

Studies on the cryptogamic vegetation of loess cliffs, II. The genus *Bryum* Hedw. on loess cliffs in the Pannonian Basin, including *Bryum gemmiferum* Wilz. & Demar. and *Bryum violaceum* Crundw. & Nyh. new to Hungary

B.O. VAN ZANTEN

State University Groningen, Biological Centre, Dept. of Plant Ecology, P.O. Box 14,
NL-9750 AA HAREN, The Netherlands

Introduction

In the framework of a study of the bryophytes of loess cliffs in the Pannonian Basin (see PÓCS, 1999) specimens were collected in Hungary and adjacent areas of Serbia (Vojvodina) together with T. PÓCS (leader of the project), and with the help of several other persons. The fieldwork was done from October 29th to November 8th in 1996, from Oct. 12th to 28th of 1997 and finally from June 15th to July 1st in 1998 (including the Titel Plateau in Vojvodina). In total c. 150 cliffs were studied, c. 140 in Hungary and 10 in Serbia. The specimens were mainly collected on (nearly) vertical cliffs, but also on the upper rim and on the slanting lower slope. The vertical parts are nearly always without any vegetation of phanerogams, but lichens are often present. On the upper rim usually there an open vegetation consisting mainly of grasses and dwarf shrubs (*Agropyro-Kochietum*). The lower slope is in general either without phanerogams or it has an open vegetation also mainly consisting of grasses. The most common bryophytes on the cliffs belong to the genera *Didymodon*, *Aloina*, *Bryum*, *Pterygoneurum*, *Tortula*, *Pottia*, *Crossidium*, *Grimmia*, *Orthotrichum*, etc. In general the more exposed cliffs are richer in species than north-facing cliffs. In places where the cliffs are shaded by trees (usually by *Robinia*) the moss vegetation is much poorer and consisting mainly of *Didymodon* and *Bryum* species. Liverworts are very scarce and exclusively found on the lower, slanting slopes in shaded and moist situations. All visited cliffs are between 80 and 350 m altitude.

For the nomenclature I followed CORLEY et al. (1981).

A complete set of specimens is deposited in the herbarium of Eszterházy K. College in Eger (EGR), Hungary and in the private herbarium of the author.

The species

On the studied loess cliffs we collected 10 species of the genus *Bryum*, viz. *Bryum argenteum*, *B. bicolor*, *B. caespiticium*, *B. capillare*, *B. cf. elegans*, *B. flaccidum*, *B. gemmiferum*, *B. rubens*, *B. torquescens* and *B. violaceum*.

1. *Bryum argenteum* Hedw.

This species was observed on about 50 % of the studied cliffs. Sporophytes are rare and seen only on 4 cliffs. In three cases (all from upper rim of cliffs) the capsules were worn out (in November and in June) and in one case (vertical cliff) the capsules were already thickened but not yet mature (in November). Axillary bulbils are frequently present. The species grows in small tufts or as isolated stems mixed among other mosses or in small pure turf on bare loess. It is indifferent for the exposition.

The species is readily recognized by its slender, julaceous stems with imbricate leaves which are either nearly entirely, or only at their tips, silvery white. However there occur some specimens which are (nearly) entirely green except for the acuminate apex. Such specimens grew exclusively on NW-, N- and E-facing cliffs. In some cases the basal part of the stems are entirely hidden in loess and in one locality (Titel-plateau, Vojvodina) the entire plants (No. 9814/W) were nearly completely buried in loess. The leaves of the buried parts are broadly ovate, abruptly shortly acuminate and strongly concave, whereas the leaves of the emerging parts (if present) of the same stems are ovate, less concave and gradually slenderly pointed.

2. *Bryum bicolor* Dicks.

