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Pohlia section *Cacodon* (Mielichhoferiaceae, Bryophyta) with axillary bulbils in the Iberian Peninsula

by

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Abstract

Guerra, J. 2007. *Pohlia* section *Cacodon* (Mielichhoferiaceae, Bryophyta) with axillary bulbils in the Iberian Peninsula. *Anales Jard. Bot. Madrid* 64(1): 55-62.

A taxonomic and descriptive study is presented of the propagiferous species—with axillary bulbils—of section *Cacodon* of the genus *Pohlia* in the Iberian Peninsula. Among the nine species of this section present in the Iberian Peninsula, seven produce axillary propagula (bulbils). The propagulum morphology, seen to be the most relevant gametophyte identification character, is described. Data are provided on the habitat and distribution of the species in the Iberian Peninsula, where they are considered rare or very rare.

Keywords: *Pohlia*, *Pohlia* section *Cacodon*, Bryophyta, Iberian Peninsula.

Resumen

Guerra, J. 2007. *Pohlia* sección *Cacodon* (Mielichhoferiaceae, Bryophyta) con bulbillos axilares, en la Península Ibérica. *Anales Jard. Bot. Madrid* 64(1): 55-62 (en inglés).

Se realiza un estudio taxonómico y descriptivo de las especies con bulbillos axilares de la sección *Cacodon* del género *Pohlia*, existentes en la Península Ibérica. De las nueve especies de la sección presentes en el área, siete producen propágulos (bulbillos) de origen caulinar. Se describe la morfología de estos propágulos, que resulta ser el carácter más relevante para la identificación de las especies. Se aportan datos sobre hábitat y distribución en la Península Ibérica, donde pueden considerarse raras o muy raras.

Palabras clave: *Pohlia*, *Pohlia* sección *Cacodon*, Bryophyta, Península Ibérica.

Introduction

The genus *Pohlia* Hedw. (1801: 171), which has undergone substantial systematic and taxonomic changes that were summarized by Shaw (1984), has traditionally been included in Bryaceae (e.g. Brotherrus, 1924). However, phylogenetic studies carried out with molecular markers, using plastid, mitochondrial and nuclear DNA sequences (Cox & al., 2000, 2004), place the genus *Pohlia* closer to Mniaceae. Its exclusion from Bryaceae has been proposed, along with *Epipterigium* Lindb. and *Mielichhoferia* Nees & Hornsch. (cf. Shaw, 2005).

Shaw (1984) considered an infrageneric subdivision with three subgenera: *Pohlia*, *Nyholmia* Shaw and *Mniobryum* (Limpr.) Nyholm, the latter with two sections, *Mniobryum* and *Cacodon* Lindb. ex Broth. In Hill & al. (2006) three sections are considered for the genus: *Pohlia*, *Cacodon* and *Apalo-*

dictyon (Müll. Hal.) Ochyra (= *Mniobryum* Nyholm, *nom. inv.*), and the genus *Pohlia* is included in the family Mielichhoferiaceae, which closely reflects the criteria proposed by Koponen (1988).

The section *Cacodon* includes 15 species in Europe (cf. Hill & al., 2006), of which 9 (*P. andalusica* (Höhn.) Broth., *P. annotina* (Hedw.) Lindb., *P. campotrachela* (Renauld & Cardot) Broth., *P. drummondii* (Müll. Hal.) A.L. Andrews, *P. filum* (Schimp.) Martensson, *P. flexuosa* Hook., *P. lescuriana* (Sull.) Ochi, *P. ludwigii* (Spreng. ex Schwägr.) Broth. and *P. prolifera* (Kindb.) Lindb. ex Broth.) are found in the Iberian Peninsula. Except for *P. lescuriana* and *P. ludwigii*, the species of section *Cacodon* produce propagula in the form of axillary bulbils with their origin in the stem, which, when developed, permit the species to be identified quite easily. None of the species of the section *Cacodon* has been found with sporophytes in the Iberian Peninsula.

In this article we provide morphological, chorological and ecological data that broaden the knowledge of these propaguliferous species in a territory where they are infrequent and probably undercollected.

