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# SOZOLOGICAL CONSIDERATIONS REGARDING THE FLORA OF BIHARIA MASSIF (APUSENI MOUNTAINS)

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**Abstract:** Threatened taxa are important for biodiversity conservation but in practice are also used as one of the key criteria in identifying Important Plant Areas. Studies on the Biharia Massif had started two centuries ago, but most data have been gathered since 1970. Even though a few sozological mentions appear in the papers regarding this area, a thorough investigation of the material has not been carried out. Of the 536 cormophyte taxa observed or cited in the area studied, 38 are present on the analyzed Red List, while three are included in the national Red Data Book. Of the 38 taxa, 13 have not been found during recent fieldwork, thus requiring more study. Most taxa have been found or mentioned from the upper part of the Cepelor Valley and the area of the Cucurbăta Mare peak, situated nearby. Of the two Natura 2000 sites present on the Biharia Massif, ROSCI0260 has a more important protective value for the plant taxa discussed, although the protection is indirect. Certain protection measures, especially the regulation of grazing and tourism, would be necessary to protect this site.

**Key words:** sozology, flora, Red Lists, Natura 2000 sites, conservation, Biharia Massif, Romania.

## Introduction

In the Romanian scientific literature, mentions regarding species chorology had already appeared in the 19th century, but only starting with A. Beldie (1977–1979) was a successive chorological scale adopted [11]. Further Romanian Red Lists for vascular plants have been compiled since 1976 [10, 12, 16, 22], while after 1990, the involvement of Romania in the activities of international biodiversity conservation conferred a new dimension to this domain.

In 1994 three Red Lists regarding the vascular plants for Romania were published [2, 9, 20], which differ both in what they regard as the total number of taxa and in their point of view on many of these taxa [4].

The Red Book of vascular plants of Romania [11] seeks to offer a unitary and detailed view of this subject, including a significant amount of information for each species, besides its sozological framing.

In Romania, protection measures were taken, at national level, through the establishment of protected areas (reserves), from early in the 20th century [8], targeting taxa of high sozological importance or small areas with high biodiversity. After 1990, National and Natural Parks have been declared, with the aim to bring together the protection of large areas with sustainable development. Taxa of high sozological importance have been used as a key criterion for identifying Important Plant Areas [23].

Following the same principle of sustainable development, the Natura 2000 European Network was established under the 1992 European Union Habitats Directive [31]. It includes areas that comprise a representative sample of species and habitats whose protection and conservation is of the greatest interest within the EU.

During the last five years, two Natura 2000 sites (ROSCI0260 – Valea Cepelor and ROSCI324 – Munţii Bihor) have been established in the Biharia Massif. The first of these is included in our research area, while the second overlaps only part of the area studied (Fig. 1).

**Materials and Methods**

The study area (Fig. 1) is located in the south-western part of the Apuseni Mountains and includes the north-eastern portion of the Biharia Massif. It comprises the upper interfluve of the Arieşul Mare and Arieşul Mic rivers, covering c. 100 km$^2$ – about 2/3 of the surface of the massif. The geological substrate is dominated by acidic rocks such as chlorite and albite schists [29], while the soils in the area are mostly acidic – brown feriiluvial and brown podsols [30]. Soil acidity is considered a limiting factor for plant species richness [1].

