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Taxonomical and nomenclatural notes on the moss *Ceratodon conicus* (Ditrichaceae, Bryophyta)

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Abstract – A revision of the nomenclatural and taxonomical data related to *Ceratodon conicus* (Hampe *ex* Müll. Hal.) Lindb. and its synonyms published by Burley & Pritchard (1990) was carried out. The lectotype designated from material filed in GOET was confirmed, but the material from duplicates of lectotype specimens filed in FH, GOET, and MANH was found not corresponding with the protologue of the species. In addition, the types of three synonyms of *Ceratodon conicus*, *C. cedricola* J.J Amann from Z+ZT, *C. dimorphus* H. Philib. from BM, and *C. purpureus* var. *graefii* Limpr. from BR, designated as holotypes by Burley & Pritchard, are here designated as lectotypes as no unequivocal original specimen exists in any case. Finally, *Ceratodon purpureus* var. *graefii* is better considered to be a synonym of *C. purpureus* (Hedw.) Brid. *sensu lato*, as its morphological characteristics match the description of this species and not that of *C. conicus*.

Bryophytes / Europe / herbaria revision / lectotypes / typification

INTRODUCTION

Burley & Pritchard (1990) recognized four species in the genus *Ceratodon* Brid. in their worldwide taxonomical revision: *C. antarcticus* Cardot, *C. conicus* (Hampe *ex* Müll. Hal.) Lindb., *C. heterophyllus* Kindb., and *C. purpureus* (Hedw.) Brid. with three subspecies. Their study was based on an extensive morphometric study including an extensive taxonomic and nomenclatural synthesis.

Ceratodon conicus was described as *Trichostomum conicum* by Hampe *ex* Müll. Hal. (Müller, 1849), based on material received *in litt.* from the German botanist Georg Ernst Ludwig Hampe (1795-1880). The protologue reads "*Germania septentrionalis, Flegesen circa Hameln prope Hohnsen in muris: Schlotheuber*". The species was first validly combined in the genus *Ceratodon* by Lindberg (1879). Interestingly, Carl Müller himself later (Müller, 1899) proposed the illegitimate homonymous combination *Ceratodon conicus*, based on *Barbula conica* Spreng. from South Africa, that according to Burley & Pritchard (1990) is a synonym of *C. purpureus* subsp. *stenocarpus* (Bruch & Schimp.) Dixon.

According to Burley & Pritchard (1990), the most important diagnostic features of *Ceratodon conicus* from the other species in the genus are: the ovate-lanceolate, slightly concave leaves, the entire, recurved to apex or just below margins, the costa excurrent in an arista of variable length, and the yellow to orange-reddish peristome teeth, 21-48 μm wide at base, usually with 3-5 trabeculae and 5-9 articulations, with narrow or absent border. The gametophytic characters were

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not found sufficiently stable by Burley & Pritchard (1990), which lead the authors to state that, in the absence of mature capsules, it is not possible to distinguish *C. conicus* from some morphs of *C. purpureus* with confidence.

Ceratodon conicus can be found with certainty in North America (Canada and U.S.A.), Europe (Austria, Germany, Norway, Switzerland, United Kingdom) and North Africa (Morocco); its habitat is terrestrial on bare earth, but it also occurs on soil-capped limestome walls, rock crevices and mountain ledges; it is probably xerophytic and strictly calcicolous (Burley & Pritchard, 1990).

The acceptance of *C. conicus* at species level has been disputed, and some authors (Husnot, 1884; Dixon, 1896) have moved it to varietal and subspecific ranks given the scarce and unreliable diagnostic morphological characters of the gametophyte, and the usual absence of sporophytes. While the authors of major large European checklists (Hill *et al.*, 2006; Ros *et al.*, 2013) accepted the taxonomic view of Burley & Pritchard (1990), others have had taxonomic difficulties deciding about the certainty of its occurrence (Kučera & Váňa, 2003), or accepting the species at infraspecific level as McIntosh (2007) in the Flora of North America.

