

Mediterranean Botany

ISSNe 2603-9109

<https://doi.org/10.5209/mbot.84615>

EDICIONES
COMPLUTENSE

Identity of north African endemic bryophytes, 3, with a special emphasis on *Funaria altissima*

Rosa María Ros¹ , Jesús Muñoz²  and Olaf Werner¹ 

Received: 9 November 2022 / Accepted: 28 February 2023 / Published online: 8 May 2023

Abstract. The types of five taxa, based on material from northern Africa, have been revised yielding the following results: *Barbula commutata* var. *erosa* Corb. is synonymized with *Streblotrichum convolutum* var. *commutatum*; *Bryum trabutii* Thér. with *Ptychostomum rubens* and is reported here for the first time from Algeria; *Thamnum alopecurum* var. *decipiens* Corb. with *Scorpiurium circinatum* and *Trichostomum mediterraneum* var. *algeriae* Müll.Hal. ex Geh. with *Hydrogonium bolleanum*. *Funaria altissima* Dixon is recognized as a distinct species, for which we provide a full description, photographs, and a key to the more closely related species. Lectotypes have been designated for all names except for *F. altissima*. The identity of two *nomina nuda* is also resolved: *Funaria hygrometrica* var. *dentata* Corb. ex Maire & Werner corresponds to typical *Funaria hygrometrica* and *Zygodon dimorphus* Thér. ex Jelenc is here identified as *Grimmia torquata*, an interesting addition to the bryophyte flora of Morocco and continental Africa.

Keywords. Algeria, distribution data, *Grimmia torquata*, Morocco, typification.

How to cite: Ros, R.M., Muñoz, J. & Werner, O. 2023. Identity of north African endemic bryophytes, 3, with a special emphasis on *Funaria altissima*. Mediterr. Bot. 44, e84615. <https://doi.org/10.5209/mbot.84615>

Introduction

During the 19th and 20th centuries, French botanists made important collection trips to the Maghreb territories controlled by France during the colonial era, namely Algeria, Morocco, and Tunisia (Jelenc, 1949). Many new taxa were described based on those specimens according to the criteria of the time, which favoured to recognize minor morphological variations if combined with differences in geographic origin. Therefore, many species and infraspecific taxa of mosses, liverworts, and hornworts were described by authors such as E. Bescherelle, M. Bizot, J.-N. Boulay, J. Cardot, M.A. Coppey, L. Corbière, M.C. Durieu de Maisonneuve, F. Jelenc, C. Meylan, C. Montagne, E.G. Paris, R. Potier de la Varde, I. Thériot and L. Trabut. Many of these names have subsequently been ignored and their identity remains doubtful (Cano *et al.*, 2000).

Within the research interests of the authors of this paper focusing on the bryophytes of northern Africa, we have made an effort to study as many of these “forgotten” names as possible in order to achieve an updated bryophyte flora of the north African countries. Most of these names are mentioned in the checklists by Ros *et al.* (1999, 2013). This work is part of a series of papers initiated in 2000 that attempt to evaluate north African endemics (Cano *et al.*, 2000; Ros & Cano, 2008).

Material and Methods

Types of several north African endemic bryophytes kept at BM, CHE, JE, and PC were studied. For each (1) new synonymy is proposed where needed, (2) the data of the type is indicated, (3) a lectotype is designated if no holotype was indicated by the author of the name and the selection is justified, (4) diagnostic and other important morphological characters are described and discussed and (5) the distribution of the taxon is given. In the case of the poorly known taxa *Funaria altissima* a complete description, illustrations, photographs and a key are provided. Where physical specimens were unavailable, their digital images were obtained from GBIF (<https://www.gbif.org/>) or the National History Museum data portal (<https://data.nhm.ac.uk/dataset/collection-specimens>). Acronyms of herbaria follow Index Herbariorum (<http://sweetgum.nybg.org/science/ih/>).

Results and Discussion

1. *Barbula commutata* var. *erosa* Corb. Revue Bryologique 41: 11. 1914

Syn. *Streblotrichum convolutum* var. *commutatum* (Jur.) J.J.Amann. Flore des Mousses de la Suisse 2: 107. 1918 syn. nov.

¹ Plant Biology Department (Botany), University of Murcia, Campus de Espinardo. E-30100 Murcia, Spain. E-mail: rmos@um.es; werner@um.es

² Royal Botanic Garden of Madrid (RJB), CSIC. Plaza de Murillo 2, E-28014 Madrid, Spain. E-mail: jmunoz@rjb.csic.es

Type: “Maroc: Immouzer, talus, sous les rochers, de 1200–1500 m, juillet 1913, leg. Mouret”. Lectotype designated here, CHE!

The only specimen found in CHE, where the original herbarium of L. Corbière is kept, and that fits the data in the protologue has been designated as lectotype.

Corbière (1914) indicated that the eroded margins were the only morphological difference of the new taxon with respect to *Barbula commutata* Jur. (Juratzka, 1874), a taxon that has long been considered as merely a robust variety of *Barbula convoluta* Hedw. (Smith, 1978; Garilleti, 2006), for which the correct name at varietal rank in *Barbula* is *B. convoluta* var. *sardoa* Bruch & Schimp. (Bruch & Schimper, 1842). The type of *B. commutata* var. *erosa* corresponds in every respect to the descriptions of *B. convoluta* var. *sardoa*, for which the currently accepted name is *Streblotrichum convolutum* var. *commutatum* (Amann, 1918), that is: plants to 7 mm high; leaves spirally contorted when dry, broadly lanceolate; margins plane or weakly recurved in the proximal 1/3, papillose-crenulate, eroded distally; apex broadly acute; costa ending before the apex to shortly excurrent as a mucro; basal juxtacostal cells long rectangular, to 50 µm long, above shorter, more or less spherical; red-brown tubers on rhizoids buried in soil, almost spherical, 86 × 96 µm; perichaetial leaves and sporophytes not observed.

Kučera *et al.* (2013) observed molecular evidence to separate *Streblotrichum commutatum* (Jur.) Hilp. from *S. convolutum* at species level, but Hodgetts *et al.* (2020) reduced it to varietal rank arguing that it is not always morphologically distinct from the latter.

Ros *et al.* (2013) previously considered *Barbula commutata* var. *erosa* a synonym of *B. convoluta* var. *sardoa*, but it had not been formally published.

