THE GENUS *BRYHNIA* AND *BRYHNIA GRAMINICOLOR* (BRYOPHYTA: BRACHYTHECIACEAE), NEW TO THE BRYOPHYTE FLORA OF TEXAS, U.S.A.

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ABSTRACT

Bryhnia graminicolor (Brid.) Grout is reported new to the state of Texas. A distribution map of *B. graminicolor* is provided for the south central states of Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas. A key to the genera in the Brachytheciaceae in Texas is provided, and relevant morphological characters are discussed to differentiate *B. graminicolor* from similar species found in Texas.

RESUMEN

Bryhnia graminicolor (Brid.) Grout es reportada por vez primera en estado de Texas. Se incluye un mapa de la distribución de *B. graminicolor* para los estados del centro sur, Alabama, Arkansas, Luisiana, Mississippi, Oklahoma, Tennessee y Texas. Se presenta una clave para los géneros de Brachytheciaceae en Texas, y se discuten los caracteres morfológicos relevantes para poder diferencia *B. graminicolor* de otras especies similares distribuidas en Texas.

INTRODUCTION

While continuing efforts to document the floristic composition and distribution of bryophytes in Texas, a specimen of *Bryhnia graminicolor* (Brid.) Grout was collected by the author in February of 2013. The collection site is on private property in the southwest corner of Montague County, which is located in extreme north-central Texas and borders the Red River (and Oklahoma) to the north. Located in the Western Cross Timbers and Central Great Plains Ecoregions (Griffith et al. 2004) the property is characterized by a series of generally level to gently sloping ridges interspersed with somewhat broad to deeply incised drainages overlooking the southern border of the Natural Resource Conservation Service's, Site 8 Reservoir. The present vegetation at the site is composed of a mature *Celtis laevigata* var. *texana, C. laevigata* var. *reticulata, Fraxinus albicans, Prunus mexicana, Quercus marilandica, Q. stellata, Sideroxylon lanuginosum, Viburnum rufidulum* overstory, and a mixed understory community which includes: *Carex muhlenbergii*, *C. planostachys, C. tetrastachya, Cyperus acuminatus, C. echinatus, C. retroflexus, Chasmanthium latifolium, Dichanthelium acuminatum, D. linearifolium, D. oligosanthes, Elymus canadensis, Antennaria parlinii, Clitoria mariana, Lespedeza repens, Symphoricarpos orbiculatus, Parthenocissus quinquefolia, Smilax bona-nox, S. tamnoides, Toxicodendron radicans, Vitis vulpina, Cheilanthes tomentosa, Pellaea atropurpurea,* and *Woodsia obtusa* (Erickson 2013). Hatch et al. (1990) indicate the mean annual rainfall is 81 cm (32 in) and the mean annual temperature is 18°C (64°F). The specimen was growing on a rock outcrop composed of a strongly cemented, slightly acid, yellowish brown sandstone of the Bonti-Exray Series (United States Department of Agriculture 2013), on a partly to fully shaded northwest facing slope at an elevation of ca. 319 m (1048 ft) (Fig. 1). The collection consisted of a fairly dense, homogeneous mat of gametophytic tissue. No sporophytes were found on the initial, or subsequent, visits to the collection site. Additional bryophytes collected from the same substrate include *Cephaloziella hyalina, Dicranella heteromalla*, and *Entodon seductrix*. A preliminary identification was made by the author using Crum and Anderson (1981), and Ignatov (2014). This initial determination was later verified by Paul G. Davison (UNAF).

Bryhnia graminicolor was not included in the Texas moss flora by Whitehouse (1954), Magill (1980), or Mahler (1980). The species was not listed for Texas in the broader regional treatments by Crum and Anderson (1981), Reese (1984), nor in the treatments of the Brachytheciaceae in the North American Floras by Grout

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Fig. 1. Rocky hillslope habitat of *B. graminicolor* in Montague County, Texas.

(1928) and Ignatov (2014). A search for the species in the on-line "Bryophyte Portal" (CNABH 2017) returned 1576 records from North America, none of which were from Texas.

DISCUSSION

The Brachytheciaceae is a large and diverse family that includes 43 genera and 250 species worldwide. The family is represented by 19 genera and 72 species in North America. Habitats, where members of the family are found, range from truly aquatic to quite xeric sites. The addition of *Bryhnia* to the Texas bryoflora, along with recent nomenclatural changes (Buck et al. 2000; Ignatov & Huttenen 2002; Ignatov 2014; Vitt 2014), brings the genera of the Brachytheciaceae in Texas to eleven, encompassing 16 species.

