Bryophytes on loess cliffs in Bulgaria: a preliminary study

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Abstract. The bryophytes of eleven loess localities in the northern part of Bulgaria were studied. A total of 37 species were found. Of them, *Acaulon triquetrum*, *Crossidium crassinerve*, *Hilpertia velenovskyi*, *Microbryum floerkeanum*, *Pterygoneurum compactum*, and *P. subsessile* were new for the bryophyte flora of Bulgaria. New data on the distribution of several red-listed species is also presented.

Key words: bryophytes, Bulgaria, loess cliffs, new chorological data, red-listed species

Introduction

Loess deposits, and more specifically erosion formations, such as loess cliffs and lower vertical surfaces, are a specific substrate for bryophytes. This is due to the physical characteristics of the vertical loess surfaces that considerably reduce the amount of direct precipitation. They are exposed to intense irradiation and have special soil properties (Pócs 1999). Therefore, specific Mediterranean and semi-desert xerophytic bryophytes establish on such substrates, being desiccation tolerant and relatively free from the competition of vascular plants. The bryophyte vegetation of loess cliffs has been studied intensively in Central Europe and some parts of Eastren Europe, and several distinctive cryptogrammic communities have been described (Pócs 1999; Kürschner & Pócs 2002; Pócs & al. 2002).

The loess complex in the northern part of Bulgaria along the river Danube is the southernmost loess formation in Europe. Therefore, it is of considerable floristic interest. The vascular flora and vegetation of loess areas in Bulgaria are relatively well studied (Tzonev 2002, and references therein). However, virtually no studies have been focused on the bryophyte flora of the loess cliffs in Bulgaria. Given that this is a specific and totally unexplored habitat type, it could be expected that new species for the country and new localities of otherwise interesting and rare species would be found.

Here we report the bryophyte species found on loess cliffs in Bulgaria during a field trip held on March 26–29, 2005.

Materials and methods

We conducted a field trip in North Bulgaria along the river Danube, starting at the vicinity of Lom to the west and reaching Tutrakan to the east. Bryophytes were sampled at eleven locations that differed with respect to loess type and vegetation structure (Fig. 1, Table 1). Most of them represented natural and semi-natural loess cliffs and the areas just at the edge of the cliffs with a more open vascular plant cover and rich bryophyte vegetation. Voucher specimens of all species reported in the present study are deposited in the bryological collection of the herbarium at the Institute of Botany, Bulgarian Academy of Sciences (SOM).

The nomenclature follows the one used in the Check-list of the Bryophytes of Bulgaria (Natcheva & Ganeva 2005). For identification of *Pterygoneurum* we have used Guerra & al. (1995), and for *Crossidium* – Cano & al. (1993).