Streblotrichum convolutum var. *commutatum* is a common taxon in Britain and Ireland (Blockeel *et al.*, 2014) but scattered through southern and central Europe (Frey *et al.*, 2006). In northern Africa it has only been reported from Egypt and Morocco (Ros *et al.*, 2013).

2. *Bryum trabutii* Thér. Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord 21: 30. 1930
Syn. *Ptychostomum rubens* (Mitt.) Holyoak & N. Pedersen. Journal of Bryology 29: 120. 2007. syn. nov.

Type: [Algeria] “Alger: La Calle, Durieu, com. Trabut n° 1394”. Lectotype designated here, PC!

The information on the label of the only specimen in Thériot's herbarium (PC) of *Bryum trabutii* closely matches the protologue (Thériot & Trabut, 1930) and accordingly it has been selected as lectotype. The specimen is conserved inside a small envelope from Trabut's herbarium with his handwritten original identification: “*Bryum Schleicheri* La Calle Durieu 1840 ex Herb. Bescherelle = *B. pallens*, N° 1394”.

The type is quite poor, but from our study we conclude that it pertains to *Ptychostomum rubens*: plants reddish and glossy, upper leaves erect, lower

leaves distant, green at the base, elliptical to spatulate, acute, unistratose, with margins bordered, recurved, and denticulate above, and costa shortly excurrent; upper and median laminal cells elongate-hexagonal, 60–80 µm long and 16–20 µm wide distally, gradually broader and rectangular proximally, marginal cells longer, narrower and more incrassate than other laminal cells, clearly differentiated; rhizoids pale brown and papillose; rhizoidal gemmae red, spherical, ~360 µm in diameter, with protuberant cells up to 20–50 µm long on subterranean rhizoids and in lower leaf axils just above the ground; setae 2.0–2.7 cm long, capsules oblong. Neither peristome nor spores were observed. This description coincides with the protologue except in the presence of gemmae, which were not detected by Thériot. This author compared his new species with *B. areoblastum* Müll. Hal. and *B. ambiguum* Duby. The former was initially synonymized with *B. nitens* Hook. by Ochi (1972) and later with *B. apiculatum* Schwägr. (Ochi, 1994), as he did previously with *B. ambiguum* (Ochi, 1985). *Bryum apiculatum*, at present combined in *Anomobryum apiculatum* (Schwägr.) D. Bell & Holyoak (Hodgetts *et al.*, 2020), differs from the type of *Bryum trabutii* in having unbordered leaves closely arranged on the stem, laminal cells abruptly broader proximally and an oblong-pyriform capsule. The recently described *Ptychostomum touwii* Bijlsma, Kruijer & M. Stech is very closely related to *P. rubens*. According to Bijlsma *et al.* (2020) both species can be distinguished by leaf posture and shape of the leaf apex. Algerian plant morphology rejects identification as *P. touwii*.

Ptychostomum rubens is a common species in southern Europe (Holyoak, 2021) although from northern Africa it had only been reported previously from Tunisia (Bizot, 1973; Ros *et al.*, 1999). Here we report the species for the first time in Algeria.

3. *Funaria altissima* Dixon. Journal of Botany, British and Foreign 69: 285. 1931

Holotype: BM000674742!, Isotypes: BM000674741!, BM000870667.

Type: [Algeria] “Ref. N° 120B, Under rocks, 5900 ft., Taharauet, Hoggar, Mts., Central Sahara, Col. Meinertzhagen, 10 Mar. 1931, Comm. Herb. Kew, Type”.

BM000870667: <https://www.gbif.org/occurrence/1057461353>. Figures 1, 2.

The Dixon herbarium at BM includes two samples, BM000674741 and BM000674742, of which the original collection (*Meinertzhagen* 120B) is mentioned in the protologue (Dixon, 1931). The label of BM000674742 has the word “type” handwritten by Dixon and the label of BM000674741 only indicates “Hogar Mt Sahara” and the number 120B and has been considered an isotype. The sample BM000870667 (<https://www.gbif.org/occurrence/1057461353>, <https://data.nhm.ac.uk/object/4620eb22-6e46-4a36-b39a-9e9556b34536>) is also part of *Meinertzhagen* 120B and, although it has not been studied in this work, the photographs are of sufficient quality to confirm that it is also an isotype.

