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COENOTAXONOMICAL CHARACTERIZATION OF THE MEGAFORBS FROM HOROABA VALLEY (BUCEGI MOUNTAINS)

CHIRIŢOIU MAGDALENA*

Abstract: In this paper are presented two associations of megaforbs of *Adenostylo-Doronicetum austriaci* Horv. 1956 and *Cirsio waldsteinii-Heracleetum transsilvanici* Pawl. et Walas 1949, which were identified in the area of the Natural Reserve Peştera-Cocora-Valea Horoabei (Bucegi Natural Parc). There are also presented the species of plants found here and which are included in the Red List of the superior plants from Romania.

Key words: megaforbs, Horoaba Canyon.

Introduction

Geographical characterization: the Bucegi Massif is situated in the Eastern side of the Meridional Carpathians. It is bordered by Prahova Valley in the East, Cerbul Valley and Glăjăria Valley in the North, the Rucăr-Bran Passage in the West, the Sub-Carpathians and Gurguiatu Massif.

Geological Structure: **t**he geological foundation of the Massif is represented by crystalline rocks belonging to the Gaetic Layer of the Meridional Carpathians. They are prevalent in the Western side and rarely on Ialomiţa Valley or on the southern slope. Above them supplementary deposits from the Jurassic and Cretaceous alternating with limestone and marl-limestone and gritstone and conglomerate are found. During the Quaternary the glacial valleys (ex. Cerbul Valley, Mălăieşti, Gaura, Ialomiţa) and the deposits which represent the frontal moraines in the majority of the valleys appeared. Because of the penetration of the rivers in this limestone 10 gorges succeed in this valley: Cheile Urşilor, Cheile Peşterii, Cheile Vărariei, Cheile Coteanu, Cheile Tătarului, Zănoaga Mică, Zănoaga Mare, Orzei, Dobreşti, Galma. Specific for the Bucegi Massif are the "Horoabe" type valleys [9].

Hidrographical net: the Bucegi Massif has a flowing waters net which has a rich and permanent flow. They are supplied by rainfall and snow melting and underground waters. This net is formed by the upper flow of the Prahova River, the upper side of Prahova Valley and Glăjăria, and the two artificial lakes situated in the central and in the southern side of the National Park Bucegi: Zănoaga and Scropoasa.

Climate: the climate is typically a mountain one, the variations of temperature being directly proportional with the altitude. The annual average temperature: -10°C and -4°C in winter and 5,4°C and 12°C in summer. The quantity of rainfall varies from one altitude to another. July is the most rainy month and October and November are the driest [1, 4].

* Argeş County Museum, 44 Armand Călinescu Street, code 110047, Piteşti, Argeş County

Material and methods

The outline of taxa of the two phytocoenoses associations was drawn considering the individual field researches as well as the study of the scientific references. On Horoaba Valley the following associations were identified: *Adenostylo-Doronicetum austriaci* Horv. 1956 and *Cirsio waldsteinii-Heracleetum transsilvanici* Pawł. et Walas 1949.

The syntaxonomical nomenclature is conformable to the stipulations of the International Code of the Phytosociological Nomenclature elaborated by H. E. Weber, J. Moraveç, J.-P. Theurillat [10].

Results and discussions

The natural reserve Peştera-Cocora-Valley Horoaba**,** which belongs to the 4th IUCN category, is part of the Bucegi Natural Parc.

The Reserve includes Ialomiţa Cave, Urşilor Gorges, Peşterii Gorges, and Horoaba Valley. The valley is a distinct protected area included on the list of the Romanian Academy as "Canyonul Horoabei" (Horoaba Canyon). It is situated on an altitude 1500-1600 m, lat. 45^0 27', long. 25^0 26', the surface is about 6 ha.

