

## THE BULLIFEROUS SPECIES OF *POHLIA* (BRYACEAE, MUSCI) IN HUNGARY

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Revision of the herbarium specimens in the Bryophyte Herbarium of the Hungarian Natural History Museum, Budapest (BP) and Eszterházy Károly College, Eger (EGR) of bulbiferous *Pohlia* species collected in Hungary revealed that four species are present in the country: *Pohlia andalusica* (Höhn.) Broth., new to Hungary, *Pohlia annotina* (Hedw.) Lindb., *Pohlia camptotrachela* (Renauld et Cardot) Broth., and *Pohlia prolifera* (Breidl.) Lindb. ex Arnell. Maps of their distribution in Hungary and some specimen data are given, and an illustrated key to all bulbiferous *Pohlia* species of Europe is provided.

Key words: distribution maps, illustrated key to European species, records of bulbiferous *Pohlia* species in Hungary

### INTRODUCTION

Within the last decades important contributions to the taxonomy of bulbiferous *Pohlia* species have been published (LEWIS and SMITH 1978, SHAW 1981, NORDHORN-RICHTER 1982, DEMARET and ARTS 1993), leading to clarification of the species concepts and the nomenclature of this complex. In the Hungarian bryological literature (BOROS 1968, ORBÁN and VAJDA 1983), five taxa of the complex in question are mentioned under various names: *P. annotina* (syn. *P. grandiflora* H. Lindb.), *P. bulbifera* (Warnst.) Warnst., *P. filum* (syn. *P. gracilis* (Bruch et Schimp.) Lindb.), *Pohlia camptotrachela*, *P. drummondii* (Müll. Hal.) A. L. Andrews. However, interpretation of these data is problematic, since the synonymy given by ORBÁN and VAJDA (1983) is erroneous, and in BOROS (1968), *P. annotina* and *P. grandiflora* are treated as separate species. In order to establish the meaning of these reports, it was thus necessary to revise the herbarium specimens of the species in question.

During revisionary work the need was felt for a key of all European bulbiferous *Pohlia* species, since existing keys were found inappropriate for one reason or another, mainly because they did not treat all species presently reported from Europe.

## MATERIAL AND METHODS

The herbarium specimens collected in Hungary of bulbiferous *Pohlia* species in the Bryophyte Herbarium of the Hungarian Natural History Museum, Budapest (BP) and Eszterházy Károly College, Eger (EGR) were revised using the taxonomic works mentioned in the introduction. Nomenclature follows ERZBERGER and PAPP (2004), KOPERSKI *et al.* (2000) and SHAW (1981).

## RESULTS

The following four species were found in the revised material. Their distributional data are shown in Figures 1–4; the specimens revised are enumerated below:

*Pohlia andalusica* (Höhn.) Broth. (Figs 1, 5G)

**Zemplén Mts:** Telkibánya: Nagy-Farkas-hegy (BP 63377, EGR: 15.09.1959 leg. L. Vajda, BP 63419, BP 63432, BP 63494, EGR: 19.10.1959 leg. L. Vajda, BP 116207: 19.10.1959 leg. Á. Boros, BP 63045, EGR: 19.06.1960 leg. L. Vajda); Telkibánya: Kis-Farkas-hegy (EGR: 15.06.1960 leg. L. Vajda); Telkibánya: Bíró-hegy (EGR: 14.06.1960 leg. L. Vajda); Telkibánya: Cser-hegy (BP 62802: 15.09.1960 leg. L. Vajda); Telkibánya: Susulka (BP 116177, EGR: 18.10.1959 leg. Á. Boros); Telkibánya (BP 63302, BP 63308, BP 63309: 15.09.1959 leg. L. Vajda); Nagybózsza: Szár-hegy (BP 116176: 08.10.1954 leg. Á. Boros); Nagybózsza: Szuha-völgy (BP 116174 28.06.1954 leg. Á. Boros, EGR 28.06.1954 leg. L. Vajda); Pálháza: Kis-Péterménkő (EGR 23.06.1953 leg. L. Vajda).

**Mátra Mts:** Parádfürdő (BP 47341: 01.10.1956 leg. L. Vajda, BP 116195, BP 116196: 01.10.1956 leg. Á. Boros, BP 116165, EGR: 20.08.1961 leg. Á. Boros).

**Börzsöny Mts:** Diósjenő: Málna-hegy (BP 62656, EGR: 04.05.1960 leg. L. Vajda); Diósjenő: Cigány-patak (EGR: 25.05.1961 leg. L. Vajda).

