

Carex radfordii (Section *Laxiflorae*: Cyperaceae), a New Species from the Southern Appalachians

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ABSTRACT. *Carex radfordii* Gaddy is a new species of *Carex* sect. *Laxiflorae* from the southern Appalachian Mountains of North Carolina, South Carolina, and Georgia. It is a robust species most closely allied to *Carex purpurifera* Mackenzie and *Carex laxiflora* Lamarck. Its long awns, glaucous blue-green blades, and brownish white basal sheaths distinguish it from other species of *Carex*.

Carex sect. *Laxiflorae* has been studied by various investigators in this century. Recently, Bryson (1980) carried out a morphological analysis, and Manhart (1984, 1985, 1986) conducted studies on the morphology, chemotaxonomy, and cytology of the section.

Carex laxiflora Lamarck, the namesake for section *Laxiflorae*, ranges across eastern North America from Maine and southern Quebec south to North Carolina west to Wisconsin and Indiana (Gleason & Cronquist, 1991). It is probably the most variable and complex species in section *Laxiflorae* and is easily confused with other species in this section. Cariciologists have often wondered whether *Carex laxiflora* was one species or a complex of species. Mackenzie (1935) described *C. purpurifera* Mackenzie from specimens that were previously thought to be *C. laxiflora*, and Bryson's (1985) description of *C. manhartii* Bryson indicates that *C. purpurifera* is, in fact, made up of at least two distinct elements.

The following species was first seen in the spring of 1979. Since then, I have observed the plant at numerous sites and mapped its distribution. I now conclude that it is a new taxon.

Carex radfordii Gaddy, sp. nov. TYPE: U.S.A. South Carolina: Oconee County, in shallow soil, over calcareous rocks, Station Cove, 25 Apr. 1986, L. L. Gaddy s.n. (holotype, CLEMS; isotypes, GA, MO, NCU, NY, US, USCH, WCUH, herbarium of C. T. Bryson). Figure 1.

A *Carex laxiflora* aristis squamis pistillatis longis et laminis venetis glaucis differt; a *Carex purpurifera* vaginis basalibus albidis brunneis differt.

Plant caespitose perennial, culms 4–6 dm tall,

strongly aphyllipodic, triangular, usually $1.5 \times$ longer than blades. Basal sheaths brownish white, 3–9 cm long, cataphylls well developed, 1–7 cm long. Blades blue-green, glaucous on undersides, 2–5.5 cm long, 7–15 mm wide, midrib well developed, with small teeth dorsally. Staminate spikes 2–4 cm long, 3–6 mm wide, usually solitary, peduncles 4–12 cm long. Pistillate spikes 3–5, peduncles 4–12 cm long, bracts 4–10 cm long, 1–2 mm wide, apices acuminate, sheaths 1–3 cm long, ligules scarious, 4–6 mm long. Perigynia 3–10 per spike, 3–4.5 mm long, obovoid, light green, beak slightly recurved, to 1.5 mm long; scales acute to aristate, often asymmetrical, rarely retuse, serrulate awns 1–5 mm long, usually overtopping the beak of the perigynia, total scale and awn length 3–9 mm, midrib green, margins scarious and hyaline. Achenes obovoid, filling body of the perigynia, 1–2.5 mm long, 0.8–1.2 mm wide, styles exserted, stigmas 3.

I take pleasure in naming this species after Albert E. Radford, Professor Emeritus, University of North Carolina (Chapel Hill), and a lifelong student of *Carex*. In the mid 1970s, Dr. Radford told me that the Brevard Belt of the Carolinas and Georgia was a rich floristic zone that offered many potential discoveries. I honor him with this discovery.

Some of the essential characters of *C. radfordii*, *C. purpurifera*, *C. laxiflora*, *C. striatula* Michaux, and *C. manhartii* are compared in Table 1. As may be seen in the table, *C. radfordii* shares many characters with *C. purpurifera* and *C. laxiflora*, and fewer characters with *C. striatula* and *C. manhartii*. Furthermore, measurements of the height of the flowering culms, pistillate scale body length, and pistillate scale awn length overlap somewhat in these five species. In height of flowering culm, *C. radfordii* is a robust species that can only be compared to *C. purpurifera*. Its blue-green blades (not obvious in herbarium specimens), which are glaucous on the undersides, are similar to those of *C. purpurifera*, except for the lack of purplish pigment in the basal sheaths. Its pistillate scale awns are usually much longer than those of *C. laxiflora*, *C.*

