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Contributions to the flora of the Hungarian caves I. Flora of the entrances of the caves Lők-völgyi-barlang and Szeleta-barlang

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Abstract: In the first part of their planned series the authors describe the flora of the entrance of two, prehistorically well-known caves in the Bükk Mts., Including the herbarium and other data, the flora of the cave Lők-völgyi-barlang consists of 11 alga and 7 bryophyte taxa, that of cave Szeleta-barlang consists of 38 alga, 12 moss, 1 fern and 1 dicotyledonous species and infraspecific taxa.

Plants living in the caves have attracted the attention of botanists for centuries. The mushrooms were the first plants to be studied in this special habitat. As early as in 1760, the first study on the flora (SCOPOLI 1760) containing data on cave plants, i.e. two mushroom species from the mercury mines near Idria in Carniolia (nowadays Idrija, Yugoslavia) was published. However MORTON & GAMS (1925) mentioned some earlier sporadic data as well, from the very beginning of the 18th century, which we could not trace. Later on, several publications appeared on the subject covering not only the mushrooms, but other phyla of the plants. Regarding the history of cave plant research we refer to MORTON & GAMS (1925) and DOBAT (1966) and their citations. A review of the Hungarian research is available as well (HAJDU 1977). Many data on cave bryophytes were published by BOROS and VAJDA, as well as GYŐRFFY.

Regarding the Hungarian cave algae mainly the mysterious dark flora (CLAUS 1955, PALIK 1964, SUBA 1957, etc.) and the flora of the lamp-lit areas in illuminated caves (HAJDU & ORBÁN 1982, P.-KOMÁROMY & al. 1985) were studied. The examination of the cave part reachest in plants i.e. the entrances, stayed behind them. There are only two publications available (KOL 1964, P.-KOMÁROMY 1977) and our knowledge on the algal flora of cave entrances is rather poor even on a world-wide scale.

In our new series we intend to publish the results of our examinations in the Hungarian caves. We restrict the term "flora" here to the green plants (incl. blue-green algae, but excl. fungi).

Description of the caves. - Both caves are situated in the Bükk Mts, NE Hungary (Fig. 1), on the territory of the Bükk National Park. In the first half of the 20th century excavations were carried out in the caves. The cave Lők-völgyi-barlang opens to S in the western slope of the valley Lők-völgy , N from Felsőtárkány (elevation 445 m s.m.). The entrance is 2.2 m high and 3.5 m wide, the cave itself is 64 m long. During the excavations soil in the vicinity of the entrance was deepened to the rock and a more then one m deep ditch was dug in the centre of the passages (KADIĆ & MOTTL 1938). The cave is rather dry, the eastern niche at the entrance is bright, the inner parts are dim (Fig. 2). Registration number in the Hungarian Cave Survey: 5343/63. - The cave "Szeleta-barlang" is situated in the southern slope of the Mt. Szeleta-tető at the elevation of 335 m s.m. It was excavated to the rock, the ground was deepened more then 4 m at some places. The cave opens to S. Formerly the entrance was sheltered by bushes and

Fig. 1. Location of the caves in Hungary (full circle: Szeleta-barlang , open circle: Lők-völgyi-barlang)

it was so low that one had to bend to enter the cave (KADIĆ 1915). Now it is 3 m high and 4 m wide. Before the entrance there is a huge heap of rocks built during the excavations (Fig. 3). This wall throws a shadow on the very beginning of the cave. The first hall of the cave is rather bright, even direct sunshine can be seen round noon. Immediately after the excavations KADIĆ (1915) reported that on the N wall of this hall one could see mosses and algae, being very picturesque in green, lilac, yellow and green colours. The climate of the cave is rather even, the air humidity is high (LOKSA 1962). Register number in the Hungarian Cave Survey: 5363/1.

METHODS

We visited the cave Lők-völgyi-barlang in 25. April, 1985. and the cave Szeleta-barlang in 26. April, 1985. The algal coat were scraped off with a knife sterilized by burning before taking each sample, and put into presterilized collecting tubes filled with inorganic fluid Bold medium (STEIN 1973). Within 12 hours all the samples were divided into two. One part of each sample was fixed by formaldehyde solution (2-4%), the other part was cultivated in the laboratory (room temperature, 12 hours light - 12 hours darkness). After 1, 9 and 15 months of cultivation these samples were examined under microscope. This way we united the advantages of the "direct method" (cf. HAJDU & ORBÁN 1981) and of the cultivation method used by us in our previous work (P.-KOMÁROMY & al. 1985). Thus we could get a better knowledge on the frequency relations of the original flora from the fixed sample and the cultivated samples helped in the identification of the coccoid green algae (reproductional stages) and in finding those species which are too rare. The cultivated samples are essential when the original scraping contained too much inorganic matter. On the first occasion P.-KOMÁROMY identified the algae. The identification of the fixed material and the 9 and 15 months old samples were carried out by BUCZKÓ. Permanent diatom slides were made when required with the hydrogen peroxide method of HORVÁTH (1975).