It is a common species found on ca. 40 % of the studied cliffs. Sporophytes (old) were observed only once (November). The most important discriminating characteristic of this species is its potential of producing large, green axillary bulbils which are, however, sometimes very scarce or absent. They were present in ca. 70 % of the

specimens. The bulbils are always only one per axil, to over 500 μm long and with distinct leaf primordia, of which the upper ones are overtopping the stem primordia. The occasional presence of brown or pale brown, spherical tubers of about 100-200 μm in diam. can help for a safe identification, if bulbils are absent. Tubers were found, however, only in 2 specimens lacking bulbils. If bulbils are present the species cannot be mistaken for any other one. *Bryum gemmilucens* Wilcz. & Dem., which is i.a. reported from a few localities in Hungary (ORBÁN 1983), has also axillary bulbils but these are smaller (to ca. 250 μm) and have smaller leaf primordia which do not overtop the stem primordia and there are several bulbils per leaf axil. *Bryum versicolor* Braun ex Br. & Schimp., a species known from Germany, Eastern France and Belgium, has similar axillary bulbils as *B. bicolor* but differs by a longly excurrent nerve (excurrent part to 500 μm) and strongly recurved leaf margin.

A very variable species e.g. in leaf shape and length of the excurrent part of nerve. Several of our specimens have a relatively longly excurrent nerve, up to ca. 300 μm which is longer than is usual in this species. The excurrent part of the nerve is either smooth or dentate. As contrasted to *B. caespiticium* (another common species on loess cliffs) a leaf border is absent or only weakly developed and the margins are usually plane but narrowly recurved at leaf base (strongly recurved till apex in *B. caespiticium*). There are some plants of which the basal portion of stems are buried in loess, these parts have, as in *Bryum argenteum*, ovate, very concave leaves and a rather longly excurrent nerve (resembling the leaves of *B. elegans*) whereas the upper leaves are much narrower and more gradually acuminate (e.g. 98.12/F). I assigned such plants only with some hesitation to *B. bicolor*.

3. *Bryum caespiticium* Hedw.

A common species found on about 30 % of the cliffs. Ca. 30 % of the specimens bore sporophytes. The species has a preference for slightly shaded places such as the slanting, grassy base or upper rim of cliffs, independent of the exposition. In November all sporophytes were old and worn out or very young and still without thickening of the capsule, those collected in June were mature and full of spores.

There are several other *Bryum* species which differ only in their sporophytes and sexual condition and they can therefore not be distinguished safely from *B. caespiticium* if sporophytes are absent and the sexual condition is unknown. These species are *B. algovicum*, *B. amblyodon*, *B. intermedium* and *B. pallescens*. All these species are synoecious whereas *B. caespiticium* is dioecious. In 22 out of 31 specimens assigned to *B. caespiticium* the sexual condition could be established: all turned out to be dioecious. Of these specimens 7 had sporophytes and they belonged all without any doubt to *B. caespiticium* (spores small, 12-18 μm and cilia well-developed with long appendices). From these facts it seems quite safe to assign the sterile plants to *B. caespiticium* as well.

Well-developed sterile plants of *B. caespiticium* can usually be distinguished from robust plants of *B. bicolor* lacking bulbils and tubers by the frequent presence of comal tufts, either with antheridia or archegonia, the reddish-brown leaf- and stem base (green, but often brownish in older parts in *B. bicolor*), a more distinct leaf border and a stronger recurvation of the leaf margin (usually till apex; only near base if at all in *B. bicolor*). *Bryum caespiticium* however develops sometimes subfloral innovations with leaves which can hardly be distinguished from those of *B. bicolor*. There remain a few, probably juvenil, specimens which are difficult to interpret. I assigned these doubtful specimens tentatively to *B. caespiticium*. TOUW (1989) came also to the conclusion that plants lacking bulbils, tubers and sporophytes are often difficult to interpret and advises against naming such specimens.

4. *Bryum capillare* Hedw.