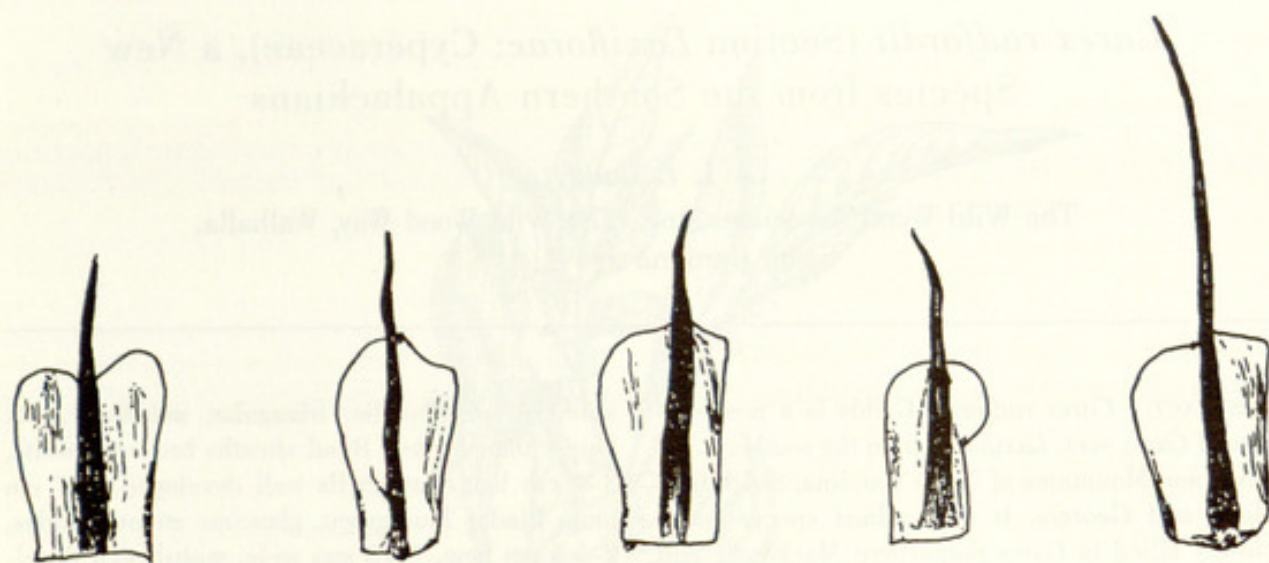


Figure 1. Variation in pistillate scale shape and awn length in *Carex radfordii* Gaddy: from lower and upper pistillate spikes of the type specimen. 9 \times . Illustration by Hu Ye.

striatula, and *C. manhartii*. Occasionally, the awns of *C. purpurifera*'s pistillate scales approach those of *C. radfordii* in length; however, on a given plant, the mean pistillate scale awn length is always greater in *C. radfordii*. The shape of the pistillate scale awn in *C. radfordii* is also distinct from that of other related species. In *C. laxiflora*, *C. striatula*, and *C. manhartii*, the pistillate scales are acute to awned; in *C. purpurifera*, the scales are more variable, often being retuse; in *C. radfordii*, the scales are long-awned to rarely retuse, with a majority usually asymmetrical. Chromosome number in *C. radfordii* has been determined to be $n = 23$, which separates it from all related species (Robert Naczi, unpublished data; Manhart, 1986).

Carex radfordii can be delimited from related species by several characters, as may be seen in

the key below. From *Carex manhartii* and *C. purpurifera*, to which it appears to be most closely related, it can be separated by its brownish white culm bases. From *C. laxiflora* and *C. striatula*, it can be distinguished by its blue-green blades with glaucous undersides and its asymmetrical pistillate scale bodies with extremely long awns.

Upon first examination, *C. radfordii* appears to be an "albino" *C. purpurifera*. Closer inspection, however, reveals that the staminate spikes of *C. radfordii* are significantly longer than those of *C. purpurifera* and that the pistillate scales are more variable in shape in *C. radfordii*. Other good field characters for *C. radfordii* are its erect flowering culms (those of *C. laxiflora* and *C. striatula* usually lean over) and its strongly aphyllopodic culm bases.

Carex radfordii is found in rich, often rocky, cal-

Table 1. *Carex radfordii* and its allies.

