STUDY OF THE ROCKY VEGETATION IN THE CODRU-MOMA MOUNTAINS (NW ROMANIA)

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RESEARCH ARTICLE

Abstract
The present work is a phytocoenologic study of rocky vegetation in the Codru-Moma Mountains. The study was carried out between 2008-2023, a number of 5 rochys plant associations having been identified, namely: Asplenietum rutae-murariae-trichomanis, Asplenio quadrivalenti-Poëtum nemoralis, Asplenietum septentrionali-adianti-nigri, Asplenio trichomani-Poëtum nemoralis and Ctenidio-Polypodietum. To highlight the floristic composition of rochys associations, as well as the grouping of plants into life forms and floristic elements, a phytocoenological table was drawn up for the 5 rochys associations and the general constancy for each species. Spectrum of life forms and floristic elements were compiled for the studied associations illustrating the share of participation of different categories in the construction of phytocoenoses.

Keywords: phytocoenoses, rockys vegetation, floristic composition, life forms, floristic elements
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INTRODUCTION

The rockys pioneer phytocoenoses that populate the rock crevices of the Codru-Moma Mountains highlight the presence of a diverse range of plant associations. Depending on the nature of the lithological substrate, chalcophilic associations are found on basic-limestone substrate (*Asplenietum rutae-murariae-trichomanis*, *Asplenio quadrivalenti-Poëtum nemoralis*) and acidophilic associations on acid-crystalline shale substrate (*Asplenietum septentrionali-adianti-nigri*, *Asplenio trichomani-Poëtum nemoralis*, *Ctenidio-Polypodietum*). The growth of phytocoenoses on the cliffs is influenced by the exposure of the rocks, their degree of disaggregation, the humidity regime, the inclination of the slope, the altitude, the geographical position in the Codru-Moma Mountains.

These phytocoenoses are characterized by a large fluctuation of random, transgressive species in the *Querco-Fagetea*, *Festuco-Brometea*, *Rhamno-Prunetea*, *Quercetea pubescenti-Petraeae*, *Molinio-Arrhenatheretea* and *Galio-Urticetea* classes.

Some phytocoenological studies related to the study of rockys associations in the Codru-Moma Mountains were carried out by Păşcuţ, 2020 and Burescu & Păşcuţ, 2010.

The present study brings a series of novelties regarding the floristic composition, the structure of the rockys vegetation, with the objective of creating a scientific foundation for the implementation of conservation measures in the studied area. They are also aimed at establishing connections between various components of rockys phytocoenoses and the factors that can create ecological imbalances in the area.

MATERIAL AND METHOD

To carry out the phytocoenological study on the rockys vegetation in the Codru-Moma Mountains, information provided by some published works was used (Burescu & Păşcuţ, 2010; Păşcuţ, 2012; Păşcuţ, 2020).

The nomenclature of species and infrataxons (subspecies) is the one provided by Sârbu et al., 2013; Ciocârlan, 2009 and respects the nomenclature solutions considered correct according to the Vienna International Code of Botanical Nomenclature (McNeill et al., 2005), respectively, the Melbourne International Code of Botanical Nomenclature (McNeill et al., 2011).

The technique of carrying out phytocoenologic relevées and quantitative and qualitative assessments was made in accordance with the recommendations provided by Cristea et al., (2004). The test surfaces of the relevées were chosen in phytocoenoses as homogeneous as possible from a floristic and ecological point of view, in which the combination of species and environmental conditions (relief, soil, microclimate) varies insignificantly, avoiding ecotone areas. The size of the relevées areas adopted varies between 1-15 m^2.

In the table comprising the rockys associations studied, there was also introduced information related to: altitude, vegetation cover, moss layer cover, exposition, slope, surface and the number of relevées carried out. The general frequency (K) was written next to each species, representing the degree of fidelity of each species to each individual association.

The identification and description of plant associations was carried out based on the floristic criterion, with the help of characteristic, edifying, dominant and differential species. The name of the associations was made in accordance with the provisions established in Phytocoenological Nomenclature Code, Weber et al. (2000).

The classification of the associations in the corresponding cenotaxonomic units (suballiance, alliance, order, class) was done in accordance with the ecological-floristic systems developed by Oberdorfer (1992), Rodwell et al. (2002), Pott (1995), Mucina (1997), Rothmaler (1994, 2000), Borhidi (2003), Sanda et al. (2008), Chifu et al. (2014).

Information on life forms and floristic elements is presented based on the works of Pop (1977), Sanda et al. (1983, 2003), Meusel & Jäger (1992), Cristea et al. (2004).

At the bottom of the table, there were written the species that appeared in a single survey, the name of the associations studied, the locations and the relevées period.

RESULTS AND DISCUSSIONS

The rockys associations studied represent a type of pioneer vegetation that develops in rock crevices and on calcareous and siliceous rocks in the Codru-Moma Mountains. Due to restrictive stational conditions, the floristic composition of these associations is characterized by a large fluctuation of random species. These associations, with a rather vast area, have a rich floristic composition in which numerous transgressive species abound: *Querco-Fagetea*, *Festuco-Brometea*, *Rhamno-Prunetea*, *Quercetea pubescenti-Petraeae*, *Molinio-Arrhenatheretea* and *Galio-Urticetea* classes.

