

THE TAXONOMY OF *CAREX BROMOIDES* (CYPERACEAE)

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INTRODUCTION

Carex bromoides Willd. (Cyperaceae) is a widespread and frequent sedge of eastern North America. It belongs to *Carex* sect. *Deweyanae* (Tuckerman ex Mackenzie) Mackenzie, a group of 4–7 primarily woodland species of eastern Asia and most of North America. Members of sect. *Deweyanae* are lax, caespitose sedges with setaceous lower bracts, mostly gynecandrous spikes, distigmatic pistillate flowers, and spongy-based, prominently beaked, thick-margined, nonpunctulate perigynia ascending at maturity. Morphologically the most distinctive member of sect. *Deweyanae*, *C. bromoides* is unique in the section in possessing perigynia 4–6 times as long as wide and achenes 2–3 times as long as wide. Other members of the section have perigynia only 2–3.5 times and achenes 1–2 times as long as wide. The high number (5–10 on the abaxial surface) and prominence of perigynium veins are also diagnostic of *C. bromoides*. The *C. deweyana* group of sect. *Deweyanae* (*C. bolanderi* Olney, *C. deweyana* Schwein., *C. leptopoda* Mackenzie, and *C. senanensis* Ohwi) have fewer (0–5 on the abaxial surface) and weaker perigynium veins. The *C. laeviculmis* group (*C. kreczetoviczii* Egorova, *C. laeviculmis* Meinsh., the latter species referred to sect. *Deweyanae* by Reznicek and Ball 1980) is similar to *C. bromoides*, however, in possessing 5–9 somewhat conspicuous veins on the abaxial surface of the perigynium.

Although *C. bromoides* is a widespread species and was described very early (Willdenow 1805), no infraspecific taxa have been proposed, probably because it is relatively morphologically uniform over most of its range. The recognition of noteworthy morphological variation in this species, undescribed even in the most recent taxonomic treatments of it (Fernald 1902; Kükenthal 1909; Mackenzie 1931), has prompted this investigation of the taxonomy of *C. bromoides*.

MATERIALS AND METHODS

This investigation is based upon herbarium and field studies of *Carex bromoides*. I examined more than 1500 specimens of *C. bromoides* from the 37 herbaria listed in the acknowledgments. To study infraspecific morphologic variation in *C. bromoides*, I measured at least 17 vegetative and reproductive characters on each of over 50 specimens. The specimens were selected to span the geographic range and morphologic variability of the species. Leaves, ligules, vegetative shoots, and inflorescences were measured as described by Reznicek (1986). I studied *C. bromoides* in the field in Québec, Ontario, Michigan, Virginia, North Carolina, South Carolina, Florida, Arkansas, and Louisiana from 1987 to 1989.

RESULTS AND DISCUSSION

Two patterns of morphologic variation are apparent in *Carex bromoides*. The first concerns two characters in plants of the eastern portion of the Blue Ridge

FIG. 1. Widest leaf width vs. culm width at mid-height for *Carex bromoides*.

The second pattern of morphologic variation evident in *C. bromoides* is clinal variation in leaf width and rhizome length (as measured by length of the longest rhizome internode on a plant) in subsp. *bromoides*. Leaf width gradually increases with decreasing latitude (Fig. 2). The correlation between leaf width and latitude is highly statistically significant and moderately strong (Pearson Correlation, $r = -0.50$, $P < 0.001$, $n = 89$). Likewise, rhizome length exhibits a latitudinal cline,

