UNEARTHING A LECTOTYPE FOR *POLYTRICHUM COMMUNE* HD. (BRYOPHYTA, POLYTRICHACEAE)

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DOI https://doi.org/10.1002/tax.12444

**Abstract** The name *Polytrichum commune*, validated in Hedwig’s *Species muscorum frondosorum* of 1801, was based on earlier entities that can be traced back to the pre-Linnaean literature of the early 16th century. More than 200 years after its valid publication it remains to be typified. The single herbarium sheet for *P. commune* in the Hedwig-Schwägrichen Herbarium in G contains nine specimens from different continents that represent four different species (*P. commune*, *P. juniperinum*, *P. perigoniale*, *P. subpilosum*). After careful study of the origins and taxonomic affinities of the specimens on this sheet, a lectotype is designated.

**Keywords** bryophyte systematics; mosses; nomenclature; *Polytrichum*

**INTRODUCTION**

*Polytrichum commune* Hedw. (the “Common Haircap” moss), is one of the most ecologically important (Wilson & Provan, 2003; Bell & Hyvönen, 2010a,b) and widespread mosses globally (Osada, 1966; G.L. Smith, 1971; Crum, 1976; Crum & Anderson, 1981). Due to its large size and broad distribution, *P. commune* has been used as a model bryophyte species in ecological and physiological studies (Sarafis, 1971; Thomas & al., 1990; Bell & Hyvönen, 2010a; Biersma & al., 2017; Brodribb & al., 2020). It has been used for centuries as an important medicinal herb (one of the so-called Quinque Herbae Capillares, or Five Capillary Herbs), and as such has been included in many herbals and pharmaceutical dispensatories, including the list of plants cultivated at the forerunner of the modern Royal Botanic Garden Edinburgh (Sutherland, 1683) and the Edinburgh Pharmacopoeia (Edinburgh Royal College of Physicians, 1699).

The genus *Polytrichum* Hedw. (Polytrichaceae) was one of the first mosses illustrated in the taxonomic literature of the pre-Linnaean era (Dodoens, 1578). *Polytrichum commune*, in particular, is one of the most commonly represented acrocarpous mosses in the herbaria of the early 16th century (Stech & al., 2018). However, more than 200 years after its valid publication in Hedwig (1801: 88), the name still lacks a designated type. Because of the long nomenclatural history of this taxon, crucial elements of the typification process have to include tracing the origins of the correct taxonomic concept, understanding how the concept of *P. commune* has developed over time, and outlining its taxonomic circumscription based on the validating description, as well as linking the name to a physical specimen.

In the interests of nomenclatural stability, we thus typify *P. commune*, one of the most widely used moss names in the Northern Hemisphere, with an original element from the Hedwig Herbarium.

*Species muscorum frondosorum* (hereafter abbreviated as *SMF*; Hedwig, 1801) is the adopted starting point for the nomenclature of mosses (apart from Sphagnaceae L.; see Dixon, 1933; Florschütz, 1960; Turland & al., 2018: Art. 13.1). After the adoption of *SMF* as the starting point of moss nomenclature, all names published in *SMF* that were not described as new to science within that work were subsequently ascribed to Hedwig (Florschütz, 1960; Geissler, 2000; Price, 2005). In most cases, original material suitable for lectotypification can be found in Hedwig’s own herbarium (Hb. Hedwig-Schwägrichen) housed in G (Price, 2005). The Hedwig part of the Hedwig-Schwägrichen Herbarium contains the original material that is essential for ensuring the correct application of many early moss names (Florschütz, 1960; Geissler, 2000; Price, 2005), the importance of which has been explained by Geissler (2000) and Price (2005).

