



# Grassland bryophyte assemblages of Fruška Gora Mountain (Serbia)

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**ABSTRACT:** The bryophyte ecology of grasslands in Fruška Gora Mountain were studied. The phytosociological survey took place in September of 2011. In total 18 bryophyte species were recorded in grasslands of Fruška Gora. Since the grasslands are subject to frequent disturbance, the bryophyte species recorded do not have strong ecological relationships among themselves, and are rather in the stage of competition and establishing bryophyte communities. Factors like short time of development, frequent habitat disturbance, harsh environment and chance establishment define the presence of 5 bryophyte assemblages in different ecological situations in the grasslands of Fruška Gora.

**KEY WORDS:** bryophytes, ecology, grasslands, Fruška Gora, Vojvodina, Serbia.

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## INTRODUCTION

Bryophytes, like vascular plants, form communities. These communities reflect the environmental conditions of microhabitats. Also, some communities of bryophytes are particularly important as a successive stage to some other vegetation types. Bryoflora is usually deficiently explored because of its low or non-economic value. In addition, bryophyte biomass, except in moist and cool ecosystems, is negligible. The need to study bryoflora in different habitats of Serbia is as important as the study of vegetation of vascular plants.

Bryophyte flora as well as bryophyte biology have been neglected for decades not only in Serbia but in the area of the former Yugoslavia. Although there was bryological research in some areas of former Yugoslavia, many territories remain underexplored; among them Serbia (PAVLETIĆ 1955). Although many national and foreign bryologists examined the bryoflora of Yugoslavia, there are still insufficient data on the occurrence of individual species. With such a lack of knowledge on the bryophyte flora, the additional huge lack of

information on bryophyte ecology is not surprising. The work of SABOVLJEVIĆ (2008) is pioneering and of great importance for the study of bryophyte ecology in Serbia. SABOVLJEVIĆ (2008) presented a preliminary survey of syntaxonomical categories from classes to associations represented on the territory of Serbia. The survey included a total of 144 units at the level of associations. A summary of these 144 associations recorded in Serbia represents the first data on their ecology, i.e. composition and structure of bryoflora in this area.

SABOVLJEVIĆ & STEVANOVIĆ (2006) reported that Vojvodina is bryologically the poorest explored area of the former Yugoslavia. Compared with other regions of Serbia, this area probably has the lowest diversity of bryophytes. This is due to a strong human impact, where up to 80% of the land is arable with a relatively uniform geomorphology.

The bryoflora of Fruška gora Mt comprises a total of 132 previously recorded bryotaxa (118 species of mosses and 14 liverworts), which represent about 21% of bryoflora of Serbia and Montenegro (CVETIĆ & SABOVLJEVIĆ 2005).

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Although major attempts have recently been made to obtain new and comprehensive knowledge of the occurrence and distribution of various moss species in Serbia, many areas are still poorly studied and many new species could probably be recorded. Even areas under legal protection, such as national parks, have no information on the bryophytes growing within them (SABOVLJEVIĆ 2006).

As grassland habitats in Serbia are, in particular, insufficiently explored bryologically, the aim of this article is to present primary and basic information on bryophyte species and ecology on these habitat types in Fruška Gora Mt.

## MATERIAL AND METHODS

The field survey of grassland habitats was conducted in the Fruška Gora National Park in September of 2011 using the method of the Zürich-Montpellier school (BRAUN-BLANQUET 1964) adjusted to bryophytes. Each sampling plot included the data records of surface size of a relevée (from 0.4 m<sup>2</sup> to 1 m<sup>2</sup>), the relevée number, date of collection, locality name, type of habitat, terrain slope, and exposure using a GPS eTrex Legend device. Geographical coordinates and altitude were also recorded. Simultaneously, all bryophyte species present were collected according to the methodology set out in PILOUS & DUDA (1960). A moss-cover of individual species was also recorded. Small terrestrial species were collected with the substrate.

Bryophytes collected within the plot of one relevée were stored together in a paper bag labeled with a collection code. Moss-cover of each species is given using the Braun-Blanquet cover-abundance scale: r - 1-2 individuals with insignificant cover-abundance; + - cover-abundance not higher than 1 %; 1 - 1 to 5 % cover-abundance; 2 m - cover-abundance about 5%; 2 - 5 to 15 % cover-abundance; 2b - 15 to 25 % cover-abundance; 3 - 25 to 50 % cover-abundance; 4 - 50 to 75 % cover-abundance; 5 - 75 to 100 % cover-abundance (BRAUN-BLANQUET 1964).

