Bryophyte vegetation of Iskur River and its main tributaries

Beáta Papp[1], Anna Ganeva[2] & Rayna Natcheva[2]

[1] Botanical Department, Hungarian Natural History Museum, Budapest, Pf. 222. H-1476, Hungary, pappbea@bot.nhmus.hu

[2] Institute of Botany, Bulgarian Academy of Sciences, Acad. G. Bonchev St., bl. 23, 1113 Sofia, Bulgaria, animoss@bio.bas.bg, renimoss@bio.bas.bg

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Abstract. The bryophyte vegetation was sampled at 32 localities along Iskur River and some of its tributaries to describe the various bryophyte assemblages. Eighty-four bryophyte species were inventoried. Three species (*Fissidens arnoldii, Pohlia annotina, Rhynchostegiella curviseta*) were recorded for the first time in Bulgaria. According to the bryophyte vegetation, two large groups could be distinguished: 1) the upper reaches of Iskur River and its tributaries taking their source from Vitosha and Stara Planina Mts, and 2) the lower sections of Iskur River. The bryophyte assemblages of the source area at Lakatnik and the sites situated in the upper course of Iskur River in the Rila Mts were very different from those of the other sampling sites.

Key words: aquatic bryophyte vegetation, bryophytes, Bulgaria, Iskur River

Introduction

The bryophyte flora and vegetation of rivers and streams comprise species growing in or beside the water (inundated or periodically submerged). The species composition, abundance and frequency depend on the water characteristics (temperature, chemical content, acidity, velocity, etc.) and on the presence/absence of suitable substrates such as boulders of different size and tree roots (Glime & Vitt 1987; Vitt & al. 1986). Some of the species are more frequently encountered in the upper river stretches and mountain streams, others are confined to the lower stretches, where anthropogenic activities change the water quality (Vanderpoorten & Klein 1999a).

In Eastern Europe and the Balkan region only a few studies deal with aquatic-riparian bryophyte assemblages. Correlation between the bryophyte vegetation and water quality along the Hungarian Danube section are presented in Papp & Rajczy (1995, 1998a). Bryophyte assemblages of various streams in Hungary and their relation to the chemical parameters of water are summarized in Papp & Rajczy (1998b). Bryophyte species composition of some Greek streams and their correlation with environmental conditions are described in Papp & al. (1998) and Papp (1999). Bryophytes as indicators of water pollution have been explored in some rivers of Slovenia (Vrhovšek & al. 1984, 1985). Bryophyte diversity along Maritsa River in Bulgaria is investigated in the study of Gecheva (2004).

This is the first study describing the aquatic, semi-aquatic and river-bank bryophyte flora and vegetation along Iskur River, covering the larger part of the river course and some of its tributaries. Relation of various bryophyte assemblages to water quality and other water parameters are discussed.

Study area

Iskur is the longest river flowing entirely across the territory of Bulgaria. It is a right-side tributary of the Danube (Fig. 1), 368 km long, and with a catchment area of 8646 km^2. It takes its source from the northwestern part of the Rila Mts, and then flows to the north-northeast. Along its course the river crosses areas of varied bedrock and relief types (Kopralev 2002). The bedrock upriver in the Rila Mts is siliceous, mostly granite (sites 1–4) and the river gains water predominantly from snowmelt. The river's middle course flows through the Samokov valley (sites 5–6) and enters a gorge between the Vitosha, Plana and Lozenska mountains (sites 7–9). The riverbed in this part of the study area is composed of siliceous metamorphic rocks and sediments. Then it crosses the Sofia plain (site 15), where its bed is built of alluvial deposits, and passes the western part of the Stara Planina Mts (sites 16–21) and the Forebalkan (sites 22–30) through a deep and long gorge, formed mostly of calcareous rocks. The river's lower course is situated in the Danubian plain (sites 31 and 32) where the water flow is relatively slow, with a wide riverbed, steep right banks and gently sloping left banks. In its middle and lower course the river is mostly fed by rains, with the addition of some karst waters from the Stara Planina Mts. The maximum flow rate in the Rila Mts occurs in May-June, whereas in the Danubian plain it is in March-June. The minimum flow rate is usually in August-October. Iskur River is regulated by several dams in its middle and lower course. The middle course of Iskur River is rather polluted by various industries developed along the river and by communal waste from the human settlements. It is characterized by a strongly aggravated oxygen regime and high concentrations of petrol products after the city of Sofia. The lower course is relatively less polluted due to sedimentation and the diluting effect of the numerous tributaries.