**Kőszeg Mts:** Bozsok: Hegyhát (BP 75621, BP 75623: 18.06.1970 leg. L. Vajda, BP 116197, EGR: 11.06.1970 leg. Á. Boros, BP 116199: 13.06.1970 leg. Á. Boros).



Fig. 1. Records of *Pohlia andalusica* (Höhn.) Broth. in Hungary (according to herbarium specimens revised by the author).



Fig. 2. Records of *Pohlia annotina* (Hedw.) Lindb. in Hungary (according to herbarium specimens revised by the author).

*Pohlia annotina* (Hedw.) Lindb. (Figs 2, 5H, I)

**Zemplén Mts:** Telkibánya: Nagy-Farkas-hegy (BP 116207: 19.10.1959 leg. Á. Boros, EGR: 19.10.1959 leg. L. Vajda); Telkibánya: Bíró-hegy (BP 63532: 19.06.1959 leg. L. Vajda); Telkibánya: Cser-hegy (EGR: 15.09.1960 leg. L. Vajda); Telkibánya (BP 71300: 10.08.1967 leg. L. Vajda); Erdőbénye (BP 46638, EGR: 25.08.1955 leg. L. Vajda).

**Bakony Mts:** Nagyvázsony: Kab-hegy (BP 116234, EGR: 05.10.1955 leg. Á. Boros).

**Órség:** Óriszentpéter (BP 77914: 30.05.1972 leg. L. Vajda).

**Vendvidék:** Szakonyfalu (BP 47066: 12.07.1955 leg. L. Vajda); Alsószőlnök (BP 63258: 07.10.1959 leg. L. Vajda).

**Kőszeg Mts:** Bozsok: Széleskő (BP 75624: 17.06.1970 leg. L. Vajda).

*Pohlia camptotrachela* (Renauld et Cardot) Broth. (Figs 3, 5E)

**Zemplén Mts:** Telkibánya: Farkas-hegy (BP 116206: 19.10.1959 leg. Á. Boros, mixed with *P. andalusica*).



Fig. 3. Records of *Pohlia camptotrachela* (Renauld et Cardot) Broth. in Hungary (according to herbarium specimens revised by the author).

*Pohlia proligera* (Breidl.) Lindb. ex Arnell (Figs 4, 5J)

**Zemplén Mts:** Telkibánya: Nagy-Farkas-hegy (BP 116207, EGR: 19.10.1959 leg. Á. Boros, mixed with *P. andalusica*, *P. annotina*).

**Bakony Mts:** Nagyvázsony: Kab-hegy (BP 42500: 05.10.1955 leg. L. Vajda).

**Órség:** Szőce (BP 27930: 06.08.1954 leg. L. Vajda).

**Vendvidék:** Szakonyfalu (EGR: 12.07.1955 leg. L. Vajda).

**Kőszeg Mts:** Kőszeg: Óház-hegy (BP 70991: 09.05.1965 leg. L. Vajda, BP 116235: 09.05.1965 leg. Á. Boros).

## DISCUSSION

*Pohlia andalusica* has up to now not been reported from Hungary (BOROS 1968, ORBÁN and VAJDA 1983). The results of the present revision establish this species as new to the Hungarian bryophyte flora. From the specimens quoted above it is evident that this species – like most of the other bulbiferous *Pohlia* species – has not been correctly understood by former Hungarian bryologists who interpreted their collections as *P. annotina* (syn. *P. grandiflora* H. Lindb.) in most cases, and as *P. filum* (syn. *P. gracilis* (Bruch et Schimp.) Lindb.) or as *P. bulbifera* in some instances.

The presence of *P. annotina* in Hungary was confirmed by the present revision, and in this case most of the specimens were correctly labelled as *P. annotina* or the synonym *P. grandiflora*. (However, many specimens labelled this way turned out to be different species).

No specimens labelled *P. camptotrachela* were seen during the present revision, and the report of this species in ORBÁN and VAJDA (1983) is obviously



**Fig. 4.** Records of *Pohlia proligera* (Breidl.) Lindb. ex Arnell in Hungary (according to herbarium specimens revised by the author).

erroneous according to the present taxonomy, as can already be seen by the synonymy given by these authors (*P. grandiflora*, *P. proliger*, *P. annotina*). However, a single specimen labelled *P. bulbifera* was revised to *P. camptotrachela*. This represents the first true report of this species in Hungary.