Brachytheciastrum was segregated from *Brachythecium* by Ignatov & Huttenen (2002) based on a phylogenetic analysis of molecular and morphological characters. These two genera, along with *Rhynchostegium* B.S.G., account for 50% of the species in the family known to occur in Texas. The remaining eight genera, *Bryhnia* Kaur., *Bryoandersonia* Robins., *Clasmatodon* Wilson, *Donrichardsia* H.A. Crum & L.E. Anderson, *Eurhynchiastrum* Ignatov & Huttunen, *Homalotheciella* (Card.) Broth., *Oxyrrhynchium* (Bruch, Schimper & W. Gümbel) Warnstorf, and *Palamocladium* Müller Hal. are monotypic in the state. The genus *Donrichardsia* in Texas, represented by *Donrichardsia macroneuron* (Grout) H.A. Crum & L.E. Anderson, is endemic to the state where it is known from a single locality on the 700 Springs Ranch in Edwards County.

KEY TO THE GENERA OF THE BRACHYTHECIACEAE IN TEXAS

The following key is adapted from Crum and Anderson (1981) and incorporates updated nomenclature, and

recent generic concepts, as proposed by Buck et al. (2000) and Vitt (2014) by moving *Clasmatodon* out of the Fabroniaceae and into the Brachytheciaceae, and Ignatov (2014) by splitting *Eurhynchium* into *Eurhynchiastrum* and *Oxyrrhynchium*.

1. Leaf cells prorate; distal end of costa with one or more abaxial teeth ____ **Bryhnia**
1. Leaf cells not prorate; costa with or without abaxial teeth.
  2. Leaf apices twisted $^1/_4$ turn.
    3. Leaves deeply concave and closely overlapping; stems julaceous ____ **Bryoandersonia**
    3. Leaves plane to somewhat concave and more loosely foliate; stems not julaceous ____ **Rhynchostegium**
  2. Leaf apices plane, not twisted.
    4. Costa with one or more abaxial teeth.
      5. Leaves broadly ovate, apices acute; seta rough ____ **Eurhynchiastrum**
      5. Leaves narrowly oblong-ovate, apices bluntly acute to rounded-obtuse; seta smooth ____ **Oxyrrhynchium**
    4. Costa without teeth on abaxial surface.
      6. Plant aquatic; costa very broad, occupying 1/3 or more of the width of leaf base ____ **Donrichardsia**
      6. Plants terrestrial; costa narrower, occupying less than 1/3 the width of leaf base.
        7. Leaf apex coarsely serrate ____ **Palamocladium**
        7. Leaf apex entire to serrate, but not coarsely serrate.
          8. Calyptra with a few long hairs ____ **Homalotheciella**
          8. Calyptra glabrous.
            9. Capsule erect, narrowly elliptic to oblong; leaves apices acute to narrowly obtuse; plants typically on tree bases and trunks ____ **Clasmatodon**
            9. Capsules inclined, horizontal, or pendant, cylindric to subcylindric; leaf apices acute to acuminate; plants usually on soil or rock.
              10. Stem leaves deeply plicate, 1.3–2.2 mm long ____ **Brachythecium** (p.p.)
              10. Stem leaves not or slightly plicate, smaller, 0.5–1.8 mm long.
                11. Alar cells distinctly differentiated ____ **Brachytheciastrum** (p.p.)
                11. Alar cells not or moderately differentiated.
                  12. Stem leaves larger, 1.0–1.6 mm long, serrulate distally, apices gradually tapered to acuminate ____ **Brachythecium** (p.p.)
                  12. Stem leaves smaller, 0.5–1.0 mm long, coarsely serrate to base, apices abruptly short acuminate ____ **Brachytheciastrum** (p.p.)

Bryhnia Kaur., Bot. Not. 1892:61. 1892.

For a description of the genus see Crum and Anderson (1981) or Ignatov (2014). *Bryhnia* includes between five and seven species worldwide, with three species (*B. graminicolor* (Brid.) Grout, *B. novae-angliae* (Sull. & Lesq.) Grout, and *B. hultenii* E.B. Bartram in A.J. Grout) represented in the North American flora (Ignatov 2014). The range of *B. novae-angliae* in North America is from Newfoundland and Labrador west to Ontario, Illinois and Indiana, south to Arkansas and Alabama, and east to Georgia, North Carolina, and Tennessee. *Bryhnia hultenii* is known only from British Columbia and Alaska in North America. The distribution of *B. graminicolor* is discussed below.

Etymology.—Named for Niels Bryhn (1854–1916), a Norwegian bryologist and author of the European representative of the genus.