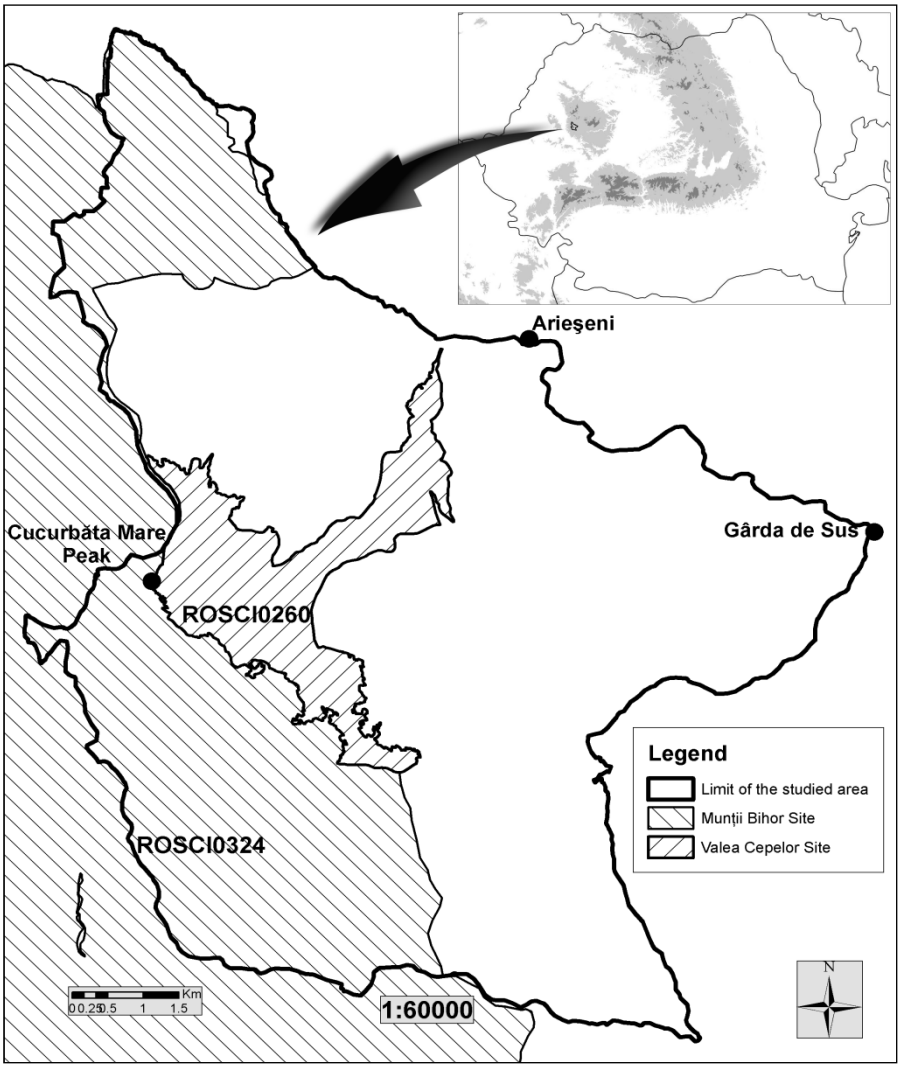


**Fig. 1: The area studied and the location of the two Natura 2000 sites**

The database that has been compiled includes not only recent original data [25], but also data from other sources [13, 24, 28, 14, 15, 3, 5, 6, 7] and **CL** Herbarium *(Cluj-Napoca)*, an important part being contributed before 1980 [17, 18, 19; C. Olaru, unpublished data]. Even though a few sozological mentions appear in the papers regarding this area, a thorough investigation of the material has not been carried out.

In order to assess the sozological importance of this area we have compared the available floristic data to certain significant papers in this field. From existing Red Lists we have selected the list of Oltean *et al.*, 1994 [20]. We have also analyzed more recent works [21], and the most substantial [11], which, as its authors mention, was not based on the existing Red Lists.

As regards sozological categories, different versions have been used over time. In the Red Lists the old IUCN categories were used [20]: Ex (Extinct), E (Endangered), V (Vulnerable), R (Rare), I (Indeterminate), K (insufficiently Known), O (out of danger) and NT (Not Threatened). On the other hand, [11] has adopted a version of the new IUCN categories: EX (Extinct), EW (Extinct in the Wild), CR (Critically Endangered), EN (Endangered), VU (Vulnerable), LR (Lower Risk), DD (Data Deficient) and NE (Not Evaluated), that, compared to the latest version, leaves apart NT (Near Threatened) and has LR instead of the current LC (Least Concern). Oprea (2005) [21] presents a similar version, including also NT but with a different meaning – Not Threatened.