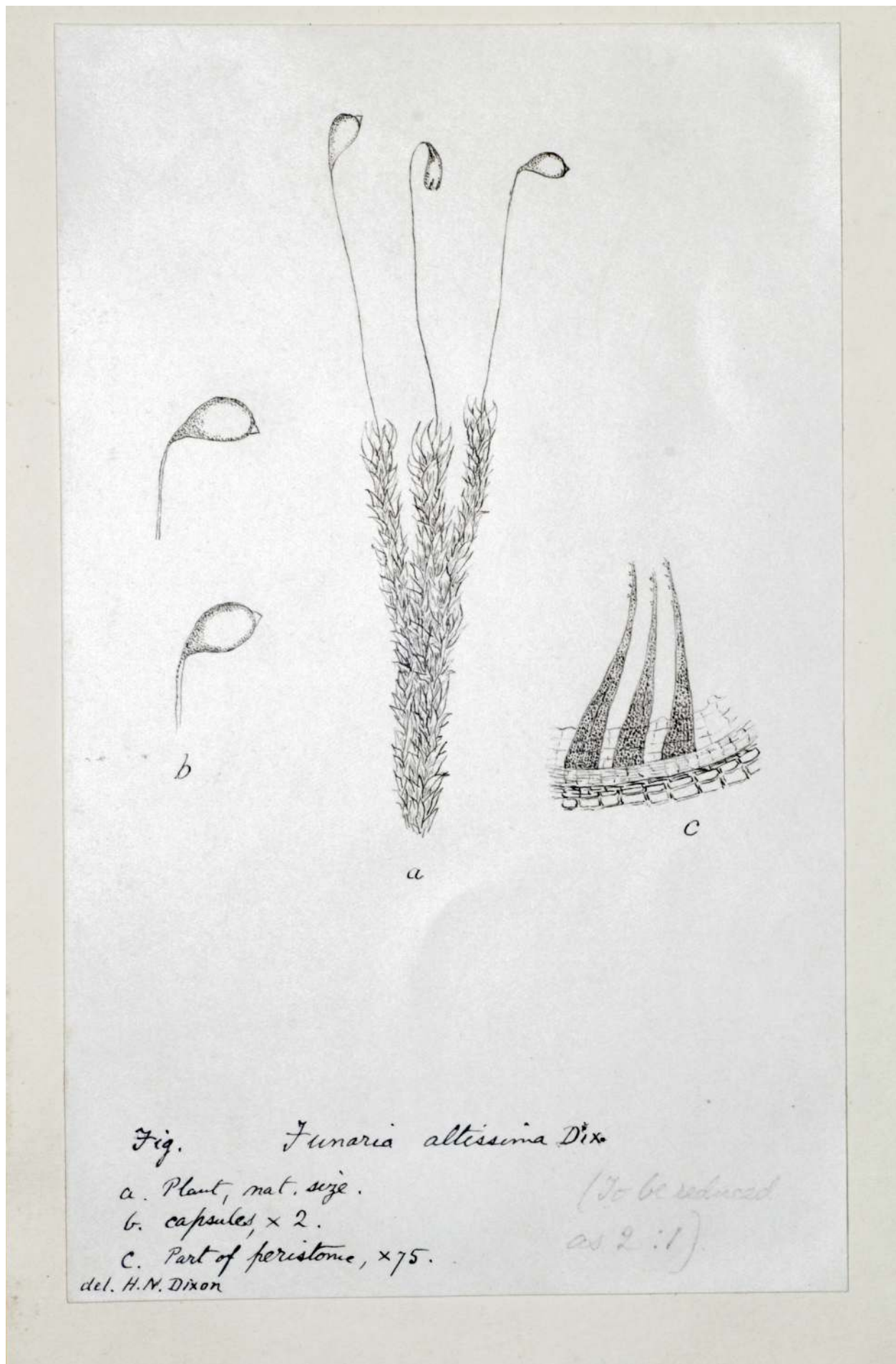


Figure 1. *Funaria altissima* Dixon. Unpublished drawing by Dixon glued onto the holotype sheet (BM000674742).

The study of the holotype and isotype BM000674741 enabled us to confirm that the species belongs to *Funaria* according to the diagnostic characters currently admitted (Medina *et al.*, 2018): the very long seta and the revoluble annulus. Nevertheless, the slightly asymmetric and non-striate undehiscent capsule, only slightly sulcate when dry and empty in the neck make it similar to *Entosthodon*, which however lacks a revoluble annulus. Unfortunately, no material is available to be sequenced for further molecular evidence. Here we include a detailed description of the taxon:

Plants 30–35 mm high, gregarious, yellowish green in the upper part, yellowish below. Stems erect, reddish, branched and strongly tomentose. Rhizoids brown to reddish, smooth. Leaves regularly arranged along the entire length of the stem, erect when dry, erect-patent when moist, $2.6\text{--}2.8 \times 0.7\text{--}0.8$ mm, gradually larger towards the stem apex, the vegetative along the stem lanceolate to elliptical, slightly concave; apex acute to short acuminate; margins plane, entire in the lower part, denticulate beyond the middle by projecting cell ends, widely incurved distally. Costa single, percurrent to excurrent, $35\text{--}50$ μm wide at the middle of leaf, ventral and dorsal superficial cells long rectangular, in cross-section 2–3 ventral superficial cells and 4 dorsal superficial cells, and a large central stereid group. Distal and medial laminal cells hexagonal to rectangular, lax and rather thin-walled, $40\text{--}110 \times 15\text{--}25$ μm , proximal cells oblong-rectangular, $55\text{--}120 \times 20\text{--}33$ μm , differentiated marginal cells forming 2–3 rows of narrower and longer cells than the internal laminal cells. Perichaetial leaves $3.2\text{--}4.5 \times 1.2\text{--}1.6$ mm, larger than vegetative leaves, oblong-ovate to widely elliptical, strongly concave, long acuminate with a relatively long excurrent costa. Sexual condition autoicous; antheridial branches subapical, below perichaetium, perigonal leaves similar to vegetative leaves but smaller, paraphyses clavate often with a spherical apical cell; perichaetia apparently without paraphyses. Seta erect, straight, apparently non-hygroscopic, smooth, 20–25 mm long. Capsule long-exserted, inclined to horizontal to pendent when dry and empty, slightly asymmetric and curved, orange, pyriform, $2.5\text{--}2.7 \times 1.5\text{--}1.7$ mm, non-striate when closed, only slightly sulcate when dry and empty in the neck, $\sim 1/4$ total length of the urn, mouth diameter 0.45–0.50 mm, less than $1/2$ of urn width; annulus revoluble of 2–3 rows of large cells, exothecial cells at middle part of urn oblong-hexagonal to long rectangular, $30\text{--}90 \times 20\text{--}25$ μm , walls incrassate, lacking alternating vertical bands, becoming shorter and wider towards the mouth where there are 5–7 rows of shortly rectangular oblate cells, stomata immersed only present at neck. Peristome double, inserted somewhat below the mouth; exostome teeth 16, well developed, obliquely directed, slightly sigmoid, orange at the lower half and yellowish at the upper half, lance-acuminate, $250\text{--}300$ μm long, $35\text{--}40$ μm wide at the base, and separated from each other by a distance of $25\text{--}30$ μm , papillose-striate below, becoming papillose above, without transverse bars

delimiting trabecula, appendiculate at the tips and fused in a latticed disk; endostome segments fused in a membrane, yellowish, up to 100 μm long, $\sim 1/3$ the length of the exostome teeth, papillose. Operculum conic to mamillate or umbonate, cells in obliquely radial rows. Calyptra not seen. Spores spherical to reniform, orange-brown, $27\text{--}30$ μm , finely papillose by low irregular ridges.

The habitat was not mentioned by Dixon when describing the species. The only data are those on the label of herbarium samples, indicating that it was found under rocks at 5900 ft. (1798 m asl). From the presence of calcium carbonate crusts on the stem leaves it can be deduced that the specimen grew in a place where water of a basic nature flowed or seeped. Jelenc (1952), in the series of papers where he listed the bryophytes reported from northern Africa, mentioned that the species was known from “Hoggar méridional: Fort Motylinski”, that is situated in the village of Tagkhaukhaut (22.67806N , 5.91976W , Tamanrasset), but neither the original publication (Dixon, 1931) nor the herbarium specimens mention this information. We are not able to confirm that the locality in the protologue is the same as in (Jelenc, 1952), but everything points to this, as differences in transliterations from Arabic names are common. There have been no subsequent reports from Algeria or anywhere else, thus confirming it as a north African endemic.