Bryhnia graminicolor (Brid.) Grout, Bull. Torrey Bot. Club. 25:231. 1898. Synonyms: *Hypnum graminicolor* Brid., *Hypnum sullivantii* Spence ex Sull. in Gray, *Eurhynchium subscabridum* Kindb., *Eurhynchium sullivantii* (Spruce ex Sull.) Jaeg. & Sauerb. var. *holzingeri* Ren. & Card., *Bryhnia graminicolor* var. *holzingeri* (Ren. & Card.) Grout. Representative illustrations can be found in Crum and Anderson (1981).

Etymology.—*graminicolor* referring to the pale green to yellowish "grass-like" coloration of the gametophyte.

Bryhnia graminicolor, and its purported close relative *B. novae-angliae,* have been variously placed within the Brachytheciaceae and their relationship remains uncertain. Grout (1928) placed both entities within the Brachytheciaceae as distinct species in *Bryhnia,* although acknowledging their relationship below the generic level was unclear. Andrews (1957) placed *B. graminicolor* in *Rhynchostegium* [as *Rhynchostegium graminicolor* (Brid.) A.L. Andrews], and *B. novae-angliae* in *Brachythecium* [as *Brachythecium novae-angliae* (Sull. & Lesq.) Jaeg. & Sauerb.]. Robinson (1962), maintaining there is only a weak segregation between the two, treats them as distinct species within *Bryhnia,* suggesting the wide distribution and presence of sporophytes in *B. graminicolor* indicated some stability in the species. Crum and Anderson (1981) and Ignatov (2014) retain Robinson's

separation. However, Ignatov advocates that among the North American members of *Bryhnia*, *B. graminicolor* is not closely related to the other core groups in the genus, and thus may justify the splitting of *B. graminicolor* into its own genus. The lack of a consensus on the placement of the species may benefit from a closer look using molecular markers in light of the misleading morphology (Ignatov 2014).

Voucher specimen: **TEXAS. Montague Co:** Jeanne and Wayne Erickson's property at 500 Fossil Hill Drive near the city of Bowie, at summit of the hillslope just S of the residence, upland *Quercus-Celtis* woodland, rock outcrop, sandstone rock substrate, elev. 1048 ft, N 33.45575, W -97.87744, 8 Feb 2013, *Dale A. Kruse 4762* (BRIT, TAES, UNAF). **Fig. 2, Fig. 3 A-F.**

The following abbreviated description is adapted from Crum and Anderson (1981) and Ignatov (2014). *Bryhnia graminicolor* is a light green to dirty yellowish-brown pleurocarpous moss growing in moderate to somewhat densely compact tufts or mats. **Primary stems** prostrate to ascending, or occasionally stoloniferous, with regularly pinnate, ascending, straight or flexuose branches, to about 5 mm. **Stem leaves** stiffly spreading when wet, narrowly ovate to lanceolate, acute to acuminate, broadest well below the middle, weakly to moderately plicate, 0.6–1.1 mm long, margins serrate to serrulate nearly to the base. **Costa** moderately weak and ending in distal portion of the leaf but below the apex, smooth to moderately toothed on back, often ending in an abaxial spine(s). **Laminal cells** elongate, strongly papillose from distal cell ends. **Basal cells** shorter, cells in alar region subquadrate to short rectangular. **Branch leaves** erect spreading when wet, 0.4–0.6 mm long, lanceolate, acuminate, apices not twisted, widest below the middle, plane to only slightly recurved. **Costa** strong and ending in distal portion of the leaf but below the apex, smooth to moderately toothed on back, often ending in an abaxial spine(s). **Laminal cells** oblong-linear, abaxially papillose from distal cell ends. **Capsules** exserted, inclined, 1.5–2 mm, seta 7–10 (15) mm long.

Fig. 2. Habit (dry) of *B. graminicolor* (*Kruse 4762*).