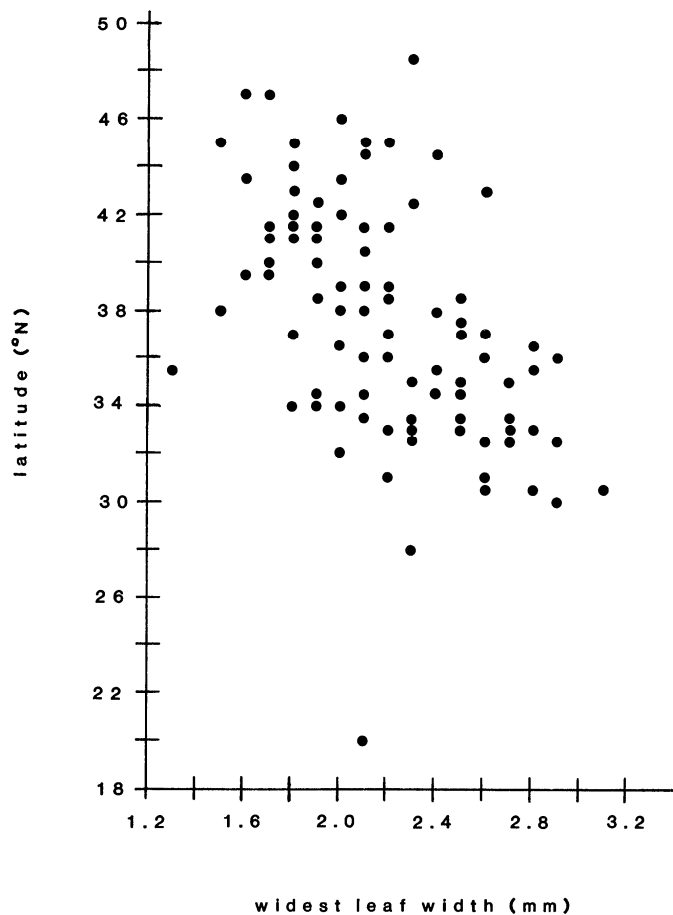


FIG. 2. Clinal variation in leaf width in *Carex bromoides* subsp. *bromoides*. The gap in data points between 20° and 28° reflects a gap in the subspecies' latitudinal range between southern Hidalgo and central peninsular Florida.

gradually increasing with decreasing latitude (Spearman Rank Correlation, $r_s = -0.45$, $P < 0.005$, $n = 32$). A few specimens of subsp. *bromoides* from the southeastern United States approach subsp. *montana* in leaf width (Fig. 1). These plants usually have long-creeping rhizomes (longest internodes 6–20 mm long), which are almost always lacking in subsp. *montana* and provide a means of differentiating the two subspecies. Because dead leaves of the previous season (often the widest leaves on a plant) and long-creeping rhizomes provide valuable taxonomic characters, they should be included when gathering and preparing specimens of *C. bromoides*.

TAXONOMY

Carex bromoides Willdenow, Sp. pl. 4: 258. 1805. *Lonicoperis bromoides* (Willdenow) Rafinesque, Good Book 27. 1840.—TYPE: "Pennsylvania," *Muhlenberg s.n.* (holotype: B-W No. 17193, photo: MICH!).

Plants densely to loosely caespitose. Rhizomes short to long with internodes 0.2–20 mm long, 0.9–1.2 mm thick. Roots fibrous, smooth, pale to dark brown. Fertile culms 23–88 cm tall, 0.5–1.6 mm wide at mid-height, acutely trigonous, hollow, erect to spreading, elongating in fruit, antrorsely scabridulous-angled distally, with glabrous, pale brown basal sheaths. Leaves 3–4, all in basal eighth to quarter, much shorter than culms in fruit; blades 1.0–18.5 cm long, 1.1–4.4 mm wide, uppermost longest, diminishing in length to bladeless sheaths at base of culm, flat to barely plicate, glabrous, margins and abaxial surface of main veins antrorsely scabridulous, more strongly scabridulous distally, the widest leaves 1.3–4.4 mm wide; leaf sheaths 2–17 cm long, tightly enveloping culms, glabrous, green, inner band of sheaths hyaline, apex concave and not thickened to slightly thickened; ligules 1.0–3.5 mm long, inverted V-shaped with apex blunt. Vegetative shoots 16–71 cm tall; leaves 3–6, similar to those of fertile culms except blades ca. 5–57 cm long; pseudoculms 4–17 cm tall. Inflorescences (12–) 21–55 mm long, usually with pistillate and staminate flowers but rarely entirely staminate, with the upper spikes closely overlapping and the lowest 2 spikes overlapping or separate, 3.3–16 (–23) mm distant; lowermost bract 5.0–24 (–28) mm long, sheathless, body squamiform, oblong to lanceolate, midrib prolonged into a green, antrorsely scabridulous, setaceous awn 1.3–19 mm long, the upper bracts much reduced, squamiform and short-awned to awnless. Spikes 3–8, simple, most often gynecandrous but also entirely pistillate, entirely staminate, or with staminate flowers scattered throughout. Terminal spike 9–20 (–25) mm long, 1.5–5.0 mm wide, usually with 0–3 staminate and 8–18 pistillate flowers, sessile or on peduncle up to 3.0 mm long. Basal spike 10–17 (–20) mm long, 1.8–5.0 mm wide, usually with 0–2 staminate and 9–19 pistillate flowers, sessile. Remaining spikes shorter than terminal or basal spike, 4–15 (–18) mm long, 1.0–4.4 mm wide, usually with 0–3 staminate and 2–16 pistillate flowers, sessile. Pistillate scales 2.8–4.1 mm long, 1.1–1.6 mm wide, oblong to lance-ovate, acuminate to cuspidate with cusp up to 0.6 mm long, glabrous, stramineous to castaneous with hyaline margins and green center, 1-veined. Staminate scales 2.8–3.9 mm long, 1.4–1.6 mm wide, oblong to lance-ovate, acute to acuminate, awnless, otherwise like pistillate scales. Perigynia (3.5–) 3.9–5.5 (–6.1) mm long, 0.8–1.3 mm wide, erect to appressed-erect, plano-convex, narrowly lanceolate, (3.5–) 4.0–6.1 (–6.6) times as long as wide, green to pale brown, sessile, 3–6-veined adaxially, 5–10-veined abaxially, spongy-thickened at base surrounding