Material and Methods

All the available material (65 specimens) of the studied species deposited in the Iberian herbaria have been studied. In addition, all the lectotypes of the species that it was possible to locate were studied. The bulbils were photographed with a SPOT INSIGHT U3.5 digital camera mounted on an OLYMPUS BH2 microscope. Measurement of the leaves, cells, etc., were made with a micrometer attached to the same microscope.

Substantial differences exist between the morphology of the propagula type in this group of *Poblia*, which, furthermore, tends to change as the bulbils mature (cf. Andrews, 1935; Nyholm, 1958; Wilczek & Demaret, 1970; Crum, 1976; Townsend, 1995). Although the nomenclature to define the different types of axillary bulbils is similar in all the recent studies on the group (Wilczek & Demaret, 1970; Lewis & Smith, 1977, 1978; Demaret & Wilczek, 1979, 1980; Shaw, 1981a, 1981b; Sotiaux & Arts, 1989), in this paper, for the sake of simplicity, we have only distinguished the following two types of bulbil. Bulbil A) ovoid, elliptic, oblong, obconic, subspherical or cylindrical with laminate leaf primordia (Fig. 1 a-k) and B) subspherical or obconic to vermicular with different degrees of spiralling and with toothlike leaf primordia, that is with apical teeth (Fig. 1 l-n; Fig. 2 a-o). Not only are the leaf primordia differences of primary importance, but also the form and size are important.

Taxonomy

Poblia Sect. *Cacodon* Lindb.ex Broth., Nat. Pflanzenfam. 1(3): 547. 1903

Poblia Sect. *Pobliella* Loeske, Stud. Morph. Syst. Laubm.: 125. 1910, *nom. nud.*

Type: *Poblia erecta* Lindb.

Small to moderately robust plants. Upper leaves usually similar to lower not forming comal tufts. Median laminal cells narrowly hexagonal-rhomboidal to linear or vermicular. Dioicous. Bulbils usually present. Capsule horizontal to pendulous, ovoid to pyriform; neck short. Exothecial cells short rectangular, with evenly thickened, sinuose walls; stomata superficial or rarely slightly sunken. Annulus differentiated. Endostome hyaline; segments well developed and keeled, rarely imperfect or rudimentary.

KEY TO THE IBERIAN SPECIES

1. Bulbils 1(2) in the axils of leaves, usually longer than 380 μm long 2
1. Bulbils usually numerous in the axils of leaves, usually shorter than 380 μm long 3
2. Bulbils oblong to cylindrical, with laminate leaf primordia arising from base to apex **1. P. drummondii**
2. Bulbils ovoid to elliptical or subspherical, with laminate leaf primordia arising only at the apex **2. P. filum**
3. Bulbils mainly isodiametric, spherical to short oblong, with 1-4 toothlike primordia of 1-2(3) cells .. **4. P. camptotrachela**
3. Bulbils mainly long, obconic, oblong, ovoid or vermicular, sometimes all three types mixed in the same plant, with laminate leaf primordia of 3-6 cells wide at the base or with toothlike primordia 4
4. Bulbils mainly obconic, sometimes oblong, reddish to brownish, with laminate leaf primordia of 3-6 cells wide at the base **3. P. andalusica**
4. Bulbils ovoid, shortly oblong or vermicular, greenish or reddish, with toothlike primordia 5
5. Plants with bulbils ovoid or shortly oblong in the axils of middle and lower leaves, and usually vermicular in the axils of upper leaves, toothlike primordia less than 1/10 of bulbil length **5. P. flexuosa**
5. Plants with only vermicular bulbils, toothlike primordia more than 1/10 of bulbil length 6
6. Bulbils vermicular, mainly with 2-4(5) multicellular toothlike primordia **6. P. annotina**
6. Bulbils vermicular, with 1(2) unicellular toothlike primordia **7. P. proligera**

1. *Poblia drummondii* (Müll. Hal.) A.L. Andrews, Moss Fl. N. Amer. 2: 196. 1935

Bryum drummondii Müll. Hal., Bot. Zeitung (Berlin) 20: 328. 1862, basionym. Lectotype: BM! (Fig. 1 a-d)