Following the rockys vegetation study carried out in the Codru-Moma Mountains, the following cenotaxons were identified:

Class *Asplenietea trichomanis* (Br.-Bl. in Meier et Br.-Bl. 1934) Oberdorfer 1977

Order *Tortulo-Cymbalarietalia* Segal 1969

Aliance *Cymbalario-Asplenion* Segal 1969 em. Mucina 1993

Association *Asplenietum rutae-murariae-trichomanis* R. Tüxen 1937

Aliance *Cystopteridion* Richard 1972

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

Order *Androsacetalia vandelli* Br.-Bl. in Maier et Br.-Bl. 1934

Aliance *Asplenion septentrionalis* Oberdorfer 1938

Association *Asplenietum septentrionali-adianti-nigri* Oberdorfer 1938

Association *Asplenio trichomani-Poëtum nemoralis* Boşcaiu 1971

Aliance *Hypno-Polypodion* Mucina 1993

Association *Ctenidio-Polypodietum* Jurko et Peciar 1963

The *Asplenietum rutae-murariae-trichomanis* association (figure 1), is found in the form of clumps between the crevices of calcareous rocks, with generally shaded exposure. It is spread on the cliffs along the valleys and intramontane streams of the Codru-Moma Mountains. Due to the shaded exposure of the cliffs and the inclusion of these phytocoenoses in the beech groves, a shaded microclimate was created with moderate air humidity throughout the year, and lower temperature during the summer. This fact allowed the installation of *Ctenidium* and *Syntrichia* bryophytes within these phytocoenoses. In the floristic composition of the association there are a number of 58 species of rockys plants (table 1). The physiognomy of the association is given by the characteristic species *Asplenium ruta-muraria* and *Asplenium trichomanes* ssp. *quadrivalens*, which are in a codominance relationship. Next to them the characteristic species of the *Cymbalario-Asplenion* alliance, the *Tortulo-Cymbalarietalia* order and the *Asplenietea trichomanis* class grow: *Cardaminopsis arenosa, Cystopteris fragilis, Poa nemoralis, Polypodium vulgare,*

Sedum hispanicum, Sedum maximum, Valeriana tripteris (table 1). A significant number of transgressive species from the *Querco-Fagetea* class penetrate into these rockys pioneer phytocoenoses on the calcareous substrate, namely: *Hedera helix, Asplenium scolopendrium, Campanula persicifolia, Geranium robertianum, Lamium galeobdolon, Mycelis muralis* and *Festuco-Brometea* class, such as: *Hypericum perforatum, Sedum acre, Vincetoxicum hirundinaria Teucrium chamaedrys, Thymus glabrescens.*

Figure 1. ***Asplenietum rutae-murariae-trichomanis*** **association next to Briheni village**

The phytocoenoses of the association *Asplenio quadrivalenti-Poëtum nemoralis* grow on the shaded calcareous cliffs, with a large slope, located on shaded slopes. The physiognomy of the association is given by the two edifying species, *Asplenium trichomanes* ssp. *quadrivalens* and *Poa nemoralis*, in a codominant relationship. The floristic composition of the association consists of 57 analyzed species, of which 8 species are characteristic for the *Cyptopteridion* alliance, the *Tortulo-Cymbalarietalia* order, the *Asplenietea trichomanis* class, namely: *Asplenium adulterinum, Asplenium ruta-muraria, Cardaminopsis arenosa, Cystopteris fragilis, Polypodium vulgare, Sedum maximum, Sedum hispanicum, Valeriana tripteris* (table 1). Being phytocoenoses that grow on the rocks inside the beech forests, the floristic composition of the association includes a large number of species characteristic of the *Querco-Fagetea* class, of which the most common are: *Asplenium scolopendrium, Geranium robertianum, Lamium galeobdolon, Moehringia muscosa, Mycelis muralis, Rubus hirtus, Hedera helix, Galium schultesi* (table 1). In this association, the muscinal layer has an important role in maintaining humidity, which is why the *Ctenidium molluscum* and *Marchantia polymorpha* species have a relatively high frequency.

In the Codru-Moma Mountains, the phytocoenoses of the *Asplenietum septentrionali-adianti-nigri* association were identified growing on siliceous rocks with a large slope, along some valleys and streams at the edge of the hornbem and beech forests. It grows on a shallow lithosol, poor in organic substances and with a weak acid-neutrophylous pH. The 30 inventoried species are floristically and ecologically subordinated to the coenotaxa corresponding to the alliance, order and class that justify the inclusion of the phytocoenoses on the siliceous shale cliffs in the *Asplenietum septentrionali-adianti-nigri* association. The physiognomy of the association is given by the *Asplenium adiantum-nigrum* and *Asplenium septentrionale* species. Along with these, the differential and recognition species for the *Asplenion septentrionalis* alliance, the *Androsacetalia vandelii* order and the *Asplenietea trichomanis* class are developing: *Asplenium adulterinum, Asplenium trichomanes* ssp. *trichomanes, Poa nemoralis*, *Polypodium vulgare, Sedum maximum, Silene nutans* ssp. *dubia* (table 1). The floristic composition of the association also includes a significant number of transgressive species from the *Festuco-Brometea* classes: *Euphorbia cyparissias, Hypericum perforatum, Potentilla argentea, Sedum acre, Thymus glabrescens, Teucrium chamaedrys, Dichanthium ischaemum* and *Querco-Fagetea* class: *Campanula persicifolia*, *Clinopodium vulgare*, *Cruciata glabra*, *Dryopteris filix-mas*, *Geranium robertianum*, *Mycelis muralis*, *Moehringia muscosa*, which signifies a strong imprint of the woody and grassy vegetation on the vegetation of the cliffs as a result of their areas intersecting in some places (table 1). High humidity is maintained on these rocks all year round, a fact demonstrated by the presence of the species *Ctenidium molluscum*.