Dixon (1931) previously pointed out the great similarity of *F. altissima* with *F. microstoma* Bruch & Schimp.; indeed, they share the narrow capsule mouth, the endostome less than $\sim 1/2$ exostome length and the spore size, clearly separating it from the cosmopolitan *F. hygrometrica* Hedw. (Miller & Miller, 2007; Fife & Seppelt, 2012; Ignatov *et al.*, 2017). Here we confirm some of the characteristics that Dixon mentioned as distinguishing features including the habit of elongate stems and equally foliate throughout, apical male branches opposed to basal branches, narrow stem leaves usually distinctly bordered, a seta that is longer and thinner showing no or only very weak torsion when dry, a non-striate capsule when dehiscent, exostome teeth much narrower and distant from each other at the base by approximately $1/2$ or $2/3$ the width of a tooth and lacking a transverse bar that delimits the trabecula. The following key allows separation of the above mentioned species.

- 1a. Capsule mouth wider than $1/2$ capsule width, endostome $2/3$ or more the exostome length, spores $12\text{--}20$ μm ***F. hygrometrica***
- 1b. Capsule mouth less than $1/2$ capsule width, endostome less than $1/2$ exostome length, spores $23\text{--}30$ μm 2
- 2a. Plants $0.4\text{--}0.6$ mm high, upper leaves widest above middle, $2.0\text{--}2.5$ mm long, c. 1.5 mm wide; seta to 10 mm long, arcuate when moist, flexuose, strongly hygroscopic, capsule striate when undehiscent ***F. microstoma***
- 2b. Plants $30\text{--}35$ mm high, upper leaves widest at middle, $3.2\text{--}4.5$ mm long, $1.2\text{--}1.6$ mm wide; seta $20\text{--}25$ mm long, straight, apparently non-hygroscopic; capsule non-striate when undehiscent ***F. altissima***

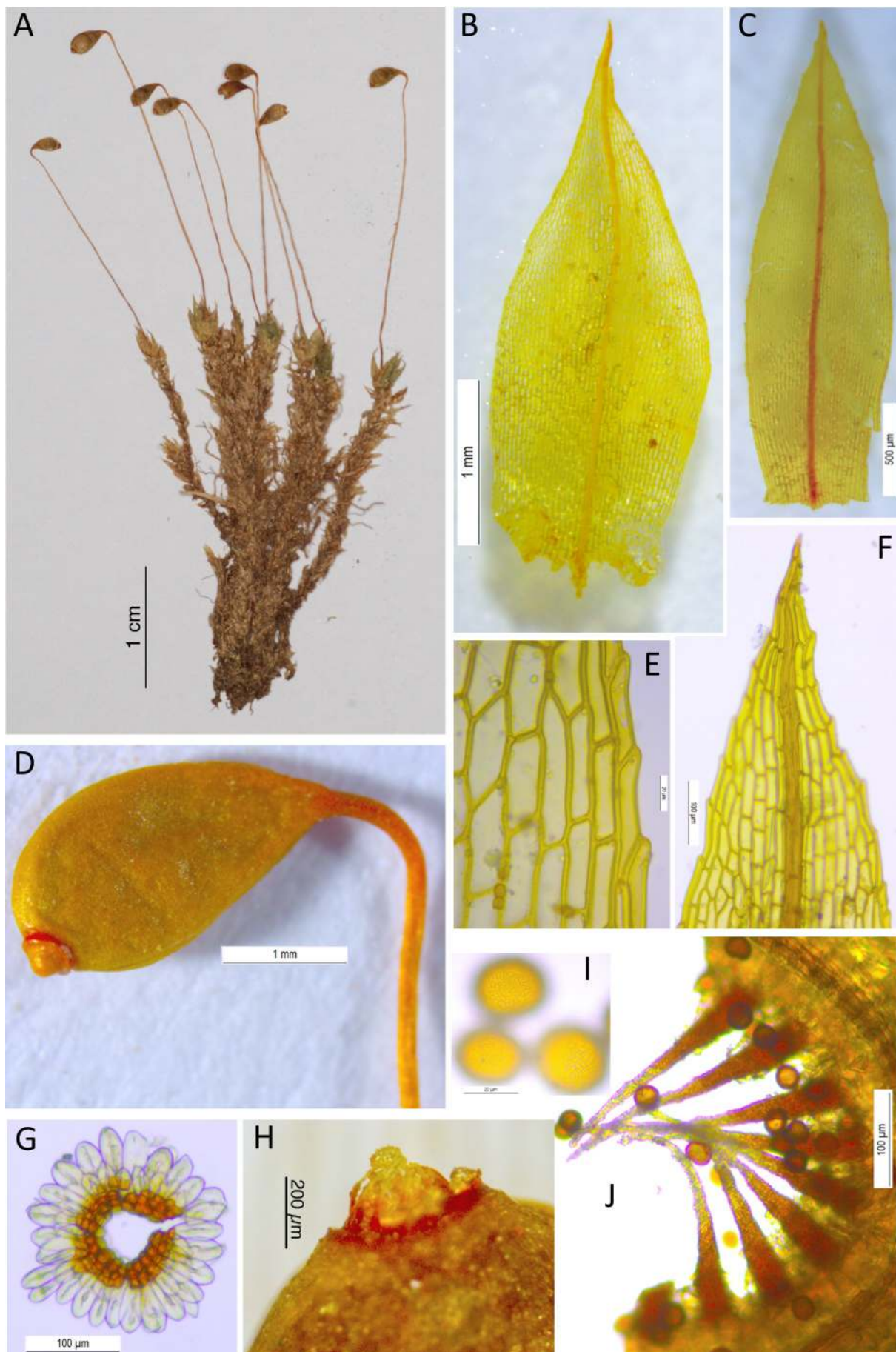


Figure 2. *Funaria altissima* Dixon. A, Habit; B, Perichaetial leaf; C, Vegetative leaf; D, Capsule undehiscent showing narrow capsule mouth; E, Denticulate margin of the upper part of a vegetative leaf; F, Apex of a vegetative leaf; G, Part of the detached, revolute annulus; H, Dehiscent capsule showing exostome fused at the tips as a latticed disk; I, Spores; J, Partial external view of the peristome (*Meinertzhagen* 120B, holotype, BM000674742).