Plants 0.5-4.5(5) cm high, generally growing in loose turfs, sometimes dense, greenish, sometimes yellowish, slightly shiny when dry. Leaves appressed to more or less erect when dry, erect-patent when moist, ovate, rarely ovate-lanceolate, sometimes carinate, not or hardly decurrent, 0.8-1.5(1.8) \times 0.2-0.5(0.7) mm; apex acute, sometimes slightly obtuse, not twisted; margins plane, sometimes slightly recurved at the base, very slightly denticulate towards the apex, entire in lower half; upper leaves similar to the lower leaves. Costa 56-60(70) μm wide near leaf base, ending below apex; cross section rounded. Upper and middle laminal cells long-rhomboidal to linear, sometimes long oblong, 35-85(90) \times 6-10 μm , walls (0.9)1.2-1.5 μm wide; basal cells mainly rectangular, sometimes long rhomboidal, 86-100 \times (8)12-14 μm ; alar cells long-rectangular, 30-50 \times 8-10(12) μm . Bulbils 1(2) in the axils of upper leaves, oblong to cylindrical, (350)400-700(1000) μm long, red –when fresh and alive– to brownish, opaque, with laminate leaf primordia arising from base to apex.

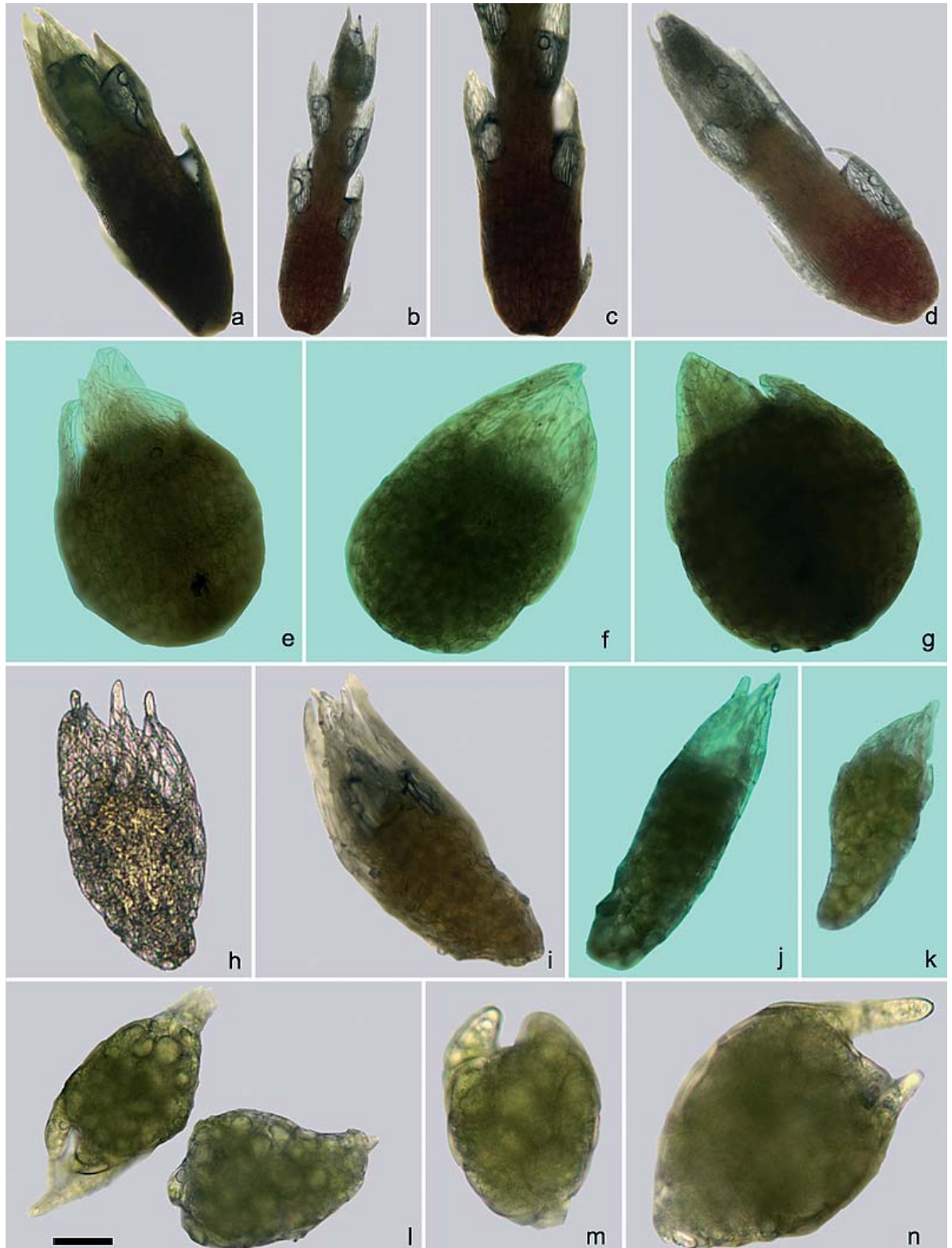


Fig. 1. *Pohlia drummondii* (MUB 18549): **a-d**, bulbils. *P. filum* (MUB 21458): **e-g**, bulbils. *P. andalusica* (MUB 21460): **h-k**, bulbils. *P. camptotrachela* (MACB 14339): **l-n**, bulbils. Scale: a, b, d-g = 100 μ m; c = 70 μ m; h-k = 80 μ m; l-n = 30 μ m.



Fig. 2. *Pohlia annotina* (MA 7549): **a-e**, bulbils. *P. prolifera* (MUB 1584): **f-i**, bulbils. *P. flexuosa* (MUB 21471): **j-l**, vermicular bulbils; **m, n**, sinuous outline bulbils; **o**, bulbils angular outline with papillae. Scale: a-e = 35 μ m; f-i = 35 μ m; j = 25 μ m; k, l, n, o = 30 μ m; j = 20 μ m; m = 12 μ m.

Habitat. On sandy, acid and very wet soils on stream banks, in high mountains of the northern Iberian Peninsula. Infrequent in the Iberian Peninsula.