We have also analyzed information from the standard forms of the two Natura 2000 sites in the area (ROSCI0260 – Valea Cepelor and ROSCI324 – Munţii Bihor), in order to evaluate the degree of protection that nationally important taxa receive indirectly from the Natura 2000 Network in the area.

**Results and Discussion**

Of the 536 cormophyte taxa observed or cited in the area studied, 38 are present on the analyzed Red List [20]. Of these, 25 been observed during the recent fieldwork, some having been previously cited from the area (Table 1), while 13 taxa (listed after the table) were observed/cited by different authors but have not been observed recently. More fieldwork is necessary to clarify the presence of these taxa in the study area.

Considering the prevalence of categories, 34 taxa are considered Rare, *Arnica montana* appears as Vulnerable, and *Campanula kladniana* has Indeterminate Status. The four other taxa have been considered as Rare or Vulnerable.

In the critical vascular plants Red List of Romania [21], three taxa are mentioned as Vulnerable (*Arnica montana*, *Gentiana punctata*, *Taxus baccata*); *Lilium jankae* and *Syringa josikea* are considered Vulnerable and Rare, while another four taxa are considered Not Threatened, but rare.

The Red Book [11] lists only three of the taxa considered (*Rhynchospora alba* and *Lilium jankae* as Vulnerable, and *Scrophularia vernalis* as Low Risk), therefore it is not presented in Table 1.

Most taxa (21) have been found or mentioned from the upper part of the Cepelor Valley and the area of the Cucurbăta Mare peak, situated nearby. Fifteen other taxa have been observed in other parts of the massif, while two of them have been cited [14, 15] without a specific location. Therefore, the area from the upper part of the Cepelor Valley and the Cucurbăta Mare peak is important, hosting a large number of species of sozological importance.

Since the study area overlaps two Natura 2000 sites in the area, we have analyzed the information from the standard forms of these sites that have been established with protective aims.

ROSCI0260 – Valea Cepelor has been established to protect eight Natura 2000 habitats and four species, two of which are plants: *Campanula serrata* and *Tozzia carpathica.* The first is

widespread in the mat-grass pastures of the upper part of the massif. The second has been mentioned in the literature from the Biharia Massif [26] but we have not found it during the recent fieldwork. The following taxa – *Arnica montana, Dianthus barbatus* subsp. *compactus, Diphasiastrum alpinum, Gentiana punctata, Lilium jankae* and *Pseudorchis albida* – are present in the "other important species of flora and fauna" list of the standard form, which has only an informative value.

With regard to the habitats that the site was designed to protect, only two of them – 4070* (Scrub with *Pinus mugo* and *Rhododendron hirsutum*) and 3220 (Alpine rivers and the herbaceous vegetation along their banks) are mainly found in the area from the upper part of the Cepelor Valley and the Cucurbăta Mare peak, which harbours, as we have mentioned, most of the species of sozological importance. Still, the area of the two habitats covers (and thus protects) only a small part of the above-mentioned zone. We also need to make clear that the thickets of mountain pine in the Biharia Massif, although included in habitat type 4070*, are lacking any *Rhododendron* species.

ROSCI324 – Munţii Bihor has been established to protect seven Natura 2000 habitats and certain animal species. Although a significant part of it overlaps the study area, none of the plant taxa from Table 1 are mentioned in the standard form of this site. Since the source of Valea Cepelor is completely enclosed in ROSCI0260 – Valea Cepelor, the Munţii Bihor site is less important for the protection of threatened species from the Biharia Massif.

Although the two Natura 2000 sites were established for taxa that are threatened at a European level from this area (implemented in Romanian legislation through OUG 57/2007 [32]), the Cepelor Valley site especially could have protective importance for nationally threatened taxa as it encloses the area where most of these are present, and also because two of the habitats that the site aims to protect are to be found mostly in this area.

Unfortunately, during fieldwork, we have not seen actual protection measures in the area, horses being free to trample and graze the plants in late summer and autumn, while the access of tourists is unregulated. The fact that most of the area from the upper part of the Cepelor Valley to the Cucurbăta Mare peak is on rough terrain (steep slopes, scree, tall scrub), continues to be the most important protection factor for this area and the plant taxa present here. Certain protection measures for plant communities and the included threatened taxa would be necessary at the source of the Cepelor Valley, most important being the regulation of grazing and tourist access. It would also be important to include the nationally threatened taxa in the standard forms of the two Natura 2000 sites, at least in the "other important species of flora and fauna" list.