Additionally, to preclude the possibility that this taxon has been described previously, we collated the descriptions of all north African and sub-Saharan African taxa included in Ros *et al.* (2013) and O'Shea (2006)

respectively. *Funaria altissima* shows a combination of characters not shared with any other taxon, and thus we conclude that *F. altissima* is distinct from all the 18 taxa included in *Funaria* (Table 1).

Table 1. Taxa of *Funaria* present in north and sub-Saharan Africa according to Ros *et al.* (2013) and O'Shea (2006), with indication of the main differences from *F. altissima*, or if they belong to *Entosthodon*.

Taxa	Main differences from <i>Funaria altissima</i>	References
<i>F. acicularis</i> Müll.Hal.	Capsule mouth wide; endostome segments long- acuminate, very narrow	Müller (1886)
<i>F. anomala</i> Jur.	Peristome teeth not fused in a latticed disk; without annulus	Unger & Kotschy (1865)
<i>F. bogosica</i> Müll.Hal.	Peristome teeth not fused in a latticed disk; without annulus	Müll.Hal. in Venturi (1872)
<i>F. cameruniae</i> Dixon	Belongs to genus <i>Entosthodon</i>	Dixon (1933)
<i>F. chevalieri</i> P. de la Varde	Capsule erect; capsule mouth wide; without annulus	Potier de la Varde (1943)
<i>F. decaryi</i> Thér.	Belongs to genus <i>Entosthodon</i> . Currently considered a synonym of <i>Entosthodon dixonii</i> Sim	Schatz <i>et al.</i> (2021)
<i>F. delicatula</i> Thér.	Belongs to genus <i>Entosthodon</i>	Thériot (1920)
<i>F. hygrometrica</i> Hedw. var. <i>hygrometrica</i>	Plants short, bulbiform; capsule mouth wide	Lüth (2019)
<i>F. hygrometrica</i> var. <i>calvescens</i> (Schwägr.) Kindb.	Capsule mouth wide	Schwaegrichen (1816)
<i>F. hygrometrica</i> var. <i>mauritanica</i> (Besch.) Paris	Capsule mouth wide	Bescherelle (1880)
<i>F. imerinensis</i> Cardot	Capsule erect; without peristome	Renauld & Cardot (1915), Schatz <i>et al.</i> (2021)
<i>F. kilimandscharica</i> Müll.Hal.	Capsule mouth wide	Müller (1890)
<i>F. mayottensis</i> (Besch.) Broth.	Plants 1–2 cm long; leaves reddish	Bescherelle (1885)
<i>F. nubica</i> Müll.Hal.	Capsule smooth; without annulus	Müller (1899)
<i>F. perlaxa</i> Thér.	Capsule erect; without peristome	Thériot (1930)
<i>F. rhomboidea</i> J.Shaw	Belongs to genus <i>Entosthodon</i>	Magill (1987)
<i>F. subleptopoda</i> Hampe	Originally compared with <i>F. calvescens</i> and now considered a synonym of it	Schatz <i>et al.</i> (2021)
<i>F. succuleata</i> (Wager & C.H.Wright) Magill	Belongs to genus <i>Entosthodon</i>	Magill (1987)

4. *Thamnium alopecurum* var. *decipiens* Corb. Revue Bryologique 31: 38. 1904

Syn. *Scorpiurium circinatum* (Brid.) M.Fleisch. & Loeske. Allgemeine Botanische Zeitschrift für Systematik, Floristik, Pflanzengeographie 13: 22. 1907.

Type: “Ruisseau des Singes, Gorges de la Chiffa. Algérie, 14 Août 1897, Leg. J. Rechin”. Lectotype designated here, CHE!

The only specimen at CHE, which matches the data in the protologue, is here designated as lectotype. The label states “*Thamnium alopecurum* Br. eur. type et var. *decipiens* (var. nov.)”.

As Corbière (1904) indicated, the envelope contains two specimens, one of a typical specimen of *Thamnobryum alopecurum* and a second one that was described as a new variety, which we conclude can unequivocally be identified as *Scorpiurium circinatum*. Corbière himself observed that the new variety seemed to be an aberrant form of “*Thamnium alopecurum*” and described the plant as slender and with julaceous-curved branches, a character that at once separates it from the typical forms of the species and indeed suggests “*Eurhynchium circinatum*”. In fact, both species can be confused because of the presence of decumbent or erect secondary stems and mid-leaf cells rounded-quadrate

to shortly elongated. However, in *Thamnobryum* the dendroid ramification is easily observed, with a long stipe and an apical, branched frond, whereas in *Scorpiurium circinatum*, the plants are irregularly branched or sub-dendroid. The stem leaves are also clearly different, rounded-triangular or ovate triangular and gradually narrowed to acuminate apex in *T. alopecurum*, but markedly triangular and suddenly narrowed to an acuminate apex in *S. circinatum* (Hedenäs, 1992).

Scorpiurium circinatum is widely distributed in Eurasia, northern Africa and Macaronesia (Dierßen, 2001). It is a common and widespread species in the Mediterranean Region, though not reported for Egypt or Syria (Ros *et al.*, 2013).

5. *Trichostomum mediterraneum* var. *algeriae* Müll.Hal. ex Geh. Revue Bryologique 6: 33. 1879. *Trichostomum ehrenbergii* var. *algeriae* (Müll.Hal. ex Geh.) Paris. Index Bryologicus 1377. 1898. *Didymodon ehrenbergii* var. *algeriae* (Müll.Hal. ex Geh.) Paris. Index Bryologicus edition secunda: 68. 1904. *Barbula ehrenbergii* var. *algeriae* (Müll.Hal. ex Geh.) Latzel. Beihefte zum Botanischen Centralblatt. Zweite Abteilung, Systematik, Pflanzengeographie, angewandte Botanik 48(3): 480. 1931. *Hydrogonium ehrenbergii* var. *algeriae* (Müll.Hal. ex Geh.) Podp. Conspectus Muscorum Europaeorum 198.

1954. *Hyophila ehrenbergii* var. *algeriae* (Müll.Hal. ex Geh.) Pavletic. *Prodromus Flore Brifita Jugoslavije* 213. 1955.

Syn. *Hydrogonium bolleanum* (Müll.Hal.) A.Jaeger. Bericht über die Thätigkeit der St. Gallischen Naturwissenschaftlichen Gesellschaft 1877–78: 405 (Gen. Sp. Musc. 2: 669). 1880. syn. nov.

