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## ***Pohlia robertsonii* and *P. rabunbaldensis* (Bryopsida, Mniaceae), Two New Species from the Western and Eastern United States**

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**Abstract.** *Pohlia robertsonii* is newly described from central California. Plants with polysetous sporophytes immediately separate this species from all other members of the genus *Pohlia* in North America. *Pohlia robertsonii* is further characterized by firm, but not thickened leaf cells, paroicous inflorescences, long, narrowly cylindrical capsules, and irregular peristomes in which the endostome segments equal or exceed the exostome teeth, and lack cilia. The peristomial formula is 4:2:2–4. *Pohlia rabunbaldensis* is described from the southern Appalachian Mountains of Georgia and North Carolina. The slender gametophytes bear single bud-like gemmae in upper leaf axils. The dull leaves that are somewhat shriveled on drying resemble those of *P. annotina*, but the large single gemmae with flexuose, broadly laminate leaf primordia resemble those of *P. drummondii*. The conspicuously decurrent leaves distinguish *P. rabunbaldensis* from both previously known species.

**Keywords.** Appalachian mosses, California mosses, Mniaceae, *Pohlia*, *Pohlia rabunbaldensis* n. sp., *Pohlia robertsonii* n. sp., Rabun Bald.

The moss genus *Pohlia* is diverse in temperate to arctic regions of the Northern Hemisphere; and Shaw (1982) recognized 32 species in North America. The genus has traditionally been included in the Bryaceae (e.g., Brotherus 1924) but Cox and Hedderson (1999) showed that *Pohlia* belongs in a monophyletic Mniaceae that is distinct from the Bryaceae. This surprising result, based on DNA sequences, has been repeatedly corroborated by subsequent molecular analyses using nuclear, plastid, and mitochondrial sequences (Cox et al. 2000; Cox et al. 2004). At present, it appears that the Mniaceae s.s. are either sister to *Pohlia* (plus *Epipterigium* and *Mielichhoferia*), or this pohlioid group forms a paraphyletic grade basal to the Mniaceae. In either case, it is clear that *Pohlia* must be excluded from the Bryaceae.

Two new *Pohlia* species from the United States, described below, were each collected during recent weekend forays organized to promote interactions between professional and amateur bryologists, and to further our floristic knowledge of selected areas. Discoveries of new taxa during the forays serve to highlight the value of these field meetings.

**POHLIA ROBERTSONII** J. R. Shevock & A. J. Shaw,  
*sp. nov.* FIGS. 1a–j

Plantae parvae acrocarpae simplices vel sparsim furcatae. Folia lanceolata, cellulae folium rhombeae vel linearirhombeae parietibus firmis sed non incrassatis. Inflorescentiae paroicae polysetae. Capsulae anguste longicylindricae. Peristomium duplex dentibus exostomii obtusis val late acutis. Endostomium membrana basilari humilis segmentis angustis ciliis nullis. A speciebus Pohliae om-