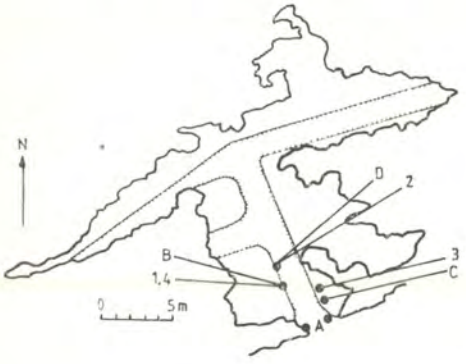

Fig. 2. The map of the cave Lők-völgyi-barlang (redrawn from KADIĆ & MOTTL 1931). 1-4: algological sampling sites; A-D: collecting sites for other plants (the line with dots mark the ditches excavated)

Four samples were taken from Lők-völgyi-barlang and 11 from Szeleta-barlang (Table 1, Figs.2-3). Mosses were collected from all of the surfaces where they were observed. The presence of ferns and fern prothallia were only noted in the field-book. The former unpublished bryophyte collections were revised as well (Lők-völgyi-barlang: BOROS 22.05. 1937; Szeleta-barlang: BOROS 29.05. 1928; VAJDA 21.10. 1969). The nomenclature of mosses follows DUELL (1984, 1985). Either the bryophyte specimens or the alga samples are deposited in BP.

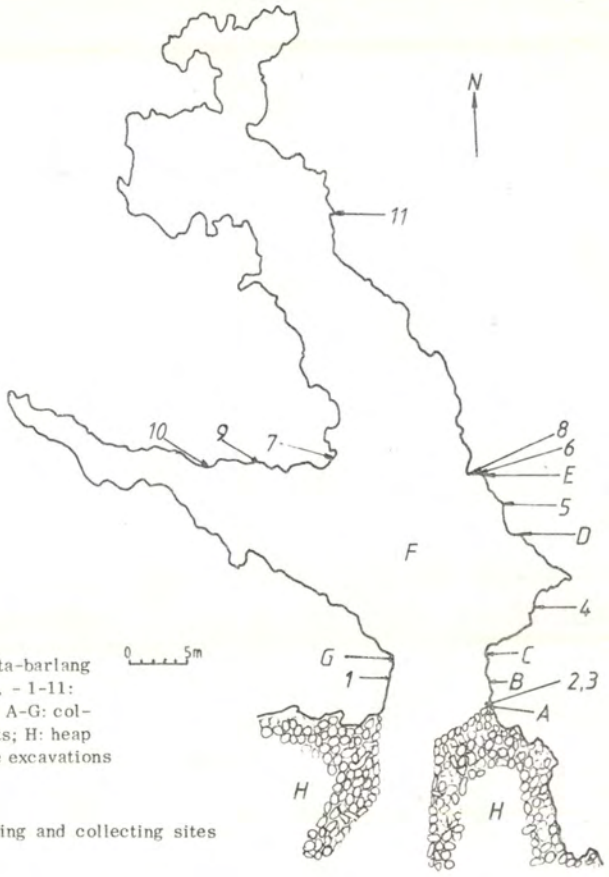

Fig. 3. The map of the cave Szeleta-barlang (redrawn from Kadić 1915). - 1-11: algological sampling sites; A-G: collecting sites for other plants; H: heap of rocks piled up during the excavations

Table 1. Description of the sampling and collecting sites

I. Lők-völgyi-barlang (Fig. 2)

1. Bluish-green coating on the rock of the ceiling, 2-3 m from the entrance
2. Glaucous coating on the wall of the excavation ditch, cca. 5 m from the entrance
3. Blackish coating on the wall of the cave (dropping water), 2-3 m from the entrance
4. Greyish-green coating near 1.

A. Side walls of the entrance (on rock)
B. On the rock of the ceiling, near 1.
C. On the rock in the eastern niche, near 3.
D. On the wall of the excavation ditch, ground level, near 2.