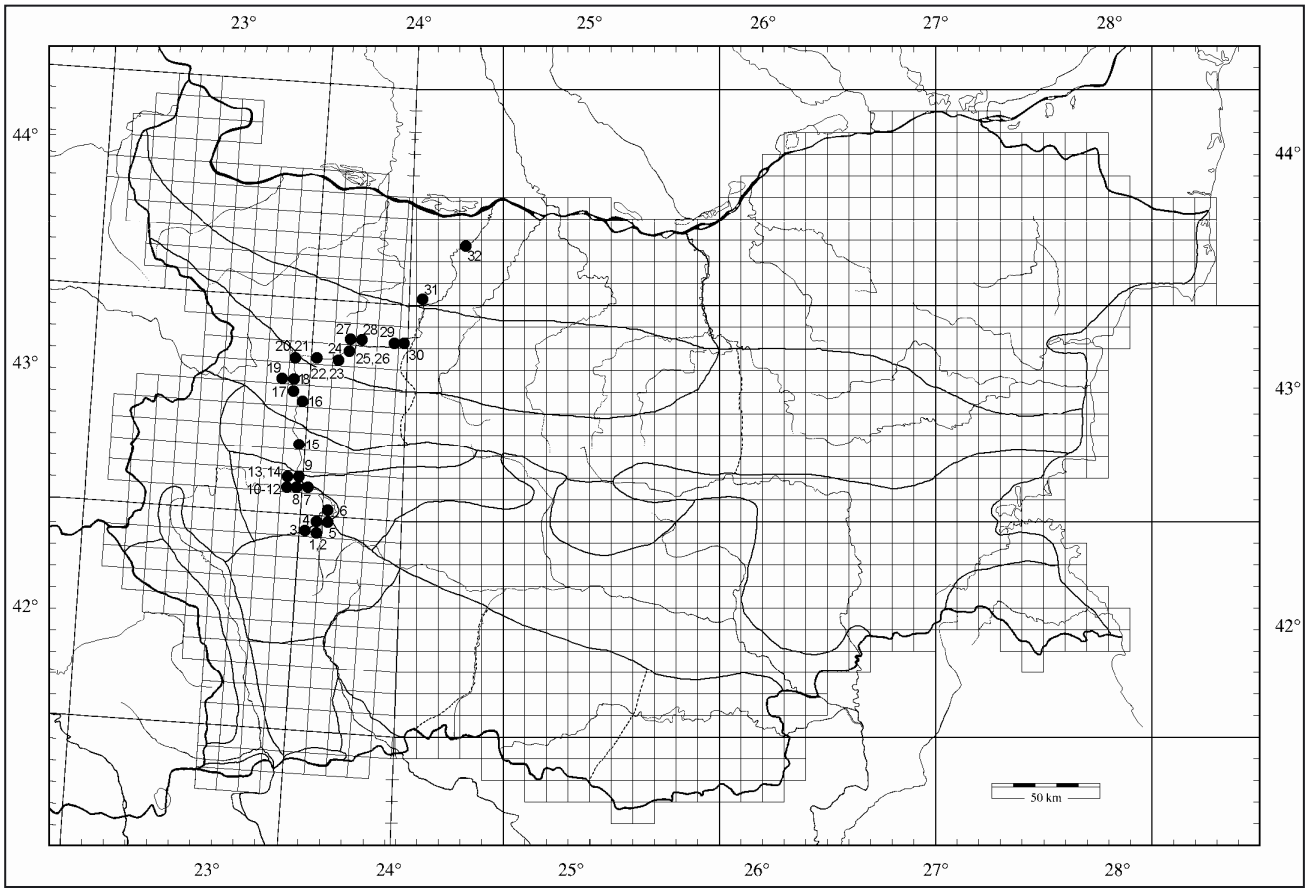

Fig. 1. Map of Bulgaria showing the location of the 32 sampling sites along Iskur River and some of its tributaries. For locality numbers see text.