Although *P. proliger* is mentioned by ORBÁN and VAJDA (1983) – as an erroneous synonym of *P. camptotrachela* – no specimen labelled *P. proliger* was found during the present revision. The first true data on this species from Hungary were found in two specimens labelled *Mniobryum albicans* (Wahlb.) Limpr. (accepted name: *Pohlia wahlenbergii* (F. Weber et D. Mohr) A. L. Andrews) annotated by G. Nordhorn-Richter, Duisburg, during revision in 1981. Four more specimens of *P. proliger* were found in the present study, under labels meaning *P. annotina*.

On the basis of the revised material, three species reported earlier have to be excluded from the Hungarian bryoflora: *P. bulbifera*, *P. drummondii* and *P. filum*. All specimens labelled *P. bulbifera* proved to be either *P. andalusica*, *P. annotina* or *P. camptotrachela*. *P. drummondii* is not mentioned by BOROS (1968); ORBÁN and VAJDA (1983) report this species, but their data probably refer to *P. annotina*, since this name is (erroneously) quoted as synonym. No specimen labelled *P. drummondii* nor any Hungarian collections representing this taxon were found in the present study. *P. filum* was earlier treated under the synonym *P. gracilis* (in ORBÁN and VAJDA (1983) as a variety of *P. drummondii*), but all specimens labelled *P. gracilis* proved to be *P. andalusica*.

From the results of the revision, *P. andalusica* seems to be the most frequent species in Hungary, followed by *P. annotina* and *P. proliger*, while *P. camptotrachela* appears to be rare, since only one collection of that species could be found. Their distributional area seems to be restricted to regions with siliceous bedrock, as in the mountain ranges of northeastern Hungary, the Zemplén, Mátra and Börzsöny Mts, thus indicating a need for a low pH of the substrate. This ecological requirement is also fulfilled in the regions of western Hungary like Órség, Vendvidék, and Kőszeg Mts, where acidic soils dominate on gravelly deposits. The site at Kabhegy in Bakony Mts seems exceptional at first sight, since this region has dolomite as bedrock; but the bryophytes might have grown on an argillose soil layer isolating them from the underlying rock. The specimen labels often note humid forest roads as collection sites; turf on forest edges, edges of hollow roads, margins of swamps and ditches are also mentioned, sometimes on a loamy-sandy soil.

The growth sites of these species are clearly not permanently available, since open soil usually is overgrown by higher plants after some time. This may account for the relatively small number of collections. In the opinion of the author, the bulbilliferous *Pohlia* species are under-collected in Hungary, and more attention should be paid to places where they could possibly occur.