This species was found on 7 cliffs (Nos. 96102/M, 96107/R, 96115/Q, 97166/B, 97217/FA, 9838/F and 9841/V), usually on humus covered loess in somewhat shaded situations and all without sporophytes. In two well-developed specimens (96102/M and 9838/F) the leaves are spirally twisted around the stem. In the other specimens the leaves are only slightly spirally twisted, but the shape of the leaves (greatest width in midleaf) indicate that they belong to *B. capillare*. They represent probably poorly developed specimens of shaded habitats. Tubers (65-140 μm in diam.) are present in No. 96107/R.

5. *Bryum* cf. *elegans* Nees ex Brid.

On two cliffs we collected specimens (97201/IA & 9841/L) which I am not able to place satisfactorily, although the plants have some characteristic features. The specimens, which are sterile and lack tubers, grew either in large pure patches on a vertical, SW-facing loess cliff in partial shade (9841/L) or mixed among *Bryum argenteum* (97201/IA). The stems are catenulate with broadly ovate, very concave leaves with the nerve excurrent in an often somewhat recurved, entire or dentate piliferous point of up to 200 μm in length. The leaf margin is entire, not recurved and the border is hardly to weakly developed. The leaves are not at all spirally twisted. The plants match in these characteristics *B. elegans*, but there are some differences. *B. elegans* has

strongly papillate rhizoids (papillae high and sharply pointed) whereas the rhizoids of our specimens are densely papillate by low, not pointed papillae. NYHOLM (1993), however writes about the rhizoids of *B. elegans*: "The size of the papillae on the rhizoids seems to be very variable. In several plants ... rhizoids partly coarsely partly finely papillose". *B. elegans* is a species of the lower montane to montane zone, whereas our specimens were collected at 100-150 m. The walls of the lamina cells are, according to the description, porous which is not the case in our specimens. However, in a specimen (Slovakia, Martinské hole: Fackovský Klak, PILOUS No. 341) which certainly belong to *B. elegans*, because of its high and sharp papillae on rhizoids, I found the cell walls also only indistinctly porous. SYED (1973: 272) depicts an aberrant form of *B. torquescens* which matches our specimens. *B. funckii* Schwaegr. has a similar leaf shape, but the nerve is wider (ca. 60 µm at base versus ca. 40 µm in our specimens) and the excurrent part of nerve is much shorter and broader (up to ca. 100 µm).

In my opinion the plants represent a form of *B. elegans* with less coarsely papillose rhizoids than is usual in this species, however there is also a possibility that the plants have to be referred to an aberrant phase of *B. torquescens* or of the extremely variable *B. capillare*. Unfortunately I could not find antheridia or archegonia so that the shape of the end cell of the paraphysia, which are sharply pointed in *B. torquescens* and rounded in *B. capillare*, could not be examined.

6. *Bryum flaccidum* Brid. (incl. *Bryum laevifilum* Syed)

Found on 3 cliffs, without sporophytes and growing in shaded habitats (Nos. 96100/X, 97214/A and 9828/D). The leaves of these specimens are twisted around their own axis and usually not around the stems. The filiform, axillary gemmae, which are characteristic of this species, are either abundant (96100/X and 9828/D) or scarce (No. 97214/A). Tubers (ca. 180 µm, brown) are present in Nos. 96100/X and 9828/D. The status of this taxon is a matter of dispute. TOUW (1989) treats it as a synonym of *B. capillare*, BOROS (1968) as forma, most recent authors [e.g. SYED (1973), SMITH (1978), CORLEY et al. (1981), ORBÁN (1983), NYHOLM (1993)] as a separate species. According to DEMARET (1993) the correct name of this species should be *B. LAEVIFILUM* Syed, a species described by SYED (1973) from a Hungarian specimen (Borsod, leg. A. BOROS, July 1948, c.fr.) and differing from *B. flaccidum* by ± smooth filaments and non-decurrent leaves. ORBÁN (1983) treats it as a separate species, but SMITH (1978) as a synonym of *B. flaccidum*. All the 3 specimens have non-decurrent leaves and a nerve ending well below apex. Nos. 97214/A and 9828/D have papillose gemmae, but No. 96100/X has (nearly) smooth ones and has therefore to be referred to *D. laevifilum* if this species is recognized. I have seen some specimens from Hungary with slightly papillose gemmae, non-decurrent leaves and with the nerve ending well before apex or reaching the apex. These specimens represent, in my opinion, intermediates between the taxa. I am therefore inclined to follow SMITH and treat *B. laevifilum* as a synonym of *B. flaccidum*.