The *Asplenio trichomani-Poëtum nemoralis* association (figure 2), is found on siliceous cliffs with a steep slope. The phytocoenoses of this association prefer rocky outcrops on shaded valleys, located on slopes with generally northern exposures. The characteristic and edifying species for the association are *Poa nemoralis* and *Asplenium trichomanes* ssp. *trichomanes*. The recognition species for the *Asplenion septentrionalis* alliance, the *Androsacetalia vandelii* order and the *Asplenietea trichomanis* class, which subordinate the association, are: *Asplenium*

adiantum-nigrum, Asplenium septentrionale, Cardaminopsis arenosa, Cystopteris fragilis, Polypodium vulgare, Sedum maximum, Valeriana tripteris (table 1). The total number of inventoried and analyzed species is 67, identified in a number of 25 relevées. The phytocoenoses of the association include many species specific to forests and scrubs, transgressive from the *Querco-Fagetea* classes: *Rubus hirtus, Dryopteris filix-mas, Geranium robertianum, Lamium galeobdolon, Mycelis muralis, Quercetea pubescenti-Petraeae* class: *Cytisus nigricans, Genista ovata, Arabis turrita, Melampyrum bihariense* and *Rhamno-Prunetea* class: *Sambucus nigra, Cornus sanguinea, Corylus avellana, Crataegus monogyna, Evonymus europaeus, Clematis vitalba* (table 1).

Figure 2 ***Asplenio trichomani-Poëtum nemoralis*** **association on Boroaia Valley**

The phytocoenoses of the *Ctenidio-Polypodietum* association (figure 3), develop between the cracks and on the shelves of the shaded cliffs, from the lower hilly area to the peaks of the Codru-Moma Mountains, on lands with shaded exposures and high inclination. Humidity is the determining factor, the association preferring the lower third of steep and shaded slopes, near valleys and mountain streams. The physiognomy of the association is given by *Ctenidium molluscum*, being the edifying and dominant species, and by *Polypodium vulgare*. In the floristic composition of the phytocoenoses of this association, a number of 76 species were inventoried (table 1). A large number of species subordinate to the association of the *Hypno-Polypodion* alliance, the *Androsacetalia vandelii* order and the *Asplenietea trichomanis* class, many of which are casmophilous, such as: *Asplenium adiantum-nigrum, Asplenium adulterinum, Asplenium ruta-muraria, Asplenium septentrionale, Asplenium trichomanes* ssp. *quadrivalens, Asplenium trichomanes* ssp. *trichomanes, Cardaminopsis arenosa, Ceterach officinarum, Cystopteris fragilis, Poa nemoralis, Sedum maximum, Valeriana tripteris* (table 1). The transgressive species from the *Querco-Fagetea* class are also well represented: *Rubus hirtus, Hedera helix, Asplenium scolopendrium, Athyrium filix-femina, Asarum europaeum, Campanula persicifolia, Dryopteris filix-mas, Galium odoratum, Geranium robertianum, Lamium galeobdolon, Luzula luzuloides, Mycelis muralis, Oxalis acetosella, Polygonatum odoratum*, characteristic of mesophyll forests, at the edge of which the phytocoenoses of these associations develop (table 1).

Figure 3 ***Ctenidio-Polypodietum*** **association on Şoimului Valley**

Table 1

The floristic composition of rocky associations in the Codru-Moma Mountains

L.f.	F. e.	Association no.	1	2	3	4	5
		Altitude (m.s.m.)	400-680	410-800	350-590	350-945	330-1000
		Vegetation cover (%)	20-80	40-75	40-80	40-80	50-100
		Moss layer coverage l(%)	0-25	0-40	0-20	0-25	5-65
		Exposition	N, NV, NE	N, NV, E	N, NV	N, NV, NE	N, NE, NV
		Slope (º)	30-90	40-90	75-90	30-90	30-90
		Surface (m²)	1-6	1-16	1-8	2-15	2-14
		No. of relevées carried out	25	17	9	25	25
0	1	2	3	4	5	6	7
H	Cp	As. *Asplenium ruta-muraria*	V	I	·	·	I
H	Cosm	As. *Asplenium trichomanes* ssp. *quadrivalens*	V	V	·	·	II
H	Cosm	As. *Asplenium trichomanes* ssp. *trichomanes*	·	·	V	V	III
H	Cp	As. *Asplenium septentrionale*	·	·	V	I	I
H	E	As. *Asplenium adiantum-nigrum*	·	·	V	I	I