Methods

The field work was carried out along Iskur River and some of its tributaries in September 1995 and in August 1996. The aquatic-riparian bryophyte flora was sampled at 32 localities (Fig. 1), along ca. 100 m long sections from the water level to the point where the bank begins to level out. This is the zone of water level variations. It is about half a meter wide in the upper flow of Iskur River and its tributaries, but in the lower course of the river it reaches up to 2 meters.

To describe the bryophyte vegetation of various river sections and tributaries, the abundance-frequency values for each species at each sampling site were estimated, using a 1–4 scale. To compare the bryophyte assemblages, a hierarchical cluster analysis (Czekanowski index, UPGMA fusion technique) was used from the SYN-TAX 2000 software package (Podani 2001). Data from some sampling sites (4, 5; 8, 9; 11, 12, 24, 25) were merged to characterise a section (Table 1).

Nomenclature follows Erzberger & Papp (2004) and Koperski & al. (2000). New floristic results for the country and various regions, and nature conservation status of some species are given according to Ganeva & Natcheva (2003), Natcheva & Ganeva (2005), Natcheva & al. (2006). Specimens of all species are preserved in the Herbarium of the Hungarian Natural History Museum, Budapest (BP).

Site details:

1. Rila Mts, Beli Iskur River, 1500 m, 09.09.1995.
2. Rila Mts, Beli Iskur River at Beli Iskur village, 1200 m, 09.09.1995.
3. Rila Mts, Cherni Iskur River above Govedartsi village, 1200 m, 10.09.1995.
4. Rila Mts, at the confluence of Beli Iskur and Cherni Iskur Rivers, 1100 m, 19.08.1996.
5. Rila Mts, Iskur River above Samokov, below the confluence of Beli and Cherni Iskur Rivers, 1080 m, 09.09.1995.
6. Iskur River, below Samokov, small dam and bridge at the village, on a cloth in the river, 990 m, 19.08.1996.
7. Iskur River near Pasarel, below the Pasarel storage lake, 820 m, 19.08.1996.
8. Iskur River between Kokalyane and Pasarel villages at Stroitelite monument, Zheleznitsa stream, Urvich castle, 650 m, 09.09.1995. and 19.08.1996.
9. Iskur River at Kokalyane, above the storage lake of Pancharevo, 650 m, 08.09.1995.
10. Mt Vitosha, Zheleznishka River above Zheleznitsa village, 1120 m, 06.09.1995.
11. Mt Vitosha, Zheleznishka River below Zheleznitsa village, 1080 m, 06.09.1995.
12. Mt Vitosha, Zheleznishka River below Zheleznitsa village, 950 m, 06.09.1995.
13. Mt Vitosha, Yanchovska River above Bistritsa village, 1080 m, 20.08.1996.
14. Mt Vitosha, Yanchovska River in Bistritsa village, 960 m, 20.08.1996.
15. Iskur River after Dolni Bogrov near Sofia, 580 m, 18.08.1996.
16. Stara Planina Mts, Mt Sofiyska, Iskur River at Loukovo village (Rebrovo) at Batouliyska River, 540 m, 13.08.1996.
17. Stara Planina Mts, Batouliyska River, 500 m, 13.08.1996.
18. Stara Planina Mts, Iskur River at Svoge, 500 m, 05.09.1995.
19. Stara Planina Mts, Iskrechka River at Svoge, 500 m, 05.09.1995.
20. Stara Planina Mts, Iskur River at Lakatnik, 450 m, 07.09.1995.
21. Stara Planina Mts, source in limestone bedrock at Lakatnik, 450 m, 07.09.1995.
22. Stara Planina Mts, Iskur River at Eliseyna village, limestone, 380 m, 14.08.1996.
23. Stara Planina Mts, Iskur River at Eliseyna village, 360 m, 14.08.1996.
24. Stara Planina Mts, Iskur River at Cherepishki Monastery, 290 m, 14.08.1996.
25. Stara Planina Mts, Iskur River at Reburkovo stream, 290 m, 14.08.1996.
26. Stara Planina Mts, rIskur River at Mezdra, different stones and concrete elements under the bridge, 270 m, 14.08.1996.
27. Stara Planina Mts, Iskur River, tributary from Vratsa before Mezdra, 300 m, 15.08.1996.
28. Stara Planina Mts, Iskur River after Mezdra at Brusen village, large rockwall, 210 m, 15.08.1996.
29. Stara Planina Mts, Malki Iskur at Roman, on the stones of a dam (concrete and other stones), 230 m, 15.08.1996.
30. Stara Planina Mts, Iskur River after Roman at Radovene village, 240 m, 15.08.1996.
31. Iskur River after Cherven Bryag at Chomakovtsi village, 190 m, 16.08.1996.
32. Iskur River at Staroseltsi village, 150 m, 16.08.1996.

