

CAREX CUMBERLANDENSIS, A NEW SPECIES OF  
SECTION CAREYANAE (CYPERACEAE) FROM THE  
EASTERN UNITED STATES OF AMERICA

Robert F.C. Naczi

Claude E. Phillips Herbarium  
Department of Agriculture and Natural Resources  
Delaware State University  
Dover, DE 19901-2277, U.S.A.  
rnaczi@dsc.edu

Robert Kral

Botanical Research Institute of Texas  
509 Pecan Street  
Fort Worth, TX 76102-4060, U.S.A.

Charles T. Bryson

USDA-ARS  
Southern Weed Science Research Unit  
P.O. Box 350  
Stoneville, MS 38776, U.S.A.  
cbryson@ars.usda.gov

ABSTRACT

*Carex cumberlandensis* is described as new from mesic forests in Alabama, Arkansas, Georgia, Indiana, Kentucky, Mississippi, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia. Previously, specimens of *C. cumberlandensis* had been confused with *C. digitalis* and *C. abscondita*. *Carex cumberlandensis* has vegetative shoots much taller than the culms, very narrow staminate spikes, short staminate scales, and obtuse staminate scales, all of which distinguish it from *C. digitalis*. Unlike *C. abscondita*, *C. cumberlandensis* has the lower spikes on long and drooping or nodding peduncles, distichously imbricate perigynia, the bract blade of the distalmost lateral spike (12-)17-51 times as long as wide, and always densely caespitose habit. The chromosome number of *C. cumberlandensis* is  $2n = 23 II$ .

RESUMEN

Se describe como nuevo *Carex cumberlandensis* de los bosques mesófilos de Alabama, Arkansas, Georgia, Indiana, Kentucky, Mississippi, Carolina del Norte, Ohio, Pennsylvania, Carolina del Sur, Tennessee, Virginia, y West Virginia. Previamente, se habían confundido especímenes de *C. cumberlandensis* con *C. digitalis* y *C. abscondita*. *Carex cumberlandensis* tiene renuevos vegetativos mucho más altos que los culmenes, espigas estaminadas muy estrechas, escamas estaminadas cortas y obtusas, todo lo cual lo distingue de *C. digitalis*. Al contrario que *C. abscondita*, *C. cumberlandensis* tiene las espigas inferiores nutantes o colgantes en largos pedúnculos, utrículos imbricados dísticamente, la lámina de la bráctea de la espiga lateral más distal (12-)17-51 veces más larga que ancha, y siempre un hábito densamente cespitoso. El número cromosómico de *C. cumberlandensis* es  $2n = 23 II$ .

INTRODUCTION

*Carex* section *Careyanae* Tuck. ex Kük. is a group of sedges endemic to eastern North America that is most diverse in mesic deciduous forests of the southeastern United States. Tuckerman (1843) first used the name "Careyanae" for this

group, but without description or designation of rank. Kükenthal (1909) validated the name at the rank of section, but circumscribed *Carex* sect. *Careyanae* to include species currently placed in *Carex* sect. *Laxiflorae* Kunth and *Carex* sect. *Siderostictae* Franchet ex Ohwi. Most authors since Kükenthal (e.g. Mackenzie 1935; Fernald 1950; Bryson 1980; Manhart 1986; Gleason & Cronquist 1991) have included sect. *Careyanae* s.s. in sect. *Laxiflorae*. Bryson (1980) and Manhart (1986), based on morphological and biochemical evidence, respectively, found sect. *Laxiflorae* s.l. to consist of two subgroups that correspond to sect. *Careyanae* s.s. and sect. *Laxiflorae* s.s. A phylogenetic analysis of sect. *Laxiflorae* and closely related sections revealed that sect. *Careyanae* s.s. and sect. *Laxiflorae* s.s. are not each other's sister groups and are best treated as separate sections (Naczi 1989, 1992). In addition, molecular evidence supports the separation of sect. *Careyanae* and sect. *Laxiflorae* (Starr et al. 1999). Thus, various lines of evidence indicate sect. *Careyanae* is worthy of recognition.

Morphologic apomorphies that diagnose sect. *Careyanae* include perigynia acutely triangular in cross-section and perigynia with numerous (usually 40 or more), longitudinal sclerenchyma traces ("nerves" of earlier authors, e.g. Fernald 1950; Gleason & Cronquist 1991) that are impressed in living perigynia but raised in dried perigynia (Naczi, 1989, 1992, 1997). Additional character states shared by members of sect. *Careyanae*, though not unique to them, include glabrous leaf and bract blades, long-sheathing proximal bracts, usually unisexual spikes with the terminal one staminate, and glabrous perigynia with entire apices. This section contains eight species and three nonautonymic varieties (with synonyms from recent floras and taxonomic works in brackets or parentheses): *C. abscondita* Mack. [*C. abscondita* var. *glauca* (Chapm.) Fernald, *C. abscondita* var. *rostellata* Fernald, *C. magnifolia* Mack.], *C. austrocaroliniana* L.H. Bailey, *C. careyana* Torr., *C. digitalis* Willd. var. *asymmetrica* Fernald, *C. digitalis* var. *digitalis*, *C. digitalis* var. *macropoda* Fernald, *C. laxiculmis* Schwein. var. *copulata* (L.H. Bailey) Fernald [*C. copulata* (L.H. Bailey) Mack.], *C. laxiculmis* var. *laxiculmis* ( $\times$  *C. absconditiformis* Fernald), *C. plantaginea* Lam., *C. platyphylla* J. Carey, and one undescribed species (the subject of this paper).