Burley & Pritchard (1990) revised most of the approximately 70 names attributable to the genus *Ceratodon*, which were included in Index Muscorum (Wijk *et al.*, 1959, 1969). They designated the lectotype and three isolectotypes for *Trichostomum conicum,* and put into its synonymy three additional names: *Ceratodon cedricola* Amann from Morocco, *C. dimorphus* Philib., and *C. purpureus* var. *graefii* Limpr., the latter two from Switzerland.

In the course of a taxonomical study of *Ceratodon* species, some nomenclatural and taxonomical inconsistencies in the treatment of Burley & Pritchard (1990) were found. Based on the study of the protologues and the types designated by these authors, in this paper intends to solve the problems detected.

MATERIALS AND METHODS

We revised the types of *Trichostomum conicum* designated by Burley & Pritchard (1990), which were the lectotype and isolectotypes from GOET at the Georg-August-Universität Göttingen and borrowed the isolectotype from FH. The label data of the isolectotype from MANCH was analyzed through photographs sent by the curator of the herbarium, together with other specimens identified under this name. We also borrowed a specimen from STU, mentioned by Meinunger & Schröder (2007) as a possible type. Additionally, we revised the types of the three synonyms proposed by Burley & Pritchard (1990), namely *Ceratodon cedricola* from Z+ZT, *C. dimorphus* from BM, and *C. purpureus* var. *graefii* from BR.

RESULTS AND DISCUSSION

Type revision of *Ceratodon conicus*

Ceratodon conicus (Hampe *ex* Müll. Hal.) Lindb., *Musci Scand.* 27. 1879 (non *Ceratodon conicus* (Lindb.) Müll. Hal., *Hedwigia* 38: 98. 1899, *hom. illeg.*).

Basionym: *Trichostomum conicum* Hampe *ex* Müll. Hal., *Syn. Musc. Frond.* 1: 575. 1849; *Ceratodon purpureus* var. *conicus* (Hampe *ex* Müll. Hal.) Husn., *Muscol. Gall*. 60. 1884; *Ceratodon purpureus* subsp. *conicus* (Hampe *ex* Müll. Hal.) Dixon, *Stud. Handb. Brit. Mosses* 68. 1896. **Lectotype** (designated by Burley & Pritchard, 1990): [Germany, Niedersachsen] Auf Mauern bei Flegesen … (unreadable) Hameln bei Hohnsen, Mai coll. *Schlotheuber* pastor eccl. 784, Hampe misit 15/2 48, C. Müller det. (GOET 011795!).

Burley & Pritchard (1990) designated the lectotype of *Ceratodon conicus* from GOET and also four isolectotypes from FH, GOET(2) and MANCH. Nevertheless, at present, only one specimen is kept at GOET, where duplicates of Hampe's Herbarium are preserved. All of them have a revision label handwritten by J.S. Burley in 1985, on which he writes: "Appears to be a good species *C. conicus* (Hampe) Lindb". This specimen is barcoded (GOET 011795) and considered an isotype by the herbarium keepers.

As no more specimens were found at GOET whose label matches exactly the protologue, and we have not found any other potential type specimen exhibiting a revision label of Burley, we consider the above described specimen as the lectotype. Nevertheless, there is a non-barcoded specimen in GOET with the label "*Trichostomum conicum* Hampe n.sp., Auf einer Gartenmauer in Hachmühlen unweit Hameln", lacking collector name and date. However, the locality data do not correspond with those of the lectotype, as it is in the neighboring zones of the locality of the lectotype (Flegessen) but at a certain distance. Although it has not a revision label of Burley, it could be the GOET isolectotype mentioned by Burley & Pritchard (1990), since the locality data are the same as in the next two herbaria specimens, which were also considered isolectotypes by these authors.

The MANCH specimen studied and annotated by Burley in 1985, and designated as isolectotype in Burley & Pritchard (1990) (labelled "Garden wall near Hachmühlen Hannover, Pastor *Schlotheuber*, May 17/47"), cannot be considered part of the type material. The reason is that it was collected from a different locality (the same as the above mentioned specimen from GOET). Besides, it was collected one year earlier than the lectotype specimen. There is another specimen kept at MANCH that has been collected from one of the above mentioned neighboring localities by the same collector, but without collecting date "Ex herb. Hampe, *Ceratodon conicus*, Hannover, Legit *Schlotheuber*". Therefore, none of the specimens kept at MANCH can be considered part of the type material.