Table 1. List of the species and their abundance-frequency values at 32 sites along the Iskur River and some of its tributaries. For locality numbers see text.

Species / Locality	1, 2	3	4, 5	6	7	8, 9	10	11, 12	13	14	15	16	17	18	19	20	21	22	23	24, 25	26	27	28	29	30	31	32
Hepaticae																											
Barbilophozia barbata (Schmidel ex Schreb.) Loeske		1																									
Chiloscyphus pallescens (Ehrh. ex Hoffm.) Dumort.	1						3	1									1										
Chiloscyphus polyanthos (L.) Corda		2				1	1		2	1			1				2										
Conocephalum conicum (L.) Dumort.						1			1																		
Jungermannia obovata Nees		1																									
Marchantia polymorpha L. emend. Burgeff subsp. *polymorpha*		2			1	1	2	3	1				3	1			3										
Pedinophyllum interruptum (Nees) Kaal.																	1										
Pellia endiviifolia (Dicks.) Dumort.		1	1		1	1	2		1	1						1	3			1							
Plagiochila porelloides (Torrey ex Nees) Lindenb.		1					1																				
Porella cordaeana (Huebener) Moore		1					1																				
Scapania undulata (L.) Dumort.	2	3					1																				
Musci																											
Amblystegium fluviatile (Hedw.) Schimp.						2							1											2			
Amblystegium humile (P. Beauv.) Crundw.														2				2								2	1
Amblystegium serpens (Hedw.) Schimp. var. *juratzkanum* (Schimp.) Rau & Herv.										1																	
Amblystegium serpens (Hedw.) Schimp. var. *serpens*				1		1									1	1							2			1	
Amblystegium tenax (Hedw.) C.E.O. Jensen					2	2	1	2					2		1		2					1				2	
Amblystegium varium (Hedw.) Lindb.								2																			
Atrichum undulatum (Hedw.) P. Beauv.				1																							
Barbula convoluta Hedw.														1													
Blindia caespiticia (F. Weber & D. Mohr) Müll.Hal.	2																										
Brachythecium plumosum (Hedw.) Schimp.	4	3																									
Brachythecium populeum (Hedw.) Schimp.																										1	
Brachythecium rivulare Schimp.	1	2	2		1		3	2	3	3							1										
Brachythecium rutabulum (Hedw.) Schimp.			2			1		2		2			2				1									3	
Bryum alpinum Huds. ex With.				1									1				1										
Bryum argenteum Hedw.				1				1				3				1	1						2				1
Bryum bicolor Dicks.								1				3	1	1		1	1				2	1	2			2	2
Bryum capillare Hedw. s.l.						1							1														
Bryum laevifilum Syed						1																					
Bryum pseudotriquetrum (Hedw.) Gaertn., B. Mey. & Scherb.	2	4	1	1	1		3		2				2				1										
Bryum rubens Mitt.						1								1													
Bryum schleicheri Schwägr.																	1										
Bryum spp.												1			1	1											1
Calliergonella cuspidata (Hedw.) Loeske		1		1									1														
Ceratodon purpureus (Hedw.) Brid.	1			1				1							1												
Cinclidotus aquaticus (Hedw.) Bruch & Schimp.																	4										
Cinclidotus fontinaloides (Hedw.) P. Beauv.																	2										
Cinclidotus riparius (Brid.) Arn.						1											4						1				
Cirriphyllum piliferum (Hedw.) Grout				1																							
Climacium dendroides (Hedw.) F. Weber & D. Mohr		1																									

