

## *Pohlia bolanderi* from Sierra Nevada, Spain, New to the European Bryophyte Flora

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**Abstract.** *Pohlia bolanderi* (Lesq.) Broth. is reported for the first time for Europe from the south of Spain (Sierra Nevada range). A description from European material is provided and differences from closely related species, with which it has been confused, are discussed. It is also known from alpine regions in western North America, including British Columbia, Washington, Oregon, California, and Nevada.

**Keywords.** Disjunct distribution, European flora, moss, *Pohlia bolanderi*, Sierra Nevada.

*Pohlia bolanderi* (Lesq.) Broth. (Bryaceae) has until now been considered to be an endemic species of western North America, known from the alpine regions in British Columbia, Washington, Oregon, California, and Nevada (Shaw 1982). Here we report its presence in Europe for the first time. The overall distribution, including this new record, is shown in Figure 1. *Pohlia bolanderi* thus belongs to the western North American-western Mediterranean disjunct element (Schofield 1988). Two additional species, which, like *P. bolanderi*, are clearly alpine, show the same disjunction: *Schistidium cinctidodonteum* (Müll. Hal.) B. Bremer (Ros et al. 2000) and *S. occidentale* (E. Lawton) S. P. Churchill (Casas et al. 2001). The locality where we found *P. bolanderi* is the same locality as the one where *S. occidentale* was recorded for the first time in Europe. These two new records should be added to the checklist of bryophytes from the Sierra Nevada by Rams et al. (2001). Furthermore, there are several moss species that share this distribution and show the same intercontinental pattern e.g., *Cladopodium whippleanum* (Sull.) Renauld & Cardot (Düll 1992; Jiménez et al. 2002), *Crossidium aber-rans* Holz. & E. B. Bartram (Ros & Guerra 1986), *Fissidens sublimbatus* Grout (Ros et al. 2001), and *Phascum vlassovii* Laz. (Jiménez et al. 1989).

The Sierra Nevada mountain range is located in southern Spain, close to and parallel with the Mediterranean coast, and belongs to the Mediterranean biogeographic region. It occupies about 2,000 square kilometers and contains five of the six described Mediterranean bioclimatic belts (Rivas-Martínez et al. 1997). The Sierra Nevada occupies a wide elevational range and, consequently, spans

a broad ecological gradient from the so-called Bajas Alpujarras, around the town of Lanjarón (400 m), to peak of Mulhacén (3,482 m), the Iberian Peninsulas highest mountain. The Sierra Nevada is an isolated range that is thought to have provided a refuge for alpine species after the last glacial period, because of its special geographical position in the extreme south of Europe (Blanca et al. 2002; Delgado Calvo-Flores et al. 2001).

*Pohlia bolanderi* has been collected in the Sierra Nevada at just a few localities, on siliceous soil in late thaw areas until July, at sites 2,450–2,550 and at 2,950–3,125 m a.s.l., well above timberline. It can thus be considered an alpine-subalpine species, having habitat preferences as in North America (Shaw 1982). In spite of being restricted to a few localities in the Sierra Nevada, the species is locally abundant in an area that occupies approximately one square kilometer, known as headwaters of the Guarnón River and Corral del Veleta.

**Material description.**—A description based on American material can be found in the revision of *Pohlia* published by Shaw (1982). European material of *Pohlia bolanderi* (see Fig. 2) is characterized as follows:

Slender, glossy green plants growing in more or less compact turfs. Rhizoids reddish to brownish, smooth to finely papillose. Stems erect, simple, green to brownish, 5–15 mm; transverse section pentagonal-rounded, central strand present. Vegetative leaves erect to erect-patent when dry, erect-patent when moist, imbricate, very often seriate in 5 ranks and carinate, ovate to ovate-lanceolate, 1.0–1.5 × 0.4–0.7 mm, 2.0–2.5 times as long as wide; apex acute; margins plane or rarely recurved in bas-



FIGURE 1. Known distribution of *Pohlia bolanderi*. North American reports from Shaw (1982).

