5 | 3 | 3 | D | *Crataegus monogyna* | + | + | + | + | · | IV |
| mPh | Cp-Bo | 2 | 0 | 0 | D | *Juniperus communis* | + | · | + | + | + | IV |
| nPh | E | 2 | 3 | 3 | P | *Rosa canina* | + | + | + | + | · | IV |
| mPh | Eua | 2 | 3 | 3 | P | *Prunus spinosa* | + | + | + | · | · | III |
| H | Cosm | 3 | 0 | 4 | P | *Asplenium trichomanes* ssp. *quadrivalens* | + | + | + | · | · | III |
| nPh | Ec | 3.5 | 3 | 2.5 | P | *Rubus sulcatus* | · | · | + | + | · | II |
| H | Eua | 2.5 | 2.5 | 3 | P | *Galium album* | · | · | + | + | · | II |
| H | E | 3 | 3 | 2.5 | D | *Hypochaeris radicata* | · | · | + | + | · | II |
| Th-TH | Eua | 2.5 | 3 | 4 | D.P | *Medicago lupulina* | · | + | + | · | · | II |
| H | Eua | 2 | 3 | 0 | P | *Sedum maximum* | + | · | + | · | · | II |

where: L.f. - life forms; mPh - Mezophanerophytes; nPh - Nanophanerophytes; Ch - Camephytes; H - Hemicryptophytes; G - Geophytes; Th - Annual terophytes; TH - Biannual terophytes; F.e. - floristic elements; Cp-Bo - Circumpolar boreal; Eua-Eurasian; E - European; Ec - Central European; End Carp - Carpathian endemism; M -Mediterranean; P - Pontic; Cosm-Cosmopolitan; Mp - Mediterano-Pontic.
U - humidity, T - temperature, R - the chemical reaction of the soil; K – constancy; 2n – karyotype.
Species that occur in a single relevé: *Cerastium holosteoides* (4); *Dianthus spiculifolius* (3); *Festuca rubra* (3); *Galium mollugo* (5); *Gratiola officinalis* (4); *Leontodon hispidus* (3); *Linum catharticum* (2); *Scleranthus annuus* (4); *Stachys officinalis* (3); *Thymus dacicus* (4); *Trisetum alpestre* (4); *Verbascum phlomoides* (4); *Verbascum nigrum* (5); *Xanthium spinosum* (4).
Place and date of mapping: 1 – 5 Rasteţului hill (Bihor county) 03.07.2011.

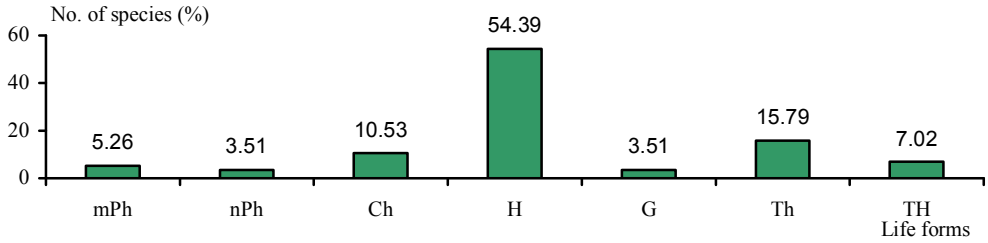


Fig. 2 The life forms spectrum of *Asplenio rutae-murariae-Melicetum ciliatae* association Soó 1962

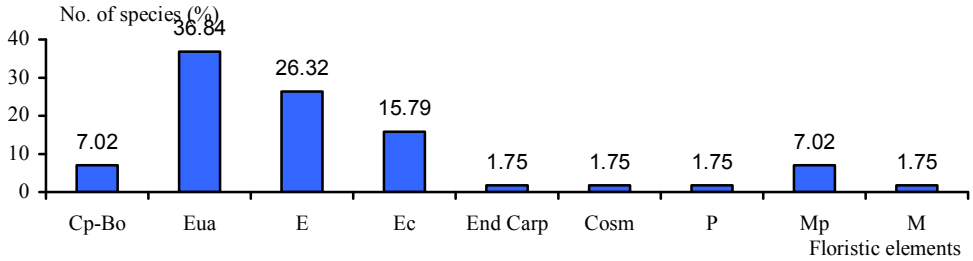


Fig. 3 Spectrum of floristic elements of the *Asplenio rutae-murariae-Melicetum ciliatae* association Soó 1962

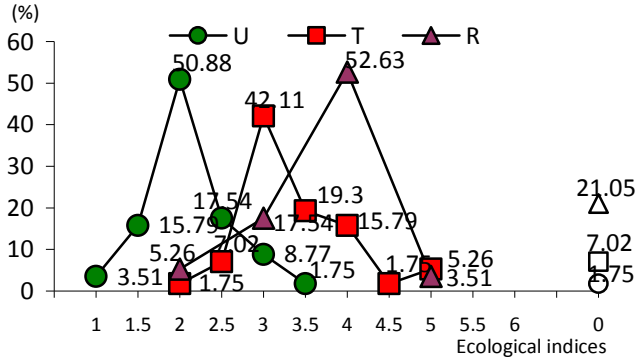


Fig. 4 Diagram of ecological indices for the *Asplenio rutae-murariae-Melicetum ciliatae* association Soó 1962

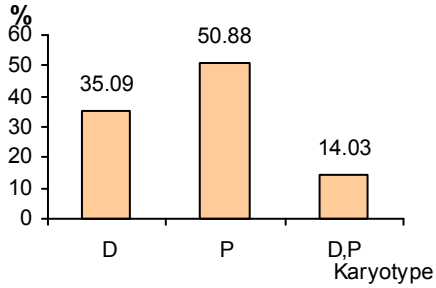


Fig. 5 Karyotype spectrum of the *Asplenio rutae-murariae-Melicetum ciliatae* association Soó 1962

## CONCLUSIONS

The study was conducted in 2008. The association was found in the Vaşcău Plateau on the limestone rocks of Rasteţului Hill, near the town of Câmp, Bihor County, and the following conclusions were made.

The chalcophile association grows in the investigated territory on pioneer rocky slopes, preferring sunny or partially sunny expositions on skeletal, sandy soil at altitudes of 450-520 m.

The floristic composition of the association, totalizing 57 species is dominated by calcio-phillic elements with low preferences on soil moisture. An important coenotic role is played by xerophytes and xero-mesophytes species specific to the *Seslerio-Festucion pallentis* alliance, *Stipio pulcherrimae-Festucetalia pallentis* order and *Festuco-Brometea* class.

These phytocenosis are important stages in the process of fallowing and covering of barren rocks with vegetation.

These phytocenoses have low economic significance, having in their floristic composition some forage plants: *Festuca valesiaca*, *Sanguisorba minor*, *Brachypodium pinnatum*, *Trifolium montanum* and medicinal ones: *Thymus comosus*, *Hypericum perforatum*, *Sedum acre*.

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