Type: [Algeria] “Ravin du Rimel à Constantine, L. Debat”. Lectotype designated here, PC!, isoelectotypes BM000669711 and JE.

The lectotype is a specimen in the herbarium of L. Debat, kept at the Cardot herbarium in PC that matches the information in the protologue (Geheeb, 1879). It contains four well-conserved groups of plants glued onto a sheet, each comprising many plants. There exists two unequivocal duplicates of the original material, one in JE containing only four plants glued on a small card and another in BM (BM000669711), from Geheeb herbarium (<https://data.nhm.ac.uk/object/7a71b4d1-5cc0-477d-a6a7-1c48aa376efc/1665273600000>), containing two well-conserved groups of plants.

The plants are large, 2.0–2.5 cm high, profusely branched, without axillary gemmae. Leaves are 2–3 mm long and show a great morphological variability, especially the median and upper laminal cells, which are 8.0–12.5 µm wide, smooth in some plants but with 1–4 distinct papillae per cell in others. The dorsal surface of the costa is strongly papillose, by projecting only one cell end, distinguishing it from *Hydrogonium orientale* (F.Weber) Jan Kučera [= *Barbula indica* (Hook.) Spreng.], a species that shows some morphological and ecological similarities with *H. bolleanum*. González-Mancebo & Ros (2002) and Werner *et al.* (2003) observed that Mauritanian plants of *H. orientale* submerged in water had smooth laminal cells, similar to that of *H. bolleanum* [= *Barbula bolleana* (Müll.Hal.) Broth.], whereas plants temporarily emergent have papillose laminal cells as an adaptation to water availability. *Barbula consanguinea* (Thwaites & Mitt.) A.Jaeger, a species that can be confused with *H. bolleanum* and *H. orientale* differs from the Algerian plants by its smaller median and upper laminal cells, which are 6–10 µm wide (Köckinger *et al.*, 2012).

Hydrogonium bolleanum is an austral-tropical-temperate element (Dierßen, 2001) frequent in southern Europe and northern Africa (Frey *et al.*, 2006; Ros *et al.*, 2013), as well as in sub-Saharan Africa (O’Shea, 2006).

The identity of two additional unpublished names, therefore invalid, have been also studied:

6. “*Funaria hygrometrica* var. *dentata* Corb.” ex Maire & Werner. Bulletin de la Société d’Histoire Naturelle de l’Afrique du Nord 25: 52. 1934 nom. nud.

Maire & Werner (1934) listed this invalid name in a paper based on collections made by R. Maire and M.E. Jahandiez and stored at the Institut Scientifique Chérifien and in the Herbarium of the Université d’Alger, crediting its authorship to L. Corbière. To the best of our knowledge, the material at Algerian institutions has

been lost, and so we searched in the Corbière Herbarium at CHE where there is one specimen of which the label reads: “Maroc: Rabat, bords du Bou-Regreg, janv. 1912, leg. Mouret”. Although this CHE specimen lacks any indication to var. *dentata* and the collector is not Jahandiez, the locality matches Maire & Werner (1934) which suggests that it is part of the original collection. The specimen contains two small envelopes (numbered 74 and 96), both of them corresponding to typical material of *Funaria hygrometrica*.

7. “*Zygodon dimorphus* Thér.” ex Jelenc. Bulletin de la Société d’Histoire Naturelle de l’Afrique du Nord 46: 117. 1955 nom. nud.

Jelenc (1955) included this name in a catalogue of bryophytes of northern Africa based on previous unpublished lists by Trabut, Maire and Weiller. It lacks a description and thus it is invalid. Indeed, Jelenc (1955: 117) himself indicated “Je n’ai trouvé ni échantillon, ni trace de la description de cette plante. Est-ce un *nomen nudum*? Je cite cette récolte pour conserver, le cas échéant, l’antériorité à l’auteur de la découverte”.

We found in the Thériot herbarium at PC a specimen labeled “D^R. R. Maire – Iter Marocanum XV 1928, *Zygodon dimorphus* Thér. sp. nov., In atlante rifano: in cedretis montis Tiziren, 1880–2000 m, N° 2499, die 18 junii”, with the species name handwritten by Thériot, and so we assume that the name was based on this sample.

The specimen includes brown plants with leaves arranged in spiral rows, crisped when dry, shortly hair-pointed, with recurved margins in the middle part of leaf and at least in one side to the base; the laminal cells are strongly incrassate, quadrangular to rounded or oblate in the upper part and long-rectangular and sinuose in the basal part; the marginal cells have the transverse walls more thickened than the longitudinal walls and has numerous brown multicellular, spherical gemmae in the leaf axils. These characters enable us to identify the specimen as *Grimmia torquata* Drumm. Here we report *G. torquata* for the first time in Morocco and continental Africa, although known from Tenerife and La Palma in Canary Islands (Arechavaleta *et al.*, 2010) and Madeira (Borges *et al.*, 2008).

Conclusions

After the study of the types of five bryophyte taxa considered until now endemic to northern Africa, we recognize only one of them, *Funaria altissima*, as a distinctive endemic species. We conclude that the number of north African endemic bryophytes is low, and that most of the infraspecific taxa described from this area at the end of the 19th and beginning of the 20th centuries are not worthy of taxonomic recognition.

Acknowledgements

The authors thank the curators of BM, CHE, JE and PC herbaria for the loan of type specimens. Also Rafael Medina and an anonymous reviewer for the correction of a previous version of the manuscript.

