

**DECAYING WOOD COMMUNITIES  
FROM THE UPPER BASIN OF THE ARIEȘ RIVER  
CONSERVING RARE AND VULNERABLE BRYOPHYTES**

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**Abstract:** Environmental change is an important factor for bryophyte survival. The main threats of lignicolous species richness focuses on changing of certain habitats, due decreasing of forest surface, forest canopy and amount of decaying wood. The upper basin of the Arieș River is located in the north-western part of Romania, in Apuseni Mountains. The mountain climate favored the development of spruce, beech and mixed forests.

*Lophozia ascendens* is a rare species occurring in five associations *Lophocoleo heterophyllae* - *Dolichothecetum seligeri* Phil. 1965, *Riccardio - Scapanietum umbrosae* Phil. 1965, *Leucobryo - Tetraphidetum pellucidae* Barkm. 1958, *Anastrepto orcadensis - Dicranodontietum denudati* Ștef. 1941 nom. invers, *Calypogeietum trichomanis* Neum. 1971. *Lophozia ascendens* is well correlated (Spearman Correlation Coefficient calculated for 132 relevés) with the hepatics coverage (0.49329), *Blepharostoma trichophyllum* (0.37787) and *Riccardia palmata* (0.36619). *Buxbaumia viridis* is a vulnerable species occurring only in two association: *Lophocoleo heterophyllae - Dolichothecetum seligeri* Phil. 1965 and *Riccardio - Scapanietum umbrosae* Phil. 1965.

*Lophozia ascendens* has a larger occurrence and seems to be less threatened, but *Buxbaumia viridis* occur only in the north-western part of the studied area, in sheltered mixed or spruce forests, solitary or scattered, ca 68 individuals. These forests should be protected with a minimal management. The fallen logs and trunks should be left untouched, not removed or burned.

### Introduction

Bryophyte conservation is a quite new current in Europe. The decreasing of the natural habitats, which are replaced with the semi natural or man-made ones, the industrialization accelerated during the last half of the century, have had far-reaching effects in bryophytes survival. The main threats in European bryoflora are the habitat destruction, the fragmentation of distribution of habitats and pollution [21].

Before 1980s bryophytes were protected together with other plants in nature reserves, in the frame of higher plants communities. The first document which have provide bryophyte conservation is Bern Convention (1979), but even if most of the European countries agreed, this convention is not an legal instrument and haven't a clear agenda and strategy. It has been strongly revised in 1990, after the first international symposium on bryophyte conservation from Uppsala (Sweden). As a result of the bryologists discusses 26 bryophytes (rare, endemic or a restricted to some threatened habitats) have been included in the Appendix I of the Bern Convention. This Convention appendices are periodically revised.

A second very important action has been the adoption of EU - Habitats Directive European Community Directive and Nature Conservation Policy, in 1992, which include the 31 european bryophyte species (Annex II), 22 of them already listed in Bern Convention. This step was the most important for bryophytes conservation, with a stronger legal status, for the 15 European Countries and for the future candidates, too. This step is also important due the larger frame of bryophyte conservation, not only as singular species, as well as components of the habitats where they live, where all ecological requirements favor a good development of the target species. Several of the 253 threatened habitats which need conservation, host threatened

bryophytes. Such habitats will be efficiently preserved in the protected areas selected as Special Areas of Conservation (SACs). All European SACs will create a network (Natura 2000 network) as a political instrument for Nature Conservation in Europe, as the best way to manage Union's natural heritage.

The implementation of Habitat Directive started in the European Union countries but is extending in the other countries as a requirement for nature protection as entity not only inside of political borders.

The main target of the Habitat Directive is to preserve the listed species and habitats and to promote a favorable conservation status (Article 6). This objective require better knowledge concerning species and habitats distribution, about their population effectives and dynamics, about habitat preferences of the target species. A favorable conservation status include a monitoring, too [21].

An important role in bryophyte conservation in Europe has played the European Committee for Conservation of Bryophytes (ECCB), which edited in 1995 the Red Data Book of the European Bryophytes, establishing the main threats, the most important sites from each country, and the future objectives for a better attention for the bryophyte conservation. Even if the financial support can't be compared with that for other botanical research fields, the efficient activity of this Committee has remarkable results as long as bryophytes are included in Bern Convention and in Habitat Directive lists. Hallingbäck [20] published the guidelines for establishing the UICN Categories for bryophytes. The Conservation Conferences hold every 3-4 year.

