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SUPPLEMENT TO IDENTIFICATION KEYS FOR HUNGARIAN BRYOPHYTES

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Abstract: 'Keys for the Identification of bryophytes occurring in Hungary', published in 2021, are here supplemented (addition of six taxa newly found in Hungary, one species and one subspecies of liverworts, four species of mosses). Some keys have been improved, and some errata amended. The list of references has also been updated.

Keywords: liverworts, mosses, additional taxa, Hungary

Since the publication of 'Keys for the Identification of bryophytes occurring in Hungary' (Erzberger 2021, simply called 'Keys' below), five taxa of bryophytes have been newly reported from Hungary, four species and one subspecies: *Encalypta spathulata* Müll.Hal. (Ellis *et al.* 2021c), *Hymenoloma crispulum* (Hedw.) Ochyra (Ellis *et al*. 2022; Németh and Erzberger 2023), *Marchantia polymorpha* L. subsp. *montivagans* Bischl. & Boissel.-Dub. (Aszalósné Balogh *et al.* 2021), *Pohlia bulbifera* (Warnst.) Warnst. (Ellis *et al.* 2021c) and *Sphaerocarpos michelii* Bellardi (Ellis *et al*. 2022; Wolf *et al.* 2023). Another new species, *Lewinskya fastigiata* (Bruch ex Brid.) Vigalondo, F.Lara & Garilleti, which has been mentioned in 'Keys' in a note, has been confirmed to occur in Hungary in the meantime (Németh and Erzberger, unpublished). In order to keep the identification keys for Hungarian bryophytes up to date, it is necessary to supplement the published keys in several points. Since the publication of a completely revised version of the original paper is not feasible momentarily, as a pragmatic compromise the necessary amendments are here published in the same format as the original keys, so that they can be printed out and incorporated into the printed version or used with the online version.

Taxonomy and nomenclature follow the latest Hungarian and European checklists (Erzberger and Papp 2020; Hodgetts *et al*. 2020). Four species missing in the Hungarian checklist (Erzberger and Papp 2020) were already included in 'Keys', but without proper references, which are given here: *Rhytidiadelphus loreus* (Hedw.) Warnst. (Ellis *et al.* 2021a), *Calypogeia arguta* Nees & Mont., *Hydrogonium croceum* (Brid.) Jan Kučera and *Orthothecium rufescens* (Dicks. ex Brid.) Schimp. (Ellis *et al.* 2021b).

A few errata in 'Keys' concerning the year of a reference (p. 14, 32), numbering (p. 139) and the use of certain terms (dextrorse and sinistrorse, p. 175, 176) have also been amended.

Amendments to 'Keys'

Page 3

Abstract: At present, 698 bryophyte taxa are known to occur in Hungary, 2 hornworts, 151 liverworts and 545 mosses.

Page 14

SMITH, A.J.E. (1990). *The Liverworts of Britain and Ireland*. Cambridge University press, Cambridge, 362 pp.

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Key to species of *Sphaerocarpos*	121
Key to species of Rhabdoweisiaceae (incl. *Hymenoloma*)	142

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Family	46a. Hymenolomataceae
	78a. *Hymenoloma*

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SMITH, A.J.E. (1990). *The Liverworts of Britain and Ireland*. Cambridge University press, Cambridge, 362 pp. – Second choice after the publication of PATON (1999) as concerns the illustrations as well as the descriptions. Missing taxa are the same as in PATON (1999).

Page 37
Thalloid liverworts

1 Thallus circular, completely covered by clavate involucres on dorsal side.....***Sphaerocarpos*** (p. 121)
– Thallus not as above, not covered completely by clavate involucres.....2

Page 56
Group 19 Acrocarps with exserted erect capsule, peristome teeth 16, entire or slightly and irregularly divided

3 Alar cells differentiated, sometimes orange or brownish....3a
– Alar cells not differentiated.....4
3a Leaves strongly crisped when dry, cuticle longitudinally striate, alar cells not conspicuously orange.....***Hymenoloma crispulum*** (rr)
– Leaves ± straight, not crisped when dry, cuticle smooth, alar and basal cells conspicuously orange.....***Blindia acuta*** (n.s.)

Page 70
Group 30 Acrocarps with isodiametric cells, apex acute, subacute or acuminate, margins recurved at least on one side, costa not excurrent or lacking

4 Leaves acute or acuminate; capsule ± cylindrical, sulcate, strumose.....***Ceratodon*** (p. 143)
– Leaves longly acuminate; capsule ellipsoidal, smooth, not strumose.....4a
4a Alar cells differentiated, enlarged at least in some leaves; cuticle longitudinally striate.....***Hymenoloma crispulum*** (rr)
– Alar cells not differentiated; cuticle smooth, not striate.....***Dicranoweisia cirrata*** (w)

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Key to Marchantiales pp. (incl. *Asterella, Clevea, Conocephalum, Lunularia, Mannia, Marchantia, Reboulia*)

2 Gemmae cups semi-lunate; air-pores volcano-shaped, simple; female receptacles cruciate, 4-rayed..... ***Lunularia cruciata*** (r)