The Reserve is very important from a botanic viewpoint because many species included on the Red Lists of the superior plants from Romanian are found here [6]. Among them: *Pinus cembra* L., *Dianthus glacialis* Haenke subsp. *gelidus* (Schott, Nyman & Kotschy) Tutin, *Doronicum carpaticum* (Griseb. & Schenk) Nyman, *Ligularia sibirica* (L.) Cass., *Silene nutans* L. subsp. *dubia* (Herbich) Zapal*, Festuca pratensis* Huds. subsp. *apennina* (De Not.) Hegi*, Secale montanum* Guss. (R), *Angelica archangelica* L.*, Aquilegia nigricans* Baumg. (V), *Leontopodium alpinum* Cass., *Gentiana lutea* L. (V şi R) etc [2].

Among the endangered species we mention:

- *Campanula patula* L. subsp. *abietina* (Griseb.) Simonk. (endangered European taxon)
- *Dianthus spiculifolius* Schur (endangered subendemic taxon)
- *Dianthus tenuifolius* Schur (endangered subendemic taxon)
- *Hesperis matronalis* L. subsp**.** *candida* (Kit.) Hegi & Em.Schmid (endangered endemic taxon)
- *Larix decidua* Mill. (globaly endangered taxon)
- *Linum perenne* L. subsp. *extraaxillare* (Kit.) Nyman (endangered subendemic taxon)
- *Sesleria rigida* Heuff. ex Rchb. (endangered subendemic taxon)
- *Thymus comosus* Heuff. ex Griseb. (endangered endemic taxon)
- *Trisetum macrotrichum* Hack. (endangered endemic taxon) [8, 2].

Because of the favorable conditions phytocoenoses belonging to the high mountain weeds frequently appear. Two associations of megaforbs were identified within this type of vegetation: *Adenostylo-Doronicetum austriaci* Horv. 1956 and *Cirsio waldsteinii-Heracleetum transsilvanici* Pawl. et Walas 1949.

The two coenoses could be found along the steep valleys from the mountain and subalpine near the rivers. They vegetate on colluvial moist and cold, nutrients rich soils [3, 7].

MULGEDIO-ACONITETEA Hadač et Klika 1944

ADENOSTYLETALIA ALLIARIAE Br.-Bl. 1930

Adenostylion aliariae Br.-Bl. 1926

Adenostylo-Doronicetum austriaci Horv. 1956

The *Adenostylo-Doronicetum austriaci* association Horv. 1956 has some Carpathians elements in its floristic structure (*Cirsium waldsteinii, Leucanthemum waldsteinii, Dentaria glandulosa*). This association is a Carpathian-Balkan variant of the *Adenostylo-Cicerbicetum* association Br.-Bl. 1950 from Alps [3].

The whole coenotic structure is dominated by species belonging to the *Adenostylion aliariae* alliance Br.-Bl. 1926, *Adenostyletalia alliariae* order Br.-Bl. 1930 (*Leucanthemum waldsteinii, Rumex alpinus, Senecio germanicus, Chaerophyllum hirsutum, Cirsium waldsteinii, Aconitum toxicum*) and to the *Mulgedio-Aconitetea* class Hadač et Klika 1944 (*Athyrium distentifolium, Ranunculus platanifolius, Cicerbita alpina, Valeriana sambucifolia*) [5, 3].

The hemicryptophytes are the prevalent bioforms (68%). They are followed by therophytes (3%) and other categories (**Fig. 1**).

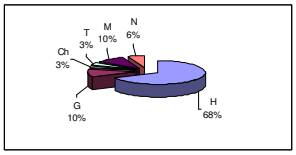

Fig. 1. The spectrum of the bioforms of the *Adenostylo-Doronicetum austriaci* association

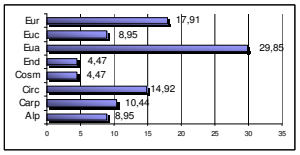

Fig. 2. The spectrum of the floristic elements of the *Adenostylo-Doronicetum austriaci* association

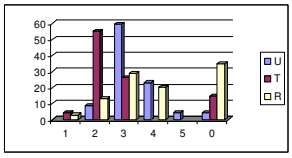

Fig. 3. The spectrum of the ecological indexes of the *Adenostylo-Doronicetum austriaci* association

The prevalent floristic elements are the Eurasian (29,85%) and the European ones (17,91%), followed by the Carpathians species (10,44%) and the Circumpolar ones (14,92%) (**Fig. 2**) .