al, middle or upper part of leaf, entire, generally serrate to serrulate at apex, bordered by one row of linear cells,  $(55\text{--}75\text{--}95\text{--}125) \times (3\text{--}5\text{--}7) \mu\text{m}$ ; upper and median laminal cells linear-rhomboidal to vermicular,  $(40\text{--}45\text{--}70\text{--}90) \times (5\text{--}8\text{--}10\text{--}15) \mu\text{m}$ , smooth, thin-walled, bulging on both faces, basal cells rectangular to hexagonal,  $(30\text{--}35\text{--}50\text{--}55) \times (10\text{--}14\text{--}16\text{--}20) \mu\text{m}$ ; lamina monostratose. Costa strong, green to brownish,  $45\text{--}75 \mu\text{m}$  wide at base, reaching  $2/3$  length of leaf or almost to apex, sometimes forked above, in transverse section more or less semicircular, with 2–4 ventral epidermal cells in one row, 2 guide cells, hydroids, (0)1–4 rows of dorsal stereids and one row of dorsal epidermal cells. Perichaetial leaves erect, ovate-lanceolate to lanceolate,  $1.9\text{--}2.1 \times 0.5\text{--}0.6 \text{ mm}$ ,  $3.0\text{--}4.5$  as long as wide, margins recurved to a variable extent; other characters as in vegetative leaves. Apparently dioicous (as in North American plants), only archeogonia observed. Sporophytes absent in Spanish material.

In addition to the new collections made in the Sierra Nevada, we found two misidentified specimens in Spanish herbaria. One is in the MA-Musci herbarium, Madrid, where it was labelled *P. andalusica* (Höhn.) Broth., and the other one is in the GDA herbarium, Granada, where it was labelled *P. drummondii* var. *carinata* (Boulay) Podp. [= *P. filum* (Schimp.) Martensson]. Probably the main feature responsible for these misidentifications was the presence of carinate leaves, a feature common to *P. bolanderi*, *P. andalusica*, and *P. filum*. Neither of the samples have axillary gemmae, however, a

consistent feature of *P. filum* and *P. andalusica*. *Pohlia bolanderi* does not produce gemmae.

*Pohlia andalusica* has obconic to oblong-obovate gemmae ( $250\text{--}500 \mu\text{m}$ ) with laminate leaf primordia arising in clusters in a few upper leaf axils, while *P. filum* has egg-shaped gemmae ( $300\text{--}600 \mu\text{m}$ ) with stiffly-appearing primordia often restricted to the gemma apex (Arts 1990; Lewis & Smith 1977; Shaw 1982).

The sporophytes of *P. bolanderi* differ from those of *P. andalusica* and *P. filum* in capsule shape, exothecial cell shape, and peristome morphology (Shaw 1984). The capsules of *P. bolanderi* are rather like those of *P. cruda* (Hedw.) Lindb. or even *P. elongata* Hedw. – elongate and relatively narrowly cylindrical-pyriform. The capsules of *P. filum* and *P. andalusica*, like those of other gemmiferous *Pohlia* species, are more shortly and broadly pyriform. *Pohlia bolanderi* has long-rectangular exothecial cells with straight walls, while those of *P. andalusica* and *P. filum* are short-rectangular with sinuose walls. The endostome of *P. bolanderi* has a basal membrane that reaches about  $1/3\text{--}2/5$  the exostome length, with relatively narrow endostome segments that are narrowly or not at all perforate along the keels. Endostomial cilia are rudimentary or absent. In contrast, both *P. andalusica* and *P. filum* have higher basal membranes ( $1/2$  the exostome length), with broadly (ovoid) perforate endostome segments and long, nodulose cilia.

The endostomes of *P. bolanderi* are like those of *P. elongata* and *P. longicollis* (Hedw.) Lindb. in having narrowly perforate segments and rudimen-