– Gemmae cups goblet-shaped, circular; air-pores barrel-shaped, each composed of 4 (6) rings of superimposed cells; female receptacles at apex of thallus, stellate, deeply divided with usually (5) 8–9 (11) terete lobes ***Marchantia polymorpha***.....3

3 Thallus usually prostrate, without or with a discontinuous dark median band on dorsal side; margins usually crenulate by protruding marginal cells; margins of appendages of median scales sharply toothed.....3a

– Thallus usually growing erect, with a conspicuous, dark median band on dorsal side; margins usually entire; margins of appendages of median scales entire or nearly so..... ***Marchantia polymorpha*** subsp. ***polymorpha*** (r)

3a Thallus dark green (young parts), 6–9 (15) mm wide, with a discontinuous darker median band on dorsal side; growing often in man-made habitats..... ***Marchantia polymorpha*** subsp. ***ruderalis*** (w)

– Thallus yellowish-green (young parts), 7.5–11 (20) mm wide, lacking distinct median band on dorsal side; in natural, wet habitats, in Central Europe usually at high elevations..... ***Marchantia polymorpha*** subsp. ***montivagans*** (rr)

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Key to species of *Sphaerocarpos*

References: Smith (1990), Paton (1999), Nebel and Philippi (2005), Schill *et al*. (2009), Xiang and Zhu (2019), Hugonnot and Chavoutier (2021), Wolf *et al*. (2022)

– Spore tetrads yellowish to dark brown, (70) 90–130 (150) µm diameter, individual spores ± distinct at maturity, their distal face with (6) 8–12 irregular to ± hexagonal areolae, (8) 10–14 (20) µm wide, across diameter, areolae delimited by smooth lamellae, 2.5–5 µm high, at junctions of areolae protruding as spines 7–10 (12) µm long, rendering spore tetrads spinulose in silhouette, each areola with a single central tubercle difficult to see in light microscope, best seen in SEM.....***Sphaerocarpos michelii*** (rr)

– Spore tetrads light brown to red-brown, (120) 135–170 µm diameter, individual spores indistinctly delimited at maturity, their distal face with 4–6 irregularly hexagonal areolae, (15) 20–32 (36) µm wide, across diameter, areolae delimited by papillose lamellae, 10–12.8 µm high, hardly protruding at junctions of areolae, tetrads in silhouette winged, not spinulose, central tubercle of areola lacking.....
.....***Sphaerocarpos europaeus*** (*Sphaerocarpos texanus*) (n.s.)

Page 130, 131 **Key to species of *Encalypta***

References: Nyholm (1998), Smith (2004), Guerra *et al*. (2006), Magill (2007), Meinunger and Schröder (2007)

1 Plants with clusters of brownish filamentous gemmae in leaf axils; plants dioicous, rarely with sporophytes; urn spirally striate, spirally furrowed when dry; uppermost leaves obtuse or subacute; costa not excurrent.....
.....***Encalypta streptocarpa*** (w)

– Plants without gemmae in leaf axils; urn smooth or with longitudinal, not spiral stripes or furrows; costa excurrent or not.....2

2 Seta yellow; base of loosened calyptra lobed ("ciliate"), calyptra shiny, smooth; capsule smooth; vaginula ± elongate, in upper part with cup-shaped remnant of base of calyptra; peristome present, single; leaves with sharp, short or slightly elongate point; spores not papillose, with numerous

radial plicae on the proximal surface, distal surface with a central depression surrounded by a stout circular ridge from which 5 short radial ridges run towards equator..... ***Encalypta ciliata*** (r)

– Seta red; base of loosened calyptra ± strongly erose; vaginula short, in upper part with umbrella-like remnant of base of calyptra; peristome present or absent; leaves with or without hair point; spores with large hemispherical papillae on distal face.....3

3 Peristome present, well-developed, red-brown; capsule with prominent longitudinal red-brown striae, deeply furrowed when dry; calyptra smooth or erose at base, papillose throughout..... ***Encalypta rhaptocarpa*** (n.s.)

– Peristome absent; capsule smooth or with faint golden striae, weakly furrowed when dry.....4

4 Leaves without hair point, bluntly pointed, costa ceasing below leaf apex (rarely shortly excurrent); margin usually incurved towards leaf apex; capsule smooth or almost so; calyptra smooth or erose at base..... ***Encalypta vulgaris*** (w)

Note: In ***Encalypta vulgaris*** var. ***apiculata*** (rr) the costa is shortly excurrent or ending in a more or less long hairpoint.

– Upper leaves with ± elongate hair point; margin usually plane; capsule finely yellow striate; calyptra erose to unevenly frayed at base..... ***Encalypta spathulata*** (rr)

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Key to species of Dicranaceae

In the first couplet, the second line should lead to 5, not 4.

