Cryptogamie, Bryologie, 2005, 26 (2): 167-172

New taxonomical data on the genus *Microbryum* Schimp. (Pottiaceae, Musci)

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(Received 1 January 2004, accepted 25 June 2004)

Abstract – *Microbryum piptocarpum* (Durieu & Mont.) J. Guerra & M. J. Cano is synomized with *M. curvicolle* (Hedw.) R. H. Zander based on morphological and biometrical studies. *Pottia* x*andalusica* Ros & R. Oliva is synomized with *Microbryum fosbergii* (E. B. Bartram) Ros, O. Werner & Rams comb. nov. Lectotypes are designated for *Phascum piptocarpum* Durieu & Mont. and *P. rectum* With.

Musci / Pottiaceae / taxonomy / *Microbryum piptocarpum* / *Microbryum fosbergii* / *Pottia* x*andalusica* / lectotypes / synonyms

INTRODUCTION

Although proposed by Schimper (1860), the genus *Microbryum*, was little used by bryologists until Zander (1993) revived it to include species of *Phascum* Hedw., subgenus *Microbryum* (Schimp.) G. Roth, and species of *Pottia* (Ehrh. ex Rchb.) Fürnr. with conic opercula, considered by Warnstorf (1916) as "Conostegiae". According to Zander (1993), *Microbryum* can be distinguished by the combination of small size, upper lamina staining red with KOH, single round to semicircular costal stereid band, apiculate capsules when cleistocarpous, while the peristomes, when present are commonly apically truncate and seemingly large in comparison with the size of the capsule, and the calyptrae are often papillose.

The previous concept of the genera *Phascum* and *Pottia*, which was mainly based on the cleistocarpous versus stegocarpous condition, is in clear contrast with chloroplast *rps*4 sequence data (Werner *et al*., 2002, 2004). These studies show that *Phascum* and *Pottia*, as traditionally defined, are polyphyletic and support the morphologically-based concept of the genus *Microbryum* (Zander, 1993). The cleistocarpous capsules should no longer be considered the main morphological feature for separating these two genera, because this feature probably evolved several times independently as a response to environmental pressure.

In the framework of the "Flora Briofítica Ibérica", some new conclusions concerning various taxa belonging to this complex are presented, taking into consideration previous taxonomic treatment of the genus *Phascum* in the Iberian Peninsula (Guerra *et al*., 1991).

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MATERIAL AND METHODS

To test whether the specimens with straight setae named *Microbryum piptocarpum* Durieu & Mont. can be distinguished from *M. curvicolle* (Hedw.) R. H. Zander by any other morphological character, a biometrical analysis was performed that included the relevant characters usually used to define the genus *Microbryum*. To carry out this analysis, eight specimens of *M. piptocarpum* were studied: the type, all the published reports under this name deposited at BCB and MUB herbaria, and another specimen not published under this name but with straight setae (MUB 7942). For *M. curvicolle*, a selection of 11 specimens from MUB herbarium were used.

As regards the Spanish *Pottia* x*andalusica* Ros & R. Oliva, all the published specimens (two and the type) were studied morphologically and compared with the type of *Pottia fosbergii* E. B. Bartram. No biometrical analysis was carried out in this case because of the few specimens known for the former species and because of the absence of gametophyte differences between both taxa.

For the lectotypification of *Microbryum rectum* (With.) R. H. Zander, the type of this species was found at LINN.

Specimens studied:

Microbryum curvicolle - GERMANY: Turingia, Kiffhäuser, *Cano* (MUB 12323). SPAIN: Alicante, Guardamar del Segura, Laguna de la Mata, prox. a Las Maravillas, *Guerra & García-Zamora* (MUB 3061); Villena, Sierra de Salinas, barranco de la Fuente de Enmedio, *Ros* (MUB 5893). Almería, Tabernas, cruce a Turrillas en la carretera Murcia-Almería, *Ros et al.* (MUB 2970); Turre, Sierra de Cabrera, Loma del Colorado, cortijo "La Humbría", *García-Zamora & Ros* (MUB 8269); Turre, Sierra de Cabrera, cercanías al cortijo "Colorado", *García-Zamora & Ros* (MUB 8262). Jaén, Sierra de Cazorla, Hinojares, carretera Quesada-Pozo Alcón km 58, *Ros & Monreal* (MUB 14546). Murcia, Lorca, Sierra de la Almenara, Alto del Peral, *Ros* (MUB 1306); Moratalla, prox. El Sabinar, *Ros et al.* (MUB 13774); Murcia, El Valle, *Ros & Cano* (MUB 15496); Murcia, Puerto de la Cadena, *Ros* (MUB 1303). Islas Baleares, Palma de Mallorca, Bassa Plana, *Cano et al.* (MUB 11285).