Table 1. Contninuation

Species / Locality	1, 2	3	4, 5	6	7	8, 9	10	11, 12	13	14	15	16	17	18	19	20	21	22	23	24, 25	26	27	28	29	30	31	32
Cratoneuron filicinum (Hedw.) Spruce					3	3	1	1	1				1		1		4							2			
Dichodontium pellucidum (Hedw.) Schimp.		1	2																								
Dicranella palustris (Dicks.) Crundw.		1																									
Dicranella rufescens (With.) Schimp.							1																				
Dicranella schreberiana (Hedw.) H.A. Crum & L.E. Anderson															1												
Dicranoweisia crispula (Hedw.) Milde	1																										
Didymodon fallax (Hedw.) R.H. Zander																							2				
Didymodon insulanus (De Not.) M.O. Hill						1																	2				
Didymodon rigidulus Hedw.																	1						1				
Didymodon sinusous (Mitt.) Delogne													1										1				1
Didymodon vinealis (Brid.) R.H. Zander													1														
Eurhynchium crassinervium (Taylor) Schimp.						1																					
Eurhynchium hians (Hedw.) Sande Lac.				1		2		2	2	1							1										
Fissidens adianthoides Hedw.		2					2																				
Fissidens arnoldii R. Ruthe																								1			
Fissidens crassipes Wilson ex Bruch & Schimp. subsp. *crassipes*						2											2							2			
Fontinalis antipyretica Hedw.		2	1	2			1		1				1	1	2	1	1			1							
Funaria hygrometrica Hedw.			1					1			3	1		1													
Hygrohypnum duriusculum (De Not.) D.W. Jamieson	3	3	3				3	1	2																		
Hygrohypnum luridum (Hedw.) Jenn.		1	3					2	1	1			1		1												
Hynum lindbergii Mitt.		2																									
Leptobryum pyriforme (Hedw.) Wilson												2									1						
Leptodictyum riparium (Hedw.) Warnst.					4	1					2	1		4	2	4		3	4	4	4	4	4	4	4	3	4
Leskea polycarpa Hedw.																							2				
Mnium marginatum (Dicks. ex With.) P. Beauv.						1																					
Philonotis fontana (Hedw.) Brid.		2		1																							
Philonotis seriata Mitt.		1																									
Plagiomnium affine (Blandow ex Funck) T.J. Kop.				1																							
Plagiomnium rostratum (Schrad.) T.J. Kop.						1	2	1		1																	
Plagiomnium undulatum (Hedw.) T.J. Kop.							2	1	2	1							2										
Platyhypnidium riparioides (Hedw.) Dixon	2	2	2			4	4	4	4	1			4	1	4		4					1		3			
Pohlia annotina (Hedw.) Lindb.	1			1																							
Pohlia cruda (Hedw.) Lindb.	1																										
Pohlia melanodon (Brid.) A.J. Shaw								1		1				1										1			
Pterigynandrum filiforme Hedw.	1																										
Racomitrium aciculare (Hedw.) Brid.	2																										
Rhizomnium punctatum (Hedw.) T.J. Kop.	2	1	2			1	1	1	1	1																	
Rhychostegiella curviseta (Brid.) Limpr.																	1										
Sanionia uncinata (Hedw.) Loeske	3																										
Schistidium agassizii Sull. & Lesq.	3	1																									
Schistidium apocarpum (Hedw.) Bruch & Schimp. s.l.	2		2			1																				1	
Schistidium rivulare (Brid.) Podp. subsp. *rivulare*	2																										
Thamnobryum alopecurum (Hedw.) Gangulee				1													1										
Tortula muralis Hedw.																1											
Trichostomum crispulum Bruch																	1										

Results

Floristic data

Eighty-four species (11 liverworts and 73 mosses) were found at 32 locations along Iskur River and its main tributaries. A list of the species and their abundance-frequency values in various river sections and tributaries are given in Table 1. The bryophyte species richness is relatively high. The only other comparable study, where bryophyte diversity along the entire river course in Bulgaria was investigated, is the study of Gecheva (2004). In that study, 73 species were found at 23 sites. During our investigations, three species (*Fissidens arnoldii, Pohlia annotina, Rhynchostegiella curviseta*) were recorded for the first time in Bulgaria. *Fissidens arnoldii* was found on the stony dam of Malki Iskur at the town of Roman. *Pohlia annotina* was recorded at Beli Iskur and on the bank of Iskur River at the town of Samokov. *Rhynchostegiella curviseta* was found in the source area of Lakatnik.