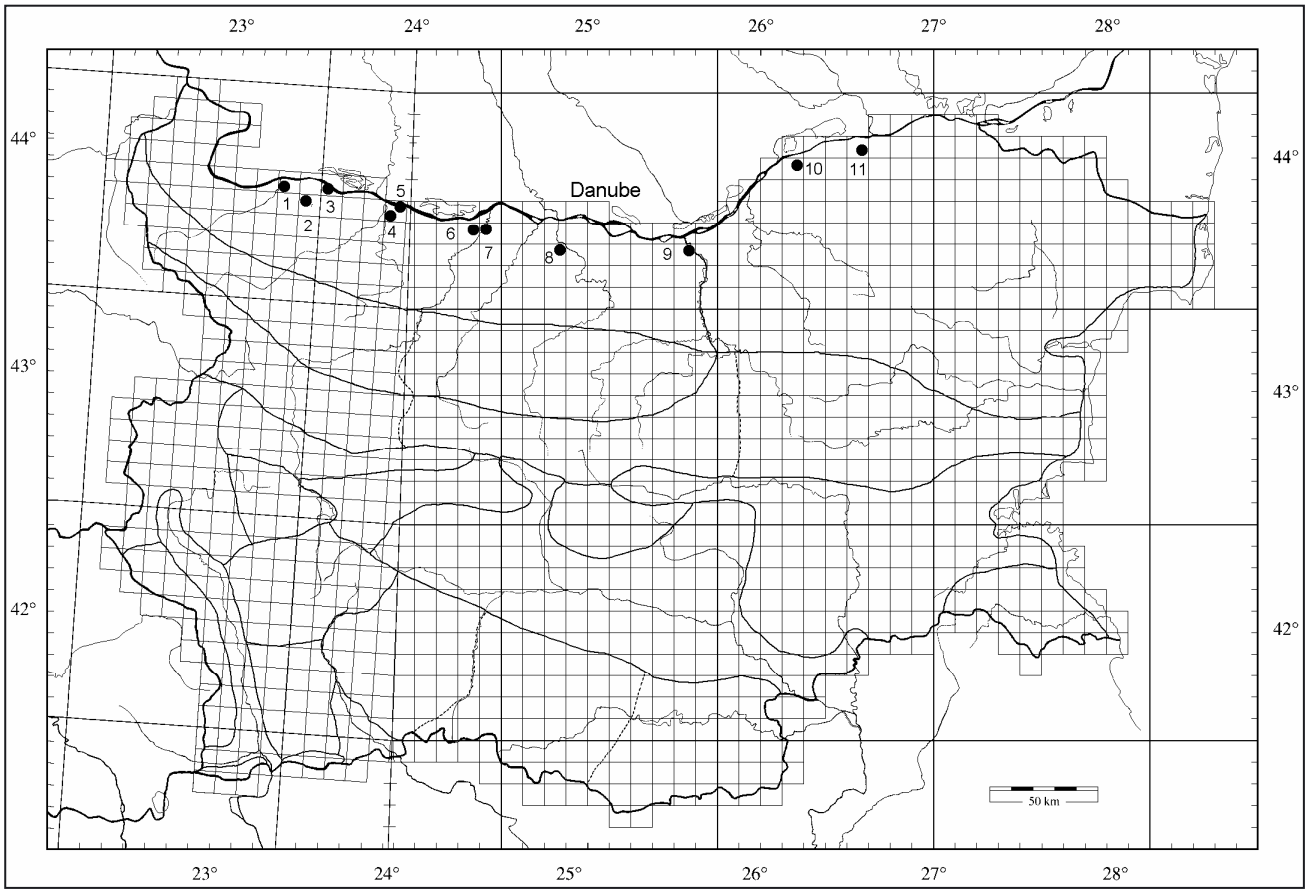

Fig. 1. Map of Bulgaria showing the position of eleven loess localities sampled for bryophytes. The localities are numbered according to Table 1.

Table 1. List of loess localities in North Bulgaria sampled for bryophytes.

No	Floristic region/Locality	Elevation, m asl.	Coordinates	Type
	Danubian Plain			
1.	Southwards of Lom	100	N 43°47′50.7″ E 23°15′55.8″	semi-natural loess cliff
2.	Southwards of Mokresh village	80	N 43°44′13.7″ E 23°24′34.9″	semi-natural loess cliff
3.	Southwards of Dolni Cibar village	129	N 43°47′38.7″ E 23°30′40.0″	natural loess cliff and loess soil
4.	At Mizia village	50	N 43°41′37.7″ E 23°50′49.2″	calcareous cliffs with loess soil
5.	Ca. 8 km to the northeast of Mizia village, along the road to Oryahovo	51	N 43°42′32.1″ E 23°51′07.7″	semi-natural loess cliff and the surrounding steppe area
6.	At Krushovene village	42	N 43°39′15.2″ E 24°24′40.3″	semi-natural loess cliff
7.	Northeast of Kroushovene village, along the road to Gigen village	40	N 43°41′45.9″ E 24°26′00.4″	semi-natural loess cliff
8.	between the villages Debovo and Muselievo	112	N 43°35′07.6″ E 24°55′12.9″	steep loess-chalk hill slopes
9.	Along the road to Byala, ca. 3 km after Nov Grad village	100	N 43°33′52.7″ E 25°36′04.9″	loess soil in a semi-open steppe community
	Northeast Bulgaria			
10.	Westwards of Slivo Pole village	40	N 43°56′13.7″ E 26°11′37.5″	semi-natural loess cliff
11.	At the Stenata locality, southwards of Toutrakan	21	N 44°01′21.7″ E 26°33′43.0″	semi-natural loess cliff

Results and discussion

As a result of the current study, a total of 37 bryophyte species were found (Table 2). Of them, *Acaulon triquetrum* (Spruce) Müll.Hal., *Crossidium crassinerve* (De Not) Jur., *Hilpertia velenovskyi* (Schiffner) R.H. Zander, *Microbryum floerkeanum* (F. Weber & D. Mohr) Schimp., *Pterygoneurum compactum* Cano, J. Guerra & Ros, and *P. subsessile* (Brid.) Jur. are reported for the first time for the bryophyte flora of Bulgaria. Furthermore, *Aloina rigida* (Hedw.) Limpr. is a Data Deficient species according to the recent Red List of Bulgarian bryophytes (Natcheva & al. in press). There is only one old report of the species for Bulgaria from the vicinity of Rouse (Velenovský 1902). Other red-listed species with new localities in the Danubian Plain and North-East Bulgaria are *Brachythecium campestre* (Müll.Hal.) Schimp. (VU), *Bryum radiculosum* Brid. (VU), *Microbryum curvicolle* (Hedw.) R.H. Zander (DD), and *Tortula protobryoides* R.H. Zander (EN).