0	1	2	3	4	5	6	7
H	Eua	As. *Poa nemoralis*	II	V	IV	V	III
G	Cp	As. *Polypodium vulgare*	II	II	II	IV	V
-	-	As. *Ctenidium molluscum*	III	IV	IV	II	V
		Cymbalario-Asplenion, Cystopteridion,Tortulo-Cymbalarietalia, Asplenion septentrionalis, Hypno-Polypodion, Androsacetalia vandelli, Asplenietea trichomanis					
H	Eua	*Sedum maximum*	II	III	V	IV	IV
TH	Ec	*Cardaminopsis arenosa*	I	I	·	I	I
H	Cosm	*Cystopteris fragilis*	I	II	·	I	I
H	Ec	*Valeriana tripteris*	II	II	·	I	I
H	E	*Asplenium adulterinum*	·	I	I	·	I
Th	M	*Sedum hispanicum*	I	I	·	·	·
H	Eua	*Sile nutans* ssp. *dubia*	I	·	II	·	·
H	Atl-M	*Ceterach officinarum*	·	·	·	·	I
		Querco-Fagetea					
H	Eua	*Campanula persicifolia*	II	I	II	II	II
H	Cosm	*Dryopteris filix-mas*	I	I	II	III	II
Th	Cosm	*Geranium robertianum*	II	III	II	III	IV
H	Ec	*Lamium galeobdolon*	II	III	I	III	IV
H	Ec	*Moehringia muscosa*	II	III	II	II	II
H	E	*Mycelis muralis*	II	III	II	III	III
H	Eua	*Asarum europaeum*	I	I	·	II	II
G	Cp	*Asplenium scolopendrium*	III	IV	·	II	II
H	Eua	*Campanula rapunculoides*	I	I	·	I	I
G	Ec	*Galium schultesii*	I	II	·	I	I
l-nPh	Atl-M	*Hedera helix*	III	II	·	I	II
Th	Eua	*Moehringia trinervia*	I	I	·	I	I
G	Eua	*Polygonatum odoratum*	I	I	·	I	II
H	Cp	*Clinopodium vulgare*	I	I	II	·	·
H	Eua	*Cruciata glabra*	·	I	II	I	·
nPh	Eua	*Daphne mezereum*	I	I	·	I	·
G	Ec	*Dentaria bulbifera*	·	I	·	I	I
mPh	E	*Euonymus latifolius*	·	I	·	I	I
G	E	*Hepatica nobilis*	I	I	·	·	I
H	E	*Lamium maculatum*	I	·	·	I	I
nPh	E	*Rubus hirtus*	·	II	·	IV	III
MPh	Eua	*Acer platanoides* (youth)	·	I	·	·	I
MPh	Ec	*Acer pseudoplatanus* (youth)	·	·	·	I	I
H	Eua	*Actaea spicata*	I	·	·	·	I
Th	Eua	*Alliaria petiolata*	·	·	·	I	I
H	Cosm	*Athyrium filix-femina*	·	·	·	I	II
H	E	*Carex digitata*	·	·	I	I	·
Mh	E	*Carpinus betulus* (youth)	·	·	·	I	I
MPh	E	*Fagus sylvatica* (youth)	·	I	·	·	I
G	E	*Galanthus nivalis*	·	I	·	·	I
G	Eua	*Galium odoratum*	·	·	·	I	II
H	Eua	*Geum urbanum*	I	I	·	·	·
H	Mp	*Glechoma hirsuta*	I	·	·	I	·
H	E	*Luzula luzuloides*	·	·	·	I	II
H	E	*Melica uniflora*	·	I	·	I	·
H	E	*Mercurialis perennis*	·	·	·	I	I
H	Cp	*Oxalis acetosella*	I	·	·	·	II
H	E	*Polystichum aculeatum*	·	II	·	·	I
H	Cosm	*Polystichum setiferum*	·	·	·	I	I
H	Atl-M	*Sanicula europaea*	·	I	·	I	·
MPh	Ec	*Tilia platyphyllos* (youth)	·	·	·	I	I
MPh	Eua	*Ulmus glabra* (youth)	·	·	·	I	I
H	Eua	*Calamagrostis arundinacea*	·	·	·	·	III
G	Carp	*Festuca drymeja*	·	·	·	·	II
		Festuco-Brometea					
H	Eua	*Hypericum perforatum*	I	I	I	I	·
Ch	Eua	*Sedum acre*	I	·	III	·	I
H	E	*Vincetoxicum hirundinaria*	I	I	·	·	I
H	Eua	*Brachypodium pinnatum*	I	I	·	·	·
H	Eua	*Dichanthium ischaemum*	I	·	I	·	·
H	Eua	*Euphorbia cyparissias*	I	·	II	·	·
H	Eua	*Potentilla argentea*	I	·	I	·	·
Ch	Ec	*Teucrium chamaedrys*	II	·	III	·	·