achene, abruptly contracted to gradually narrowed to a beak; beaks 1.2–2.2 (–2.8) mm long, 0.28–0.51 of total perigynium length, serrulate on margins, the apex bidentulate with teeth up to 0.2 mm long. Achenes 1.7–2.2 mm long, 0.7–1.1 mm wide, plano-convex to biconvex, ovate-oblong, 1.9–2.9 times as long as wide, tightly enveloped by perigynia, brown, sessile. Styles slender, somewhat enlarged at base, jointed with achene, withering; stigmas 2, 2.0–3.4 mm long. Anthers 3, 1.7–2.9 mm long.

The distribution of pistillate and staminate flowers in the inflorescence of this species is quite variable. Though usually gynecandrous, spikes may exhibit virtually every arrangement possible of male and female flowers. Often recognizing only a portion of this variability, several early authors contradicted each other regarding the order of the sexes, as discussed by Boott (1858).

***Carex bromoides* subsp. *bromoides*.**

Densely to loosely caespitose. Rhizomes short to long, internodes 0.2–20 mm long. Culms (0.5–) 0.6–1.0 (–1.1) mm wide at mid-height. Widest leaf (1.3–) 1.5–2.9 (–3.1) mm wide.

Carex bromoides subsp. *bromoides* is widespread in eastern North America, from Nova Scotia west to Minnesota and south to Florida and Texas (Fig. 3). The

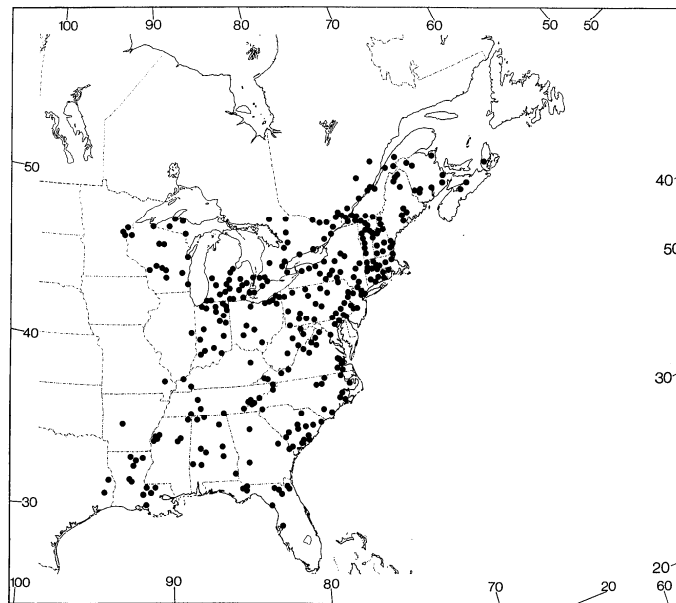


FIG. 3. Distribution of *Carex bromoides* subsp. *bromoides* north of Mexico.

range of this subspecies is nearly continuous in the eastern United States. It is, however, rare in much of the Interior Low Plateaus and the southern portion of the Piedmont physiographic provinces. *Carex bromoides* subsp. *bromoides* has also been collected in the Sierra Madre Oriental of Mexico (Hidalgo: banks of brooks, Trinidad, 5800 ft., 30 April 1904, *Pringle 8809*, GH, MICH, MO, PH, UC). Many other species of vascular plants occur in the mountains of eastern Mexico as well as in the eastern United States and Canada. Such disjuncts include *Asplenium resiliens* Kunze, *Epifagus virginiana* (L.) Bart., *Liquidambar styraciflua* L., *Mitchella repens* L., and *Nyssa sylvatica* Marsh. (Miranda & Sharp 1950; Dressler 1954).