The following taxa were cited in the literature but have not been found during recent fieldwork:

*Syringa josikaea* J. Jacq. ex Rchb., V/R [20], VU-R [21], cited in [28], upper portion of Arieşul Mare, not found [19]; *Taxus baccata* L., V/R [20], VU [21], cited in [28, 19] Cucurbăta, near Galbena Valley; *Trollius europaeus* L. R [20], NT [21], cited in [19] pastures around Iarba Rea; *Viola dacica* Borbás, R [20], NT [21], cited in [14, 15], no location; *Carex brunnescens* (Pers.) Poir., R [20], NT [21], cited in [18, 19] around Scoarţa village; *Coeloglossum viride* (L.) Hartman, , R [20], NT [21], sheet in (CL), Biharia; *Crepis conyzifolia* (Gouan) A. Kerner, , R [20], NT [21], sheet in **CL**, Arieşeni; *Dactylorhiza sambucina* (L.) Soó, , R [20], NT [21], cited in [18, 19], Galbena Valley; *Doronicum carpaticum* (Griseb. & Schenk) Nyman, , R [20], NT [21], cited in [18, 19], Culmea Stânişoara; *Epilobium alpestre* Krocker, R [20], NT [21], cited in

[3], source of Cepelor Valley; *Euphrasia coerulea* Hoppe & Fumrohr , R [20], NT-R [21], cited in [28], Cucurbăta Mare peak; *Rhynchospora alba* (L.) Vahl., R [20], NT -R [21], cited in [14], no location; *Scrophularia vernalis* L., R [20], NT -R [21], cited in [3], green alder scrub under Cucurbăta Mare.

**Table 1: Taxa of sozological importance observed from the study area of the Biharia Massif.**

| **Taxon** | [20] | [11] | **Site: observed/cited** |
|---|---|---|---|
| *Allium schoenoprasum* L. ssp. *sibiricum* Hartman | R | NT | Source of Cepelor Valley, moist cliffs! |
| *Allium victorialis* L. | R | NT | Source of Cepelor Valley, Piatra Grăitoare Peak, steep moist slopes! |
| *Arnica montana* L. | V | Vu | [13, 24, 19, 5], (CL) Sporadic in mat-grass pastures and *Vaccinium myrtillus* heath all over the massif. |
| *Campanula kladniana* (Schur) Witasek | I | NE | Source of Cepelor Valley, cliffs! |
| *Dactylorhiza incarnata* (L.) Soó | R | NT | [19] Swamps near Scoarţa and Iarba Rea. |
| *Dactylorhiza maculata* (L.) Soó. | R | NT | [19, 7] Moist pastures and swamps around Scoarţa, Iarba Rea, Ştei and at the source of Cepelor Valley. |
| *Dianthus barbatus* L. ssp. *compactus* (Kit.) Heuff. | R | NT | [13, 24, 28, 3] Under the cliffs near peaks Cucurbăta Mare and Piatra Grăitoare. |
| *Diphasiastrum alpinum* (L.) Holub | R | NT | [24, 28] Sunny, rocky places on the Cucurbăta Mare peak. |
| *Drosera rotundifolia* L. | R | NT | [28, 19] Peat bogs in Cepelor Valley and near Ştei. |
| *Epilobium alsinifolium* Vill. | R | NT | [28, 3, 19] Moist places near Cucurbăta Mare peak. |
| *Epilobium anagallidifolium* Lam. | R | NT | Source of Cepelor Valley, Piatra Grăitoare peak, dry cliffs! |
| *Epilobium nutans* FWSchmidt | R | NT | [13, 24, 5] Moist places around Cucurbăta Mare peak. |
| *Gentiana punctata* L. | R | VU | [13, 24, 3] Under the cliffs near Cucurbăta Mare. |
| *Gymnadenia conopsea* (L.) R.Br. | R | NT | [19, 7] Pastures around Pătrăhaiţesti, Ştei, Galbena. |
| *Juncus filiformis* L. | R | NT | [24, 3, 5] Moist places at the source of Cepelor Valley. |
| *Lilium jankae* A.Kern. | R | VU-R | [24] Source of Cepelor Valley, moist, sunny, grassy cliffs. |
| *Luzula luzulina* (Will.) Dalla Torre & Sarnth. | R | NT-R | Spruce forest near Vârtop! |
| *Menyanthes trifoliata* L. | R | NT | [19] Swampy areas on Iarba Rea and Galbena valleys. |
| *Monotropa hypopitys* L. | R | NT | Beech forest, Galbena valley! |
| *Platanthera bifolia* (L.) Rich. | R | NT | Source of Cepelor Valley, moist pastures! |
| *Pseudorchis albida* Á. & D. Löve | R | NT | [13, 19] Moist pastures and swamps, around Iarba Rea, and at the source of Cepelor Valley. |
| *Scorzonera rosea* Waldst.*et* Kit. | R | NT | [13, 14, 19, 5] Sporadic in pastures in the upper part of the massif. |
| *Sedum telephium* L. ssp. *fabaria* (W. D. J. Koch) Kirschl. | R | NT | [13, 24, 28, 3] Under the cliffs near Cucurbăta Mare peak. |
| *Silene nutans* ssp. *dubia* (Herbich) Zapal. | R | NT | [19] (**CL**), Cliffs around Piatra Grăitoare and Cucurbăta Mare peaks. |
| *Symphyandra wanneri* (Rochel) Heuff. | R | NT | [19] Cliffs around Piatra Grăitoare peak. |