Character	<i>C. radfordii</i>	<i>C. purpurifera</i>	<i>C. laxiflora</i>	<i>C. striatula</i>	<i>C. manhartii</i>
Height of flowering culms	4–6.5 dm	3.7–6.7 dm	3.1–5 dm	3–5.5 dm	2.1–3.9 dm
Blade color	Blue-green, glaucous underside	Blue-green, glaucous underside	Dark green	Whitish blue-green	Dark green
Basal sheath color	Brownish white	Purple	Brownish white	Brownish white	Reddish purple
Shape of pistillate scale	Long-awned to asymmetrical to retuse	Long-awned to retuse	Acute to awned	Acute to awned	Acute to awned
Scale length	2–4 mm	1.7–5 mm	2–4.5 mm	1.5–5.7 mm	3.5–4 mm
Awn length	1–5 mm	1–5 mm	0.5–2.3 mm	0.8–3.7 mm	0.1–3.5 mm
Chromosome number	$n = 23$	$n = 17, 18, 19$	$n = 20$	$n = 18, 20$	$n = 14$

careous woodlands on well-drained soils. The plant is found from about 300 m to just under 650 m in elevation. Of the closely related species discussed in Table 1, *Carex radfordii* is sympatric only with *C. manhartii* (see below). Most known sites are located in the Brevard or Chauga Belt, a belt of meta-sedimentary rock along a transition zone between the Piedmont and the Blue Ridge of the Carolinas and Georgia. The rocks of this belt have weathered to produce soils with high concentrations of calcium and magnesium (Hatcher, 1969). The soil pH at *C. radfordii* sites is fairly high for the generally acidic southern Blue Ridge region; at Station Cove, the type locality, the pH is 6.0 (Gaddy, 1990). Although it occurs in rich coves with *C. austro-caroliniana* Bailey, *Carex radfordii* is usually found at rockier, better-drained microsites than those occupied by *C. austro-caroliniana*. Below Whitewater Falls, North Carolina, *C. radfordii* grows alongside of *C. manhartii*. When a plant of *C. radfordii* from the type locality was experimentally grown in low calcium, low pH soils with a plant of *C. laxiflora* from the Blue Ridge of North Carolina and a plant of *C. striatula* from the Piedmont of South Carolina, all three species retained their distinguishing morphological characteristics.

KEY TO *C. RADFORDII* AND RELATED SPECIES

- 1a. Base of culms brown, brownish white, or white.
 - 2a. Blades whitish green to blue-green, undersides white striolate; pistillate scales symmetrical, awns 0.5–3.7 mm long.
 - 3a. Blades whitish green to blue-green *C. striatula*
 - 3b. Blades dark green *C. laxiflora*
- 2b. Blades blue-green, undersides glaucous; pistillate scale bodies often asymmetrical, awns 1–5 mm long *C. radfordii*
- 1b. Base of culms reddish, reddish purple, or purplish.
 - 3a. Blades green, undersides not glaucous *C. manhartii*
 - 3b. Blades blue-green, undersides glaucous *C. purpurifera*

Paratypes. U.S.A. **Georgia:** Stephens County, Cedar Creek, Camp Mikell Rd. off Ga. Rt. 184, just W of Camp Mikell, N of Toccoa, elev. ca. 300 m, deep gorge, 19 June 1975, D. E. Boufford 16552 & E. Wood (GA). **North Carolina:** Macon County, Whitewater Falls, just below falls on lower portion of rich slopes, 15 May 1994, L. L. Gaddy

s.n. (CLEMS). **South Carolina:** Greenville County, with *Carex austro-caroliniana* and *Cladastis kentuckea* off Bentfield Rd. N side of Saluda River, 17 May 1993, S. R. Hill 25034 (CLEMS); Oconee County, in rich, calcareous woods along Ramsey Creek below Rich Mountain, 20 Apr. 1992, L. L. Gaddy s.n. (CLEMS); Rich woods, Station Cove, 22 Apr. 1986, L. L. Gaddy s.n. (CLEMS); NE side of ridge at Tamasee Creek, Rich cove woodland, Comp. 17, Std. 16, 8 May 1993, S. R. Hill 24994 (CLEMS). Pickens County, Rich woods, below “the Narrows” in the Eastatoe Gorge, 23 Apr. 1987, L. L. Gaddy s.n. with D. A. Rayner (CLEMS); 1.3 mi. S of NC line, N of Rocky Bottom, elev. ca. 2100 ft., diverse mesic forest slope near creek crossing, soil a rich alkaline or neutral loam, occasional to frequent, conspicuously glaucous perennial, 10 Apr. 1988, S. R. Hill 19102 (CLEMS); shaded rich mesic woodland, 1.3 mi. S of NC line, N of Rocky Bottom, elev. ca. 2100 ft., occasional glaucous herb on steep slope, 9 May 1988, S. R. Hill 19271 with C. Horn (CLEMS).

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