Analyzing the ecological indexes we find out the following:

-regarding the humidity (U) that the most of the studied megforbs are mesophilous (U_3=59,42%) and meso-hygrophilous (U_4=23,18%), indicating a constantly moist but not swampy soil

-regarding the temperature (T), the micro-termophilous (T_2=55,07 %) and micro-meso-termophilous (T_3=26,08%) are better represented, indicating a cold climate, characterized by low temperatures of the water and of the soil during the entire vegetative season, specific to the upper mountain and sub alpine stand

- the index regarding the soil reaction (R) shows the existence of the acid-neutrophilous (R_3=28,98%) and low-acid-neutrophilous (R_4=20,28%) species, together with the euryionics ones (R_0=34,74%). In a high percentage (R_2=13,04%) exist the acidophilous species (**Fig. 3**). The quick humification and the mineralization of the organic material leads to a proper mineral nourishing, which lead to the forming of a big volume of the aerial organs as well as to the accumulation of a big quantity of substances for supply in the underground organs in few weeks.

MULGEDIO-ACONITETEA Hadač et Klika 1944

ADENOSTYLETALIA ALLIARIAE Br.-Bl. 1930

Adenostylion aliariae Br.-Bl. 1926

Cirsio waldsteinii-Heracleetum transsilvanici Pawl. et Walas 1949

The characteristic species of the association *Cirsio waldsteinii-Heracleetum transsilvanici* Pawl. et Walas 1949 (syn.: *Cardueto-Heracleetum palmati* Beldie 1967, *Heracleetum palmati* auct. rom.) are *Heracleum palmatum* and *Cirsium waldsteinii*. In the composition of the phytocoenoses from the Romanian Carpathians the specific species of

the *Adenostylion aliariae* alliance Br.-Bl. 1926, *Adenostyletalia alliariae* order Br.-Bl. 1930 (*Carduus personatus, Senecio germanicus, Rumex arifolius, Leucanthemum waldsteinii, Doronicum austriacum*) and *Mulgedio-Aconitetea* class Hadač et Klika 1944 (*Ranunculus platanifolius, Milium effusum, Valeriana sambucifolia, Athyrium distentifolium*) are found. There are a lot of species belonging to the forests of the upper mountain stand. Because the snow layer lasts a long period of time in the resorts in which these coenoses are present lead their evolution toward the groups having *Salix silesiaca* and *Alnus viridis* [5, 3], (**Tab. 1**).

The hemicryptophytes are the prevalent bioforms (73%). They are followed by therophytes (3%) and other categories (**Fig. 4**).

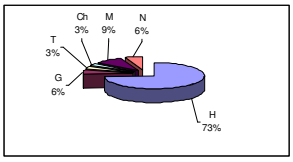

Fig. 4. The spectrum of the bioforms of the *Cirsio waldsteinii-Heracleetum transsilvanici* association

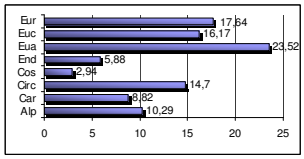

Fig. 5. The spectrum of the floristic elements of the *Cirsio waldsteinii-Heracleetum transsilvanici* association

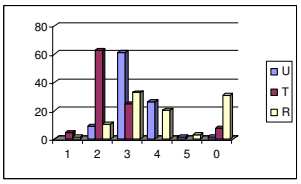

Fig. 6. The spectrum of the ecological indexes of the *Cirsio waldsteinii-Heracleetum transsilvanici* association

The prevalent floristic elements are the Eurasian (23,52%) and the European (17,64%) ones, followed by the Central-European species (16,17%) and the Carpathians species (8,82%) and the circumpolar ones (14,7%) (**Fig. 5**) .