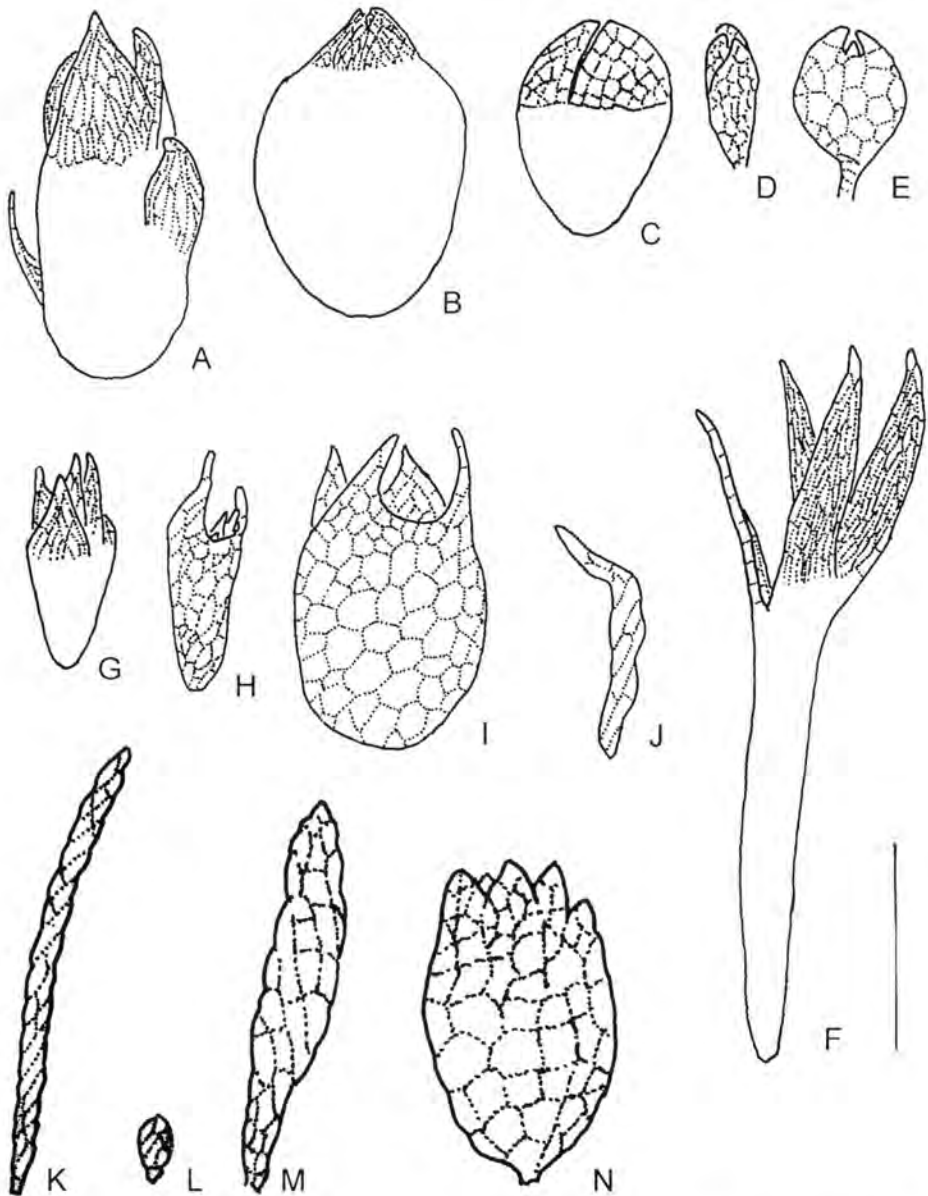


Fig. 5. Typical bulbils of *Pohlia* species. A = *Pohlia drummondii* (Müll. Hal.) A. L. Andrews, B = *Pohlia filum* (Schimp.) Mårtensson, C = *Pohlia bulbifera* (Warnst.) Warnst., D = *Pohlia andrewsii* A. J. Shaw, E = *Pohlia camptotrachela* (Renauld et Cardot) Broth., F = *Pohlia tundrae* A. J. Shaw, G = *Pohlia andalusica* (Höhn.) Broth., H, I = *Pohlia annotina* (Hedw.) Lindb., J = *Pohlia prolifera* (Breidl.) Lindb. ex Arnell, K–N = *Pohlia flexuosa* Harv. Scale bar = 200  $\mu$ m. (A–J: after SHAW (1981), modified, K–N: after DEMARET and ARTS (1983), modified).

Key to the bulbiferous species of *Pohlia* in Europe

The following key is based essentially on SHAW (1981), LEWIS and SMITH (1978), NEBEL (2001) and NORDHORN-RICHTER (1982), with inclusion of *P. flexuosa* Harv. (syn. *P. myldermansii* R. Wilczek et Demaret) based on DEMARET and ARTS (1983) and SMITH (2004). Typical bulbils of all species are shown in Figure 5. For detailed descriptions of the species and illustrations showing the range of variation reference should be made to these works, especially to SHAW (1981) and SMITH (2004).

- |    |   |   |
|----|---|---|
| 1  | Bulbils solitary in leaf axils in upper part of stem  | 2 |
| 1* | Bulbils numerous in leaf axils at least in upper part of stem   | 4 |
| 2  | Leaf primordia pale, usually forming a crown at the top of the bulbils, small, inconspicuous, comprising 1/5 (–1/3) of total bulbil length; bulbils ovoid, usually less than twice as long as wide, ripe up to 600 µm long, yellowish; leaves straight, appressed to erect when dry   |   |
|    | 2. <i>Pohlia filum</i> (Schimp.) Mårtensson<br>(N America, N, C Europe, Asia; Fig. 5B)  |   |
| 2* | Leaf primordia conspicuous, green, distributed over the whole bulbil surface or apical and then comprising ca 1/2 of total bulbil length  | 3 |
| 3  | Bulbils oblong to cylindrical, usually at least twice as long as wide, ripe 450–1200 µm × 270–500 µm, reddish-brown; leaf primordia green, acute, erect-patent, inserted from the base, rarely from the middle of the bulbil body; plants glossy, leaves flexuose, patent when dry  |   |
|    | 1. <i>Pohlia drummondii</i> (Müll. Hal.) A. L. Andrews<br>(N America, N, C Europe, Asia; Fig. 5A)   |   |
| 3* | Bulbils (including primordia) usually narrowed towards the apex and the base in outline, not larger than 600 µm, yellowish-green when young, red-brown when mature; leaf primordia 3–5(–8), laminate, erect, comprising ca 1/2 of total bulbil length, inserted at same level at flattened bulbil apex; plants glossy, leaves straight, appressed to erect when dry |   |
|    | 7. <i>Pohlia andalusica</i> (Höhn.) Broth.<br>(N America, W, C Europe, Asia; Fig. 5G)   |   |
| 4  | All bulbils ± globose, hardly longer than wide  | 5 |
| 4* | Bulbils oblong, obconic, or elongate and vermicular; sometimes ± globose, but then also elongate bulbils formed by the same plant ( <i>P. flexuosa</i> )  | 7 |
| 5  | Primordia of all bulbils broadly triangular-laminate, obtuse, reaching about 1/3 of total bulbil length, conspicuously concave, forming a dome over the   |   |