In Romania some important parts of this steps were missed. Still miss a national red list, there are a lot of species uncertain for Romania, there are very few studied areas (especially results of doctoral studies) and the number of bryologists is very low (no more than five). Three relative recent lists of the bryophytes from Romania have been published until now: Dihoru (1994, 2001) specify the species frequency in Romania; Mihai *et al.* (1998) mention for each species the historical region(s) of occurrence, Mohan (1942) specify the distribution and references. Now, all this lists are incomplete (some of them need corrections) and don't answer to the international requirements for elaborating a national red list for bryophytes. Therefore we consider this a future aim for the romanian bryologists. Meanwhile we use the UICN categories established for the European bryophytes [40], our contribution answering to one of the ECCB biggest project, the revision of the Red Data Book.

During the last years, the interest in bryophyte conservation attract some attention especially forced by the european movement. Most of the international projects have a larger target than vascular plants and bryologists, lichenologists a.o., have a difficult job answering to this projects objectives.

Our study focus on two boreal-mountain species distribution and eco-coenology, in the upper basin of the Aries river: *Buxbaumia viridis* and *Lophozia ascendens*.

Such studies are very important for those bryophytes growing on temporary substrates (e.g. rotten wood) and stringent for short-lived fugitive species, because the effect of changes in habitat parameters is very important for their conservation. Fugitive species are more sensitive than resident species to any of the habitat parameters. Both, fugitive and resident species are most sensitive to reduced habitat density (habitat fragmentation) [23].

*Buxbaumia viridis* grows usually as scattered individuals. It is a dioic moss therefore is difficult to observe the male plants, but the female plants, carrying capsules are noticed easy. This moss occur in temperate zone, especially in the boreonemoral one, preferring old coniferous forests, with a constant high air humidity and rich in decaying wood. *Buxbaumia viridis* is a short lived fugitive species. The restrictive ecological preferences related especially with the decrease of old growth forests confirm the vulnerable status in the European Red Book of this species. Also the Bern Convention protect *Buxbaumia viridis*.

In the National Red Lists from Europe *Buxbaumia viridis* have the same status (Poland, Switzerland, Germany, United Kingdom) or is considered rare (Italy)[6, 24, 39, 41]. In Finland 64 % of the known sites are already included in Natura 2000 [23]. In Romania *Buxbaumia viridis* is protected only due Bern Convention and Habitats Directive implementation, but is successfully protected in some natural reserves and National Parks which are hot spots for other species, especially vascular plants.

*Lophozia ascendens* is more frequent, the individuals grows in small groups, having the same ecological preferences as *Buxbaumia viridis*. Is a European rare species.

The current factors causing loss or decline of the above mentioned species are: the removal of dead wood, the change in the microclimate of deforested areas, the diminishing area of suitable shady mesic spruce forest. Shelterwood and intensive thinning prescriptions for timber harvest will cause its demise, as logs dry out. *Buxbaumia viridis* is collected in some countries.

Most of the epixilic species reproduce sexually [36] and their location on the forest floor, where the air currents are weak, reduce the dispersal ability of the spores and the species spreading.

The upper basin of the Arieș river is located in the north-western part of Romania, belonging to the northern Apuseni Mountains, and cover an area of 580 km<sup>2</sup>. The highest altitude is 1849 m in Biharia Peak and the lower is 565 m, at the confluence between Arieșul Mic and Arieșul Mare river. The studied area has an amphitheater shape, bordered by the main peaks of Bihor Mountains, Găina Massif and the west part of Muntele Mare Mountains.

The region has a mountain climate, with mean annual temperature of 7.46 °C and mean annual precipitation of 724 mm. The high altitude determines a change of this climatic factors, mean annual temperature decreasing from the base of the mountain (7.46 °C), towards the top (3°C).

Under these conditions beech, spruce and mixed forests predominate. Oak and hornbeam trees occur only in small stands, toward the lower limit of the study area. The riparian forests have been dramatically reduced to few, small patches and isolated trees (mostly willows and alders) along streams.