The specimen from the Hampe Herbarium at FH ("*Ceratodon purpureus minor*, *Trichostomum conicum* ..., Germania pr. Hachmühlen, FH00290580!"), although without collecting date, might also belong to above mentioned non-type Hachmühlen collection, parts of which are filed at GOET and MANCH. Morphologically, the specimen seems to correspond to the concept of *C. conicus* of Burley & Pritchard (1990): ovate to lanceolate leaves, entire margin, excurrent costa in most of the leaves, cross-section of leaves without guide cells; two-three sheeting internal perichaetial leaves, widely ovate to orbicular, rounded to obtuse, apiculate or not, with narrow, poorly developed costa, excurrent in a short apiculus or not; capsule not strumose and erect, peristome teeth not bordered, 30-32 μm wide at the base each, with 3-5 trabeculae and 3-4 articulations; spores 10-12 μm in diameter.

Finally, the label information of the specimen kept at STU reads "Hannover, *Ceratodon purpureus* (L.) Brid. var. *conicus* (Hpe) … , loc. class. des *Trichostomum conicum* Kr. Hameln, Hachmühlen auf der Gartenmauer der Gastwirtschaft, VI. 1880, leg. *Schlotheuber*". This specimen was mentioned in The atlas of German mosses (Meinunger & Schröder, 2007), together with the lectotype as the only certain

German occurrences of the species, considering that other collections from the country are sterile and therefore doubtful. Also in this case, the collecting site is different from that of the lectotype and the same as the above mentioned specimens from FH, GOET and MANCH; moreover label data given do not match the information on collecting date (June 1880). According to Wagenitz (1988), the Hannovarian ecclesiastic pastor and botanist Schlotheuber lived between 1789 and 1866. The label is hand-written by Fritz Koppe (Martin Nebel, curator of STU, pers. comm.). Probably, he or another person separated a part of the original specimen to a duplicate with a new label in which mistakes were inserted.

The type of *Ceratodon cedricola*

Ceratodon cedricola J.J. Amann, *Rev. Bryol.* 51: 57. 1924. Holotype (as considered by Burley & Pritchard, 1990): *Ceratodon* sp. nova, *cedricola* Amann, Maroc. Atlas moyen. Ras El Ma, sur tronc de Cèdre. 27.3.23, l. *P. Jaccard* (Z+ ZT!). **Lectotype, designated here**: based on the former specimen, instead of holotype (= ***Ceratodon conicus*** (Hampe *ex* Müll. Hal.) Lindb., *Musci Scand.* 27. 1879).

Burley & Pritchard (1990) considered the specimen mentioned above to be the holotype of this name, kept at Z+ ZT, but due to the fact that Amann did not designate any specimen as the nomenclatural type and no unequivocal specimen exists, in our opinion the specimen kept at Z+ ZT should be better designated as lectotype.

The study of the type allowed us to confirm that the morphological characteristics of the specimen correspond to those given by Burley & Pritchard (1990) for *C. conicus*: leaves ovate to lanceolate, with entire margin and excurrent costa, with 3-4 guide cells in cross-section; both internal perichaetial leaves wide ovate to orbicular, strongly sheathing, with rounded to obtuse, non apiculate apex, costa narrow, poorly developed and non excurrent; capsule slightly strumose, erect to inclinate; peristome teeth not bordered, 32 µm wide at the base, with 4-5 trabeculae and 3-5 articulations; spores inmature. Amann (1924), when describing the species, considered *C. cedricola* to be closely related to *C. corsicus* Bruch & Schimp. (= *C. purpureus* subsp. *stenocarpus*) and distinguishable from the last one by the dense, tight, felted and smaller sized tufts (4-5 mm), the characteristics of perichaetial leaves, the small and narrow capsule, and the smooth and not bordered peristome teeth. Nevertheless, most of these characters are shared also by *C. purpureus s.l.*