2. *Pohlia filum* (Schimp.) Martensson, Kung. Svenska Vetenskapsakad. Avh. Naturskyddsärenden 14: 149. 1956

Bryum filum Schimp., Syn. Musc. Eur. (ed. 2): 470. 1876, basionym. Lectotype designated by Shaw (1981): BM!
(Fig. 1 e-g)

Plants 1.5-5(6) cm high, growing generally in loose turfs, sometimes dense, greenish, sometimes yellowish or orange, slightly shiny when dry. Leaves mainly appressed, sometimes erect when dry, erect to erect-patent when moist, ovate to ovate-lanceolate, usually carinate, decurrent, very pronounced on lower leaves, (1)1.2-1.8(1.9) × 0.2-0.5(0.7) mm; apex acute, very rarely obtuse in young leaves, not twisted; margins plane, sometimes slightly recurved at the base, slightly denticulate towards the apex; entire in lower half; upper leaves similar to rest. Costa (48)50-60(65) μm wide near leaf base, ending below apex; cross section rounded. Upper and middle laminal cells long rhomboidal to linear, 40-86(95) × (7)10-12(14) μm, walls 0.8-0.1(1.2) μm wide; basal cells mainly rectangular, (80)90-100(110) × 10-14 μm; alar cells mainly rectangular, 30-60 × 8-10 μm. Bulbils solitary in the axils of upper leaves, ovoid to elliptical or subspherical, (300)350-500(550) μm long, brownish, opaque, with laminate leaf primordia arising only in the apex.

Habitat. Generally on sandy, acid and very wet soils on stream banks and, in very clear running water in high mountains of the northern Iberian Peninsula, sometimes on humid banks permanently covered with melting snow. A very rare species in the Iberian Peninsula; only known from the Pyrenees and north Portugal.

Observations. *Pohlia filum* is difficult to distinguish from *P. drummondii* in the absence of bulbils, which have a characteristic shape. *P. filum* is reported to have more decurrent and appressed leaves (cf. Lewis & Smith, 1978; Shaw, 1981; Nordhorn-Richter, 1982) and this is also the case in Iberian specimens.