Analyzing the ecological indexes we find out the following:

- regarding the humidity (U) that the most of the studied megforbs are mesophilous (U_3=60,93%) and meso-hydrophilous (U_4=26,56%), indicating a constantly moist but not swampy soil; the xero-mesophilous (U_2=9,37%), hydrophilous (U_5=1,56%) are poorly represented. The late melting of the snow, at the beginning of summer provides a good irrigation of the soil. The maintaining of a high hygrometric level (which does not permit the evaporation) is favorised by the low temperatures and the high degree of humidity and the poor solar action on the megaforbs
- regarding the temperature (T), the micro-thermophilous (T_2=62,5%) and micro-meso-termophilous (T_3=25%) are well represented, indicating a cold climate, characterized by low temperatures of the water and of the soil during the entire vegetative season, specific to the upper mountain and subalpine stand. Cryophilous (T_1=4,68%) and eury-thermophilous (T_0=7,81%) are poorely represented while the moderate-thermophilous (T_4) and thermophilous (T_5) are absent.
- the index regarding the soil reaction (R) shows the existence of the acid-neutrophilous (R_3=33,38%) and low-acid-neutrophilous (R_4=22,03%) species, together with the euryionics ones (R_0=28,81%). In a high percentage (R_2=13,55%) exist the acidophilous species, while the strong-acidophilous are poorly represented (R_1=1,69%) (Fig. 6). The quick humification and the mineralization of the organic material leads to a proper mineral nourishing, which lead to the forming of a big volume of the aerial organs as well as to the accumulation of a big quantity of substances for supply in the underground organs in few weeks.

Table 1. 1-5 Ass. *Cirsio waldsteinii-Heracleetum transsilvanici* Pawł. et Walas 1949, 6-9 Ass. *Adenostylo-Doronicetum austriaci* Horv. 1956

	Cirsio waldsteinii-Heracleetum transsilvanici					*Adenostylo-Doronicetum austriaci*			
Number of relevee	1	2	3	4	5	6	7	8	9
Exposition	SE	NE	N	N	NV	N	NV	NE	N
Altitude (m x 10)	160	165	170	180	121	145	150	155	160
Slope (^{0})	20	70	80	30	45	80	80	45	45
Surface (m^2)	100	100	100	100	100	100	100	100	100
Char. ass.									
Cirsium waldsteinii	1	+	1	1	+	2	2	+	+
Heracleum palmatum	2	1	-	+	3	-	-	2	-
Doronicum austriacum	-	-	+	2	+	1	1	1	1
Adenostyles alliariae	+	-	+	-	-	+	+	+	3
Adenostylion et ***Adenostyletalia***									
Stellaria nemorum	-	-	+	+	+	+	+	+	+
Aconitum paniculatum	+	+	+	-	-	+	+	+	+
Leucanthemum waldsteinii	+	+	+	+	+	+	+	-	+
Alnus viridis	-	-	+	+	-	-	-	-	-
Delphinium elatum	-	+	+	-	-	-	-	-	-
Cortusa matthioli	-	+	+	+	-	-	-	-	-
Rumex alpinus	-	-	+	-	-	+	-	-	-
Geranium phaeum	+	+	-	-	-	-	+	-	-
Senecio germanicus	+	+	+	-	+	+	1	+	-
Rumex arifolius	+	-	-	-	-	-	-	-	-
Angelica archangelica	1	+	+	+	-	+	1	+	-
Valeriana montana	-	+	+	-	-	-	-	-	-
Rosa pendulina	-	+	-	-	-	-	-	-	-
Mulgedio-Aconitetea									
Cicerbita alpina	-	-	+	-	1	-	-	1	+
Geranium sylvaticum	+	-	+	+	-	-	+	+	+
Ranunculus platanifolius	+	-	-	-	-	-	-	-	-
Athyrium distentifolium	-	-	+	+	1	+	+	+	2
Myosotis sylvatica	+	+	+	+	+	+	+	+	+
Oxalis acetosella	+	+	+	+	+	-	+	+	+
Aliae									
Geum rivale	-	+	-	+	+	-	+	+	+
Caltha laeta	-	+	-	+	-	-	-	+	-
Thalictrum aquilegiifolium	-	-	-	+	+	-	-	-	-
Rubus idaeus	-	-	-	-	+	+	+	+	+
Pulmonaria rubra	+	-	-	+	-	+	+	+	+
Anthriscus sylvestris	-	+	-	+	+	+	+	+	-
Salix silesiaca	+	+	-	+	+	-	+	+	-
Urtica dioica	+	-	+	-	-	+	+	-	+
Lamium maculatum	-	-	+	-	-	-	+	-	+
Sorbus aucuparia	+	-	-	-	-	-	+	+	+
Sambucus racemosa	-	+	+	-	-	+	+	-	+
Picea abies	+	+	+	-	+	+	+	+	+
Soldanella hungarica	+	+	-	+	-	+	-	+	+
Chaerophyllum hirsutum	+	+	+	-	-	+	+	+	+
*Campanula * abietina*	+	+	+	-	-	+	+	-	-
Dentaria glandulosa	+	-	-	-	-	+	-	-	-
Fragaria vesca	-	+	-	-	-	-	-	-	-
Doronicum carpaticum	+	+	+	+	-	-	-	+	+
Valeriana tripteris	+	-	-	-	-	-	-	-	-
Milium effusum	+	-	+	+	-	-	+	-	+
Silene pusilla	+	+	+	+	-	+	-	-	-
Veronica urticifolia	+	+	+	-	+	-	-	+	-