II. Szeleta-barlang (Fig. 3)

1. On the wall of the cave, 2-3 m from the entrance
2. On the inner wall of the heap of rocks in the entrance
3. Blackish coating near 2.
4. Bluish coating on the wall of the cave
5. Epiphytic algae from mosses near 6. and 8.
6. Ivy green coating on the cave wall, ground level

Table 1 (continued)

7. Steel blue coating on the cave wall
8. Dark green coating cca. half m higher then 6.
9. Light green coating on the cave wall
10. Ivy green coating on the wall
11. On dripstone in the semi-darkness

A. On the heap of rocks in the entrance
B. - E. On the cave walls
F. On soil
G. On the cave wall

RESULTS

Lők-völgyi-barlang

Algae - One of the four samples was completely sterile. The remaining three samples contained 11 species. The only species occurring in all of the three samples was Navicula contenta f. biceps (Table 2).
Bryophytes - We gathered 6 species from the cave. Rhynchostegiella tenella, that was collected by BOROS in remarkable quantities with sporophytes, has vanished from the cave, and Tortula muralis collected also by BOROS in the eastern niche (our C. site) incrusted with calc was found only in the entrance region (Table 4). No higher plants were found in the cave.

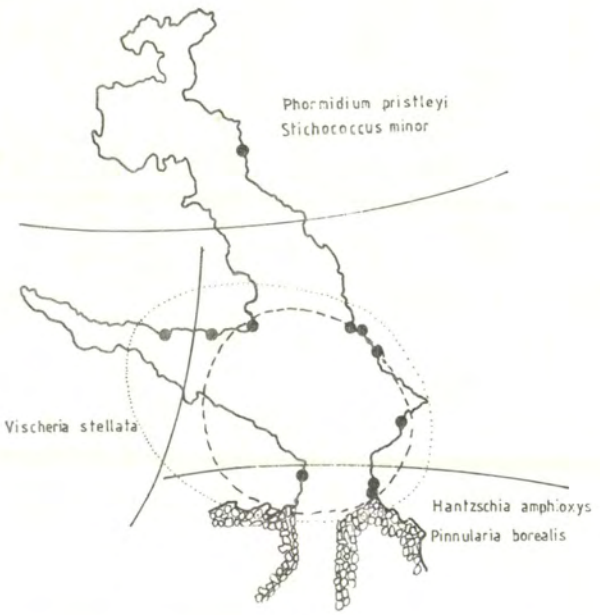

Fig. 4. Distribution pattern of the alga species in Szeleta-barlang (inside the dotted line: Navicula contenta f. biceps; inside the broken line: Melosira roeseana, Trochiscia granulata and Gloeocapsa punctata)

Szeleta-barlang

Algae - In course of the examination 36 species and 2 forms were identified (Table 3). Apart from Cymbella affinis, all species are typical aerophytic organisms and/or are already known from caves. Cymbella affinis is a freshwater epiphyte being quite common in Hungarian waters. The most frequent alga species in the cave was Navicula contenta f. biceps (9 samples), Gloeocapsa punctata (7 samples), Melosira roeseana (6 samples) and Trochiscia granulata (5 samples) were frequent as well. Distribution of these species may be limited by the light conditions in the cave (Fig. 4). Two species proved to be sciophylous as they occured only in the sample from the semi-darkness (Phormidium pristley and Stichococcus minor). The fifth frequent species, Monodus subterranea (5 samples) could be found in the samples either from the vicinity of the entrance or from the semi-darkness. In this case light limitation is out of question. There were 18 species occurring in only one sample.

Bryophytes - We gathered 8 species and varieties from the cave (Table 5). There were 4 species once collected here and not collected again. Eucladium verticillatum, a remarkable plant of cavern habitats was gathered by BOROS in 1928. Neither VAJDA nor we have found this species. VAJDA gathered 3 species in 1969 which were not found by us: Leptobryum pyriforme, Platydictya confertum and Bryum laevifilum (in the cushion of the previous species). We detected only one species being new to the cave: Rhynchostegiella tenella. The richest collecting site in bryophyte taxa was the B. The specimen from site A. was unidentifiable because of the thick coverage of blue-green algae and lichens (Lepraria).

Higher plants - Asplenium trichomanes L. was noted by BOROS in his field book. We also found this species in collecting sites C. and D. Besides we noted fern prothallia (most probably of A. trichomanes) at sites C, D. and E. We found prothallia in the bryophyte specimens of BOROS and VAJDA as well. In BOROS's field book there is a note of Stellaria media (L.) Vill. Anyhow, we have found no flowering plant in the cave.