Another species of interest is *Blindia caespiticia*. It was reported for the first time by Podpéra (1954) for the Rila and Vitosha Mts, without furhter specification of location. Petrov (1975) did not mention it in his comprehensive work on the Bulgarian bryophyte flora. Düll & al. (1999) treated it as doubtful for the country and in need of verification. Therefore, it was evaluated as data deficient (DD) in the Red list of Bryophytes in Bulgaria (Natcheva & al. 2006). During our surveys, this species was collected on the bank of Beli Iskur.

Some species were found for the first time in some of the regions. These are mostly common species but they have been under-recorded or the areas have been neglected by bryologists. *Conocephalum conicum, Pellia endiviifolia, Plagiochila porelloides, Amblystegium varium, Bryum bicolor, Cratoneuron filicinum, Dicranella rufescens* are new to Mt Vitosha; *Amblystegium humile, Bryum rubens, Bryum bicolor, Didymodon sinuosus, Amblystegium fluviatile, Hygrohypnum luridum, Leptobryum pyriforme* are new to Stara Planina Mts. For the Forebalkan, new species are *Pellia endiviifolia*, *Amblystegium humile, A. serpens, Bryum argenteum, B. bicolor, Cinclidotus riparius, Didymodon fallax, D. insulanus, D. rigidulus, D. sinuosus, Fontinalis antipyretica, Leptobryum pyriforme, Leptodyctium riparium, Leskea polycarpa.* New to the Danubian plain are *Amblystegium humile, A. serpens, A. tenax, Brachythecium populeum, B. rutabulum, Bryum argenteum, B. bicolor, Didymodon sinuosus, Schistidium apocarpum.*

Bryophyte vegetation

Two large groups can be distinguished in the bryophyte vegetation along Iskur River based on cluster analysis (Fig. 2). One group consists mainly of bryophyte assemblages found in the sites along the tributaries of Iskur River taking their source from the Vitosha and Stara Planina Mts (sites 11–14, 17). Some of the upper sections of Iskur River (sites 4, 5, 8 & 9) are also included. The other large group is formed by the sampling sites of the lower sections of Iskur River and some tributaries situated downstream (sites 6, 7, 15, 16, 18–20, 22–32). The bryophyte vegetation in the source area at Lakatnik (site 21), the upper flow of Iskur River (sites 1–3), and a tributary (site 10) in the Rila Mts are very different from that of the other sampling sites.

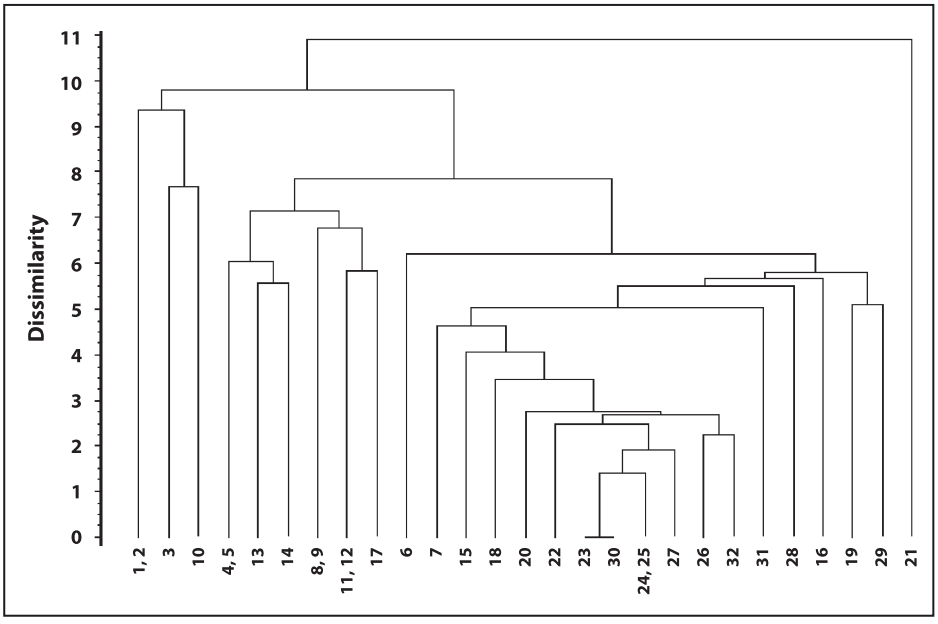

Fig. 2. Results of hierarchical cluster analysis on the basis of bryophyte vegetation from different river and tributary sections. For locality numbers see text.