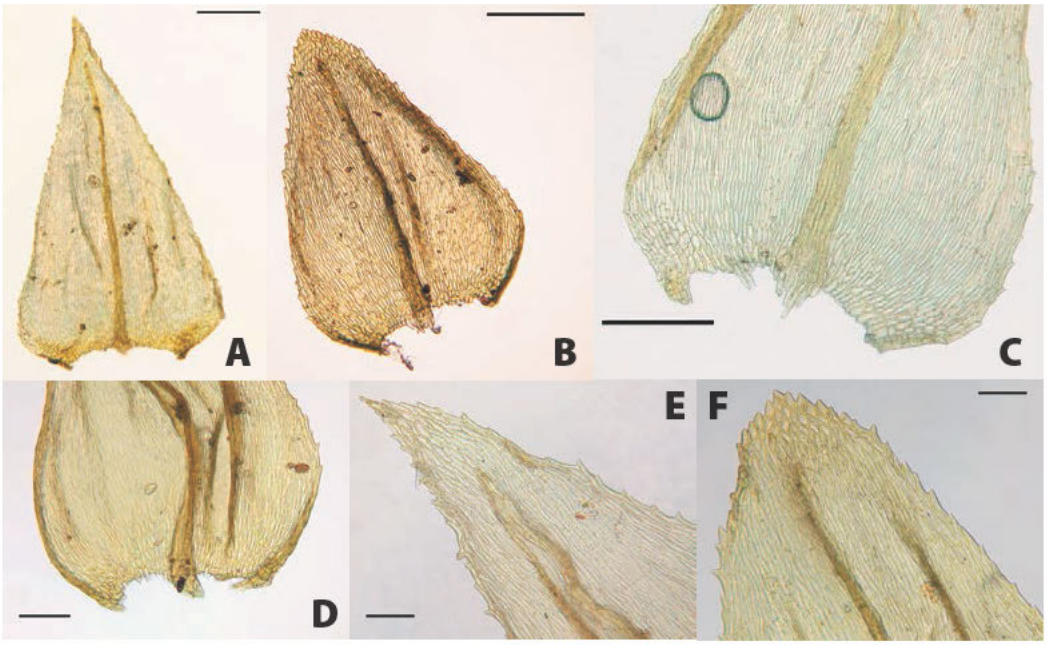

Fig. 3. Photomicrographs of *B. graminicolor* (*Kruse 4762*): **A.** Stem leaf (10×); **B.** Branch leaf (10×); **C.** Stem leaf base and alar region (20×); **D.** Branch leaf base and alar region (20×); **E.** Stem leaf apex (40×); **F.** Branch leaf apex (40×). Scale bars: A–D measure 200 µm; E-F measure 50 µm.

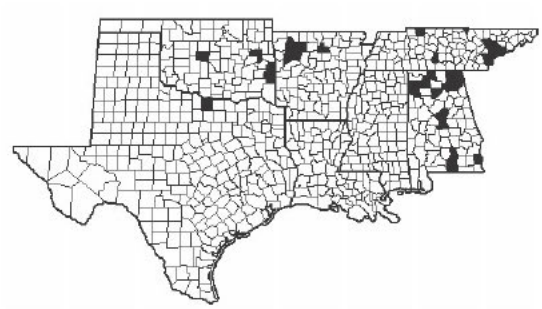

Fig. 4. County level distribution map of *B. graminicolor* in the south-central United States based on specimens examined and selected records from CNABH, Churchill et al. (1981), and Richardson and Palmer (2016).

Due to the often prominent abaxial spines at the distal end of the costa, *B. graminicolor* is most easily confused with *Rhynchostegium*, *Eurhynchiastrum*, or *Oxyrrhynchium* in Texas. *Rhynchostegium* typically has distal leaf tips that are twisted ¼ turn and leaf cells without papilla. In both *Eurhynchiastrum* and *Oxyrrhynchium* the leaf cells are epapillose.

Distribution

The range of *B. graminicolor* in North America is generally continuous, at the state level, east of the Great Plains from Newfoundland and Labrador west to Quebec and Ontario then along a western limit from Minnesota south to Iowa, Nebraska, Kansas, Oklahoma, and now Texas. One disjunct record from Utah is the only known specimen west of the Great Plains. The Texas record reported here is apparently the southwestern limit for the

species in North America. Figure 4 provides a county level distribution record for selected south-central states based on 199 records, for the mapped states, from CNABH and the new Texas record. The eastern Oklahoma records, from Muskogee and LeFlore counties, are from Churchill et al. (1981), and Richardson and Palmer (2016) respectively. None of the county records in Figure 4 have been verified by the author. CNABH specimen records where a county was not specified, or one could not be reasonably determined, were not mapped.

The genus *Bryhnia* has a Holarctic distribution across North America and Eurasia (Ignatov 2014). *B. graminicolor*, as currently circumscribed, is limited to the central (Boreal Region) and eastern United States and Canada (Eastern North American Region) of the Holarctic Kingdom (Schofield 1992).

Ecology

Bryhnia graminicolor is a terricolous or saxicolous, less frequently corticulous, moss growing on rock faces, crevices, and ledges, and often on banks along roads and streams in shaded to somewhat open moist forested habitats. Although usually found at lower elevations (up to 900 m) than its close relative *B. novae-angliae*, Ignatov (2014) notes the habitat (wet logs and lumber) and the high elevation (2040 m) of the Utah collection as unusual for the species.

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