0	1	2	3	4	5	6	7
Ch	Ppn	*Thymus glabrescens*	I	·	III	·	·
		Rhamno-Prunetea					
mPh	E	*Sambucus nigra*	I	I	·	I	III
l-nPh	Ec	*Clematis vitalba*	I	I	·	I	·
mPh	Ec	*Cornus sanguinea*	I	I	·	I	·
mPh	E	*Corylus avellana*	·	I	·	I	II
mPh	P	*Cornus mas*	·	I	·	·	I
mPh	E	*Crataegus monogyna*	I	·	·	I	·
mPh	E	*Evonymus europaeus*	·	·	·	I	I
mPh	E	*Ligustrum vulgare*	·	I	·	I	·
H	Eua	*Origanum vulgare*	I	·	·	·	I
		Quercetea pubescenti-Petraeae					
Th	DB	*Melampyrum bihariense*	I	I	·	I	I
Th	M	*Arabis turrita*	I	·	·	I	I
H	Ec	*Calamintha menthifolia*	I	I	I	·	·
nPh	Ec	*Cytisus nigricans*	·	·	·	I	I
nPh	Alp	*Genista ovata*	·	·	·	I	I
H	Eua	*Primula veris*	·	I	·	·	I
G	Atl-M	*Tamus communis*	·	·	·	I	I
		Molinio-Arrhenatheretea					
H	Eua	*Veronica chamaedrys*	·	I	I	I	I
H	Eua	*Galium mollugo*	I	·	·	I	I
H	Eua	*Achillea millefolium*	I	·	·	·	I
		Galio-Urticetea					
H	Eua	*Salvia glutinosa*	II	III	II	I	III
Th	Eua	*Galeopsis speciosa*	I	I	·	I	II
H	Cosm	*Urtica dioica*	·	·	·	I	I
		Variae Syntaxa					
H	Eua	*Fragaria vesca*	I	I	III	I	I
H	Eua	*Galium album*	II	III	I	I	I
H	Ec	*Doronicum austriacum*	II	IV	·	I	II
H	Cp	*Hieracium umbelatum*	·	·	I	I	I
TH	E	*Verbascum phlomoides*	I	I	·	I	·
H	Eua	*Chelidonium majus*	·	·	·	I	II
H	M	*Parietaria officinalis*	I	I	·	·	I
Th	M	*Sedum cepae*	I	·	·	·	I
H	Cp	*Solidago virgaurea*	·	·	·	I	I
		Bryophyta					
-	-	*Marchantia polymorpha*	·	I	·	I	I
-	-	*Hypnum cupressiforme*	·	·	·	I	·
-	-	*Syntrichia ruralis* var. *calcicola*	I	·	·	·	·
-	-	*Polytrichum commune*	·	·	·	I	·

Legend: L. f. – life forms; F. e. – floristic elements; Species that occour in a single relevée in studied associations: *Achillea collina* (1); *Agrimonia eupatoria* (1); *Anthriscus sylvestris* (2); *Asperula cynanchica* (1); *Brachypodium sylvaticum* (4); *Carex pilosa* (5); *Centaurea biebersteinii* (1); *Chamaecytisus hirsutus* ssp. *leucotrichus* (4); *Circaea lutetiana* (4); *Corydalis solida* (2); *Dactylis polygama* (5); *Dianthus carthusianorum* (1); *Dianthus spiculifolius* (1); *Dryopteris carthusiana* (5); *Festuca gigantea* (2); *Festuca pallens* (5); *Festuca valesiaca* (1); *Fragaria viridis* (1); *Geranium pusillum* (1); *Genistella sagittalis* (1); *Gentiana asclepiadea* (4); *Helianthemum nummularium* (1); *Heracleum sphondylium* (2); *Hieracium pilosella* (1); *Lunaria rediviva* (5); *Medicago lupulina* (1); *Melittis melissophyllum* (5); *Paris quadrifolia* (4); *Peucedanum longifolium* (1); *Poa compressa* (1); *Polygonatum latifolium* (5); *Potentilla arenaria* (1); *Primula acaulis* (5); *Primula elatior* ssp. *leucophylla* (1); *Pulmonaria officinalis* (5); *Rosa canina* (1); *Rubus idaeus* (5); *Sanguisorba minor* (1); *Saxifraga cuneifolia* (4); *Scrophularia nodosa* (5); *Sedum sexangulare* (1); *Senecio ovatus* (2); *Silene alba* (5); *Solanum dulcamara* (5); *Sorbus torminalis (tineret)* (5); *Spiraea chamaedrifolia* (5); *Stachys germanica* (1); *Staphylea pinnata* (5); *Symphytum tuberosum* (5); *Teucrium montanum* (1); *Thymus comosus* (1); *Thymus pannonicus* ssp. *pannonicus* (1); *Thymus pulegioides* (1); *Trifolium alpestre* (1); *Tussilago farfara* (4); *Valeriana officinalis* (2); *Viola reichenbachiana* (4); *Vulpia myuros* (3).

Association no. 1 - *Asplenietum rutae-murariae-trichomanis* (the relevées period 2008-2022 in the following locations Morilor Valley, Ormanului Valley, Briheni village, Șopotesei Valley, Crișului Văratec Valley, Ponoare meadow, Câmp Moți village, Rastetului hill, Bănișoara Sfâraș, Țarinii Valley (Bihor county), Moneasa Valley (Arad county)

Association no. 2 - *Asplenio quadrivalenti-Poëtum nemoralis* (the relevées period 2009-2020 in the following locations Tărcăiței Valley, Tisa peak, Briheni village, Șopotesei Valley, Ponoare meadow, Brătcoaia meadow, Caprei peak (Bihor county)

Association no. 3 - *Asplenietum septentrionali-adianti-nigri* (the relevées period 2008-2015 in the following locations Mic Valley, Crișului Văratec Valley, Briheni village (Bihor county)

Association no. 4 - *Asplenio trichomani-Poëtum nemoralis* (the relevées period 2008-2023 in the following locations Șerbanului Valley, Crișului Văratec Valley, Briheni village, Zărzagului Valley, Cusuiuș Valley, Tărcăiței Valley, Toaca hill, Caselor hill (Bihor county), Urvișului Valley, Archiș Valley, Clitului Valley, Hășmașului Valley, Boroaia Valley, Zugăului Valley, Izoiu Mic peak, Râului Valley (Arad county)

Association no. 5 - *Ctenidio-Polypodietum* (the relevées period 2008-2023 in the following locations Zărzagului Valley, Râposu brook, Ormanului Valley, Șerbanului Valley, Morilor Valley, Șoimului Valley, Moșcoru Valley, Pontului Valley, Finișului Valley, Moara Dracului - Briheni village, Mic Valley, Crișului Văratec Valley, Dealul Mare hill, Cusuiuș Valley (Bihor county), Urvișului Valley, Clitului Valley, Hășmașului Valley, Moneasa Valley, Boroaia Valley, Izoiu Mic peak, Osoiu Mare peak, Megheș Valley - Piatra Mică, Osoi brook to Merișoara peak, Râului Valley, Moma peak (Arad county).