Discussion

Relation of bryophyte assemblages to water parameters

In the upper reaches of Iskur River two main tributaries (Beli Iskur and Cherni Iskur) collect the water of the mountain area. The bryophyte assemblages of these tributaries are completely different from the lower stretches of the river and differ from each other, too. In both tributaries *Brachythecium plumosum* and *Hygrohypnum duriusculum* dominate the bryophyte vegetation. Along Beli Iskur River (sites 1 & 2) *Sanionia uncinata*, *Schistidium* species (*S. agassizii, S. rivulare, S. apocarpum*) and *Racomitrium aciculare* play an important role, while along Cherni Iskur River (site 3) *Bryum pseudotriquetrum, Scapania undulata*, *Brachythecium rivulare, Chiloscyphus polyanthos, Fissidens adianthoides, Fontinalis antipyretica, Philonotis fontana,* and *Platyhypnidium ripariodes* are characteristic members of the bank bryophyte assemblage. The sampling site in the upper stretch of a tributary of Iskur River (Zheleznishka River) sourced in Mt Vitosha (site 10) is merged with the sampling site of Cherni Iskur. The bryophyte assemblages of these areas are characteristic of running waters of high flow velocity and water level fluctuation at high altitudes (Englund & al. 1997; Peñuelas & Sabater 1987). *Brachythecium plumosum*, *Hygrohypnum duriusculum* and *Scapania undulata* prefer waters with low concentration of dissolved minerals. Human interference and polluted effluents from the villages increase the dissolved mineral concentration and the trophic level of waters. With increasing pH, Ca^{2+} and Mg^{2+} concentrations the abundance-frequency of these species decreases and, conversely, other species appear and spread, e.g. *Hygrohypnum luridum, Platyhypnidium riparioide* and *Cratoneuron filicinum* (Vanderpoorten & Klein 1999b). A similar trend of changes can be detected in the bryophyte vegetation after the confluence of Beli and Cherni Iskur Rivers (sites 4 & 5). *Brachythecium plumosum* disappears, but *Hygrohypnum duriusculum* thrives. Furhtermore, *Hygrohypnum luridum* emerges and becomes co-dominant. *Platyhypnidium riparioides* and *Fontinalis antipyretica* occur in medium abundance and *Brachythecium* species (*B. rivulare, B. rutabulum*) are also important elements. This sample section (site 4 & 5) is placed in a group jointly with the tributaries of Iskur River springing in the Vitosha and Stara Planina Mts (Yanchovska River, sites 13 & 14), the lower section of Zheleznishka River (sites 11 & 12), and Batouliyska River (site 17). Downstream, in the gorge between the mountains Vitosha, Plana and Lozenska at Pasarel and Kokalyane villages, the bryophyte vegetation of Iskur River changes again. *Cratoneuron filicinum* and *Amblystegium tenax* are characteristic species there. Dominant elements of the bryophyte assemblages are *Leptodyctium riparium* at Pasarel (site 7), and *Platyhypnidium riparioides* at Kokalyane (sites 8 & 9). *Marchantia polymorpha* and *Bryum pseudotriquetrum* appear in medium abundance at Pasarel, while *Amblystegium fluviatile, Fissidens crassipes, Eurhynchium hians,* and *Pellia endiviifolia* occur in medium abundance at Kokalyane. The latter bryophyte vegetation type is similar to that of the tributaries of Iskur River taking their source in the Vitosha and Stara Planina Mts (Yanchovska, Zheleznishka and Batouliyska Rivers). With its high abundance of *Leptodyctium riparium,* the bryophyte vegetation of the river section at Pasarel is similar to that in the lower reaches of Iskur. The bryophyte assemblages of Yanchovska, Zheleznishka, and Batouliyska Rivers are dominated by *Platyhynidium ripariodes*. *Brachythecium rivulare* and *B. rutabulum* are also abundant. *Amblystegium tenax, Hygrohypnum* species (*H. duriusculum, H. luridum*), *Bryum pseudotriquetrum, Chiloscyphus* species (*C. pallescens, C. polyanthus*), and *Cratoneuron filicinum* are characteristic species in a near-water or water environment, while in higher places above the water level *Mnium marginatum, Pellia endiviifolia, Plagiomnium* species (*P. rostratum, P. undulatum*), and *Rhizomnium punctatum* are important elements. Some of these species prefer oligotrophic waters, e.g. *Chiloscyphus pallescens, Pellia endiviifolia* and *Amblystegium tenax*. Others can tolerate a wider trophic range, e.g. *Amblystegium fluviatile*, *Fissidens crassipes, Platyhypnidium ripariodes,* and *Leptodyctium riparium*, but they often occur in waters with various eutrophication levels (Vanderpoorten & al. 1999). The latter species are also characteristic members of the bryophyte vegetation in a mesosaprobic section of the Danube (Papp & Rajczy 1995).