Hieracium transsylvanicum	+	-	-	-	-	-	-	+	-
Spiraea ulmifolia	+	-	-	-	+	-	+	+	+
Clematis alpina	+	-	-	-	-	-	+	-	-
Poa nemoralis	+	-	-	-	-	-	-	-	-
Luzula sylvatica	+	+	-	+	-	-	+	-	+
Astrantia major	-	+	-	-	-	-	-	-	-
Cystopteris fragilis	-	+	+	-	-	-	-	-	+
Asplenium viride	-	+	-	-	-	-	-	-	-
Primula veris	-	+	-	-	-	-	-	-	-
Alchemilla xanthochlora	-	+	+	+	-	+	-	-	-
Dianthus spiculifolius	-	-	+	-	-	-	-	-	-
Aconitum anthora	-	-	+	-	-	-	-	-	-
Ligularia sibirica	-	-	1	-	-	-	-	-	-
Gentiana lutea	-	-	+	-	-	-	-	-	-
Polystichum lonchitis	-	-	+	-	-	-	-	-	-
Scrophularia heterophylla	-	-	+	-	-	-	+	-	-
Galium album	-	-	+	-	-	-	-	-	-
Cirsium erisithales	-	-	+	-	-	-	-	-	-
Daphne mezereum	-	-	+	+	-	-	-	-	-
Aquilegia nigricans	-	-	+	-	-	-	-	-	-
Dentaria bulbifera	-	-	+	-	-	-	-	-	-
Saxifraga cuneifolia	-	-	-	+	-	-	-	-	-

Place and data of record: 1-5 Horoaba Valley (04.08.2007), 6-9 Horoaba Valley (05.08.2007).

Conclusions

The following aspects are revealed after studying the the megaforbs from the natural reserve Peştera-Cocora Horoaba Valley:

- The floristic composition shows the specific ecological conditions of the steep rivers valleys from the mountain and subalpine stands.
- The prevalence of the hemicryptophytes within this type of vegetation,
- The high percentage of European, Eurasian and Central-European species shows the affiliation to the Central-European area,
- The Circumpolar, Alps and Carpathians elements underline the mountain character of the flora.
- The existence of the endemic species suggests the ecologic conservatism of the resorts they vegetate in.
- The high mountain weeds are generally represented by meso- and meso-hydrophilous, micro-termophilous and micro-meso-termophilous, and acid-neutrophilous and low-acid-neutrophilous.

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