References

- Amann, J. 1918. Flore des Mousses de la Suisse, 2^a partie. Herbar Boissier, Genève.
- Arechavaleta, M., Rodríguez, S., Zurita, N. & García, A. (Eds.). 2010. Lista de especies silvestres de Canarias. Hongos, plantas y animales terrestres. 2009. Gobierno de Canarias.
- Bescherelle, É. 1880. Florule bryologique de la Réunion et des autres îles austro-africaines de l'océan Indien. *Annales des Sciences Naturelles, sér. Botanique* 6(9): 229–380.
- Bescherelle, É. 1885. Florule bryologique de Mayotte. *Annales des Sciences Naturelles, sér. Botanique* 7(2): 82–98.
- Bijlsma, R.J., Kruijer, J.D. & Stech, M. 2020. *Ptychostomum touwii*, a new bryophyte species distinguished from *Ptychostomum rubens* by iterative morpho-molecular analysis, and a note on *Bryum microerythrocarpum*. *Gorteria* 42: 56–65.
- Bizot, M. 1973. Mouses africaines récoltées par M. Dénes Balázs. *Acta Botanica Academiae Scientiarum Hungaricae* 18: 7–28.
- Blockeel, T.L., Bosanquet, S.D.S., Hill, M.O. & Preston, C.D. 2014. Atlas of British & Irish Bryophytes: the distribution and habitat of mosses and liverworts in Britain and Ireland. Volume 2. Pisces Publications, Newbury.
- Borges, P.A.V., Abreu, C., Aguiar, A.M.F., Carvalho, P., Jardim, R., Melo, I., Oliveira, P., Sérgio, C., Serrano, A.R.M. & Vieira, P. (Eds.). 2008. A list of the terrestrial fungi, flora and fauna of Madeira and Selvagens archipelagos. Direcção Regional do Ambiente do Governo Regional da Madeira and Universidade dos Açores. Funchal and Angra do Heroísmo.
- Bruch, P. & Schimper, W.-P. 1842. *Barbula*. In: Bruch, P., Schimper, W.-P. & Gumbel, T. (Eds.). *Bryologia Europaea, seu, Genera muscorum Europaeorum monographice illustrata*. Volume 2: 63–108, Plates 137–145, 147–151, 153–166, 168–169. E. Schweizerbart. Stuttgartiae.
- Cano, M.J., Ros, R.M. & Guerra, J. 2000. Identity of north African endemic bryophytes, 1. *J. Bryol.* 22: 269–272.
- Corbière, L. 1904. Contribution à la flore bryologique de l'Algérie. *Revue Bryologique* 31(1): 31–42.
- Corbière, L. 1914. Troisième contribution à la flore bryologique du Maroc d'après les récoltes du Lieutenant Mouret. *Revue Bryologique* 41: 10–14.
- Dierßen, K. 2001. Distribution, ecological amplitude and phytosociological characterization of European bryophytes. *Bryophytorum Bibliotheca* 56: 1–289.
- Dixon, H.N. 1931. Two mosses from the central Sahara. *Journal of Botany, British and Foreign* 69: 285–287.
- Dixon, H.N. 1933. Mosses collected on Mt. Cameroon by Miss M. Steele. *Annales Bryologici* 6: 20–30.
- Fife, A.J. & Seppelt, R.D. 2012. Australian Mosses Online 67. Funariaceae. Available from: http://www.anbg.gov.au/abrs/Mosses_online/67_Funariaceae.html [Accessed 19 Mar 2022].
- Frey, W., Frahm, J.-P., Fischer, E. & Lobin, W. 2006. Liverworts, mosses and ferns of Europe. English edition revised and edited by T. L. Blockeel. Harley Books. Essex.
- Garilleti, R. 2006. *Barbula* Hedw. In: Guerra, J. & Cros, R.M. (Eds.). *Flora Briofítica Ibérica*. Vol. III. Pottiales: Pottiaceae, Encalyptales: Encalyptaceae: 245–252. Universidad de Murcia. Sociedad Española de Briología, Murcia.
- Geheeb, A. 1879. Une nouvelle espèce de mousses d'Europe et sa relation avec une espèce d'Afrique. *Revue Bryologique* 6: 33–37.
- González-Mancebo, J.M. & Ros, R.M. 2002. Some interesting bryophytes from the Adrar massif (Mauritania). *Cryptogam. Bryol.* 23: 263–270.
- Hedenäs, L. 1992. Flora of Madeiran Pleurocarpous mosses (Isobryales, Hypnobryales, Hookeriales). *Bryophytorum Bibliotheca* 44: 1–165.
- Hodgetts, N.G., Söderström, L., Blockeel, T.L., Caspari, S., Ignatov, M.S., Konstantinova, N.A., Lockhart, N., Papp, B., Schröck, C., Sim-Sim, M., Bell, D., Bell, N.E., Blom, H.H., Bruggeman-Nannenga, M.A., Brugués, M., Enroth, J., Flatberg, K.I., Garilleti, R., Hedenäs, L., Holyoak, D.T., Hugonnot, V., Kariyawasam, I., Köckinger, H., Kučera, J., Lara, F. & Porley, R.D. 2020. An annotated checklist of bryophytes of Europe, Macaronesia and Cyprus. *J. Bryol.* 42(1): 1–116. doi: 10.1080/03736687.2019.1694329
- Holyoak, D.T. 2021. European Bryaceae. A guide to the species of the moss family Bryaceae in Western & Central Europe and Macaronesia. Pisces Publications. Berkshire.
- Ignatov, M.S., Ignatova, E.A., Fedosov, V.E., Ivanova, E.I., Blom, H.H., Muñoz, J., Bednarek-Ochyra, H., Afonina, O.M., Kurbatova, L.E., Czernyadjeva, I.V. & Cherdantseva, V.Y. 2017. Moss flora of Russia. Volume 2: Oedipodiales-Grimmiales. KMK Scientific Press, Moscow.
- Jelenc, F. 1949. Muscinées de l'Afrique du Nord [1]. *Bulletin Trimestriel de la Société de Géographie et d'Archéologie de la Province d'Oran* 72: 59–76.
- Jelenc, F. 1952. Muscinées de l'Afrique du Nord [4]. *Bulletin Trimestriel de la Société de Géographie et d'Archéologie de la Province d'Oran* 75: 49–93.
- Jelenc, F. 1955. Contribution à l'étude de la flore et de la végétation bryologiques Nord-Africaines (5e fascicule). *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord* 46 (3–4): 107–120.
- Juratzka, J. 1874. *Muscorum species novae*. *Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft in Wien* 24: 377–378.
- Köckinger, H., Kučera, J., Hofmann, H., Müller, N. & Amann, G. 2012. *Barbula consanguinea* discovered in Switzerland and Austria, with a revision of former European records of *B. indica*. *Herzogia* 25(1): 61–70. doi: 10.13158/heia.25.1.2010.61
- Kučera, J., Košnar, J. & Werner, O. 2013. Partial generic revision of *Barbula* (Musci: Pottiaceae): Re-establishment of *Hydrogonium* and *Streblotrichum*, and the new genus *Gymnobarbula*. *Taxon* 62(1): 21–39.
- Lüth, M. 2019. Mosses of Europe - A Photographic Flora. Volume 1. Michael Lüth. Freiburg.