Hedwig (1801: 88) broadly defined *Polytrichum* Hedw. as follows: “Peristomium simplex: denticuli breves, duplo plures, membranulum apicibus prehendentes. *Flo* masculus femineus-que terminalis”, translated as: “A simple peristome with a doubled number of short teeth that possess a membrane at their apices. Male and female gametangia terminal.” The genus *Polytrichum*, as treated by Hedwig (1801), comprised 17 species: *P. aloides* Hedw., *P. alpinum* Hedw., *P. commune*, *P. convolutum* Hedw., *P. dendroides* Hedw., *P. formosum* Hedw,
P. hercynicum Hedw., P. juniperinum Hedw., P. magellanicum Hedw., P. nanum Hedw., P. norwegicum Hedw. (= Polytrichastrum alpinum (Hedw.) G.L.Sm.), P. pensilvanicum Hedw., P. piliferum Hedw., P. pulverulentum Hedw. (= Pogonatum urnigerum (Hedw.) P.Beauv.), P. pumilum Hedw., P. undulatum Hedw., and P. urnigerum Hedw., and one infraspecific taxon (P. undulatum var. minus Hedw.). Out of these 18 taxa, P. formosum and P. pumilum (= Pogonatum urnigerum (Hedw.) P.Beauv.) were newly described by Hedwig (1801). All the other names and polynomials used by Hedwig under the genus Polytrichum in SMF originated from earlier works, such as those of Vaillant (1727), Dillenius (1741), Linnaeus (1763), Hedwig (1787) and Bridel (1798). Hedwig (1801) placed the species he enumerated into four main groups based on features of the apophysis of the capsule and the stems (simple or branched), as follows: (1) Sporangio apophysi protuberante instructo, caule simplici (P. commune, P. juniperinum, P. piliferum, P. pulverulentum, P. formosum); (2) Sporangio apophysi instructa, caule ramoso (P. alpinum); (3) Sporangio absque apophysi protuberante, trunco simplici (P. convolutum, P. hercynicum, P. nanum, P. aloides, P. pensilvanicum, P. pumilum, P. undulatum); (4) Sporangio absque apophysi, trunco ramoso (P. norwegicum, P. urchigerum, P. magellanicum, P. dendroides).

Hedwig’s broad concept of Polytrichum was gradually narrowed through subsequent studies by later bryologists, resulting in the recognition of six segregate genera: Atrichum P.Beauv., which includes A. undulatum (Hedw.) P.Beauv. and P. undulatum var. minus Hedw. (= A. tenellum (Röhl.) Bruch & Schimp.); Pogonatum P.Beauv., with P. aloides (Hedw.) P.Beauv., P. convolutum (Hedw.) P.Beauv., P. commune (Hedw.) P.Beauv., P. nanum (Hedw.) P.Beauv., P. pensilvanicum (Hedw.) P.Beauv. and P. urnigerum; Oligotrichum Lam. & DC., with O. hercynicum (Hedw.) Lam. & DC.; Polytrichadelphus (Müll.Hal.) Mitt., with P. magellanicus (Hedw.) Mitt.; Dendroligotrichum (Müll.Hal.) Broth., with D. dendroides (Hedw.) Broth.; and Polytrichastrum G.L.Sm., with P. alpinum. Thus, out of the 18 taxa initially recognized under Polytrichum by Hedwig, only four of his names now remain in this genus: P. commune (the type), P. formosum, P. juniperinum and P. piliferum. Hedwig’s original concept of P. commune can be elucidated by exploring three major elements: (1) Hedwig’s (1801) references to earlier treatments, (2) his original description of P. commune, and (3) his specimens in the Hedwig-Schwägrichen Herbarium in G.

In the validating description of Polytrichum commune, Hedwig (1801: 88) cited the earlier polynomials of Plu-mier (1705), Barrelier (1714), Vaillant (1727), Micheli (1729) and Dillenius (1741), as well as the binomial “Polytrichum commune” of Linnaeus (1763, 1784), which was used by Bridel (1798). Linnaeus’s (1763) concept of P. commune is clearly a broad one as he cited several earlier polynomials in synonymy. Moreover, Linnaeus (1763) stated that P. commune was common in Europe. To assist in understanding Linnaeus’s concept of his species of Polytrichum, all specimens designated by himself as P. commune (mounted on sheets Herb. Linnaeus 1263.1 and 1263.2) housed in the herbarium of the Linnaean Society of London (LINN), were studied by the first author (see the discussion below).