Below is the list of localities with grassland habitats in Fruška Gora Mt studied in September 2011, with their coordinates, altitude, relevée size, inclination, exposure and the percentage bryophyte coverage of the sampling plot. The collectors were Pavel Širka, Marko Sabovljević & Dragiša Savić.

1. Stari Ledinci; 45°11'18.37"N, 19°48'06.88"E; 268 m; dry grassland; 0.4 m<sup>2</sup>; 10-30°; W; 90 %;
2. Stari Ledinci; 45°11'18.86"N, 19°48'08.82"E; 273 m; dry grassland; 0.4 m<sup>2</sup>; 30°; W; 90 %;
3. Stari Ledinci; 45°11'19.47"N, 19°48'10.02"E; 279 m; dry grassland; 0.6 m<sup>2</sup>; 0°; -; 70 %;
4. Stari Ledinci; 45°11'19.51"N, 19°48'10.11"E; 280 m; dry grassland; 0.6 m<sup>2</sup>; 0°; -; 70 %;
5. Stari Ledinci; 45°11'19.61"N, 19°48'10.13"E; 280 m; dry grassland; 0.6 m<sup>2</sup>; 0°; -; 70 %;
6. Erdelj; 45°11'30.26"N, 19°42'35.98"E; 259 m; dry grassland; 0.6 m<sup>2</sup>; 30°; E; 80 %;
7. Erdelj; 45°11'30.17"N, 19°42'36.52"E; 261 m; dry grassland; 0.6 m<sup>2</sup>; 30°; E; 60 %;
8. Erdelj; 45°11'29.48"N, 19°42'35.90"E; 277 m; dry grassland; 0.6 m<sup>2</sup>; 30°; E; 60 %;
9. Čerević; 45°12'32.75"N, 19°40'01.38"E; 163 m; dry grassland; 0.6 m<sup>2</sup>; 40°; SW; 50 %;
10. Čerević; 45°12'33.04"N, 19°40'00.79"E; 161 m; dry grasslands 0.6 m<sup>2</sup>; 40°; SW; 50 %;
11. Andrevlje; 45°10'24.31"N, 19°38'48.48"E; 235 m; pasture; 0.6 m<sup>2</sup>; 5°; S; 80 %;
12. Andrevlje; 45°10'23.82"N, 19°38'51.46"E; 232 m; pasture; 0.6 m<sup>2</sup>; 5°; S; 85 %;
13. Susek; 45°13'28.17"N, 19°32'30.75"E; 116 m; wet pasture; 0.4 m<sup>2</sup>; 0°; -; 95 %;
14. Susek; 45°13'35.69"N, 19°32'47.42"E; 116 m; wet pasture; 0.4 m<sup>2</sup>; 0°; -; 70 %;
15. Susek; 45°13'35.71"N, 19°32'47.53"E; 116 m; wet pasture; 0.4 m<sup>2</sup>; 0°; -; 60 %;
16. Susek; 45°13'36.17"N, 19°32'49.18"E; 116 m; wet pasture; 0.4 m<sup>2</sup>; 0°; -; 95 %;
17. Ležimir; 45°07'40.93"N, 19°34'39.99"E; 280 m; dry grassland; 0.6 m<sup>2</sup>; 60°; S; 50 %;
18. Ležimir; 45°07'40.93"N, 19°34'39.85"E; 283 m; dry grassland; 1 m<sup>2</sup>; 60°; S; 50 %;
19. Ležimir; 45°07'41.11"N, 19°34'39.82"E; 284 m; dry grassland; 0.6 m<sup>2</sup>; 60°; SW; 50 %;
20. Ležimir; 45°07'41.21"N, 19°34'40.06"E; 285 m; dry grassland; 0.6 m<sup>2</sup>; 30°; E; 80 %;
21. Ležimir; 45°07'41.91"N, 19°34'34.48"E; 274 m; dry grassland; 0.6 m<sup>2</sup>; 60°; S; 40 %;
22. Ležimir; 45°07'41.94"N, 19°34'34.57"E; 274 m; dry grassland; 1 m<sup>2</sup>; 70°; NW; 60 %;
23. Ležimir; 45°07'42.00"N, 19°34'34.42"E; 273 m; dry grassland; 0.6 m<sup>2</sup>; 70°; NW; 70 %;
24. Ležimir; 45°07'41.95"N, 19°34'34.44"E; 273 m; dry grassland; 1 m<sup>2</sup>; 80°; W; 50 %;
25. Ležimir; 45°07'40.89"N, 19°34'37.84"E; 277 m; dry grassland; 1 m<sup>2</sup>; 70°; NW; 40 %;
26. Ležimir; 45°07'40.98"N, 19°34'37.92"E; 275 m; dry grassland; 0.6 m<sup>2</sup>; 70°; NW; 70 %;
27. Ležimir; 45°07'41.02"N, 19°34'37.96"E; 275 m; dry grassland; 0.6 m<sup>2</sup>; 80°; NW; 60 %;
28. Ležimir; 45°07'41.03"N, 19°34'38.12"E; 276 m; dry grassland; 0.6 m<sup>2</sup>; 30°; SE; 40 %;
29. Ležimir; 45°07'41.01"N, 19°34'38.87"E; 278 m; dry grassland; 0.6 m<sup>2</sup>; 70°; SW; 60 %;