Microbryum piptocarpum - GREECE: Thessalía, Oros Pilio, Kato Gadzea, *Cano et al.* (MUB 12138). SPAIN: Barcelona, Anoia, Castelfullit de Riubregós, *Brugués & Lloret* (BCB 31611). Granada, prox. a Benamaurel, *Ros & Guerra* (MUB 3489). Lérida, La Segarra, Biosca, *Lloret & Cros* (BCB 31612). Zaragoza, Leciñena, *Casas* (BCB 31778). Zaragoza, Batea, *Casas* (BCB 30717).

Microbryum aff. piptocarpum - GREECE: Sterea Elláda, Oros Párnitha, *Cano et al.* (MUB 12051). SPAIN: Huelva, Sierra de Aracena, Alájar, Peña de Arias Montano, *Cano et al.* (MUB 7942).

Pottia x*andalusica* - SPAIN: Badajoz, Sierra de Monsalud, Cabezo Alto, *Ederra* (PAMP 6705). Sevilla, La Sauceda, c. Castillo de las Guardas, *Guerra et al.* (MUB 11416).

RESULTS AND DISCUSSION

Microbryum curvicolle and *M. piptocarpum*

Variations in the morphological characters are shown in Fig. 1, where it can be seen that all the studied characters clearly overlap.

Phascum piptocarpum was described by Durieu & Montagne (Montagne, 1856) based on northern African material. Although the exact locality is given in

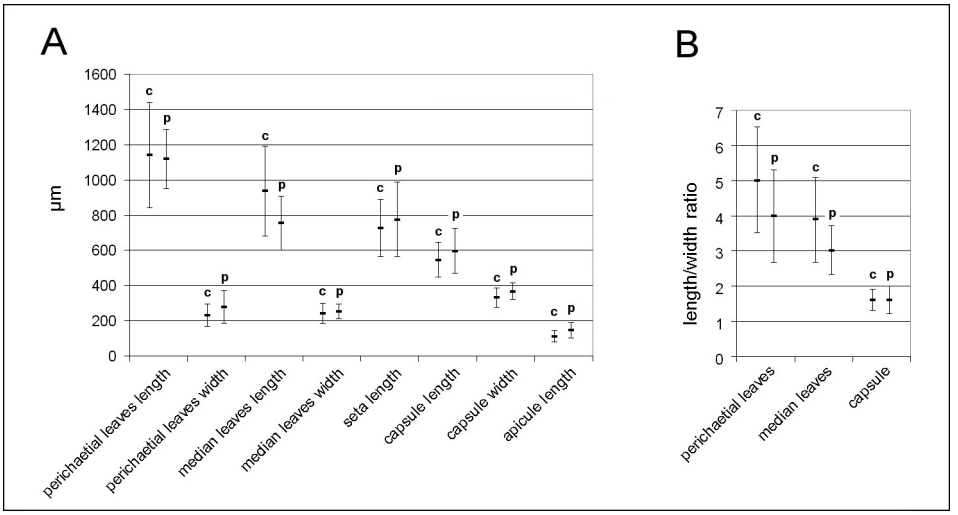

Fig. 1. Measured morphological characters in *Microbryum curvicolle* and *M. piptocarpum*. Segments represent the standard deviation. Average is marked in the middle part of the segment. Measures are always in pairs: those of *M. curvicolle* are situated on the left and indicated by the letter "c" and those for *M. piptocarpum* on the right and indicated by the letter "p". Graphic A: absolute values of the measures. Graphic B: length/width ratio of some of measured characters.

the protologue as "*ad sepes apud Blidah, Algeria, martio 1849: Durieu*", only the country "Algeria" is indicated on the packet available in the Herbarium Montagne (PC). Also written on the label is "*sp. nova ut censet el Durieu*" and in the next lines "*Phascum bryoides*?" and "*v. curvicollum*". It is clear that the authors hesitated about the identity of the species, as indicated not only by the former sentences, but also due to the fact that the specimen designated as lectotype is glued on a card between two specimens of *P. bryoides* Dicks. Unfortunately, the collection is very scarce, consisting of two plants, only one of which is entire, while the other only has the sporophyte and four detached leaves.

Guerra *et al.* (1991) studied another specimen located in PC (Algérie, *Durieu*) but did not designate any lectotype.