DISCUSSION

Algae - The alga flora of the Szeleta-barlang is very rich, the riches among the examined caves in Hungary. In the cave Szoplaki-ördöglyuk (P.-KOMÁROMY 1977) 21 alga species, in the small ice-cave near Telkibánya (KOL 1964) 24 species were detectable. The alga flora of the Lők-völgyi-barlang is the poorest of all. The reason for this contrast is that the Lők-völgyi-barlang is very dry and small - its climate is far from being a real "cave-climate". On the contrary, Szeleta-barlang has a rather even, cave-like climate. The air humidity is high, dropping waters are quite common. The stands are diverse as well: limestone rock, dripstone, calc-tuff, clay and soil.

Bryophytes - A remarkable phenomenon is the disappearance of certain species from the caves. The excavation works in Lők-völgyi-barlang finished in 1933. BOROS collected here four years later. This must be the reason of vanishing of Rhynchostegiella tenella, a typical "cave-plant" from this cave. Most probably after the gathering the species could not proliferate again in the more and more dry cave (as during the excavations the entrance became bigger). The flora is now richer but this is characteristic of the entrance region only. At present we can give no explanation of the disappearance of four species from the Szeleta-barlang . The site of Eucladium verticillatum might have been destroyed as the excavations lasted till the forties.

METHODOLOGICAL REMARKS

Examination of the fixed algological samples resulted 18 taxa. After 1 month cultivation further 10 taxa, after 9 months further 8 taxa and after 15 months further 2 species was found (Table 3). Though we have worked with the greatest care (we used presterilized instruments during the examination) one cannot exclude the possibility of contamination. Probably Chlorhormidium flacci-

Table 2. Occurrence of algal species in the cave Lők-völgyi-barlang

Species	Sampling sites 1 abcd	2 abcd	3 abcd	
CYANOPHYTA				
1. Calothrix sp.			-+--	1
2. Chroococcus minutus (Kütz.) Näg.			-+++	1
3. Gloeocapsa punctata Näg.	++++		++++	2
4. Plectonema nostocorum Born.	++++		++++	2
XANTHOPHYCEAE				
5. Chloridella neglecta (Pascher et Geitler) Pascher	--++			1
BACILLARIOPHYCEAE				
6. Melosira roeseana Rabh.	---+		++++	2
7. Navicula contenta f. biceps Arnott	++++	--++	++++	3
CHLOROPHYTA				
8. Chlorella zofingensis Dönz		--++		1
9. Chlorella sp.		++++	++++	2
10. Chlorhormidium flaccidum (Kütz.) Fott	--++			1
11. Stichococcus sp.			-++-	1
Species number	6	3	8	

Age of samples: a = 0 month, b = 1 month, c = 9 months, d = 15 months

Table 4. Bryophyte flora of Lők-völgyi-barlang (B - identified by Boros)

Species	Boros (1937)	Our collecting sites A.	B.	C.	D.
1. Porella platyphylla (L.) Pfeiff.	-	+	-	-	-
2. Amblystegium serpens (Hedw.) B.,S.& G. var. serpens	-	+	-	-	+
3. Anomodon viticulosus (Hedw.) Hook. & Tayl.	-	+	-	-	-
4. Bryum laevifilum Syed	-	+	-	-	-
5. Fissidens viridulus (Sw.) (Wahlenb.) var. tenuifolius (Boul.) A.J.E. Sm.	+(B)	-	+	+	-
6. Rhynchostegiella tenella (Dicks.) Limpr. var. tenella	+(B)	-	-	-	-
7. Tortula muralis Hedw.	+	+	-	-	-