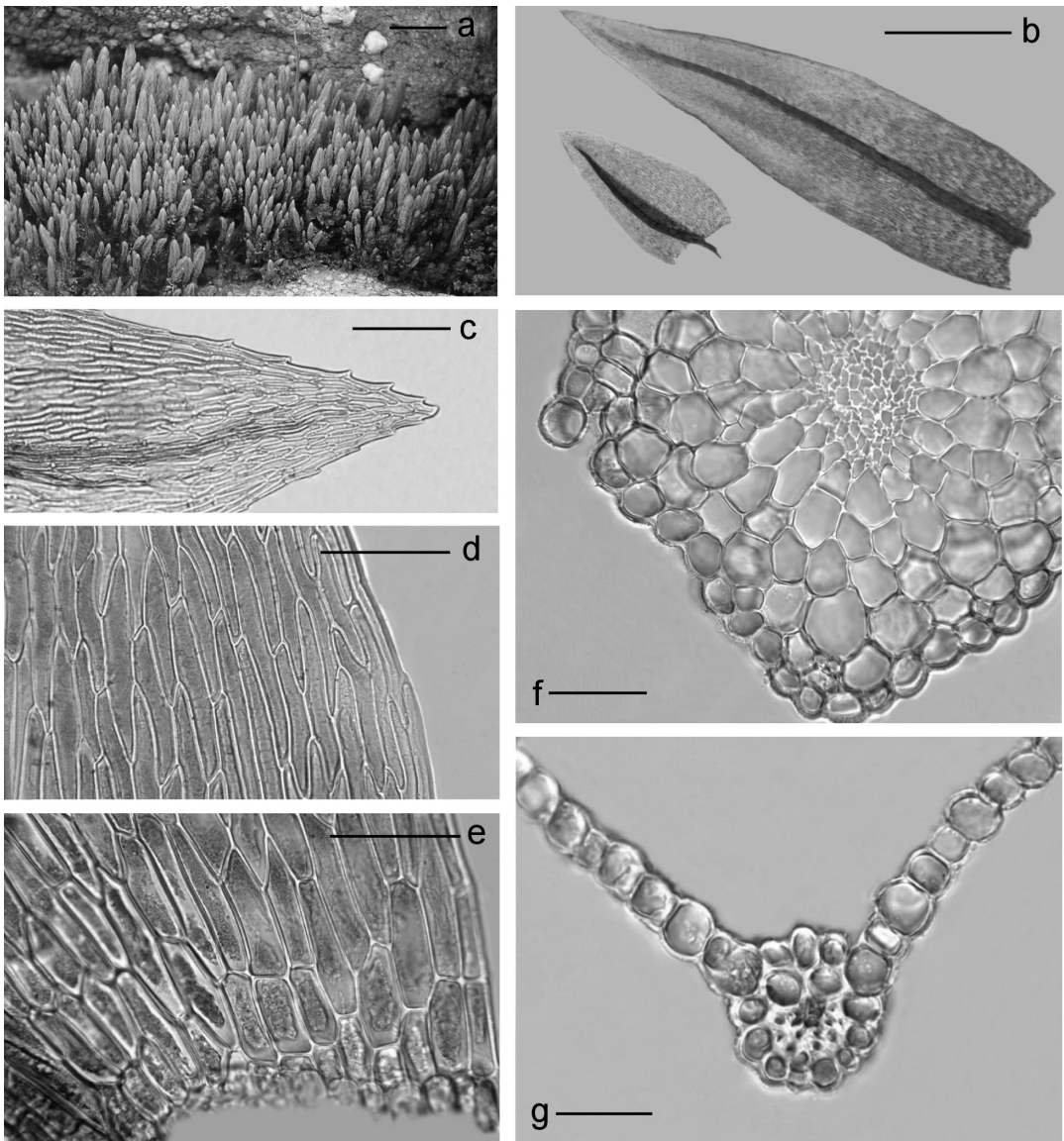


FIGURE 2. Field photograph and light microscope micrographs of *Pohlia bolanderi* from European material at MUB herbarium. — a. Habit. — b. Perichaetial leaf and vegetative leaf. — c. Leaf apex of vegetative leaf. — d. Median and marginal cells of vegetative leaf. — e. Basal cells of a vegetative leaf. — f. Stem transverse section. — g. Leaf transverse section at middle part. (Scale bars: a = 1 cm; b = 0.5 mm; c, f, g = 100  $\mu$ m; d, e = 50  $\mu$ m.)

tary cilia, and it is probably more closely related to those species than it is to *P. andalusica* and *P. filum*. Before Shaw (1982) recognized *P. bolanderi* at the species level, most North American collections were identified as *P. longicollis* or *P. cruda* (Hedw.) Lindb. in American herbaria. *Pohlia cruda* has peristomes with broadly keeled and perforate endostome segments and long cilia. Gametophytically, it can be rather similar to *P. bolanderi*.

*Pohlia andalusica* was found growing together with *P. bolanderi* at one of the collecting sites in the Sierra Nevada, which allowed us to make mor-

phological comparisons between them. The habit of the plants is very different: *P. bolanderi* has erect vegetative leaves, more or less disposed in five ranks and imbricate, whereas *P. andalusica* has leaves that are more shiny and less clearly disposed in five ranks. The leafy shoots of *P. andalusica* and *P. filum* are more slender and the leaves are more strongly erect-patent. Although gemmae can sometimes be sparse in these species (especially *P. filum*), a careful search almost always reveals a few.

*Selected specimens studied.*—SPAIN. GRANADA PROVINCE, SIERRA NEVADA, Corral del Veleta, 3,050

m, *Gil* (MA-MUSCI18344); (GDA29034); 3,000 m, *Ros* (MUB14145); 3,075 m, *Rams* (MUB15929); El Veredón, 3,120 m, *Rams* (MUB15930); Alrededores del borreguil del Guarnón, 3,100 m, *Ros* (MUB14218); Peñones de San Francisco, 2,550 m, *Varo* (GDA7749); Alrededores de la Hoya de La Mora, 2,450 m, *Rams* (MUB15924); Alrededores de la Laguna del Majano, 2,950 m, *Rams* & *Mallona* (MUB15925).

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