**Table 1.** Survey of bryophyte assemblages recorded in grasslands of Fruška Gora. The relevee numbers correspond to the details from Material and methods.

Assemblage 1. <i>Barbula unguiculata</i> - <i>Didymodon vinealis</i> dry calk grasslands								
relevée	1	2	3	4	5	9	10	
<b><i>Barbula unguiculata</i></b>	2m	1	1	+	1	1	2a	
<b><i>Didymodon vinealis</i></b>	2m	+	1	+	2m	2a	1	
<i>Bryum capillare</i>	1		2m		+	1		
<i>Trichostomum crispulum</i>	+		+	2m	1			
<i>Pseudocrossidium hornschuchianum</i>	+		1		+	+		
<i>Dicranella varia</i>						1	1	
<i>Didymodon insulanus</i>	1							+
<i>Phascum cuspidatum</i>	+	+						
<i>Didymodon acutus</i>						+	+	
<i>Didymodon luridus</i>				+				
<i>Aloina aloides</i>					+			
Assemblage 2. <i>Oxyrrhynchium hians</i> seminatural dry grasslands (after culture)								
relevée	6	7	8	11	12	13	16	20
<b><i>Oxyrrhynchium hians</i></b>	1	2a	2b	1	2m	1	+	2a
<i>Bryum capillare</i>		+						
<i>Didymodon rigidulus</i>			+					+
<i>Fissidens taxifolius</i>			+					
Assemblage 3. <i>Syntrichia ruralis</i> - <i>Bryum capillare</i> sandy dry grasslands								
relevée	17	18	19	21	28			
<b><i>Syntrichia ruralis</i></b>	2a	2b	2b	2b	3			
<b><i>Bryum capillare</i></b>	2m	+	1	1	+			
<i>Barbula unguiculata</i>	2m	+			+			
<i>Didymodon luridus</i>		+		+				
<i>Calliergonella cuspidata</i>			+					
<i>Oxyrrhynchium hians</i>			+					
<i>Hypnum cupressiforme</i>			+					
Assemblage 4. <i>Hypnum cupressiforme</i> - <i>Calliergonella cuspidata</i> mesic calk grasslands								
relevée	22	23	24	25	26	27	29	
<b><i>Hypnum cupressiforme</i></b>	2b	2a	2b	3	2a	2a	2b	
<b><i>Calliergonella cuspidata</i></b>		2b	2b	2b	2b	2b		
<i>Bryum capillare</i>					+			
<i>Syntrichia ruralis</i>						+		
<i>Pseudocrossidium hornschuchianum</i>				+				
Assemblage 5. <i>Physcomitrella patens</i> salty grasslands								
relevée	14	15						
<b><i>Physcomitrella patens</i></b>	+	1						

## RESULTS AND DISCUSSION

In the field survey of grasslands of Fruška Gora Mt a total of 29 phytosociological relevés were made. In the grassland habitats of Fruška Gora 18 species of mosses were recorded.

These were:

*Aloina aloides* (Koch ex Schultz) Kindb.  
*Barbula unguiculata* Hedw.  
*Bryum capillare* Hedw.  
*Calliergonella cuspidata* (Hedw.) Loeske  
*Dicranella varia* (Hedw.) Schimp.  
*Didymodon acutus* (Brid.) K. Saito  
*Didymodon insulanus* (De Not.) M. O. Hill  
*Didymodon luridus* Hornsch.  
*Didymodon rigidulus* Hedw.  
*Didymodon vinealis* (Brid.) R. H. Zander  
*Fissidens taxifolius* Hedw.  
*Hypnum cupressiforme* Hedw.  
*Oxyrrhynchium hians* (Hedw.) Loeske  
*Phascum cuspidatum* Hedw.  
*Physcomitrella patens* (Hedw.) Schimp.  
*Pseudocrossidium hornschuchianum* (Schultz) R. H. Zander  
*Syntrichia ruralis* (Hedw.) Weber & D. Mohr.  
*Trichostomum crispulum* Bruch.