Dillenius’s herbarium sheet, with several stems of Polytrichum commune, is housed in the herbarium of the University of Oxford (OXF [HM_420-001]). It is presumed that Linnaeus had studied material exchanged with Dillenius (Isosvita, 1970). Dillenius’s polynomial “Polytrichum quadrangulare vulgare, Juccae folis serratis” (= the Common 4-angled Polytrichum, or great Goldilocks) both refer to the 4-angled form of the capsule, while “great Goldilocks” alludes to the calyptra made up of golden hair-like fibres, these being prominent features of Polytrichum sect. Polytrichum, to which P. commune belongs. These features are also found in Polytrichum sect. Juniperifolia Brid.; however, members of this latter section never have serrate leaves (A.J.E. Smith, 2004).

To establish the correct identity of the specimens of Polytrichum commune in the herbaria of Dillenius and Linnaeus, it was necessary to examine leaf sections to observe the anatomy of the leaf lamina and particularly of the lamellar end-cells (or the apical cells of leaf lamellae), which are crucial for distinguishing many species of Polytrichum from each other. The deeply grooved or U-shaped apical cells of the lamellae are the most important anatomical character of P. commune (A.J.E. Smith, 2004). The specimens on sheet HM_420-001 in the Dillenius Herbarium (OXF), except for the smaller, fertile stem at the top left hand corner of the herbarium sheet, and the specimens of the Linnaean herbarium (LINN 1263.1 – 2 sterile stems glued on a small sheet at the top left hand corner of the herbarium sheet & LINN 1263.2 – the first element comprising a single sterile stem at the left-hand side, out of five elements glued on the herbarium sheet) possess the deeply grooved lamellar end-cells characteristic of P. commune. This defining character of P. commune was not mentioned by Hedwig, Linnaeus or Dillenius as they did not include anatomical observations of leaf sections in their respective works. Characters such as the prominent, transparent leaf sheath (amplexicaul), serrated leaf margins and tapering leaf apices, as well as the round (“disc-like”) depressed apophysis of the 4-angled capsule, were mentioned by Hedwig (1801) in his protologue, and these features were also observed in the specimens of Dillenius (OXF [HM_420-001] – both leaf and capsule characters) and Linnaeus (LINN 1263.1 and 1263.2 – leaf characters only).

**CITATIONS FROM EARLIER LITERATURE**

Hedwig (1801) used the binomial “Polytrichum commune” from Species plantarum (Linnaeus, 1763), that also appeared in Systema vegetabilium (Linnaeus, 1784) as well as the slightly later work Muscologia recentiorum of Bridel (1798). Although moss names published before 1 January 1801 have no nomenclatural standing, it is useful to look at the earlier treatments of putative Polytrichum species to help understand Hedwig’s taxonomic concept of the genus and its constituent species.
The illustrations in the works cited in Hedwig’s protologue also include details relevant to the current typification. Vaillant (1727: t. 23, fig. 8) depicted only sterile plants, whereas the other illustrations seen and studied by Hedwig, i.e., Plumier (1705: t. B, 2 figs. numbered 6), Barrelier (1714: fig. 251.III), Micheli (1729: t. 59, fig. 1) and Dillenius (1741: t. LIV, fig. 1) are of fertile plants but do not clearly illustrate a 4-angled capsule with a prominent constricted apophysis, an obvious and ubiquitous feature of Polytrichum commune and related species in P. sect. Polytrichum and sect. Juniperifolia. Hedwig himself (1782: tab. VII, fig. 37) had previously illustrated a capsule of P. commune (Fig. 1), showing the 4-angled capsule and the prominent, constricted apophysis, although he did not refer to his own illustration in what became the validating description of P. commune.

HEDWIG’S ORIGINAL DESCRIPTIONS OF POLYTRICHUM AND POLYTRICHUM COMMUNE

The validating description of Polytrichum commune (Hedwig, 1801: 88) consists of a short diagnosis “trunco simplici, foliis serrulatis acutis, sporangio quadrangulo” followed by polynomials from Linnaeus (1763) and Bridel (1798): “Polytrichum commune caule simplici, anthera parallelepippo”; Dillenius (1741): “Polytrichum quadrangulare vulgar excubae foliis serratis”; Plumier (1705), Barrelier (1714) and Micheli (1729): “Muscus capillaceus major, pediculo et capitulo crassioribus”; and Vaillant (1727): “Muscus juniperifolius capitulo quadrangulo”. A description of this species was also elaborated under Hedwig’s “Observatio”, in which P. commune was characterized by the rounded apophysis with a strong depression (constriction), the angled mature capsules and epiphram. His earlier description of the number of peristome teeth from Hedwig (1782) was amended from “32” to “numerous” (although the actual number of teeth found in the species is generally 64 [G.L. Smith, 1971; A.J.E. Smith, 2004; Bell & Hyvönen, 2010a]).