Many years after being described, the species was reported from southern Spain, in Granada province (Guerra *et al*., 1991), and later by Brugués *et al.* (1993), from Lérida and Barcelona provinces, and by Casas *et al.* (1993) from Tarragona province (NE Spain). Finally, it has also been reported from the Eastern Mediterranean Basin (Greece) by Blockeel *et al*. (2002).

Although Durieu & Montagne compared *Phascum piptocarpum* with *Phascum bryoides* (at present considered belonging to different genera depending on the opinion of various authors: *Pottia bryoides* (Dicks.) Mitt., *Tortula protobryoides* (Dicks.) Lindb. or *Protobryum bryoides* (Dicks.) J. Guerra & M. J. Cano) because of the similarity in the capsule, they clearly differ in leaf shape and laminal cell papillosity.

After morphological study of all the known specimens of *Microbryum piptocarpum* (the type and the Spanish and Greek samples), the species seems

very similar to *M. curvicolle*. At first glance, *M. piptocarpum* has a straight seta, whereas *M. curvicolle* has a curved seta. Nevertheless, the distinction is not always easy, because both kinds of seta are frequently found in the same carpet.

In addition, it should be kept in mind that it is sometimes possible to find the typical plants of *M. curvicolle* with curved setae and laterally exerted capsules together with others with straight setae and apically exerted capsules. This was also observed by Guerra *et al.* (1991). Furthermore, all the specimens previously identified as *M. piptocarpum* have typically long perichaetial leaves that are longer that the leaves situated under the perichaetia, which is also a characteristic of *M. curvicolle*.

In the protologue of *Microbyum piptocarpum*, it is written that the capsule can open "*capsula exserta..., tandem decidua*". Although, as mentioned above, the selected lectotype is very scarce, microscopical study of the type shows that the apiculus of the capsule is not deciduous. In agreement with Guerra *et al.* (1991), no trace of differentiated cells was found in the basal part of the apiculus, which would otherwise make possible the rupture of the capsule, as occurs in the related species *M. rectum* (With.) R. H. Zander. It is possible that Durieu and Montagne, when studying the original material of *M. piptocarpum*, may have found some specimens with differentiated cells at the base of the operculum, but they cannot be observed in the conserved plants. The variability in this complex is such that a collection from Greece (MUB 12051, Blockeel *et al.,* 2002) exhibits straight setae and exerted capsules, as in *M. piptocarpum*, but with one row of differentiated cells at the base of the apiculus, as in *M. rectum*. Furthermore, the spores are papillose, which does not fit *M. piptocarpum* or *M. rectum*.

Moreover, many intermediate forms between different species can be observed in the genus *Microbryum*. These forms have very often been considered as hybrids: for example, the aggregate taxa of *M. starkeanum* (Hedw.) R. H. Zander (Ros *et al.*, 1996) and *Pottia* x*andalusica*, which was supposed to be a hybrid between *M. starkeanum* and *Pottia bryoides* (Ros *et al*., 1994).

Pottia x*andalusica* and *P. fosbergii*

Pottia x*andalusica* was described from Spanish specimens, in which most of the morphological features correspond to *Microbryum starkeanum*, except for the cleistocarpous nature of the capsule, which has no deciduous operculum, and the absence of differentiated cells in the basal part of the apiculus or peristome. *Pottia* x*andalusica* also possesses the typical spores of *M. starkeanum*, with protuberances that give it a wavy outline. After studying of the type of *Pottia fosbergii* E. B. Bartram from North America, it was concluded that both taxa are identical. In the protologue of this species (Bartram, 1933), the spores were described as finely papillose. Nevertheless, study of the holotype showed that the spores have some papillae and also some protuberances in outline typical of *M. starkeanum*, although not so regularly distributed as in *Pottia* x*andalusica*. Consequently, we agree with Zander (unpublished, Bryophyte Flora of North America), that the Spanish specimens are much the same as *P. fosbergii*.

As regards the hybrid origin supposed by Ros *et al.* (1994), it is not possible at the moment to confirm or reject this hypothesis. In both *Pottia* x*andalusica* and *P. fosbergii* types, a mixture in the carpet of *Pottia bryoides* and *M. starkeanum* was observed. Although *M. starkeanum* var. *fosbergii* (E. B. Bartram) R. H. Zander (Zander, 1993), lacks both a differentiated operculum and a peristome, Zander (unpublished, Bryophyte Flora of North America) found a specimen from California with a weakly differentiated operculum and a rudimentary peristome.