3. *Pohlia andalusica* (Höhn.) Broth., Nat. Pflanzenfam. 1(3): 551. 1903

Webera andalusica Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Math.-Naturwiss. Cl. Abt. 1. 104: 326. 1895, basionym. Lectotype: FH!
(Fig. 1 h-k)

Plants 0.3-0.8(1.2) cm high, growing in loose turfs or gregariously in tufts, greenish-yellow, sometimes reddish at base, slightly or not all shiny when dry. Leaves erect when dry, erect to erect-patent when moist, ovate, rarely ovate-lanceolate, sometimes slightly carinate, hardly decurrent, 0.7-0.8(0.9) × 0.3-0.4(0.5) mm; apex acute, sometimes slightly twisted; margins plane, sometimes slightly recurved at the base and in upper third, denticulate towards the apex, entire in lower half; upper leaves similar to the rest. Costa (25)30-35 μm wide near leaf base, ending below apex; cross section rounded. Upper and middle laminal cells long rhomboidal to linear-rectangular, sometimes short-vermicular, (40)50-80(90) × 6-8(10) μm, walls 1-1.2 μm wide; basal cells mainly rectangular, (30)40-50(54) × 8-10(12) μm; alar cells mainly short rectangular, 30-40 × 8-10 μm. Bulbils (1)2-3(4) in the axils of upper leaves, rarely in lower leaves, mainly obconic, sometimes oblong, (200)400-500(600) μm long, reddish to brownish, opaque to semi-transparent, with laminate leaf primordia of 3-6 cells wide at the base, arising only at the apex.

Habitat. Acid soils, sometimes calcareous, on talus and in bare patches in pastures and meadows, generally shaded, humid sites in high and medium mountains. Relatively frequent in the Iberian Peninsula.

Observations. Obconic bulbils, with leaf primordia arising only in the apex is a characteristic of *Pohlia andalusica* and therefore useful for identification purposes.

4. *Pohlia camptotrachela* (Renauld & Cardot)

Broth., Nat. Pflanzenfam. 1(3): 552. 1903
Webera camptotrachela Renauld & Cardot, Bot. Gaz. 13(8): 199. 1888, basionym. Isotype: NY!
(Fig. 1 l-n)

Plants 1-1.2(1.5) cm high, growing in loose turfs, green to yellowish, sometimes orange at base, not shiny when dry. Leaves erect when dry, erect to erect-patent when moist, generally narrow ovate-lanceolate, non carinate, not to clearly decurrent, (0.6)0.7-0.8(0.9) × 0.2-0.25(0.35) mm; apex acute, not twisted; margins plane, denticulate toward the apex, entire in lower half; upper leaves slightly broader than rest. Costa (28)30-35(40) μm wide near the base, ending below apex or percurrent; cross section rounded. Upper and middle laminal cells long rhomboidal to linear, sometimes short vermicular, 66-82(98) × 6-7(8) μm, walls 1-1.2 μm wide; basal cells mainly rectangular, 45-55 × 8-9 μm; alar cells rectangular, 35-40 × 8-9 μm. Bulbils generally in groups of 5-6(7) in axils of upper and middle leaves, rarely solitary, mainly iso-

diametric, spherical to shortly oblong, (100)125-150(200) μm long, greenish to yellowish, transparent, with 1-4 toothlike primordia of 1-2(3) cells, occasionally laminate primordia with age.

Habitat. Acid soils, on taluses and on bare ground in pastures and meadows, shaded, wet sites generally near streams and springs. Relatively frequent in the Iberian Peninsula.

Observations. *Poblia annotina* may occasionally produce similar bulbils to those of *P. camptotrachela*, but are mixed with typical bulbils of the species, and never spherical to oblong, so there need be no confusion.