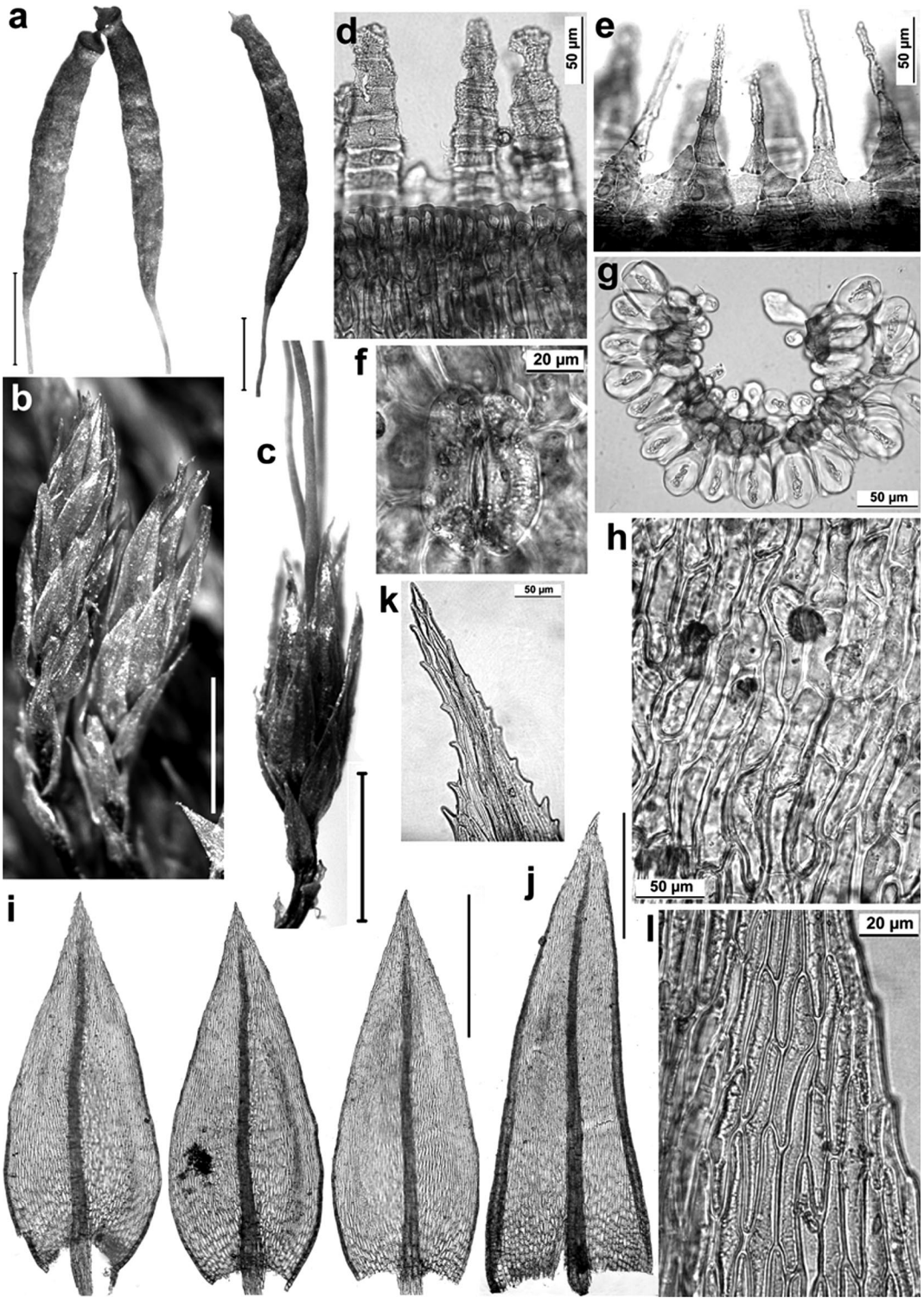


FIGURE 1. *Pohlia robertsonii*. — a. Capsules. — b. Mature gametophytes. — c. Maternal plant bearing three setae. — d. Peristome, viewed from outside. — e. Peristome, viewed from inside. Cell outlines demonstrate the 4:2:4 peristomial formula (one column of cells between segments). — f. Stomate. Note that guard cells overlap surrounding exothecial cells. — g. Annular cells. — h. Exothecial cells. — i. Vegetative leaves. — j. Perichaetial leaf, with recurved margins. — k. Leaf apex. — l. Upper median leaf cells. Scale bars: a-c: 1.0 mm; i-j: 0.5 mm; others as marked.

nibus in America septentrionali ad septentriones Mexicanis inflorescentiis polysetis diagnoscenda.

TYPE: U.S.A. CALIFORNIA. Monterey Co. Wagon Caves just north of boundary with Fort Hunter-Liggett Military Reservation off of Forest Road to The Indians, Los Padres National Forest, 36°05'00" N, 121°24'05" W, 22 Mar 2004, 295 m, *Shevock et al.* 24722 (CAS, holotype; DUKE, H. KRAM, MO, NY, UC, isotypes).

*Paratypes*.—U.S.A. CALIFORNIA. Monterey Co., Wagon Caves, *Shevock & Kellman* 24787 (CAS, DUKE, UBC, UNAM), *Robertson* 6134, 6331 (UC), *Norris & Hillyard* 106947 (UC); on divide about 0.8 km south of Santa Lucia Park, Los Padres National Forest, *Shevock et al.* 24771 (CAS, MO, NY); off of Gabilan Road at the Palisades above the Nacimiento River, Hunter-Liggett Military Reservation, *Shevock et al.* 24858 (CAS, DUKE, MO, NY) and *Shevock et al.* 24863 (CAS).