**Abbreviations:** The symbols for sozological categories are those discussed in the text above.
(CL) **CL** Herbarium (Cluj-Napoca); ! – observed for the first time during recent fieldwork

## Conclusions

Of the 536 cormophyte taxa mentioned from the area studied, 38 are present on the analysed Red List, while three are included in the National Red Book. Of the 38 taxa, 13 have not been found during the recent fieldwork, requiring more studies. Most taxa have been found or mentioned from the upper part of the Cepelor Valley and the area of the Cucurbăta Mare peak,

situated nearby. From the two Natura 2000 sites present on the Biharia Massif, ROSCI0260 has a more important protective value for the plant taxa discussed, 21 of them being found in this area, although the protection is indirect. Certain protection measures, especially the regulation of grazing and tourism, would be necessary in this site.

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## CONSIDERAŢII SOZOLOGICE ASUPRA FLOREI MASIVULUI BIHARIA (MUNŢII APUSENI)

### (Rezumat)

Taxonii ameninţaţi sunt importanţi pentru conservarea biodiversităţii dar sunt folosiţi şi practic, reprezentând unul dintre criteriile cheie pentru identificarea Ariilor Speciale de Protecţie. Studiile asupra Masivului Biharia au început acum două secole, însă majoritatea datelor au fost obţinute după 1970. Deşi unele menţiuni sozologice apar în lucrările ce privesc această zonă, o abordare focalizată pe acest subiect nu a fost realizată până în prezent. Dintre cei 536 taxoni de cormofite observaţi sau citaţi din zonă*, 38 sunt prezenţi în Lista Roşie analizată iar 3 dintre ei în Cartea Roşie Naţională*. Dintre aceştia, 13 nu au fost regăsiţi în decursul studiilor recente de teren, necesitând continuarea studiilor. Majoritatea acestor taxoni au fost menţionaţi de la obârşia Văii Cepelor şi din zona vârfului Cucurbăta Mare, situat în apropiere. Dintre cele două situri Natura 2000 desemnate în Masivul Biharia, ROSCI0260 – Valea Cepelor are o importanţă mai ridicată, deşi indirectă, în protecţia taxonilor ameninţaţi. Anumite măsuri de protecţie, îndeosebi reglementarea păscutului, ar fi necesare în acest sit.