7. *Bryum rubens* Mitt.

This species had only one known locality in Hungary: in the Nagyerdő („Great Forest”) of Debrecen town (JAKAB 1997). It is widespread in Europe, Caucasus, India, Japan and presumably introduced in N. America and New Zealand (WHITEHOUSE, 1994). We collected it twice (Nos. 9698/H and 97185/UA). The first specimen was intermixed with *B. violaceum*. Both specimens were growing on the slanting, shaded base of a cliff on loess (No. 9698/H) or clayey loess (No. 97185/UA) in riverine forest along Danube. Sporophytes were not seen.

The species is characterized by spherical tubers which are variable in size (ca. 60-300 µm in diam.) with slightly protuberant cells. The colour is pale to dark crimson. The larger tubers are usually produced on short rhizoids at the base of the stems in the substratum, or in the axils of lower leaves, whereas the smaller tubers are sometimes formed on supraterranean secondary protonema (TOUW, 1989). This phenomenon was observed in No. 97185/UA of which the subterranean tubers are ca. 160-300 µm in diam. and most of the supraterranean ones ca. 60-120 µm.

The species differs from *B. bicolor* by a crimson colour of its tubers (brown in *bicolor*), which are larger (at least the subterranean ones), a narrow (ca. 2 cells wide) but usually distinct leaf border of narrow cells (border absent or weakly developed in *B. bicolor*) and by the slightly wider lamina cells (ca. 14-20 µm, versus 10-16 µm in *B. bicolor*).

ORBÁN (1983) mentions *Bryum bornholmense* Winkelm. & Ruthe from Hungary. This species is distinguished from *B. rubens* by a broader, longer excurrent nerve and having the tubers on rhizoids far from the stem, never axillary (CRUNDW. & NYH., 1964; Nyh., 1993). Most authors treat this taxon as a separate species but TOUW (1989) synonymizes it with *B. rubens*.

8. *Bryum torquesens* Bruch & Schimp.

Found only once (No. 9838/C) on the grassy upper rim of a cliff on sandy loess. The species is monoecious. Sporophytes and (red) tubers, which are often present in this species, were not observed.

9. *Bryum gemmiferum* Wilz. & Demar.

This species is new to Hungary. It is a west Mediterranean-Atlantic species known from the Canary Islands: Lanzarote, Spain, Portugal, Ireland, Great Britain, France, Belgium, The Netherlands, Denmark, and Germany (DEMARET 1993). NYHOLM (1993) does not mention it from Scandinavia. Because of its south-western European distribution the occurrence in Hungary is remarkable. It was found on 4 loess cliffs (Nos. 9692/HA, 96119/E, 97186/D and 97187/C), in shaded as well as in open habitats, on vertical as well as on the slanting base of cliffs. Tubers, which occur rarely in this species, were not observed. Without axillary gemmae *B. bicolor* and *B. gemmiferum* cannot be distinguished. One specimen (96119/E) bears a few old setae. Capsule-bearing plants develop no gemmae, but because the plants with old setae were growing tightly mixed among gemmae-bearing plants it is likely that these fertile plants also belong to *B. gemmiferum*. All plants of this kind without gemmae probably belong to *B. bicolor* because gemmae are often few in this species and produced in abundance in *B. gemmiferum*.

The species, however, differs widely from *B. bicolor* in the size, shape and number of bulbils per leaf axil. The green or pale brownish bulbils are very small (up to ca. 150 µm long) and obtriangular in shape with pointed base. The leaf primordia are narrow, distinctly overtopping the stem primordia, divergent and usually incurved in upper part. There are up to 20 or more bulbils per axil. In the field gemmae are often difficult to find because the leaf axils are often full of tiny loess particles.