It is noteworthy that all species found during this study were mosses. No liverworts have been found in other studies of bryophytes on loess in Europe (Kürschner 2002; Kürschner & Pócs 2002), probably due to the specificity of the substrate which does not favour the establishment of liverworts. It is also interesting the prevalence of pottiaceous species (26 out of 37) that are best adapted to the semi-desert microenvironment of the loess cliffs (Pócs 1999; Kürschner 2002).

The fact that there were so many new species, some of which encountered at most of the sites, is not surprising given that: 1) loess cliffs and soils are a specific substrate inhabited by specific mosses, and 2) this habitat type has been neglected by bryologists in Bulgaria. This is unfortunate because, on the one hand, loess cliffs are a unique habitat type, listed as a prior-

Table 2. List of species on loess with their localities. The new species for Bulgaria are marked with (*), the locality numbers correspond to Table 1.

Species	Locality	New for the Danubian Plain	New for Northeast Bulgaria
Acaulon triquetrum (Spruce) Müll.Hal. *	1,2,3,4,5,9,10	+	+
Aloina rigida (Hedw.) Limpr.	1,2,3,5,6,7,10	+	
Barbula unguiculata Hedw.	1,2,3,4,5,6,7, 8,9,10,11	+	+
Brachythecium albicans (Hedw.) Schimp.	1, 10	+	+
Brachythecium campestre (Müll.Hal.) Schimp.	10		+
Brachythecium salebrosum (F. Weber & D. Mohr) Schimp.	11		+
Bryum argenteum Hedw.	1,2,5,6,7,8,11	+	+
Bryum bicolor Dicks.	2, 4, 5, 8	+	
Bryum caespiticium Hedw.	2,3,5,6,8,10,11	+	+
Bryum radiculosum Brid.	5,8,11	+	+
Bryum rubens Mitt.	3	+	
Ceratodon purpureus (Hedw.) Brid.	6	+	
Crossidium crassinerve (De Not) Jur. *	7	+	
Crossidium squamiferum (Viv.) Jur.	5,7	+	
Didymodon acutus (Brid.) K. Saito	8	+	
Didymodon cordatus Jur.	2	+	
Didymodon luridus Hornsch.	2	+	
Didymodon rigidulus Hedw.	1,2,6,7	+	
Didymodon vinealis (Brid.) R.H. Zander	1, 2, 10, 11		
Eurhynchium hians (Hedw.) Sande Lac.	1,9,11	+	+
Hilpertia velenovskyi (Schiffner) R.H. Zander *	6		
Homalothecium lutescens (Hedw.) H. Rob.	8		
Homalothecium philippeanum (Spruce) Schimp.	8		
Microbryum curvicolle (Hedw.) R.H. Zander	1,3,5	+	
Microbryum floerkeanum (F. Weber & D. Mohr) Schimp.*	5	+	
Pseudocrossidium hornschuchianum (Schultz) R.H. Zander	5	+	
Pterygoneurum compactum Cano, J.Guerra & Ros *	1,2,3,5,6	+	
Pterygoneurum ovatum (Hedw.) Dixon	1,2,4,5,6,8,9,10	+	+
Pterygoneurum subsessile (Brid.) Jur. *	1,3,4,5,7,8	+	
Syntrichia intermedia Brid.	4	+	
Syntrichia ruralis (Hedw.) F. Weber & D. Mohr	1,4,8,10	+	+
Tortula atherodes R.H. Zander	1,4,5,8,9,10,11	+	+
Tortula lanceolata R.H. Zander	1,3,4,5,8,9	+	
Tortula modica R.H. Zander	8	+	
Tortula muralis Hedw.	2,4	+	
Tortula protobryoides R.H. Zander	4,5,8,9	+	
Weissia longifolia Mitt.	1,2,5,10,11	+	+

ity habitat in the Habitat Directive 92/43/EEC and the Bulgarian Law on Amending and Supplementing the Law on Biological Diversity (2005), which harbors unique bryophyte communities (Kürschner & Pócs 2002). On the other hand, these cliffs are highly vulnerable to various kinds of anthropogenic activities and natural disturbances. During our field work we observed loess-cliff destruction by excavation works, garbage deposition and invasion of alien (*Ailanthus altissima* (Mill.) Swingle, *Robinia pseudoacacia* L.), or otherwise ruderal species (*Sambucus nigra* L., *Urtica dioica* L.).

This study was to a large degree preliminary being restricted to fewer localities. Nevertheless, it has revealed several new and interesting species for the bryophyte flora of Bulgaria. Clearly, more thorough and longer-term studies on the bryophyte flora of loess areas in Bulgaria and its threats are needed.

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