Table 3. Occurrence of algal species in the cave Szeleta-barlang

Species	Sampling sites											
	1	2	3	4	5	6	7	8	9	10	11	
	abcd	abcd	abcd	abcd	abcd	abcd	abcd	abcd	abcd	abcd	abcd	
CYANOPHYTA												
1. Calothrix sp.		-+--										1
2. Chroococcus minutus (Kütz.) Näg.					--+-							1
3. Chroococcus turgidus (Kütz.) Näg.		++++										1
4. Cylindrospermum sp.	-+--											1
5. Gloeocapsa granosa (Berk.) Kütz.		++++										1
6. Gloeocapsa punctata Näg.	++++	++++	++--	++++	++++	---+	++++					7
7. Nostoc punctiforme (Kütz.) Hariot		++++	--++									2
8. Nostoc sp.	--++				--++							2
9. Phormidium foveolarum Gom.						--+-				--++		2
10. Phormidium pristleyi F.E. Fritsch											-+--	1
11. Phormidium retzii (Ag.) Gom.				--++								1
12. Phormidium uncinatum (Ag.) Gom.					++++							1
13. Plectonema puteale (Kirchn.) Hansg.				++++			++++					2
14. Plectonema schmidlei Limanowska	++++	++++	++++									3
15. Tolypothrix distorta Kütz.		--++										1
XANTHOPHYCEAE												
16. Ellipsoidion perminimum Pascher	++--					-+--						2
17. Monodus subterranea Boye-Petersen	++--	-+--	-+--			-+--					-+++	5
18. Pleurochloris anomala James	++++											1
19. Vischeria stellata (Chodat) Pascher										--++		1
BACILLARIOPHYCEAE												
20. Cymbella affinis Kütz.							+---	+---				2
21. Gomphonema olivaceum (Lyngbye) Kütz.								---+				1
22. Hantzschia amphioxys (Ehr.) Grun.	-+++	-+++										2
23. Melosira roeseana Rabh.	+---	-+++		++++	++++	--++	++++					6
24. Navicula contenta f. biceps Arnott	++++	-+++	++++	++++	++++	++++	++++		++++	--++		9
25. Navicula contenta f. parallela Petersen				++++		++++						2
26. Nitzschia palea (Kütz.) W. Smith	+---							++++				2

Table 3 (continued)

Species	Sampling sites											
	1	2	3	4	5	6	7	8	9	10	11	
	abcd	abcd	abcd	abcd	abcd	abcd	abcd	abcd	abcd	abcd	abcd	
27. Pinnularia borealis Ehrenberg	++++	++++										2
28. Synedra ulna (Nitzsch) Ehr.								---+				1
CHLOROPHYTA												
29. Chaetophora sp.			-+--									1
30. Chlorella homosphaera Skuja						+++-		+++-	++++			3
31. Chlorella zofingensis Dönz			--++									1
32. Chlorhormidium crenulatum (Kütz.) Komáromy			-+++									1
33. Chlorhormidium flaccidum (Kütz.) Fott	-+--				---+							2
34. Gongrosira sp.		-++-										1
35. Oocystis assymetrica W. et G. S. West	-+++				-+--							2
36. Stichococcus bacillaris Näg.	-+--	-+++			++++		-+--					4
37. Stichococcus minor Näg.											--++	1
38. Trochischia granulata (Rheinsch.) Hansg.	++++			++++	++++	++++	++++					5
Species number	17	14	7	7	10	9	7	5	3	3	3	

See Table 2.

Table 5. Bryophyte flora of Szeleta-barlang (B - identified by Boros, V - by Vajda, Bg - by Baumgartner, G - by Galambos)

	Boros (1928)	Vajda (1969)	A.	B.	C.	D.	E.	F.	G.
1. Brachythecium velutinum (Hedw.) B.,S. & G. var. velutinum	+(Bg)	+(V)	-	+	-	-	+	-	-
2. Bryum laevifilum Syed	-	+	-	-	-	-	-	-	-
3. Didymodon rigidulus Hedw. var. glaucus (Ryan) Wijk & Marg.	-	+(G)	-	+	+	-	-	-	+
4. Eucladium verticillatum (Brid.) B.,S. & G.	+(B)	-	-	-	-	-	-	-	-
5. Fissidens viridulus (Sw.) (Wahlenb.) var. viridulus	-	+(V)	-	+	+	-	-	+	-
6. var. tenuifolius (Boul.) A. J. E. Sm.	+	+(V)	-	+	+	+	+	-	-
7. Leptobryum pyriforme (Hedw.) Wils.	-	+(V)	-	-	-	-	-	-	-
8. Plagiothecium nemorale (Mitt.) Jaeg.	-	+(V)	-	-	-	+	-	-	-
9. Platydictya confervoides (Brid.) Crum	-	+(V)	-	-	-	-	-	-	-
10. Rhynchostegiella tenella (Dicks.) Limpr. var. tenella	-	-	-	-	-	-	-	-	+
11. Rhynchostegium murale (Hedw.) B.,S. & G.	-	+	-	+	+	-	-	-	-
12. Taxiphyllum wissgrillii (Garov.) Wijk. & Marg.	-	+(V)	-	-	-	+	-	-	-

dum in sample 6 is the result of such a contamination. Anyway, appearance of such number of species proves that this phenomenon must be rare (contamination with 8 new species in one occasion is very unlikely). As we can see in Table 3 disappearance of species is not rare at all (e.g. Chlorella homosphaera from samples 6 and 8). Though we have only few data on the problem, it is clear that the repeated examination of the cultivation tubes is essential.

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