5. *Poblia flexuosa* Hook. f., *Icon. Pl.* 1, pl. 19, f. 5. 1836

Lectotype: designated by Long on the sheet: TCD!
Poblia myldermansii R. Wilczek & Demaret, *Bull. Jard. Bot. Belg.* 40: 417. 1970
(Fig. 2 j-o)

Plants 1.5-2 cm high, growing in loose turfs, yellowish green to green pale, sometimes orangey at base, not shiny when dry. Leaves erect when dry, erect to erect-patent when moist, ovate-lanceolate, non carinate, strongly decurrent, $0.8-0.9(1.2) \times 0.4-0.5$ mm; apex acute, not twisted; margins more or less recurved, slightly denticulate towards apex, entire in lower two-thirds; upper leaves broader than rest. Costa $42-50(55)$ μm wide near leaf base, ending below apex or subpercurrent; cross section rounded. Upper and middle laminal cells long rhomboidal, more or less linear near the margins, $45-75(95) \times (6)8-14(20)$ μm , walls $1.2-1.8$ μm wide; basal cells rectangular to long rhomboidal, $(35)40-60(65) \times (8)14-15$ μm , alar cells long rectangular, $60-70 \times 8-9$ μm . Bulbils usually numerous, normally in axils of middle and lower leaves, ovoid or shortly oblong, some more or less sinuous outline, brownish, transparent to almost opaque, others angular in outline, with small papillose protuberances, $90-100(110)$ μm long, hyaline, and a third type generally in the axils of upper leaves, vermicular, $(150)200-300(350)$ μm long, brownish, more or less transparent, with 1-2 unicellular toothlike primordia very short, not reaching 1/10 of bulbil length.

Habitat. Acid soils on very humid, shaded taluses.

Observations. Only known from two localities in the Iberian Peninsula, one near Girona (Casas, 1996) and that studied here.

Poblia flexuosa produces up to three different types of bulbil, usually mixed (at least in material studied) in the axils of upper and middle leaves. These types have

been interpreted as different stages of propagule development (Wilczek & Demaret, 1970; Townsend, 1995). However, in Smith (2004) and Hill & al. (2006) these propagule types are given taxonomic value to differentiate two varieties of *Poblia flexuosa*: var. *flexuosa* and var. *pseudomyldermansii* (Arts, Nordhorn-Richter & A.J.E. Sm.) A.J.E. Sm.

The vermicular propagules of *P. flexuosa* look like those of *P. proliger*a, although the latter are broader [$(10-15(20)$ μm in *P. flexuosa* and $30-35$ μm in *P. proliger*a] and the apical cells are much longer.

6. *Poblia annotina* (Hedw.) Lindb., *Musci Scand.*: 17. 1879

Bryum annotinum Hedw., *Sp. Musc. Frond.*: 183, pl. 43. 1801, basionim. Lectotype designated by Shaw (1981): G. Not seen.
(Fig. 2 a-e)

Plants 1-2 cm high, growing in loose turfs, yellowish to slightly orange or reddish at the base, slightly shiny when dry. Leaves erect-patent to spreading when dry, patent to spreading when moist, lanceolate to ovate-lanceolate, non carinate, non or slightly decurrent, $(1.2)1.4-1.5 \times 0.3-0.4(0.45)$ mm; apex acute, sometimes twisted; margins plane, sometimes slightly recurved at the base, sinuous-denticulate in upper third, entire in lower half; upper leaves narrower and shorter than rest. Costa $50-60$ μm wide near leaf base, ending below the apex or percurrent, cross section rounded to semicircular. Upper and middle laminal cells mainly linear, sometimes vermicular, $(60)80-120(130) \times 6-8(11)$ μm , walls $1.5-2$ μm wide; basal cells long rhomboidal to rectangular, $(30)35-55 \times 7.5-8(8.5)$ μm ; alar cells long rectangular to short linear, $50-65 \times 7.5-8$ μm . Bulbils usually numerous, in axils of middle and upper leaves, vermicular, obconic, $50-100(250)$ μm long, almost hyaline to yellowish, transparent, with 2-4(5) multicellular toothlike primordia, sometimes in axils of middle leaves or mixed, bulbils oblong or obconic, non vermicular, $50-60$ μm long, yellowish, transparent, with 2-3(4) generally multicellular toothlike primordia.

Habitat. Acid soils, sometimes calcareous on humid and shaded taluses.

Observations. Probably the most frequent occurring species of those studied here.