apex that often traps an air bubble; bulbils 230–400  $\mu\text{m} \times$  100–230  $\mu\text{m}$ , (green) yellow-orange (red), according to age; plants glossy

**3.** *Pohlia bulbifera* (Warnst.) Warnst.

(N America, N, C Europe, Asia; Fig. 5C)

5\* Primordia of some or all bulbils short and peg-like, often incurved over the apex, but not forming a complete dome 6

6 Plants glossy when dry; bulbils red-translucent, rarely more than three times as long as wide, typically 50–165  $\mu\text{m}$  long, primordia inconspicuous, developing from short, peg-like protuberances to laminate outgrowths

**4.** *Pohlia andrewsii* A. J. Shaw (N America, arctic-alpine Europe; Fig. 5D)

6\* Plants dull when dry; bulbils yellow-translucent, occasionally brown, globose to slightly elongate but rarely more than twice as long as wide, mostly (70–)80–130(–175)  $\mu\text{m} \times$  60–110(–150)  $\mu\text{m}$ , usually stipitate, leaf primordia poorly formed, peg-like, incurved, consisting of only 1(–2) cells, never laminate

**5.** *Pohlia camptotrachela* (Renauld et Cardot) Broth.

(N America, W, N Europe; Fig. 5E)

7 Leaf primordia distinctly laminate in form; plants glossy 8

7\* Leaf primordia peg-like, rarely becoming laminate on very large ovate bulbils; plants dull or glossy 9

8 Bulbils linear-cylindrical **6.** *Pohlia tundrae* A. J. Shaw

(W North America, Austrian Alps; Fig. 5F)

8\* Bulbils obconic to oblong-bulbiform **7.** *Pohlia andalusica* (see above)

9 Plants glossy when dry 10

9\* Plants dull when dry, bulbils variable in shape and size 11

10 Bulbils usually less than 120  $\mu\text{m}$  long, variable in shape and size, leaf primordia developing from 1-cellular stages into laminate outgrowths

**4.** *Pohlia andrewsii* (see above)

10\* Bulbils mostly 150–300(–450)  $\mu\text{m}$  long and to 60  $\mu\text{m}$  wide, rather uniform in shape, oblong-linear to linear-vermicular, green, yellow, orange, red, according to age; leaf primordia 1–2, reaching 1/4 of total bulbil length

**9.** *Pohlia prolifera* (Breidl.) Lindb. ex Arnell

(N America, Europe; Fig. 5J)

11 Leaves patent in the dry state; leaf cells uniformly wide from costa to margin; bulbils opaque, with (2–)3–4(–5) peg-like, erect primordia (occasionally becoming laminate with age), bulbils extremely variable in size and shape, obovate, obconic to elongate and narrowly turbinate, occasionally bulbiform, rarely vermicular, different forms often present on a single stem, mostly more than 80  $\mu\text{m}$  wide at the broadest point and 150–300(–550)  $\mu\text{m}$  long, green, yellow, orange, red, according to age **8.** *Pohlia annotina* (Hedw.) Lindb.

(N America, N Asia, Europe; Fig. 5H, I)



- 11\* Leaves patent when dry; leaf cells narrower towards the margin; bulbils translucent; leaf primordia 1–3, reaching hardly more than 1/10 of total bulbil length, bulbils variable in shape according to developmental stage: (i) vermicular, greenish (12–25 µm wide, 200–525 µm long, with poorly developed leaf primordia consisting of 1–2 unicellular teeth not longer than 30 µm; Fig. 5K); (ii) obovoid to subcylindrical, yellowish-green to orange (30–110 µm wide, 50–400 µm long, with apical teeth poorly developed or none; fig. 5L, M); (iii) obovoid-ovoid (290 µm × 360 µm, with triangular leaf primordia consisting of several cells and reaching 1/5 to 1/4 of total bulbil length; Fig. 5N)
- 10.** *Pohlia flexuosa* Harv. (W, C Europe)

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