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Key to species of Rhabdoweisiaceae incl. *Hymenoloma*

1 Lamina cells smooth, sometimes with longitudinal striae, not mamillose.....2

– Lamina cells mamillose; upper leaf margin ± bistratose, mamillae of marginal cells forming double teeth.....5

2 Capsules striate when dry and empty, less than 3 times as long as wide; leaf margin denticulate in upper part of leaf, sometimes only very slightly so.....3

– Capsules smooth; leaf margin ± entire.....2a

2a Alar cells differentiated, enlarged, at least in some leaves; cuticle longitudinally striate; leaf margin plane, bistratose above; mid-leaf cells 6–8 (10) µm wide; capsules ovoid-ellipsoid; plants saxicolous.....***Hymenoloma crispulum*** (rr)

– Alar cells not differentiated; cuticle smooth; leaves with recurved unistratose margins; mid-leaf cells 12–14 µm wide; capsules narrowly ellipsoid to subcylindrical; plants corticolous or saxicolous.....***Dicranoweisia cirrata*** (w)

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Key to species of Grimmiaceae

In this key as printed in 'Keys', the use of the terms dextrorse and sinistrorse should be interchanged. Their definition as given in the Glossary (p. 231–252) is correct. In the literature, the use of terms denoting the torsion of the seta is often ambiguous and contradictory. The correct use of dextrorse and sinistrorse is in accordance with Malcolm and Malcolm (2000), Larraín *et al.* (2013), Muñoz *et al.* in Brugués & Guerra (2015), Chavoutier (2016), but contrary to the use in the papers of Bednarek-Ochyra, e.g. Bednarek-Ochyra (2006). In Erzberger *et al.* (2016), the definition of the terms is correct, but not their use.

To sum up: in *Racomitrium*, the seta is dextrorse in *R. lanuginosum* and *R. canescens*, whereas it is sinistrorse in the other species occurring in Hungary (*R. aciculare, R. affine, R. aquaticum, R. heterostichum, R. microcarpum*).

The correct couplets are as follows:

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1 Basal leaf cells elongate, with incrassate nodulose-sinuose walls; seta elongate (capsules exserted), mostly sinistrorse (forming a left-handed helix unlike a normal screw) when dry (dextrorse in *R. lanuginosum, R. canescens*); stem without central strand. ***Racomitrium***.....4

– Basal cells never at the same time elongate and incrassate nodulose-sinuose; seta often short, untwisted or dextrorse; stem with or without central strand.....2

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4(1) Hair point present, papillose; seta dextrorse when dry.....5

– Hair point absent or present, not papillose, but often denticulate; seta sinistrorse when dry.....6

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Key to species of *Pohlia*

References: Smith (2004), Erzberger (2005), Köckinger *et al.* (2005), Guerra *et al*. (2010)

2 All bulbils ± globose, hardly longer than wide……2a

– Bulbils oblong, obconic or elongate and vermicular……3

2a Primordia of all bulbils broadly triangular-laminate, obtuse, reaching about 1/3 of total bulbil length, conspicuously concave, forming a dome over the apex that often traps an air bubble; bulbils 230–400 µm × 100–230 µm, (green) yellow-orange (red), according to age; plants glossy when dry……***Pohlia bulbifera*** (rr)

– Leaf primordia poorly formed, peg-like, incurved, consisting of only 1(–2) cell(s), never laminate; bulbils mostly (70) 80–130 (175) µm × 60–110 (150) µm, usually stalked, yellow-translucent, occasionally brown; plants dull when dry……***Pohlia camptotrachela*** (n.s.)

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Key to species of Orthotrichaceae

References: Schäfer-Verwimp in Nebel and Philippi (2001), Guerra *et al*. (2014), Caparrós et al. (2016), Blockeel (2017), Vigalondo *et al.* (2020)

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16 Capsules yellowish, thin-walled, smooth or almost so when dry, immersed in the leaves or clearly exserted above the leaves; calyptra with scattered or abundant hairs; outer peristome teeth united in pairs or not, recurved but arcuate when dry, only the tips touching the surface of capsule ('tea cup handle'); inner peristome segments whitish, sometimes with irregular outlines; leaves mostly with a narrow, acute apex……17

– Capsules pale, elongate-cylindrical, strongly sulcate when dry, hemi-emergent to shortly exserted; calyptra naked or with few short hairs; outer peristome teeth united in 8 pairs (or partly separating when old), regularly recurved when dry, touching surface of capsule throughout their length; inner peristome segments ± transparent, coarsely or finely papillose (rarely nearly smooth); leaves mostly with a broad, short apex……16a

16a Exothecial bands broad, 4 rows of cells near capsule mouth (often 6–8 below); exostome teeth cancellate (lattice-like) and frequently fenestrate (pierced by broad openings resembling windows) at apex; spores verrucose and usually with scattered coarse lines; capsule usually hemi-emergent, urceolate, deeply furrowed when dry and empty; apex of perichaetial leaves acute to acuminate, frequently asymmetric; leaves shorter and more broadly lanceolate than in the next species.....***Lewinskya fastigiata***
(in Hungary at present known from few sites only, but probably widespread)

– Exothecial bands narrow, 2–3 rows of cells near capsule mouth (sometimes 4–6 below); exostome teeth sometimes weakly fenestrate at apex; spores with thin and irregular papillae; capsule usually shortly emergent, cylindrical to ovoid-cylindrical, moderately furrowed when dry and empty; apex of perichaetial leaves shortly apiculate; leaves lanceolate.....***Lewinskya affinis*** (cc)

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