A number of species of the genus *Pohlia* have also similar axillary bulbils. They can always easily be distinguished by their shorter nerve which is ending below apex or percurrent and by the narrower lamina cells.

10. *Bryum violaceum* Crundw. & Nyh.

This species is also new to Hungary. It was collected twice, once in an abandoned vineyard on loess (No. 96102/GA) mixed with *B. bicolor* and once growing on the slanting lower slope of a loess cliff in riverine forest along Danube, on clayey loess mixed with *B. rubens* (No. 97185/U). The species is known from West, Central and North Europe, Canary Islands, Kashmir, North America and Patagonia. It was described relative recently (CRUNDWELL & NYHOLM 1964) and is very inconspicuous and often mixed with other mosses, therefore is likely that it is more widely distributed. It is mainly a lowland species of usually disturbed areas on calcareous to slightly acid soil (CRUNDW. & NYHOLM l.c.). Sporophytes are very rare, our specimens were sterile as well.

The species is distinct from other tuber-bearing *Brya* (except *B. ruderales*, see below) by a bright violet or purple colour of its finely papillate main rhizoids, the ramifications are usually lighter in colour and smooth. The spherical tubers are borne on longish rhizoids (never axillary as in *B. rubens*), numerous, 60-100 µm in diam. with non-protuberant cells and brownish or reddish-brown in colour.

Bryum ruderales Crundw. & Nyh. is also a tuber-bearing *Bryum* with violet rhizoids. This species is known from a number of localities in Hungary (ORBÁN, 1983). It differs from *B. violaceum* by more strongly papillate rhizoids (at least the larger ones) and larger tubers (ca. 125-200 µm in diam.) with slightly protuberant cells.

Bryum radiculosum Brid. is another tuber-bearing species known from Hungary (ORBÁN 1983). This species has spherical, dark brown tubers (often mixed with light brown and reddish ones), ca. 120-200 µm in diam. and with not or hardly protuberant cells. The rhizoids are brownish and strongly papillate. The nerve is strong and rather longly excurrent, the basal cells are quadrate in a rather large group. A peculiarity of this species is the presence of very large (to 400 µm) irregular shaped, often plate-like tubers which lie on the substratum (TOUW 1989). It grows usually on mortar or limestone. Sporophytes are frequent. BOROS (1963) mentions this species under the name *B. murale* Wils.

Finally *Bryum klinggraeffii* Schimp. is another tuber-bearing species which is up till now unknown from Hungary, but can be expected there. It is a lowland species known from West and Central Europe, Eastern Asia, North America and Patagonia. It prefers basic to slightly acid, usually disturbed soils. The rhizoids are finely papillose to almost smooth, pale yellowish brown. Tubers are usually abundant on rhizoids (not axillary), irregularly spherical to pear-shaped, orange- or reddish brown with protuberant cells, 50-100 µm in longest diam.

List of localities of specimens mentioned in the text

9692: Győr-Ménfőcsanak-Sopron County, Sokoró Hills, Bácsi Horog, W of Ravazd village, 230 m. Eroded gully in loess plateau.