The Apuseni Mountains represent an interesting region for all naturalists. There are a lot of publications which mention some species from this region: Fuss (1865), Györfy (1903, 1904, 1908, 1909, 1910), Schiffner (1909, 1914), Papp (1942), Ștefureac (1945, 1958), Pop (1960), Boros & Vajda (1974), Plămadă (1998), Péterfi (1908), Goia (2000, 2001), Goia & Schumacker (2000), some of them dealing with vascular plants vegetation: Csűrös & Csűrös - Káptalan (1966), Pop & Hodișan (1967), Coldea (1996). Finally, the floristical inventory of the bryophytes growing on wood substrate count 240 taxa: 220 species 16 varieties and 4 forms.

## Methods

The research method follows the Central - Europe methodology of phytosociological relevés. The classification into associations has been accomplished both based on classical methods - with special regard to the characteristic species - and by means of statistical methods (hierarchical classification, establishing of optimal number of groups, indicator species analysis) [12]. Multivariate analysis has been done using SINTAX 5.0 [31]. The correlation between *Buxbaumia viridis* and others parametric or non-parametric factors has been established for all relevés from the upper Arieș basin on decaying wood, using Spearman coefficient.

We adopted the coenotaxonomical system published by Marstaller (1993). The number of individuals has been counted for *Buxbaumia viridis* in each relevés.

For eco-coenological considerations we have used correlations and the substrate pH, which has been investigated in laboratory (1g of powder obtained from the substrate mixed with 100 ml of distilled water and after 24 hours the pH has been measured electrometric).

The species nomenclature was updated according to Grolle (1983) for liverworts and Corley & *al.* (1981) and Corley & Crundwell (1991) for mosses, patronym abbreviation follow Brummit & Powell (1992).

### Results

*Buxbaumia viridis* occur only in the north-western part of the studied area, in sheltered mixed or spruce forests, solitary or scattered. The decaying wood has a mean pH of 4.99. The bryosociological literature specify that *Buxbaumia viridis* characteristic for *Nowellion curvifoliae* Phil. 1965, alliance occurring on decaying wood on II-III roasting degree. It has been identified in two associations, both belong to this alliance:

**Cladonio - Lepidozietea reptantis** Jez. et Vondr. 1962 em. Marst. 1993

**Cladonio - Lepidozietalia reptantis** Jez. et Vondr. 1962

**Nowellion curvifoliae** Phil. 1965

*Lophocoleo heterophyllae - Dolichothecetum seligeri* Phil. 1965

*Riccardio - Scapanietum umbrosae* Phil. 1965

In the 10 relevés has been counted 68 individuals.

The Spearman correlations calculated for *Buxbaumia viridis*, taking into account all studied bryocoenosis (132 relevés) from the upper basin of Aries River are not significant, probable because are very few relevés with *Buxbaumia viridis*. The relevés with *Buxbaumia viridis* has been done in the Valleys from the upper side from the studied area (Tab. 1), more narrow and richer in precipitation comparing with other parts of the studied areas.

*Lophozia ascendens* has a wider occurrence (Tab. 1), and even if is sporadically in studied area, it is represented by numerous individuals, and seems to be less threatened. The decaying wood has a mean pH of 4.86. As previous species, *Lophozia ascendens* is characteristic for *Nowellion curvifoliae* Phil. 1965, but sporadically occur also in *Tetraphidion pellucidae* v. Krus. 1945 (occurring on II-III roasting degree wood) and *Dicranellion heteromallae* Phil. (1956) 1963 (usually occurring on acid soils). It has been identified in five associations:

**Cladonio - Lepidozietea reptantis** Jez. et Vondr. 1962 em. Marst. 1993

**Cladonio - Lepidozietalia reptantis** Jez. et Vondr. 1962

**Nowellion curvifoliae** Phil. 1965

*Lophocoleo heterophyllae - Dolichothecetum seligeri* Phil. 1965

*Riccardio - Scapanietum umbrosae* Phil. 1965

**Tetraphidion pellucidae** v. Krus. 1945

*Leucobryo - Tetraphidietum pellucidae* Barkm. 1958

*Anastrepto orcadensis - Dicranodontietum denudati* Ștef. 1941 nom. invers

**Diplophylletalia albicantis** Phil. 1960

**Dicranellion heteromallae** Phil. (1956) 1963

*Calypogeietum trichomanis* Neum. 1971

*Lophozia ascendens* is well correlated (Spearman Correlation Coefficient calculated for 132 releveés,  $p < 0.0001$ ) with: hepatics coverage (0.49329), *Blepharostoma trichophyllum* (0.37787) and *Riccardia palmata* (0.36619). The best occurrence of this species is in *Riccardio - Scapanietum umbrosae* Phil. 1965 bryocoenosis, as well for the species positive correlated with *Lophozia ascendens*.