The type of *Ceratodon dimorphus*

Ceratodon dimorphus H. Philib., *Rev. Bryol.* 15: 28. 1888; *Ceratodon purpureus* subsp. *dimorphus* (H. Philib.) Limpr., *Laubm. Deutsch.* 3: 683. 1901; *Ceratodon purpureus* var. *dimorphus* (H. Philib.) Mönk., *Allg. Bot. Z. Syst.* 15: 92. 1909; *Ceratodon purpureus* fo. *dimorphus* (H. Philib.) Mönk., *Laubm. Eur.* 158. 1927. Holotype (as considered by Burley & Pritchard, 1990): Husnot, Musci Galliae 814. *Ceratodon dimorphus* Phil. Sur le col du Simplon (Valais). Altitude 2000 m, juillet 1887, PHILIBERT (BM 000965220!). **Lectotype, designated here**: based on the former specimen, instead of holotype (= ***Ceratodon conicus*** (Hampe *ex* Müll. Hal.) Lindb., *Musci Scand.* 27. 1879).

Burley & Pritchard (1990) considered the BM specimen mentioned above as holotype, but as in *Ceratodon cedricola*, the author of the name did not designate

any specimen as the nomenclatural type, and no unequivocal specimen exists. Therefore, it should be considered a lectotype, which is done here.

The specimen shows plane, ovate to linear-lanceolate leaves, with entire to dentate margins, costa excurrent in a short apiculus, rarely percurrent, with 2-3 guide cells in cross-section; sheathing and obtuse perichaetial leaves; capsule not strumose, slightly inclinate, peristome teeth narrowly bordered, 20-26 μm wide at the base, with 3-4 trabeculae and 4-6 articulations; spores 8-10 μm in diameter.

The morphological characteristics of the peristome of this specimen correspond to those given by Burley & Pritchard (1990) for *Ceratodon conicus*, but the leaves are more variable and are not typical for this species. It seems to present intermediate characteristics with *C. purpureus* subsp. *stenocarpus*, although we agree with Burley & Pritchard (1990) to identify it as *C. conicus*.

The type of *Ceratodon purpureus* var. *graefii*

Ceratodon purpureus var. *graefii* Schlieph. *ex* Limpr., *Laubm. Deutschl.* 1: 487. 1887; *Ceratodon graefii* Schlieph., *nom. nud. in synon., Laubm. Deutschl.* 1: 487. 1887; *Ceratodon purpureus* fo. *graefii* (Schlieph. *ex* Limpr.) Mönk., *Laubm. Eur.* 158. 1927. Holotype (as considered by Burley & Pritchard, 1990): *Ceratodon graefianus* Limpr. ex Schliephacke, Helvetia, Ober–Hasli ad terram, juni 1883 leg ... Dr. H. Graef com. Schliephacke (BR-BRYO 165426-41!). **Lectotype, designated here**: based on the former specimen, instead of holotype (= ***Ceratodon purpureus*** (Hedw.) Brid., *Bryol. Univ.* 1: 480. 1826).

Burley & Pritchard (1990) selected the BR specimen mentioned above as holotype, but also in this case the author of the name did not designate any specimen as the nomenclatural type and no unequivocal specimen exists, and therefore, it should have been designated as lectotype. Also it seems that Burley & Pritchard were not aware that this name at the specific rank is invalid.

The morphological characteristics of the specimen are the followings: plane, ovate to linear-lanceolate leaves, with entire to crenulate margins, costa excurrent in an apiculus, cross section with 2 guide cells; internal perichaetial leaves sheathing with obtuse apex; capsule not strumose, erect or inclinate, slightly sulcate to smooth, peristome teeth strongly bordered, 46-50 μm wide at the base, with 4-5 trabeculae and 4-5 articulations; spores inmature. It is worth mentioning that some characteristics of the capsule and the leaves do not fit the diagnostic characters given for *C. conicus* by Burley & Pritchard (1999), especially the basally wide, strongly bordered peristome teeth. Taking into consideration the characters considered in the revision of Burley & Pritchard (l.c.), this specimen falls within the variation described for *Ceratodon purpureus s.l.* and therefore should not be considered a synonym of *C. conicus.*

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