The results obtained from the analysis of the life forms (table 2, figure 4), highlight the high share of the hemicryptophyte species group (80% in the case of the *Asplenietum septentrionali-adianti-nigri* association), followed by phanerophytes (25.37% in the case of the *Asplenio trichomani-Poëtum nemoralis* association), therophytes (15.52% in the case of the *Asplenietum rutae-murariae-trichomanis* association) and geophytes (13.15% in the case of the *Ctenidio-Polypodietum* association).

Table 2

Life forms and their weight of representation

Life forms \ Association		*Asplenietum rutae-murariae-trichomanis*	*Asplenio quadrivalenti-Poëtum nemoralis*	*Asplenietum septentrionali-adianti-nigri*	*Asplenio trichomani-Poëtum nemoralis*	*Ctenidio-Polypodietum*
MPh	no.	-	2	-	4	6
	%	-	3.51	-	5.97	7.89
mPh	no.	2	5	-	6	4
	%	3.45	8.77	-	8.95	5,26
nPh	no.	2	3	-	5	4
	%	3.45	5.26	-	7.46	5.26
l-nPh	no.	2	2	-	2	1
	%	3.45	3.51	-	2.99	1.32
G	no.	5	7	1	7	10
	%	8.62	12.28	3.33	10.45	13.15
H	no.	35	31	24	35	42
	%	60.34	54.39	80	52.24	55.26
Ch	no.	3	-	3	-	1
	%	5.17	-	10	-	1.32
Th	no.	7	5	2	6	7
	%	12.07	8.77	6.67	8.95	9.22
TH	no.	2	2	-	2	1
	%	3.45	3.51	-	2.99	1.32
Total	no.	58	57	30	67	76
	%	100	100	100	100	100

Legend: MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; l-nPh - Climbing plants; G - Geophytes; H - Hemicryptophytes; Ch - Chamaephytes; Th - Annual therophytes; TH - Biannual therophytes.

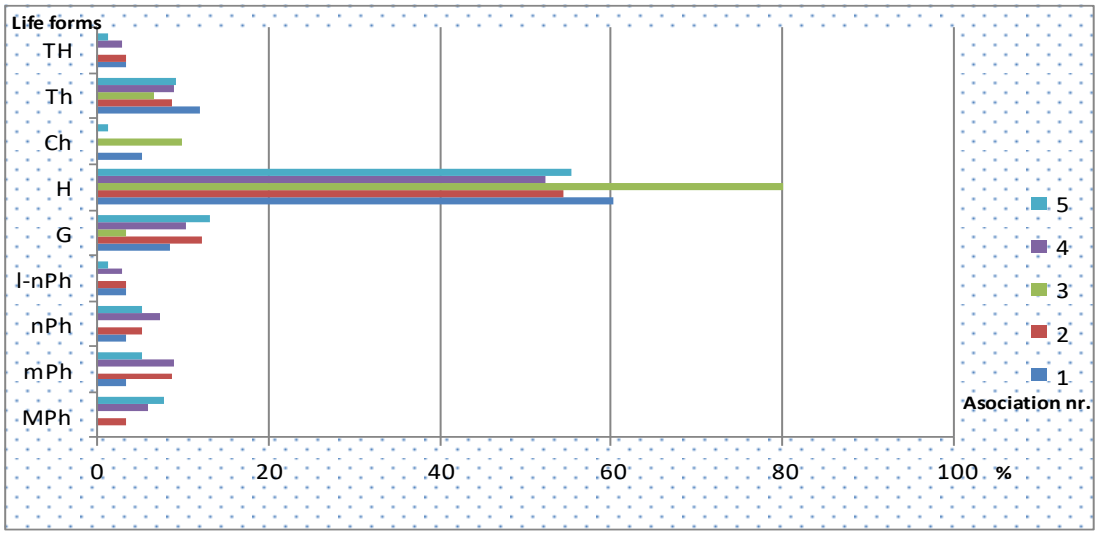

Figure 4 **The life forms spectrum for the rockys associations**

The analysis of the floristic elements of the species identified on the rocks in the Codru-Moma Mountains, highlights the dominance of Eurasian species (46.68% in the case of the *Asplenietum septentrionali-adianti-nigri* association), on which European elements were installed (24.36% in the case *Asplenio quadrivalenti-Poëtum nemoralis* association), central European (17.91% in the case of the *Asplenio trichomani-Poëtum nemoralis* association), circumpolar (13.33% in the case of the *Asplenietum septentrionali-adianti-nigri* association) and cosmopolitan (10.53% in the

case of the *Ctenidio-Polypodietum* association), (table 3, figure 5).