Small light green plants forming abundantly fertile populations on sandy soil. Stems unbranched or with 1–2 innovations or forks below inflorescences or near base, in transverse section with central, poorly delimited region of small thin-walled cells surrounded by larger thin-walled cells and 2–4 layers of smaller thickened surficial cells. Vegetative leaves lanceolate, 1.3–1.6 mm long, 0.3–0.7 mm wide, acute; margins plane or weakly recurved in upper third, serrulate to serrate near apices or sometimes nearly to midleaf; costae well-developed, ending 3–5 cells below leaf apices. Upper leaf cells irregularly hexagonal to rhomboidal, 70–120  $\mu\text{m}$  long, 6–9  $\mu\text{m}$  wide, with firm but not thickened walls, undifferentiated along margins. Basal cells gradually wider, thinner-walled, and more nearly rectangular, 50–65 (–75)  $\mu\text{m}$  long, 15–24  $\mu\text{m}$  wide. Paroicous. Perichaetial leaves slightly differentiated from vegetative leaves, to 2.0 mm long, with more conspicuously recurved margins. Setae erect, orange-brown, and slightly darker toward base, ca 13 mm long. Capsule inclined ca 10° from vertical, cylindrical to narrowly and longly pyriform, orange-brown to straw-colored when mature, often mottled with red when immature, ca 4 mm long, with neck equal to or somewhat longer than urn. Exothecial cells elongate-hexagonal, 65–110  $\mu\text{m}$  long, 11–15  $\mu\text{m}$  wide, with thickened, somewhat wavy walls,  $\pm$  abruptly smaller and rounded-isodiametric or square at rim, with abundant stomata in neck. Operculum high conic, sharply pointed. Annulus revoluble, of two rows of cells. Peristome double, with endostome segments equal to or exceeding length of exostome teeth. Exostome teeth irregular, bluntly tapered, pale orange-yellow to brown; 90–160  $\mu\text{m}$  long, finely pitted in lower outer surface,  $\pm$  coarsely papillose on upper surface. Endostome pale yellow-brown to nearly hyaline; basal membrane low, barely extending above capsule rim; segments narrow, to 175  $\mu\text{m}$ , keeled near bases, not perforate or sometimes irregularly so. Spores 16–20  $\mu\text{m}$ , finely but distinctly papillose.

The current distribution of *Pohlia robertsonii* is restricted to Monterey County, south of San Francisco, where it occurs in Los Padres National Forest and Fort Hunter-Liggett Military Reservation. The species was first encountered on 22, March 2004 during the 9th annual spring break West Coast bryological foray called the SO BE FREE. On the second day of the foray, participants organized into several smaller collecting teams with one team venturing into the Los Padres National Forest in the vicinity of The Indians. The first stop was at a spectacular sandstone rock formation in an open valley and blue oak woodland called Wagon Caves. The diversity of bryophytes at this site is extremely high. In short order several of the participants had in hand a moss with numerous polysetous sporophytes. The plants were reminiscent of *Schizymenium shevockii* Shaw, a species recently described from California collections (Shaw 2000), and that was the tentative genus name placed on the collections while in the field. When the group returned to the foray base camp at the U.C. Hastings Reserve later that day, microscopic examination of the gametophytes and sporophytes of the new taxon quickly ruled out *Schizymenium* because the sporophytes are clearly terminal and the perichaetial leaves are larger than the vegetative leaves (unlike in *Schizymenium*, where the perichaetial leaves are smaller than vegetative leaves). Review of the recently published California moss catalogue and keys (Norris & Shevock 2004a,b) clearly indicated that these plants were not included in that publication. It is also distinct from any species of *Pohlia* recorded from Mexico (Shaw *in* Sharp et al. 1994). Therefore speculation during the foray was that these plants represented an undescribed species.

*Habitat*.—*Pohlia robertsonii* occurs on sandy gravels and at the bases of rock walls, rock slabs and boulders on large volcanic, and sandstone formations in open deciduous woodland dominated by *Quercus douglasii* Hooker & Arnott and *Q. lobata* Neé, with scattered *Pinus sabiniana* Douglas. This vegetation type is common in the Coast Ranges of California. Plants of *P. robertsonii* are frequently associated with *Anacolia baueri* Hampe, *Antitrichia californica* Sullivant, *Cephaloziella divaricata* Schiffner, *Grimmia lisae* De Notaris, *Hedwigia detonsa* (Howe) Buck & Norris, *Marsupella bolanderi* (Austin) Underwood, *Philonotis capillaris* Lindberg, and *Pseudobraunia californica* (Lesquerex) Brotherus. Other rare mosses in this vicinity include *Didymodon norrisii* Zander and *Schizymenium shevockii*.