Hedwig’s (1801) original concept of Polytrichum commune was thus very broad and did not distinguish it from other related species, as presently delimited. Moreover, some features described were also included in the generic description of Polytrichum. In the protologue it was mentioned that P. commune was common throughout Europe (“Vulgaris per totam Europam”) with no specific localities or collectors given.

THE HEDWIG-SCHWÄGRICHEN HERBARIUM IN G

Hedwig died on 7 February 1799, and his student Christian Friedrich Schwäghrichen (1775–1853) took over editing SMF, bringing it to publication in 1801 (Florschütz, 1960; Price, 2005). At the time of his death, Hedwig had finished the manuscript for Phascum Hedw., Sphagnum L., Gymnostomum Hedw., Anichtangium Hedw. (= Hedwigia P.Beauv.), Tetrathis Hedw., Andreea Hedw., Octoblepharum Hedw., Splachnum Hedw., Cynodontium Hedw. (rejected against Distichium Bruch & Schimp.), Encalypta Hedw., Weissia Hedw., Grimmia Hedw., Pterigynandrum Hedw., Polytrichum, Didymodon Hedw., Trichostomum Hedw. and Barbula Hedw. in part, i.e., up to p. 114 (Florschütz, 1960). Inevitably, SMF included data that was added by Schwäghrichen after Hedwig’s death. This additional data was added in parenthesis into Hedwig’s original text and suffixed with an “S” for “Schwägrichen”. Schwägrichen took around one and a half to two years to finalise the SMF prior to its publication (Price, 2005; Price & Ellis, 2011). Considering the number of genera and associated species descriptions that Schwägrichen completed, it is not surprising that some of Hedwig’s original herbarium sheets were annotated entirely by Schwägrichen (Price & Ellis, 2011). Price & Ellis (2011) stated that the specimens on typical Hedwig Herbarium sheets with labels that were annotated by Schwägrichen should not automatically be disregarded as potential type material for Hedwig’s moss names for two reasons: firstly, based on the dates of each author’s active contributions to compiling the SMF prior to its publication, and secondly, based on the information given by Schwägrichen himself on the magnitude of the work and the number of taxa that needed to be completed. Although Hedwig appears to have treated Polytrichum within SMF, none of the sheets of Hedwig’s Polytrichaceae housed in G bear Hedwig’s own handwriting, but they were annotated by Schwägrichen, with specimens of multiple origins present on almost all of the sheets (see Price, 2005).

Fig. 1. Polytrichum commune Hedw.: plate from Hedwig (1782: t. VII, fig. 37), illustrating the strictly 4-angled capsule with the attached operculum. Reproduced with the permission of the rare books collection, library of the Royal Botanic Garden Edinburgh.

Version of Record
The single herbarium sheet for *Polytrichum commune* in the Hedwig-Schwägrichen Herbarium (G barcode G00040355) contains nine different specimens (Fig. 2: labelled by us A–I, from left to right). All nine stems were studied by the first and last authors while visiting G. A single leaf from each specimen was carefully removed and soaked in 70% ethanol and warmed in a ca. 5% KOH solution before being soaked in warm water. Each leaf was carefully sectioned, and the sections were mounted in Hoyer’s solution and retained as reference material along with the herbarium sheet in G. The first author prepared illustrations using a camera lucida attachment fixed to a Zeiss AX10 compound light microscope. Material from all of the nine elements (specimens) needed to be carefully examined and their origins established in order to understand which belonged to the original material from which a lectotype could be selected. According to Schwägrichen’s annotations, two elements (Fig. 2A,G) originated from outside Europe and one represented material that had been received from Linnaeus, approaching Bridel’s “*P. appressum*”.