In the studied area the main threats for *Buxbaumia viridis* and *Lophozia ascendens* are the removal of dead wood, deforestation and the diminishing area of suitable shady mesic spruce forest.







### Conclusions

The studied species are well represented in the studied area, especially in the upper valleys, even if both of them have very narrow eco-coenological preferences.

During the last ten years, in the upper basin of the Arieş river, the forests area decreased and many of the remained forest are thin out. In addition, the poor interest on bryophyte conservation, weak knowledge about their biology and richness of the abilited institution which manage these forests, contribute to the habitats parameter changes and the both studied species are in a great danger, even if some valleys which are now part of the National Park of Apuseni Montains have now a different management. Actually most of the relevés has been done on the decaying wood brought and stocked by the rivers.

The Forest Administration, and future managers of the National Park should collaborate with bryologists to understand the bryophytes biology and to be able to observe any change in bryophytes communities, as sensitive bioindicators of the habitat parameters. Handling the biotope informations, offered by bryocoenosis, the forest rangers should be able to ensure the needs of this species are taken into account in the management plan for the known site. Avoiding habitats fragmentation, retention of the fallen logs and trunks, untouched and not removed or burned, considered to be beneficial to this species. A necessary precursor to any recovery attempts is the ex-situ cultivation of some very rare species, in proper microhabitats offered by Botanical Gardens.

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## COMUNITĂȚI SAPROLIGNICOLE DIN BAZINUL SUPERIOR AL ARIEȘULUI, CONSERVATOARE ALE UNOR SPECII RARE SAU VULNERABILE DE BRIOFITE

### (Rezumat)

Modificările parametrilor habitatului constituie un important factor pentru supraviețuirea briofitelor. Principalele cauze care duc la scăderea diversității comunităților saprolignicole și la dispariția unor specii epixilice sunt reducerea suprafețelor împădurite, rărirea pădurilor și strângerea lemnelor cazute sau rămase în urma exploatării forestiere. Studiul de față s-a efectuat în bazinul superior al Arieșului, situat în partea de nord-vest a României (Munții Apuseni).

*Lophozia ascendens* este o specie rară, ce a fost identificată în terenul studiat în cinci asociații: *Lophocoleo heterophyllae - Dolichothecetum seligeri* Phil. 1965, *Riccardio - Scapanietum umbrosae* Phil. 1965, *Leucobryo - Tetrarhizetum pellucidae* Barkm. 1958, *Anastrepto orcadensis - Dicranodontietum denudati* Ștef. 1941 nom. invers, *Calypogonietum trichomanis* Neum. 1971, cel mai frecvent pe lemne aflate în stadiul I sau II de descompunere. *Lophozia ascendens* este bine corelată (coeficientul de corelație Spearman calculat pentru 132 relevee efectuate pe lemne căzute) cu acoperirea cu mușchi hepatici (0.49329), *Blepharostoma trichophyllum* (0.37787) și *Riccardia palmata* (0.36619). *Buxbaumia viridis* este o specie vulnerabilă, identificată doar în două asociații, aparținând alianței *Nowelion curvifoliae* Phil. 1965: *Lophocoleo heterophyllae - Dolichothecetum seligeri* Phil. 1965 și *Riccardio - Scapanietum umbrosae* Phil. 1965.

Ambele specii sunt caracteristice pentru alianța *Nowelion curvifoliae* Phil. 1965, în ale cărei asociații se regăsesc preponderent.

*Lophozia ascendens* are o răspândire mai largă și pare mai puțin periclitată, dar *Buxbaumia viridis* este semnalată numai din partea de nord-vest a teritoriului studiat, în păduri de amestec sau de conifere, identificându-se cca. 68 indivizi. Prin aplicarea unui management adecvat, care să asigure suprefețele împădurite largi, legate între ele prin coridoare împădurite, în care resturile lemnoase (trunchiuri căzute, buturugi, etc) să fie răspândite uniform, se asigură supraviețuirea acestor specii și a comunităților epixilice, cunoscute ca fiind dintre cele mai vulnerabile datorită capacității reduse de dispersie.