*Biogeographic patterns*.—Based on field work to date, *Pohlia robertsonii* is restricted to a narrow band of pinnacle-like volcanic and sandstone rock formations; a distance of only 35 km separates the

northern and southernmost occurrences. Yet within this small geographic zone of suitable habitat, the species is common and nearly all populations include abundant sporophytes. The Coast Ranges of California remain poorly explored bryologically, notwithstanding recent collecting efforts in this portion of the state (Kellman 2003). In addition to *Pohlia robertsonii*, a species that on the basis of current collections appears to be a highly localized endemic, several species otherwise restricted in California to the Sierra Nevada have recently been found in this coastal region. These include *Racomitrium depressum* Lesq., *Grimmia serrana* J. Muñoz, Shevock & Toren, and *Schizymerium shevockii*. Recently described taxa from the Coast Ranges include *Orthotrichum kellmanii* (Norris et al. 2004) and a new moss genus *Dacryophyllum* (Ireland 2004). In addition, *Campylopodia stenocarpa* (Wils.) P. Müller & Frahm, a species otherwise known from central Mexico, has been found at one of the *P. robertsonii* sites. Perhaps the most interesting flowering plant example is the southern Sierran endemic *Carlquistia muirii* (A. Gray) B. G. Baldwin, with a disjunct and remarkable occurrence at Ventana Double Cone in the central Coast Range (not far from *P. robertsonii*). Additional bryological collecting in this portion of California is likely to yield additional novelties and significant range extensions.

*Pohlia robertsonii* is readily distinguished from all species of *Pohlia* in North America north of Mexico by the polysetous condition (Fig. 1c). The plants are paroicous and were abundantly fertile everywhere they were encountered. The capsules of *P. robertsonii* are narrow-cylindric (Fig. 1a) and resemble forms of *P. elongata* from Mexico and Central America that have been named *P. spectabilis* (but which Shaw 1982, synonymized with *P. elongata*). Also like *P. elongata*, *P. robertsonii* is paroicous and the endostome has narrowly (or not at all) perforate segments and lacks cilia (Fig. 1d, e). The exostome teeth of *P. robertsonii* are shorter and more irregular than is typical of *P. elongata*. *Pohlia elongata* also has more thickened leaf cells, and is consistently monosetous. Dry plants of *P. elongata* appear dull whereas those of *P. robertsonii* have a softer texture and are more glossy. The gametophytes of *P. robertsonii* are more like those of *P. bolanderi* (Sull. & Lesq.) Broth., which is widespread in mountainous areas of western North America. *Pohlia bolanderi* has monosetous inflorescences and is dioicous. *Pohlia polycarpa* (Mitt.) Broth., a polysetous Andean species known from as far north as Guatemala, has smaller, less narrowly cylindrical capsules and exostome teeth that are longer and less irregular in development. *Pohlia*

*polycarpa* is known from high mountains, in habitats very unlike those where *P. robertsonii* occurs.

This species is named for Ronald Robertson, an active collector of California bryophytes. His collections, obtained primarily from the San Francisco Bay Area counties, have yielded many new occurrences of rare and infrequently encountered mosses. Ron was the first to collect this new species during the SO BE FREE foray and has been involved in locating all of the additional occurrences. It is a pleasure to name this species in his honor in recognition of his contributions to California bryology.

**POHLIA RABUNBALDENSIS** A. J. Shaw, *sp. nov.*

FIGS. 2a–d

Plantae graciles hebetes gemmis axillaribus. Gemmae grandes gemmaeformes 1–2 in axilla folii primordiis folii grandibus flexuosis laminaribus, Pohliae drummondii sed viridibus vel luteis non ruberis simulans. Sporophytia ignota.

TYPE: U.S.A. GEORGIA. Rabun Co. Chattahoochee National Forest, mixed hardwood forest and gneissic rock faces on north-facing slopes of the bald, 1,130–1,435 m elevation, 34°58' N, 83°18' W, *Shaw 8474*. (DUKE, holotype; NY, isotype).

PARATYPES.—U.S.A. GEORGIA. Rabun Co. Chattahoochee National Forest, mixed hardwood forest and gneissic rock faces on north-facing slopes of the bald, 1,130–1,435 m elevation, 34°58' N, 83°18' W, *Shaw 8390, 8473, 8478* (DUKE); Rabun Bald Cliffs, *Zartman 2558* (DUKE). NORTH CAROLINA. Buncombe Co. Pisgah National Forest, along the Blue Ridge Parkway at Snowball Mtn., mixed hardwood forest with scattered *Picea rubra*, ca 1,500 m elevation, 35°42' N, 82°24' W, *Shaw 13614, 13615* (DUKE).