Table 3

Floristic elements and their weight of representation

Association / Floristic elements		***Asplenietum rutae-murariae-trichomanis***	***Asplenio quadrivalenti-Poëtum nemoralis***	***Asplenietum septentrionali-adianti-nigri***	***Asplenio trichomani-Poëtum nemoralis***	***Ctenidio-Polypodietum***
Cp	no.	5	4	4	5	7
	%	8.62	7.02	13.33	7.46	9.21
Cosm	no.	4	4	3	7	8
	%	6.90	7.02	10	10.45	10.53
Eua	no.	24	19	14	20	24
	%	41.38	33.33	46.68	29.86	31.57
E	no.	7	14	4	16	17
	%	12.07	24.36	13.33	23.88	22.36
Ec	no.	10	10	4	12	10
	%	17.25	17.55	13.33	17.91	13.15
Atl-M	no.	1	2	-	3	3
	%	1.72	3.51	-	4.48	3.95
Carp	no.	-	-	-	-	1
	%	-	-	-	-	1.32
Ppn	no.	1	-	1	-	-
	%	1.72	-	3.33	-	-
M	no.	4	2	-	1	3
	%	6.90	3.51	-	1.49	3.95
DB	no.	1	1	-	1	1
	%	1.72	1.75	-	1.49	1.32
Mp	no.	1	-	-	1	-
	%	1.72	-	-	1.49	-
P	no.	-	1	-	-	1
	%	-	1.75	-	-	1.32
Alp	no.	-	-	-	1	1
	%	-	-	-	1.49	1.32
Total	no.	58	57	30	67	76
	%	100	100	100	100	100

Legend: Cp - Circumpolar; Cosm - Cosmopolitan; Eua - Eurasian; E - European; Ec - Central European; Atl-M - Atlantic-Mediterranean; Carp - Carpathian; Ppn - Ponto-Pannonic; M - Mediterranean; DB - Dacian-Balkan; Mp - Mediterrano-Pontic; P - Pontic; Alp - Alpine;

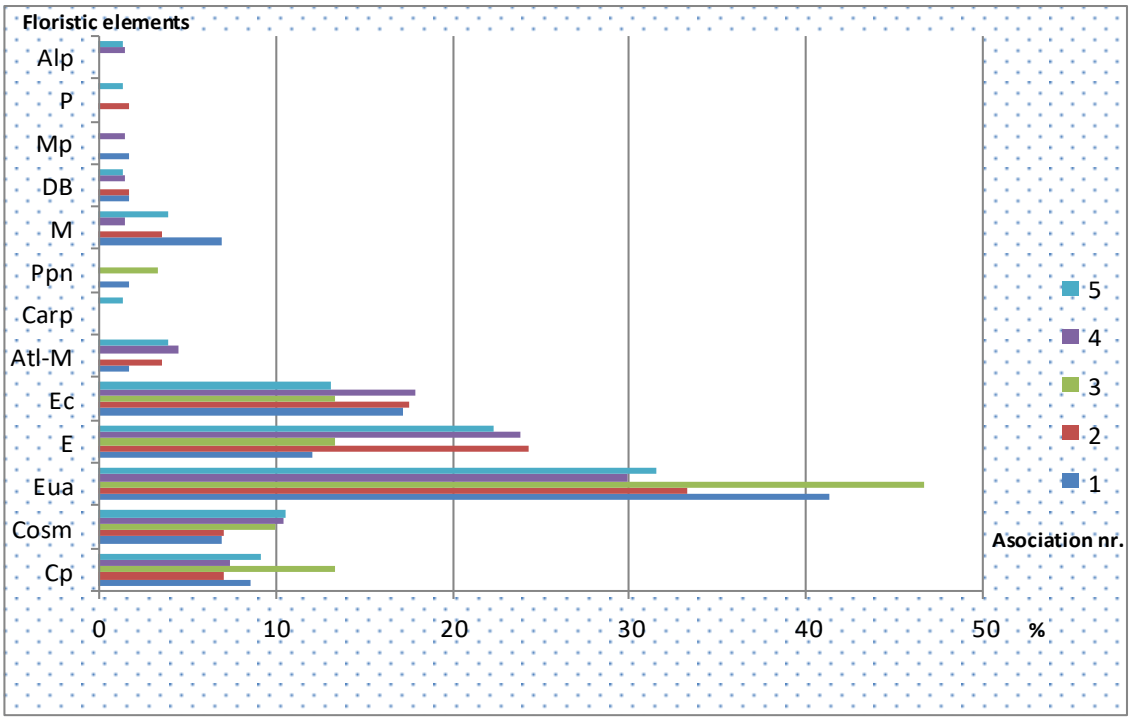

Figure 5 **Spectrum of floristic elements for the rockys associations**

CONCLUSIONS

The analysis of the life forms for the studied associations represents a fundamental element in the characterization of the rockys flora of the Codru-Moma Mountains, highlightings at the same time the characteristics of the habitats and the influences exerted on them by various disturbing factors. The high percentage of hemicryptophytes suggests a temperate climate with frosty winters and large diurnal temperature differences. The increase in the weight of hemicryptophytes and phanerophytes in the studied rockys plant groups indicates the beginning of the installation of herbaceous or woody associations. The geophytes highlight the vernal flora of the forests in which the studied rockys associations are present (beech forests, hornbeam-beech forests), as well as the vernal flora of the meadows. The significant presence of therophyte species is explained by the intensification of zoo-anthropic influences in the forest and meadow ecosystems where rockys associations are concentrated.