Downstream Iskur River, *Leptodyctium riparium* becomes the most abundant and characteristic spe-

cies. This species is regarded as the most pollution-tolerant (Frahm 1974) and shows preference for eutrophic waters (Vanderpoorten & al. 1999). In some downstream sections *Amblystegium humile* and a few colonist species, such as *Bryum argenteum, B. bicolor, Didymodon fallax,* and *D. insulanus* are also important elements. Vascular hydrophytes appear as well. *Zannichellia palustris* L. and *Potamogeton crispus* L. are most frequently encountered, occurring at sites 18, 20, 22; *Potamogeton natans* L. is quite abundant at site 22. The bryophyte assemblage of Iskrechka River (site 19), which is a tributary downstream Iskur River, is dominated by *Platyhypnidium ripariodes*. *Leptodyctium riparium* appears in medium abundance here, while in the water *Fontinalis antipyretica* thrives. The bryophyte vegetation of some other tributaries in the lower stretches of Iskur River (a tributary from Vratsa (site 27), Malki Iskur (site 29) is also dominated by *Leptodyctium riparium*. At the sampling site of Malki Iskur River, *Platyhypnidium ripariodes* is also abundant, while *Cratoneuron filicinum, Fissidens crassipes* and *Amblystegium fluviatile* occur in medium abundance.

The bryophyte vegetation of the Lakatnik karst source area is completely different from that of the other sites. Here *Cinclidotus* species (*C. aquaticum, C. riparium*), *Cratoneuron filicinum* and *Platyhypnidium riparioides* are dominant. *Pellia endiviifolia, Marchantia polymorpha, Cinclidotus fontinaloides, Chiloscyphus polyanthus, Fissidens crassipes, Amblystegium tenax,* and *Plagiomnium undulatum* are also abundant.

Nature conservation value of the bryophyte flora

Fissidens arnoldii, which is recorded for the first time in Bulgaria, is a red-listed species in Europe, evaluated as rare (ECCB 1995). It is a species of the temperate zone of Europe. In the region of Southeast Europe it is known from only one site in Croatia. It is usually found on rocks at water mills and on calcareous rocks of streams in ravines. In Bulgaria it was found on the stony dam of Malki Iskur River at the town of Roman.

Three species, *Amblystegium humile* [CR B2ab(iii)], *Brachythecium plumosum* (VU D2) and *Dicranella rufescens* (VU D2), are included in the list of threatened bryophytes of Bulgaria (Natcheva & al. 2006). *Amblystegium humile* was recorded in Iskur River at the town of Svoge (site 18) and the villages Eliseyna (site 22), Chomakovtsi (site 31) and Staroseltsi. *Brachythecium plumosum* was found in the upper flow of Iskur River in the Rila Mts, both along Beli and Cherni Iskur Rivers (sites 1, 2 & 3). *Dicranella rufescens* was collected along the stream at Zheleznitsa village on Mt Vitosha (site 10).

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