- Magill, R.E. 1987. Bryophyta. Part I Mosses. Fascicle 2, Gigaspermaceae-Bartramiaceae. In: Leistner, O.A. (Ed.). *Flora of Southern Africa*: [i]-[x], 293–444. Department of Agriculture and Water Supply, Pretoria.
- Maire, R. & Werner, R.G. 1934. Contribution à la flore cryptogamique du Maroc. Fascicule IV. Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord 25 (2): 40–60.
- Medina, R., Johnson, M., Liu, Y., Wilding, N., Hedderson, T.A., Wickett, N. & Goffinet, B. 2018. Evolutionary dynamism in bryophytes: Phylogenomic inferences confirm rapid radiation in the moss family Funariaceae. *Mol. Phylogenet. Evol.* 120: 240–247. doi: 10.1016/j.ympev.2017.12.002
- Miller, D.H. & Miller, H.A. 2007. *Funaria* Hedw. In: *Flora of North America* Editorial Committee (Ed.). *Bryophyta, part 1. Flora of North America North of Mexico* 27: 180–199. Oxford University Press. New York.
- Müller, C. 1886. *Bryologia insulae S. Thomé Africae occid. tropicae*. *Flora* 69(18): 275–286.
- Müller, C. 1890. Die Moose von vier Kilimandscharo-Expeditionen. *Flora* 73(5): 465–499.
- Müller, C. 1899. *Contributiones ad Bryologiam austro-afram*. *Hedwigia* 38: 52–155.
- O'Shea, B.J. 2006. Checklist of the mosses of sub-Saharan Africa (ver. 5 12/06). *Tropical Bryology Research Reports* 6: 1–252.
- Ochi, H. 1972. A revision of African Bryoideae, Musci (First Part). *Journal of the Faculty of Education, Tottori University. Natural Science* 23: 1–126.
- Ochi, H. 1985. An annotated list of mosses of the subfamily Bryoideae in South, Southeast and East Asia. *Journal of the Faculty of Education, Tottori University. Natural Science* 34: 41–96.
- Ochi, H. 1994. *Bryum*. In: Sharp, A.J., Crum, H. & Eckel, P.M. (Eds.). *The Moss Flora of Mexico, part 1. Sphagnales to Bryales*. *Mem. New York Bot. G.* 69: 454–490. New York Botanical Garden, New York.
- Potier de la Varde, R. 1943. Mousses nouvelles récoltées aux Iles du Cap Vert par M. Aug. Chevalier en 1934. *Bulletin du Muséum National d'Histoire Naturelle*, ser. 2(15): 239–243.
- Renauld, F. & Cardot, J. 1915. Mousses. Texte. In: Grandidier, A. & Grandidier, G. (Eds.). *Histoire physique, naturelle et politique de Madagascar*: 39: [III]–VIII, [1]–560, [2, “Table des matières”, “Errata”]. Imprimerie Nationale. Paris.
- Ros, R.M. & Cano, M.J. 2008. Identity of North African endemic bryophytes, 2. *Cryptogam. Bryol.* 29(2): 135–141.
- Ros, R.M., Cano, M.J. & Guerra, J. 1999. Bryophyte checklist of Northern Africa. *J. Bryol.* 21: 207–244.
- Ros, R.M., Mazimpaka, V., Abou-Salama, U., Aleffi, M., Blockeel, T.L., Brugués, M., Cros, R.M., Dia, M.G., Dirkse, G.M., Draper, I., El-Saadawi, W., Erdağ, A., Ganeva, A., Gabriel, R., González-Mancebo, J.M., Granger, C., Herrnstadt, I., Hugonnot, V., Khalil, K., Kürschner, H., Losada-Lima, A., Luis, L., Mifsud, S., Privitera, M., Puglisi, M., Sabovljević, M., Sérgio, C., Shabbara, H.M., Sim-Sim, M., Sotiaux, A., Tacchi, R., Vanderpoorten, A. & Werner, O. 2013. Mosses of the Mediterranean, an annotated checklist. *Cryptogam. Bryol.* 34(2): 99–283. doi: 10.782/cryb.v34.iss2.2013.99
- Schatz, G.E., Andriambololonera, S., Lowry II, P.P., Phillipson, P.B., Rabarimanarivo, M., Raharilala, J.I., Rajaonary, F.A., Rakotonirina, N., Ramananjana, R.H., Ramandimbisoa, B., Randrianasolo, A., Ravololomanana, N., Taylor, C.M. & Brinda, J.C. 2021. *Catalogue of the Plants of Madagascar*. Available from: <http://legacy.tropicos.org/Project/Madagascar> [Accessed 30 Sep 2022].
- Schwaegrichen, F. 1816. *Species muscorum frondosorum [...] Supplementum primum [...] Sectio posterior*. Sumtu Ioannis Ambrosii Barth. Lipsiae.
- Smith, A.J.E. 1978. *The moss flora of Britain and Ireland*. Cambridge University Press. Cambridge.
- Thériot, I. 1920. Contribution à la flore bryologique de Madagascar. *Recueil des Publications de la Société Havraise d'Études Diverses* 87: 95–111.
- Thériot, I. 1930. Mousses du Congo Belge et du Liberia récoltées par D. H. Linder (Expedition of the Harvard Institute of Tropical Biology and Medicine 1926–27). *Revue Bryologique et Lichénologique* 3: 30–50.
- Thériot, I. & Trabut, L. 1930. Quelques Mousses inédites de l'Afrique du Nord. *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord* 21: 28–31.
- Unger, F. & Kotschy, T. 1865. *Die Inseln Cypern ihrer physischen und organischen Natur nach, mit Rücksicht auf ihre frühere Geschichte*. Wilhelm Braumüller, Wien.
- Venturi, G. 1872. Muschi raccolti dal Signor Odoardo Beccari nella terra dei Bogos in Abissinia. *Nuovo Giornale Botanico Italiano* 4: 7–22.
- Werner, O., Ros, R.M. & González-Mancebo, J.M. 2003. The variability of the papillae on the laminal cells of *Barbula indica* (Hook.) Spreng. (Pottiaceae, Musci): a morphological and molecular approach. *Cryptogam. Bryol.* 24: 367–375.