Analyzing the floristic elements identified on the rocks in the Codru-Moma Mountains, the presence of a wide spectrum of species of different geographical origins and with specific ecological requirements is observed. The northern elements (Eurasian, European, Central-European, Circumpolar, Alpine) dominate the floristic spectrum of rockys associations in the Codru-Moma Mountains, which denotes the presence of cold and humid microclimates in these resorts. The presence of a small number of Mediterranean, Mediterranean-Pontic, Atlantic-Mediterranean, Pontic and Ponto-Pannonian species is noted, an expression of favorable microclimate conditions in some isolated resorts.

In the area of the Codru-Moma Mountains, some anthropogenic influences are felt that endanger biodiversity, lead to the deterioration of vegetation, mentioning the extraction of rocks, infrastructure, deforestation, overgrazing and human settlements.

REFERENCES

Borhidi, A., 2003. Magyarország növénytársulássai, Akadémiai Kiadó, Budapest.

Burescu, P., Păşcuţ, C.,G., 201. Inputs to knowledge of rocks vegetation within Codru-Moma Mountains (NW Romania), ,,International Conference of Sciences" University of Oradea Annals, ISSN 1224-5119, Tom. XVII/1, pp. 62-69.

Chifu, T., Irimia, I., Zamfirescu, O., 2014. The phytosociological diversity of Romania's vegetation. European Institute Publishing House, Iaşi, vol.I+II+III;

Ciocârlan, V., 2009. Illustrated flora of Romania: *Pteridophyta* et *Spermatophyta*. Ceres Publishing House, Bucharest, 1141 p.

Cristea, V., Gafta, D., Pedrotti, F., 2004. Phytosociology. Cluj University Press Publishing House, Cluj-Napoca, 396 p.

McNeill, J., Barrie, F., R., Burdet, H., M., Demoulin, V., Hawksworth, D., L., Marhold, K., Nicolson, D., H., Prado, J., Silva, P., C., Skog, J., E., Wiersema, J., H., Turland, N., J., 2007. International Code of Botanical Nomenclature (Vienna Code) adopted by the Seventeenth International Botanical Congress Vienna, Austria, July 2005 - (Regnum Vegetabile, 146), 18, Gantner, Ruggell., 568 p.

McNeill, J., Barrie, F., R., Buck, W., R., Demoulin, V., Greuter, W., Hawksworth, D., L., Herendeen, P., S., Knapp, S., Marhold, K., Prado, J., Prud'Homme Van Reine, W., F., Smith, G., F., Wiersema, J., H., Turland, N., J., 2011. International Code of Nomenclature for algae, fungi and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011, Regnum Vegetabile, 154, 30, A.R.G. Gantner Verlag KG, 240 p.

Meusel, H, Jäger, E., J., 1992. Vergleichende Chorologie der Zentraleuropäischen Flora. III, Gustav Fischer Verlag, Jena, 333 p.

Mucina, L., 1997. Conspectus of Classes of European Vegetation. Folia Geobot. Phytotax., Praha, 32:117-172.

Oberdorfer, E., 1992. Süddeutsche Pflanzen-gesellschaften, Teil IV: Wälder und Gebüsche 2, Stark berabeilete Auflage Texband, Gustav Fischer Verlag Viena, New York.

Păşcuţ, C., G, 2012. Flora and vegetation of the Codru-Moma Mountains. PhD thesis (abstract), University of Oradea.

Păşcuț C., G., 2020. Phytocoenological study of rocky vegetation from Codru-Moma Mountains based on ecological indices. University of Oradea Annals, Series: Environmental Protection. I.S.S.N. 1224-6255, vol. XXXIV, pp. 183-194.

Pop, I., 1977. Ecological biogeography, volume I. Dacia Publishing House, Cluj-Napoca.

Pott, R., 1995. Die Pflanzengesellschaften Deutschlands, 2 Aufl., Ulmer Verlug, Stuttgart.

Rodwell, J., S., Schaminée, J., H., J., Mucina, L., Pignatti, S., Dring, J., Moss, D., 2002. The diversity of European vegetation: An overview of phytosociological alliances and their relationships to EUNIS habitats, National Centre for Agriculture, Nature Management and Fisheries, Wageningen, 168 p.

Rothmaler, W., 1994. Exkursionflora von Deutschland, Band 48 Anflage, Gustav Fischer Verlag, Jena-Stuttgart.

Rothmaler, W., 2000. Exkursionflora von Deutschland, Band 3, Gefäβpflanzen: Atlasband, Spektrum Akademischer Verlag, Heidelberg-Berlin.

Sanda, V., Biţă-Nicolae, C., Barabaş, N., 2003. The flora of spontaneous and cultivated cormophytes from Romania. „Ion Borcea" Publishing House, Bacău, 316 p.

Sanda, V., Öllerer, K., Burescu, P., 2008. Phytocoenoses from Romania. Syntaxonomy, structure, dynamics and evolution. „Ars Docendi" Publishing House, Bucharest, 570 p.

Sanda, V., Popescu, A., Dolţu, I., M., Doniţă, N., 1983. The ecological and phytocenological characterization of the species of the flora of Romania. Studies and Communications, Brukenthal Museum, Sibiu, Supplement, 25:1-126.

Sârbu, I., Ştefan, N., Oprea, A., 2013. Vascular plants from Romania, Victor B Victor Publishing House, Bucharest, 1320 p.

Weber, H.E., Moravec, J., Theurillat, J., P., 2000. International Code of Phytosociological Nomenclature, 3 ed., Journal of Vegetation Science, Uppsala, 739-768.