**Element A.** – Element A, annotated by Schwägrichen on the sheet initially as “b”, then corrected to “c” in the same handwriting and relating to “c. *Commers.*” on the label, comprises a branched stem with three capsules. This collection had probably been gifted to Hedwig by the French collector Philibert Commerson (1727–1773). Commerson’s voyages took place around 1770–1771 mainly to Madagascar, Mauritius (Isle de France), Réunion and the Straits of Magellan (where he collected plants in 1767 that Hedwig, 1801 described as *Polytrichum magellanicum*; Cap, 1861). After careful anatomical study, element A belongs to *P. subpilosum* P. Beauv.,

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**Fig. 2.** *Polytrichum commune* Hedw.: original Hedwig Herbarium sheet from the Hedwig-Schwägrichen Herbarium collection in G (G00040355) with the newly selected lectotype indicated (element I among nine [A–I] elements).
the most common and most variable species of *Polytrichum* found in Africa as well as in Madagascar, Mauritius and Réunion (De Sloover, 1986). Given the identification of the material, element A would not be a logical lectotype because it does not correspond to the current delimitation of *P. commune*.

**Elements B, C, D, F, H and I.** Element B is a single stem with an intact dehisced capsule; element C is a single stem with a detached capsule; element D is a single fertile stem; however, the capsule itself is missing from the specimen. Elements F and H are single sterile stems, and element I is a single stem with a complete but undehisced capsule. The exact provenance of each of these was not indicated. All are presumed to be from Europe and could be parts of the same or different gatherings. Leaf cross sections of all six elements show deeply grooved, U-shaped lamellar end-cells, while the combination of this feature with a lack of papillose projections on lamellar end-cells, strictly serratate leaf margins, broad and excurrent costae, and longer inner perichaetial leaves with a comparatively larger leaf sheath and a white and hairy acumen collectively favours their identity with the modern concept of *P. commune* while excluding other superficially similar taxa with deeply grooved lamellar end-cells such as *P. jensenii* I. Hagen, *P. subpilosum* and *P. ericoides* Hampe (Long, 1985; De Sloover, 1986; G.L. Smith, 1976). Amongst them, elements B and I correspond most closely with the characters given by Hedwig in his brief diagnosis by virtue of including attached sporophytes. Of these two, element I includes an undamaged capsule which shows the conspicuous constriction of the disc-like apophysis, the mucronate operculum and the 4-angled capsule. Given its fertile status and the presence of the 4-angled capsule (sporangio quadrangulo), element I is the most appropriate specimen to serve as a lectotype of *P. commune*.

**Element E.** Element E comprises four short stems, one of which bears a very immature capsule covered by a calyptra. The plants have infolded leaf margins, and leaf anatomical studies confirmed that the leaf lamellae possess ovate to pyri-form end-cells with a distinct papillose knob, which confirms its identity with the modern delimitation of the taxon *Polytrichum juniperinum* (A.J.E. Smith, 2004). Since element E does not agree with the modern delimitation of the taxon, it is not a logical choice to select as a lectotype for *P. commune*.

**Element G.** Element G is a short stem in the middle of the sheet; it was annotated by Schwägrichen as “b” and cited on the label as “b Mhlbg. 251”. Hedwig received material from Rev. Gotthilf Heinrich Ernst Muhlenberg (1753–1815) from Lancaster in Pennsylvania, U.S.A. (see Price, 2005). This element belongs to *Polytrichum commune* var. *perigoniale* (Michx.) Hampe (= *P. perigoniale* Michx.), which is the most common member of the *P. commune* complex in North America (this, together with the application of the name *P. perigoniale* in North America, will be discussed in a future work; Kariyawasam & al., in prep.). The lamellar end cells in this element from North America are less deeply grooved or even flat-topped, ruling it out as belonging to *P. commune* in the strict sense. Moreover, the specimen is incomplete and sterile. Based on these observations and the North American origins of the material, this element is excluded from potential original material for *P. commune*.

**Typification and Description Based on the Type Material**


For an image of the lectotype, see Fig. 2 element I.