This subspecies grows primarily in wet deciduous forests and hardwood swamps (although often with *Taxodium* in the southeastern United States), often on floodplains, in a variety of soils, including sandy loam, alluvial sand, heavy alluvial clay, and muck. Usually, *C. bromoides* subsp. *bromoides* grows below 460 meters (1500 feet) elevation. However, several populations in the mountains of Virginia, North Carolina, and Tennessee live between 460 and 920 meters (1500 and 3000 feet); one collection is reported from 1140 meters (3700 feet). Often abundant where found, subsp. *bromoides* may dominate forest or swamp floors with nearly contiguous clumps (in the North) or continuous mats of vegetation (in the South).

***Carex bromoides* subsp. *montana* Naczi, subsp. nov.**—TYPE: SOUTH CAROLINA. Pickens Co.: ca. 2 mi. N of Rocky Bottom and 1.3 mi. S of North Carolina border along E side of Eastatoe Creek just downslope from W side of rte. 178, lightly shaded, moss-covered rocks and sandy soil at creek margin, ca. 1850 ft., common, 3 May 1989, *Naczi 2091* (holotype: MICH!; isotypes: ctb! CLEMS! GH! NCU! NY! TENN! US! VPI!).

A subsp. *bromoide* habitu semper dense cespitoso, culmis latioribus (1.0–1.6 mm latis), foliis latioribus (folio latissimo 2.8–4.4 mm lato) differt.

Densely cespitose. Rhizomes short, internodes 0.2–1.0 (–8.5) mm long. Culms 1.0–1.6 mm wide at mid-height. Widest leaf 2.8–4.4 mm wide.

Carex bromoides subsp. *montana* is restricted to the eastern portion of the Blue Ridge physiographic province of southwestern Virginia, western North Carolina, and northwestern South Carolina (Fig. 4). One collection (not mapped) from the Piedmont of northern North Carolina (Rockingham Co.: waste ground along railroad, Reidsville, 28 May 1970, *Leonard 3216 & Radford*, NCU) apparently represents an introduction from the Blue Ridge. The unusual habitat, paucity of collections of *C. bromoides* from the Piedmont, and the fact that the railroad along which it was collected connects to a railroad passing through several of the mountain counties of North Carolina strongly suggest an introduction. Many species of vascular plants are similarly endemic to the southern Blue Ridge physiographic province. These narrow endemics include several *Carex* species: *C. amplisquama* F. J. Herm., *C. biltmoreana* Mackenzie, *C. manhartii* Bryson, *C. misera* Buckl., *C. roanensis* F. J. Herm., and *C. ruthii* Mackenzie.

This subspecies grows primarily along small streams and seepages in deciduous forests, often with *Diphylllea cymosa* Michx. Commonly, it roots in moss among rocks. Unlike *C. bromoides* subsp. *bromoides*, subsp. *montana* does not occur on floodplains and prefers high elevations. Most collections of subsp. *montana* are from 770–1380 meters (2500–4500 feet) elevation, though a few are from as low as 430 meters (1400 feet). Populations of it often consist of only a few scattered clumps (e.g., *Naczi 1671*, 6 clumps; *Naczi 1666*, 3 clumps; *Naczi 2214*, ca. 45 clumps).