Slender plants forming small populations or mixed with other mosses. Stems mostly unbranched, in transverse section with central, poorly delimited region of small thin-walled cells surrounded by larger thin-walled cells and 2–4 layers of smaller thickened surficial cells. Vegetative leaves lanceolate, noticeably decurrent, 0.8–1.4 mm long, 0.3–0.6 mm wide, acute; margins of vegetative leaves plane, serrulate near apices or sometimes nearly to midleaf; costae well-developed, ending 3–5 cells below leaf apices. Upper leaf cells rhomboidal, 70–105 µm long, 9–12 µm wide, with thin to firm walls, undifferentiated along margins. Basal cells gradually wider, thinner-walled, and more nearly rectangular, 45–65(–70) µm long, 15–24 µm wide. Axillary gemmae borne singly in (0)–3–6 upper leaf axils, 400–750 µm long, orange or orange-yellow to reddish, with conspicuous, flexuose, broadly laminate leaf primordial near gemma apex as well as below, on gemma body. Apparently dioicous; male plants not seen. Perichaetial leaves triangular-lanceolate, to 2.2 mm long, with conspicuously recurved margins. Archegonia abundant.

*Habitat and biogeographic patterns.*—*Pohlia ra-*

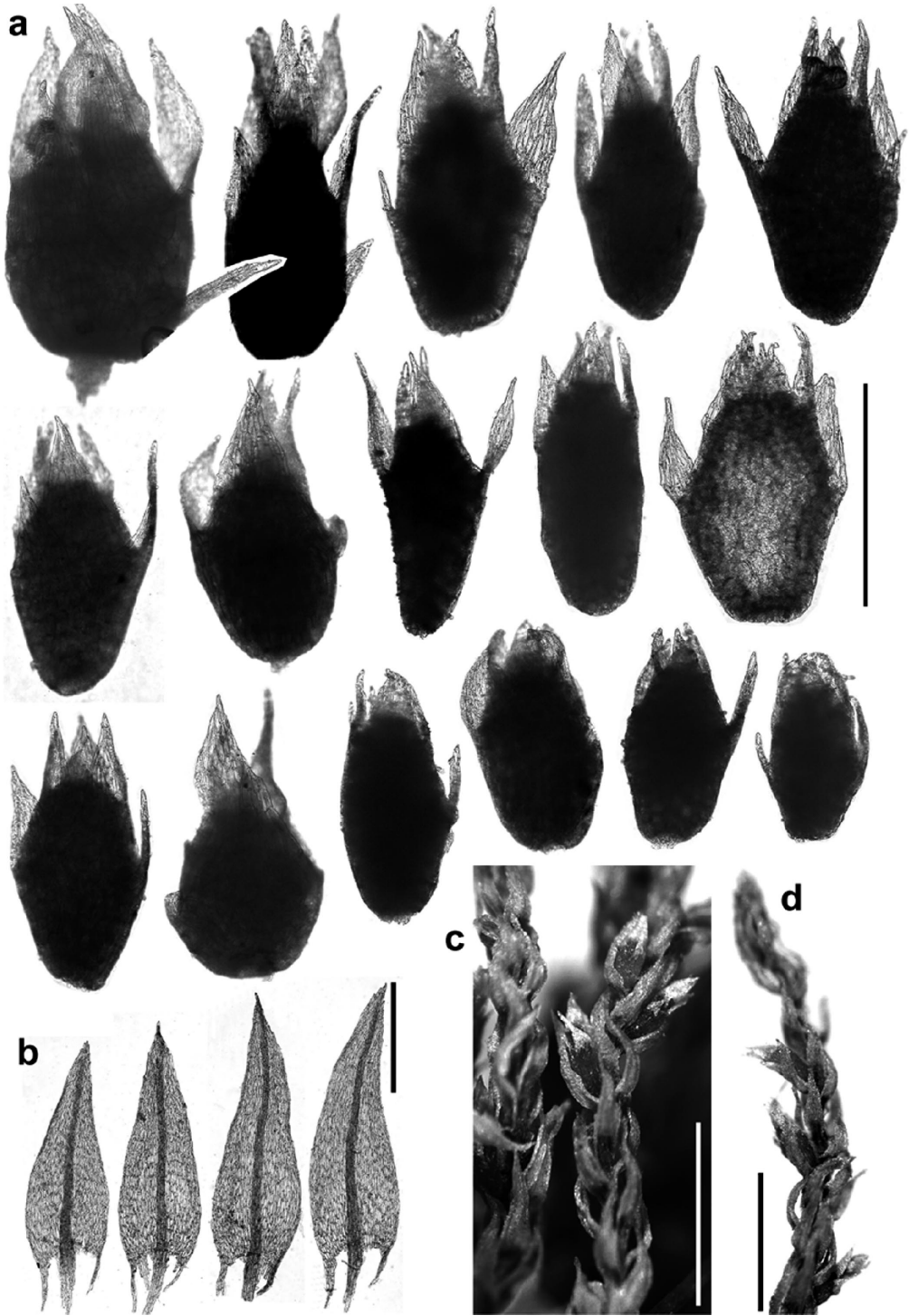


FIGURE 2. *Pohlia rabunbaldensis*. — a. Gemmae. — b. Vegetative leaves. — c-d. Gemmiferous plants. Scale bars: a-b: 0.5 mm; c-d:1.0 mm.

*bunbaldensis* was first collected during the 1996 Blomquist Foray, an annual field meeting organized by Duke University in honor of Hugo Blomquist, the first professor of botany at Duke. Rabun Bald is the second highest point in Georgia, (1,432 m), less than 25 km south of the North Carolina state line. The Bartram Trail from Beegum Gap leading to the summit of Rabun Bald climbs gradually through a southern mixed hardwood forest with *Kalmia latifolia* L. and *Rhododendron* sp., until it reaches about 1,220 m elevation and climbs more steeply. At about that point, the vegetation changes to a "northern" *Quercus rubra* L. hardwood forest. *Pohlia annotina* (Hedw.) Lindb. is abundant along the trail below the *Quercus rubra* forest but is replaced by *P. rabunbaldensis* in similar microhabitats up to the summit. Both the *P. annotina* at lower elevations and the *P. rabunbaldensis* at higher elevations occur on exposed mineral soil along the trail. The ecological ranges of the two species appear to be non-overlapping, or nearly so.