7. *Poblia proliger*a (Kindb.) Broth., *Nat. Pflanzenfam.* 1(3): 551. 1903

*Webera proliger*a Kindb., *Forh. Vidensk.-Selsk. Kristiana* 1886(6): 30. 1888, basionym. Type: not seen.
(Fig. 2 f-i)

Plants 0.3-1(2.5) cm high, growing in loose turfs, greenish to reddish at the base, shiny when dry. Leaves erect to patent when dry, erect-patent when moist, narrowly lanceolate to slightly ovate-lanceolate, carinate near the base, non decurrent, 0.9-1.2(1.5) × (0.2)0.25-0.3 mm; apex acute, sometimes very slightly twisted; margins plane, sometimes slightly recurved at the base, denticulate near the apex, entire to sinuous-denticulate in lower third; upper leaves slightly longer and broader than rest. Costa (24)28-34 µm wide near base, ending below apex, percurrent or slightly on oldest leaves, cross section plane to convex. Upper and middle laminal cells long rhomboidal to linear-vermicular, (60)74-90(100) × (4)5-9(10) µm, walls 1-1.25 µm wide; basal cells long rhomboidal to rectangular, (38)40-60 × 8-9(10) µm; alar cells long rectangular to linear, 80-90 × 4-6 µm. Bulbils usually numerous, in axils of upper leaves, vermicular, sub-cylindrical, 50-100(250) µm long, hyaline, with 1(2) unicellular toothlike primordia.

Habitat. Acid soils, sometimes calcareous on wet and shaded taluses, frequently covered with herbaceous vegetation. *Pohlia proliger* is a much more northern species, and in the Iberian Peninsula only appear at higher elevations compared to *P. annotina*.

Observations. The bulbils of this species are characteristic, although they may resemble those *Pohlia annotina* in the early stages of development. It is therefore necessary to observe a considerable number of bulbils to avoid confusion. Another character to dis-

tinguish *P. proliger* from *P. annotina* is the very shiny leaves of *P. proliger*, which permits a distinction even when bulbils are lacking.

Conclusions

To date, a group of seven species of *Pohlia* from the section *Cacodon* can be characterized in the Iberian Peninsula according to differences in size, number, morphology, etc. of their axillary bulbils. Species of this group are very similar to one another in such features as habit, size, leaf sheen, shape, leaf cell size and shape. In most cases species are not easily recognizable in the absence of bulbils. Table 1 summarises the most relevant differentiating characteristics of all the species studied.

Selected specimens studied

Pohlia drummondii

SPAIN. **Cantabria:** Vega de Liébana, Peña Prieta, 2350 m, entre pizarras en la vertiente N, *Muñoz* (MA 19350). **Huesca:** Benasque, 2700 m, rezumos y regatos en la cara sur de la brecha de Llosás, granitos, *Heras* (VIT 6877). **Lérida:** Alta Ribagorza, La Renclusa, 2000 m, *Casas* (MA 27809). **Palencia:** Laguna de Fuentes Carrionas, 2200, *Cano* (MUB 18549).

Pohlia filum

SPAIN. **Huesca:** Benasque, entre los ibones y el Pico de la Renclusa, hendiduras de rocas rezumantes cerca de un nevero, 2350 m, *Guerra* (MUB 21458). **Pyrénées,** Maladetta, *Zetterstedt s.n.* (UPS). **Pyrénées,** Maladetta, *Jones s.n.* (BM).

Table 1. Diagnostic characters of *Pohlia* section *Cacodon* in the Iberian Peninsula.