In order to determine whether or not it is a notospecies, it would be helpful, according to Zander (unpublished), to know whether the spores are unreduced, which is still unclear to us. As a consequence, its taxonomical status is difficult to assess at present. The discovery of a specimen with intermediate characteristics places the species even nearer *M. starkeanum*, which would support the inclusion of the taxon within *M. starkeanum* under var. *fosbergii*. This would mean that the species could develop both cleistocarpous and stegocarpous capsules. Although we accept that the capsule can be easily influenced by environmental conditions, as supported by molecular data (Werner *et al*. 2002, 2004), we prefer to treat it at the moment at the species level.

Taxonomical conclusions

As a result of the above observations, it has been concluded that none of the investigated characters can be used to segregate *M. piptocarpum* from *M. curvicolle* on the one hand, and *P. fosbergii* and *P.* x*andalusica* on the other. The following taxonomical changes are therefore introduced:

Microbryum curvicolle (Hedw.) R. H. Zander, *Bull. Buffalo Soc. Nat. Sci.* 32: 240. 1993. *Phascum curvicolle* Hedw., *Sp. musc. frond.* 21. 1801 (basionym). Protologue: Locis lapidosis in saltu Davenstaedtensi, 1784, *Ehrhart* (lectotype designated by Guerra *et al.* 1991: G).

Phascum piptocarpum Durieu & Mont., *Syll. gen. sp. crypt.* 51. 1856 (basionym). *Microbryum piptocarpum* (Durieu & Mont.) J. Guerra & M. J. Cano, *J. Bryol.* 22: 92. 2000, ***syn. nov.*** **Type**: "Algeria" (**lectotype designated here**: Herbarium Montagne in PC!).

Microbryum fosbergii (E. B. Bartram) Ros, O. Werner & Rams **comb. nov**. *Pottia fosbergii* E. B. Bartram, *Bryologist* 33: 18. 1930 (basionym). *Phascum fosbergii* (E. B. Bartram) J. Guerra, *J. Bryol.* 16: 59. 1990. *Microbryum starkeanum* var. *fosbergii* (E. B. Bartram) R. H. Zander, *Bull. Buffalo Sci. Nat. Sci.* 32: 240. 1993. **Type**: [U.S.A.:] Mosses of Southern California, Claremont E. side Indian Hill, Los Angeles Co., 1200 ft., 3/15/1928, *F. R. Forsberg Nº D24a* (holotype: FH!).

Pottia x*andalusica* Ros & R. Oliva, *Cryptog., Bryol.-Lichénol.* 15: 201. 1994, ***syn. nov.*** **Type**: España: Córdoba, Sierra Morena, carretera a Trassierra, *Oliva* (Holotype: Herbarium Oliva 817!, isotype: MUB 5006!)

Lectotypification of *Microbryum rectum*

In the protologue of *Phascum rectum* it is indicated: "Specimens from J. W. GRIFFITH, Esq. who found it amongst trees in the front of Garn House, very near the road leading to Henllan". In LINN there is material of *Phascum rectum* that belongs to the Smith Herbarium. In the sheet 1656.9 there are three collections, and they are each from different localities. Collection 1: North Wales, J. W. Griffith Nº 28, June 1796. Collection 2: Cambridgeshire, Rev. W. Hemsted. Collection 3: Bank in the Lakenham road, close to Norwich. W. Dawson Turner. From these three collections, the last one does not belong to this species and consequently only the two first can be chosen as lectotype. The first one, which was received by Smith in 1796, is the only one that fits with the collector and location (the village cited in the protologue, Henllan, is situated in North Wales). Consequently we choose the first collection as lectotype of *Phascum rectum*.

Microbryum rectum (With.) R. H. Zander, *Bull. Buffalo Soc. Nat. Sci.* 32: 240. 1993. *Phascum rectum* With., *Syst. Arr. Brit. Pl.* (ed. 4): 771. 1801 (basionym). **Type**:

[Great Britain:] North Wales. J. W. Griffith Nº 28, June 1796 (**lectoptype designated here**: herbarium Smith in LINN!).

Acknowledgements. We would like to thank the curators of the BCB and PC herbaria for the loan of specimens, the curator of FH and LINN who sent us valuable information about the types, L. Ellis, for studying the type of *Phascum rectum* at LINN, and J. Muñoz, M. J. Cano, J. Guerra and two anonymous referees, for their valuable comments on an earlier version of the manuscript. This work was carried out with financial support from MCyT of Spain (Projects BOS2001-0276 and REN2003-00766).

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