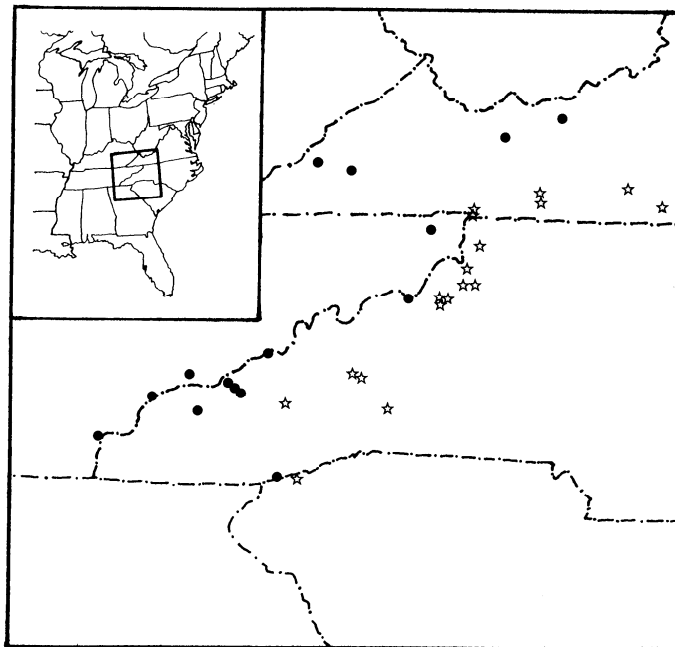


FIG. 4. Distribution of *Carex bromoides* in the mountains of Virginia, North Carolina, South Carolina, and Tennessee. Circles represent subsp. *bromoides* and stars represent subsp. *montana*.

Enigmatically, the largest population I have observed thrives in a habitat quite unlike the forested streamside or seepage. At this site, subsp. *montana* (Ahles 43616 & Duke, Radford 44101, Naczi 1657) roots in *Sphagnum* spp. in a bog with scattered *Picea rubens* Sarg., *Carex ruthii* Mackenzie, and *Vaccinium macrocarpon* Ait.

Although both subspecies of *C. bromoides* inhabit the southern Blue Ridge (Fig. 4), apparently no mixed populations have been discovered. The fact that a few populations of subsp. *bromoides* occur at high elevations and a few of subsp. *montana* at low elevations within the same region and still maintain their differences suggests that subsp. *montana* is not merely an environmental extreme of subsp. *bromoides*.

ADDITIONAL SPECIMENS EXAMINED. VIRGINIA. Patrick Co.: ca. 5 mi N of Stuart, 1.3 mi N of rte 8-rte 58 jct along W side of rte 8, Naczi 1671 (MICH). Floyd Co.: Buffalo Mt., Stevens 12986 (FARM). Wythe Co.: near Dry Run Gap, Iron Mts., Stevens 12757 (FARM). Grayson Co.: Point Lookout Mt., near Independence, Stevens 12708 (FARM); Mt. Rogers Nat. Recr. Area, 0.2 mi NW along nat. forest rd to summit of Whitetop Mt. from Va. 600 at ca. 1.5 mi N of Va. Hwy. 58, ca. 6 mi E of Damascus, Reznicek & Reznicek 7702 (ctb, MICH); Whitetop Mt., along W side of rte 600, 0.3 mi S of Smyth Co. border,

Naczi 1669 (MICH); along Big Horse Creek 0.5 mi SE of Whitetop, *Wieboldt & Wieboldt 5084* (ctb, VPI).—NORTH CAROLINA. Ashe Co.: Bluff Mountain, *Radford 44050* (ILL, UARK, US). Watauga Co.: northeast slope of Elk Knob, *Moore 3253* (NCU); 2.4 mi SE of US 421 on Junaluska Rd (ca. 6 mi E of Boone), *Solomon 1643* (VDB); Rich Mt., *Radford 45372* (DS, NCU); Boone, behind Industrial Arts Bldg., Appalachian State University, *Schroede s.n.* (TENN); along W side of rte 221 just N of Caldwell Co. border, *Naczi 1666* (MICH). Avery Co.: 4.2 mi SSE of Banner Elk on NC 184, *Ahles 43616 & Duke* (NCU); near jct of NC 105 and NC 184, *Radford 44101* (NCU); ca. 4 mi SSE of Banner Elk along W side of rte 105 just W of its jct with rte 184, *Naczi 1657* (MICH); 1 mi SSW of jct NC 184 and 105 on NC 105 (NNE of Linville), *Ahles 43646 & Duke* (MICH, NCU, WTU); ca. 1.5 mi E of Linville along E side of Blue Ridge Parkway just N of Grandfather Mt. overlook, mile 306.6, *Naczi 2214* (MICH). Buncombe Co.: Craggy Mt., *Biltmore Herbarium 196a* (NY, US); in front of Morgan Science Bldg., campus of Montreat-Anderson College, Montreat, *Rothrock 1086* (NCU). Haywood Co.: near Waynesville, *Biltmore Herbarium 196b* (US). Rutherford Co.: 3 mi N of Lake Lure, *Ahles 11251 & Bell* (GH, NCU).

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