Species	Leaf shape	Shape & width of median laminal cells	Bulbil shape	Costa width (µm)
<i>P. drummondii</i>	Ovate, rarely ovate-lanceolate	Long rhomboidal to linear, sometimes long oblong / 6-8 µm	Oblong to cylindrical, with laminate leaf primordia arising from base to apex	56-60(70)
<i>P. filum</i>	Ovate to ovate-lanceolate	Long rhomboidal to linear / (7)10-12(14) µm	Ovoid to elliptical or subspherical, with laminate leaf primordia arising only in the apex	(48)50-60(65)
<i>P. andalusica</i>	Ovate, rarely ovate-lanceolate	Long rhomboidal to linear-rectangular, sometimes short vermicular / 6-8(10) µm	Obconic, sometimes oblong, with laminate leaf primordia arising only in the apex	(25)30-35
<i>P. camptotrachela</i>	Ovate-lanceolate	Long rhomboidal to linear, sometimes short vermicular / 6-7(8) µm	Spherical to short oblong, with 1-4 toothlike leaf primordia of 1-2(3) cells	(28)30-35(40)
<i>P. flexuosa</i>	Ovate-lanceolate	Long rhomboidal / (6)8-14(20) µm	Vermicular with 1-2 unicellular toothlike primordia, or ovoid to oblong, more or less sinuous outline or papillae	42-50(55)
<i>P. annotina</i>	Lanceolate to ovate-lanceolate	Mainly linear, sometimes vermicular / 6-8(11) µm	Vermicular, rarely obconic with 2-4(5) multicellular toothlike primordia	50-60
<i>P. proliger</i>	Narrowly lanceolate to slightly ovate-lanceolate	Long rhomboidal to linear-vermicular / (4)5-9(10) µm	Vermicular to subcylindrical, with 1(2) unicellular toothlike primordia	(24)28-34

Pohlia andalusica

ANDORRA: Port de Cabús, 2350 m, *Casas* (MA 20255). SPAIN. **Granada:** Sierra Nevada, *Rams* (MUB 18578). **Huesca:** Benasque, ibones de la Renclusa, 2280 m, *Guerra* (MUB 21460). Pirenéas centrales, Port de Venasque, *Zettersdedt s.n.* (UPS). **Lérida:** Esterri de Cardós, 1000 m, *Casas* (MUB 21463).

Pohlia camptotrachela

SPAIN. **Ávila:** Puerto del Pico, Cuevas del Valle, Fuente Mari-blanca, *Soria & Ron* (MACB 14339). **Granada:** Sierra Nevada, Loma W del Mulhacén, 3150 m, *Rams* (MUB 21218).

Pohlia flexuosa

SPAIN. **Huesca:** Valle de Hecho, Selva de Oza, talud en un camino, *Guerra* (MUB 21471).

Pohlia annotina

PORTUGAL. Serra da Estrela, entre Gouveia y Manteigas, 1350 m, talud en el borde de un arroyo, *Guerra et al.* (MUB 22534). SPAIN. **Burgos:** Huidobro, suelos ácidos en el melojar, *Fuertes Lasala* (MACB 32463). **Cáceres:** camino de Guadalupe a Navalvillar de Ibor, estribaciones de la Sierra de Viejas, *Viera* (MUB 2530). **Guipúzcoa:** Eibar, Arrate, talud sobre basaltos, 570 m, *Infante & Heras* (VIT 20190). **Huesca:** Benasque, camino al Ibón de Gorgutes, 1700 m, *Guerra* (MUB 21465). **Logroño:** Villanueva de Cameros, Arroyo del Hoyo, 900 m, *Martínez Abaigar* (Herb. Martínez Abaigar *s.n.*). **Lugo:** Ancares, camino de Campo da Braña a Piornedo, 1100 m, taludes, *Casañ & Puche* (VAL 1746). **Madrid:** Lozoya del Valle, talud junto a un arroyo, 1200 m, *Jorquera & Lara* (MA 7549). **Navarra:** Goizueta, borde un camino, *de Miguel & Edera* (PAMP 4425). **Zamora:** Galende, Laguna de los Peces, 1700 m, en taludes bajo brezos, húmida, *Infante & Heras* (VIT 24692).

Pohlia prolifera

SPAIN. **Albacete:** Campamento de San Juan, Sierra del Calar del Mundo, 1200, talud ácido protegido por herbáceas, *Jiménez & Ros* (MUB 1584). **Almería:** Sierra de los Filabres, Bacaes, Barranco del Pino, *García-Zamora & Ros* (MUB 8643). Almería, Sierra de Filabres, Bacaes, Barranco de Julián, 1600-1700 m, tierra acumulada en un muro muy protegido, *García-Zamora & Ros* (MUB 8557). **Guadalajara:** hayedos de Cantalojas, 1500 m, *Riestra* (MACB *s.n.*).

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