- 9698: Veszprém County, Mezőföld, beyond MÁV resort, WNW end of Balatonkenese village, 110-120 m alt. Loess gullies with 6-8 m high cliffs.
- 96100: Borsod-Abaúj-Zemplén County, Hegyalja Hills, Mt. Tokaji Nagy-Kopasz, W slopes above Tarcál village, hollow road called Bajusz, 180-240 m alt. Loess cliffs.
- 96102: Borsod-Abaúj-Zemplén County, Hegyalja Hills, Mt. Tokaji Nagy-Kopasz, SW slopes above Tarcál village, 200 m alt. Abandoned vineyards, terrace slopes and cliffs on loess.
- 96107: Borsod-Abaúj-Zemplén County, Hegyalja Hills, Fináncdomb Hill in Tokaj town, 120-150 m. *Agropyro-Kochietum* on E facing loess cliff in shaded gully.
- 96115: Komárom-Esztergom County, Gerecse Mts., Vöröskő Hills, S of Dunaalmás village, 250 m. Loess layer on top of huge limestone (travertino) cliff, faced to ENE.
- 96119: Komárom-Esztergom County, Gerecse Mts., 4 km S of Süttő village, near "Bikol", 180 m alt. Loess cliff under dry oak forest.
- 97166: Pest County, Gödöllő Hills near Pánd, in the valley below Órhegy hill and in a small loess gorge at the W end of village, 130 m alt.
- 97185: Baranya County, Baranya Hills, E escarpment facing Danube River above Dunaszekcső village, 100-180 m alt. Steep loess cliffs, 100-180 m.
- 97186: Baranya County, Baranya Hills, Csóka Hill at the E end of Bába village, N facing natural loess cliffs, 150 m.
- 97187: Baranya County, Baranya Hills, Bába Furkótelep. Artificial, ENE facing loess cliff in the terraced vineyard „Lánka”, 140 m.
- 97201: Bács-Kiskun County, Duna-Tisza köze, Solti Plain, Nemesnádudvar. Loess cliff on the upper part of a sand mine. 100 m.
- 97214: Tolna County. Szekszárd Hills. Petre Valley NW of Szekszárd, on the W side of Cserhát Hill, in a hollow road and on a small loess cliff at 130 m.
- 9812: YUGOSLAVIA (Serbia), Vojvodina, N edge of Titel Plateau. Mošorin village. Middle loess gorge called Srinjarević Surduk, S of the church, 80-120 m.
- 9814: YUGOSLAVIA (Serbia), Vojvodina, N edge of Titel Plateau. Mošorin village. Western gorge S of the market place with very regular and long natural cliffs, rich in cryptogamic vegetation, 80-120 m.
- 9828: Veszprém County, Balaton Highlands. W slopes of Mt. Badacsony, S of Badacsonytördemic, hollow road on loess, 130 m.
- 9838: Pest County, Mezőföld. Sánc hill („Érdi Sánc”) at Százhalombatta. Loess steppe with small cliffs at about 150 m.
- 9841: Komárom-Esztergom County, Visegrád Mountains. Natural and artificial loess cliffs in and near the abandoned mine of Basaharc brick factory, facing Danube, 120-150m.

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Abstract

A preliminary account on the moss genus *Bryum*, occurring on loess cliffs in Hungary and Serbia, is given. In total 10 species were collected of which two are new to the Hungarian bryoflora, viz. *Bryum gemmiferum* Wilcz. & Demar., *B. rubens* Mitt. and *B. violaceum* Crundw. & Nyh. A discussion on the differences between *Bryum bicolor* lacking bulbils and tubers and sterile *B. caespiticium* is given.

Összefoglalás

A löszfalak virágtalan növényzete II.

A *Bryum* Hedw. nemzetség fajai a Pannon Medence löszfalain, különös tekintettel a Magyarországra új *Bryum gemmiferum* Wilz. Demar. és *Bryum violaceum* Crundw. & Nyh. előfordulására

B. O. VAN ZANTEN

Előzetes felmérés készült 3 éves terepmunka alapján a *Bryum* nemzetség magyar (és részben szerbiai) löszfalakon előforduló képviselőiről. Magyarországra nézve új az atlanti-mediterrán elterjedésű *Bryum gemmiferum* Wilcz. & Demar. és az Eurázsában általánosabban elterjedt *B. violaceum* Crundw. & Nyh., míg csak egy helyről volt ismert a két lösz lelőhelyen is megtalált *B. rubens* Mitt. A Szerző tárgyalja a fajok meddő állapotban igen fontos megkülönböztető bélyegeit.

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