The nomenclature follows SABOVLJEVIĆ *et al.* (2008).

A characteristic feature of the phytosociological records was the small number of bryophyte species in each relevé. Their number varied from one to seven. Only one taxon was recorded at nine localities. The maximum number, seven species, in the relevé area were found in only 2 localities.

The most often represented taxon was *Bryum capillare*. The appearance of this species from the field survey collection was recorded at 11 localities. The genus with the most represented species was *Didymodon* of which five species (*D. acutus*, *D. insulanus*, *D. luridus*, *D. rigidulus* and *D. vinealis*) were recorded. This is in accordance with the ecology of *Didymodon* species which inhabit mostly harsh environments. The moss cover of each species was different, but did not exceed 25 %.

Based on the field survey and subsequent determination of the bryophyte species, no exact community could be labelled as an association (or any other syntaxonomical categories of bryophyte communities). Instead, the five bryophyte assemblages were distinguished (Table 1.). Grasslands of Fruška gora Mt are at relatively low altitudes and belong to temporarily or permanently disturbed ecosystems (mowing, grazing, ploughing). Thus, in certain places only successive stages of expected bryophyte vegetation could be found. We assume these to be rather

random communities of species with similar life strategies, rapid life cycle and/or other characteristics that allow them to occur in the same place at the same time. Therefore they represent bryophyte communities that have similar ecological preferences but have not yet created closer ecological relationships.

The most common assemblage, observed at eight localities, was *Oxyrrhynchium hians* as the dominant species in semi-natural and cultural calciphile grassland with accompanying species *Bryum capillare*, *Didymodon rigidulus* and *Fissidens taxifolius*. The assemblage *Barbula unguiculata-Didymodon vinealis* was the one with the largest number of species (11), and these two species are dominant in natural calciphile grasslands. They were accompanied by the species *Bryum capillare*, *Trichostomum crispulum*, *Pseudocrossidium hornschuchianum*, *Dicranella varia*, *Didymodon insulanus*, *Phascum cuspidatum*, *Didymodon acutus*, *Didymodon luridus* and *Aloina aloides*. The assemblage *Hypnum cupressiforme-Calliergonella cuspidata* was dominant in mesic to hygrophile types of calciphile grassland with the accompanying species *Bryum capillare*, *Syntrichia ruralis* and *Pseudocrossidium hornschuchianum*. The assemblage of *Syntrichia ruralis-Bryum capillare* was recorded on sandy soils of calciphile grassland. *Physcomitrella patens* was a dominant species in wet grassland on salty soils.

As no spring time sampling was made, no ephemeral spring species or liverworts were recorded.

As the different species of bryophytes in their assemblages had not created closer ecological relationships with one another, it was difficult to separate the dominant, constant or diagnostic species as a result of investigating the communities in their early stage of formation. Whether they would stay as such would depend on the mutual relationships, as well as other parameters (degree of disturbance, vegetative propagation, number and presence of gemmes, life strategy, number of spores etc.). One can only assume that each assemblage represents a successive stage to some of the bryophyte communities. To make additional conclusions more information would be needed from the field on the basis of repeated collections of bryophytes.

The present results contribute to our knowledge of bryoflora of Fruška gora Mt and to our knowledge of the bryoflora of grasslands which have so far been little studied.

Further research is expected to lead to new and important information about communities and bryophyte diversity of Serbia.

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## Botanica SERBICA



## REZIME

## Zajednice briofita na travnim staništima Fruške Gore (Srbija)

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Uradu se izučava ekologija briofita na travnim staništima Fruške Gore, i predstavljeni su rezultati istraživanja tokom jeseni 2011. Na travnim staništima Fruške Gore zabeleženo je ukupno 18 vrsta briofita. Kako su travna staništa izložena učestaloj disturbanci, konstatovane briofite nemaju jako razvijen odnos u okviru zabeleženih zajednica. Faktor kratkog vremena uspostavljanja briofitskih zajednica kombinovan sa učestalom disturbancom, i nepovoljnim uslovima sredine i slučajnim naseljavanjem mikrostanista je ono što utiče na uspostavljanje briofitskih zajednica, koje se mogu označiti kao skupine-sinuzije pre nego kao definisane sintaksonomske kategorije. U različitim ekološkim situacijama na travnim staništima Fruške Gore uspeli smo da razlikujemo ukupno 5 takvih briofitskih skupina-sinuzija.

**Ključne reči:** briofite, ekologija, travna staništa, Fruška Gora, Vojvodina, Srbija.