At the Blue Ridge Parkway locality in North Carolina, *P. rabunbaldensis* occurs in similar vegetation dominated by *Quercus rubra*, above the more diverse lower elevation mixed hardwood forest. At the North Carolina site, the *Quercus rubra* zone grades into a *Picea rubra* forest; *P. rabunbaldensis* only extended into the lowest parts of that vegetation zone where *Quercus rubra* is still dominant, with scattered *Picea*. Evidently, *P. rabunbaldensis* is characteristic of and limited to the distinctive *Quercus rubra* elevation band present at both localities.

The large single gemmae of *P. rabunbaldensis* are somewhat like those of *P. drummondii*, a species not known in eastern North America south of New England (Shaw 1982). The gemmae of *P. rabunbaldensis* lack the characteristic red color of *P. drummondii* gemmae, and tend to be thinner (in diameter) and somewhat longer. Nevertheless, plants of *P. rabunbaldensis* were initially identified in the field as *P. drummondii* because of the large single gemmae with conspicuous, laminate leaf primordia (Fig. 2a). Dried plants, however, are easily distinguished from *P. drummondii* by the smaller, dull leaves that become more or less contorted (Figs. 2c,d). The leaves of *P. rabunbaldensis* are conspicuously decurrent (Fig. 2b), unlike those of any other North American (or European) gemmiferous *Pohlia*. The leafy stems of *P. rabunbaldensis*, with slender, somewhat distant leaves that are dull when dry, are more similar to those of *P. annotina* than to those of *P. drummondii*. *Pohlia annotina*, however, is readily distinguished by the clusters of pale, vermicular gemmae with apical, peglike leaf primordia. Rare forms of *P. annotina*, generally seen late in the growing season, can have

few gemmae sometimes occurring singly in the leaf axils, but these are translucent orange to yellow throughout (including the stiff leaf primordia). Those of *P. rabunbaldensis* have soft, flexuose, often green leaf primordia that can make up half or more the total gemma length (Fig. 2a). The only other North American *Pohlia* species with large single gemmae are *P. beringiensis* Shaw and *P. filum* (Schimp.) Mårt. *Pohlia beringiensis* has whitish leaves and single, cherry-red gemmae; *P. filum* has erect glossy leaves and single egg-shaped gemmae with the leaf primordia restricted to the apex. Both species are restricted in North America to western Canada and Alaska.

#### ACKNOWLEDGMENT

Blanka Shaw first noticed *Pohlia rabunbaldensis* at the North Carolina collecting site, and prepared the photographic illustrations of both species.

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