**Description.** Stem erect, rigid, unbranched, often over 10 cm tall. Leaves densely aggregated, sharply divided into broad sheathing base and narrower, lamellate limb, when moist widely spreading often squarrose-recurred, when dry appressed to the stems at base with somewhat spreading tips above, linear-lanceolate, gradually narrowing from the base of the limb upwards to a sharp acumen, margin densely and sharply serrate from the limb base to the apex; number of lamellae 60–70, 4–6 cells high; lamellar end cells broader than the others, deeply grooved or U-shaped. Perichaetial leaves morphologically distinct from the stem leaves, with a long sheathing base. Capsule 4-angled, shortly triangular, 3.5–4.0 × 2–3 mm; apophysis very distinct, discoid, narrowly constricted above; exothecial cells composed of conical papilae with slit-like apertures; operculum with a short rostellate beak; peristome teeth ca. 0.4 mm high, obtuse, pale, basal membrane low, brownish; spores 7–9 μm. Seta 4(–5)–7(–8) mm long. Calyptra golden-yellow, fibrillose and completely covering the capsule, 13–15 mm long.

**Discussion**

*Polytrichum commune*, a widespread and recognizable moss, is mostly distinguished by its large size, growing in tufts with 20–45 cm long wiry stems (Long, 1985; G.L. Smith, 1971; A.J.E. Smith, 2004). Examination of the original material from G revealed that several different elements were present on the type sheet (G00040355), from different continents (Europe, North America, Africa) and representing different taxa (*P. commune*, *P. perigoniale*, *P. subpilosum*). The lectotype for *P. commune* selected here amongst the material on the Hedwig Herbarium sheet in G corresponds most closely with the protologue and the current delimitation of this taxon. Although *P. commune* was not illustrated by Hedwig (1801), in his earlier publication (Hedwig, 1782), his illustration clearly shows the strictly 4-angled capsule that can also be seen in the lectotype selected. One of the anatomical features now recognized as diagnostic for this taxon, namely the end-cells of the leaf lamellae that are deeply grooved or U-shaped, was not mentioned in the early works of Linnaeus (1763), Dillenius (1741), Bridel
(1798) or Hedwig (1782, 1801). However, this feature was observed in the lectotype as well as in other specimens of *P. commune* in the collections of Linnaeus (LINN) and Dillenius (O XF). Detailed morphological features of the selected lectotype are illustrated in Fig. 3.

**AUTHOR CONTRIBUTIONS**

NEB initiated the research project on revising *Polytrichum* sect. *Polytrichum*. IUK and JH worked on the material in G and established the identities of the material on the original herbarium sheet. IUK wrote the manuscript and all authors made substantial contributions in editing the manuscript. MJP provided interpretations of material in the Schwägrichen Herbarium and related works. RRM also helped in Latin translations. — IUK, https://orcid.org/0000-0002-2527-3502; MJP, https://orcid.org/0000-0002-2706-1124; NEB, https://orcid.org/0000-0002-2401-2968; DGL, https://orcid.org/0000-0003-0816-0124; JH, https://orcid.org/0000-0001-7559-8295

**ACKNOWLEDGEMENTS**

The first author’s research at the Royal Botanic Garden Edinburgh (RBGE) was funded by the Commonwealth Scholarship Commission. U.K. RBGE is supported by the Scottish Government’s Rural and Environment Science and Analytical Services Division. The first, third, fourth and fifth authors are also grateful for the support of players of People’s Postcode Lottery during 2018, 2019 and 2020 towards...
scientific research at the RBGE. This work was also supported by the Conservatoire et Jardin botaniques de la Ville de Genève (G), the Linnean Society of London (LNN) and the Oxford University Herbarium (OXF). We are grateful to the staff of the library at the RBGE for their assistance with the literature and in particular for granting access to the rare book collections. We thank Prof. Stephen Harris and Serena Marner for their assistance in searching for Polytrichum in the Dillenius collections in OXF and Dr Mark Spencer for assisting in the Linnean Society of London’s herbarium (LNN) with the Linnaean collections. We thank Dr Mark Spencer and Dr John McNeill for their valuable and insightful comments on an earlier version of this manuscript.

LITERATURE CITED