During the course of studies on sect. *Careyanae*, we noticed specimens in several herbaria labeled as *C. abscondita* or as *C. digitalis* that do not match the descriptions or types of these names. Field work and additional herbarium work revealed these specimens to represent an undescribed species here named *C. cumberlandensis*. In this paper, we describe this species and clarify its relationships with other taxa in sect. *Careyanae*.

***Carex cumberlandensis*** Naczi, Kral, & Bryson, sp. nov. (Figs. 1, 2). TYPE: U.S.A. ALABAMA. WINSTON CO.: ca. 10 mi N of Double Springs, Sipsey River Recreation Area of Bankhead National Forest, E of river and S of bridge, T9S, R8W, NE1/4 of section 8, 4 May 1991, Naczi 2868 (HOLOTYPE: DOV\*; ISOTYPES: AUA, GH, MICH, MO, NCU, NY, US, USCH, VDB, WIN, ctb).

A *Carex digitalis* surculis vegetativis quam culmis 1.4–3.3plo altioribus, spicis terminalibus 0.6–1.3 mm latis, squamis staminatis brevioribus, squamis staminatis obtusis differt; a *Carex abscondita* habitu semper dense caespitose, laminis bractearum subtenentes spicas laterales summas (12–)17–51plo longioribus quam latoribus, pedunculis proximalibus plerumque cernuis vel nutantibus, pedunculis spicarum proximalium (28–)44–84(–91) mm longis, spicis perigyniis paucioribus instructis, perigyniis distichis differt.

Perennial herb, densely caespitose. *Rhizomes* short, 0.4–2.2 mm long between shoots or branches of the rhizomes, 1.5–1.9 mm thick, covered with cataphylls 1.3–1.8 mm long. *Shoot bases* surrounded by cataphylls, stramineous, lacking purplish coloration. *Reproductive shoots* erect or ascending; culms 7.3–27.4 cm tall, 0.4–0.7 mm wide at mid-height, smooth throughout, obtusely trigonous. *Cataphylls* glabrous, stramineous to whitish, multicostate. *Leaves* of reproductive shoots with blades 0.4–52 cm long, 1.2–5.8(–6.6) mm wide, the widest (3.2–) 3.7–5.8(–6.6) mm wide, green, flat to barely plicate, margins smooth or antrorsely scaberulous, adaxial surface smooth or sparsely antrorsely scaberulous on main veins, abaxial surface smooth; leaf sheaths 2.1–10.6 cm long, tight, glabrous; adaxial face of sheaths with hyaline and glabrous band, hyaline band with apex slightly concave to slightly convex; ligules lingulate with apex obtuse. *Vegetative shoots* 14.6–47.0 cm tall, (1.4–)1.7–3.3 times as tall as culms; pseudoculms 3.4–7.8 cm tall, 0.10–0.18 of vegetative shoot height. *Infructescence* a single terminal spike and 2–3 lateral spikes, usually with the distal 2–3 spikes overlapping, rarely with all spikes separate; proximalmost bract with blade 7.1–25.2 cm long and (0.5–)0.9–1.8 times as long as culm; bract blade of distalmost lateral spike 0.9–15.4 cm long, 1.3–3.5 mm wide, (12–)17–51 times as long as wide, and much exceeding terminal spike. *Spikes* 3–4 per culm, simple, single at nodes, erect; terminal spike 5.1–21.2 mm long, the longest (7.6–)9.6–21.2 mm long, 0.6–1.3 mm wide, entirely staminate, 4–24-flowered, on erect and smooth peduncle 2.1–44(–71) mm long, usually overlapping distalmost lateral spike and slightly exceeding it or slightly exceeded by it, rarely exceeding distalmost lateral spike and separate from it; lateral spikes 5.3–17 mm long, 2.8–4.1 mm wide, entirely pistillate, 4–8(–9)-flowered, the perigynia distichously imbricate, the internode between the proximalmost perigynia 1.8–3.0 mm long, on smooth peduncles, the proximal ones usually pendulous; the longest peduncle drooping or nodding, (28–)44–84(–91) mm long. *Staminate scales* (2.6–)2.8–3.5(–3.8) mm long, 1.1–1.7 mm wide, narrowly elliptic to elliptic, obtuse, center green and 1-nerved, margins hyaline and whitish or whitish with ferruginous speckles and streaks. *Pistillate scales* 1.3–2.2 mm long, 1.4–2.1 mm wide, 0.41–0.55 times as long as perigynium, broadly ovate, obtuse, center green and 1-nerved; margins entire, hyaline, whitish to tawny, infrequently with ferruginous speckles and short streaks. *Anthers* 3, 1.2–1.8 mm long. *Styles* jointed with summits of achenes, portions distal to achenes withering with age, portion proximal to achene (style base) persistent and becoming achene beak; base 0.1–0.2 mm wide. *Stigmas* 3,



FIG. 1. *Carex cumberlandensis*. a. Habit. b. Offshoot from clump showing pair of immature vegetative shoots (shorter than when mature) flanking central reproductive shoot. c. Rhizome cataphyll (left), proximal shoot cataphyll (middle), and distal shoot cataphyll (right). Scale bars equal 1 cm, with the scale the same for a and b. Drawn by Robert Kral from the holotype.

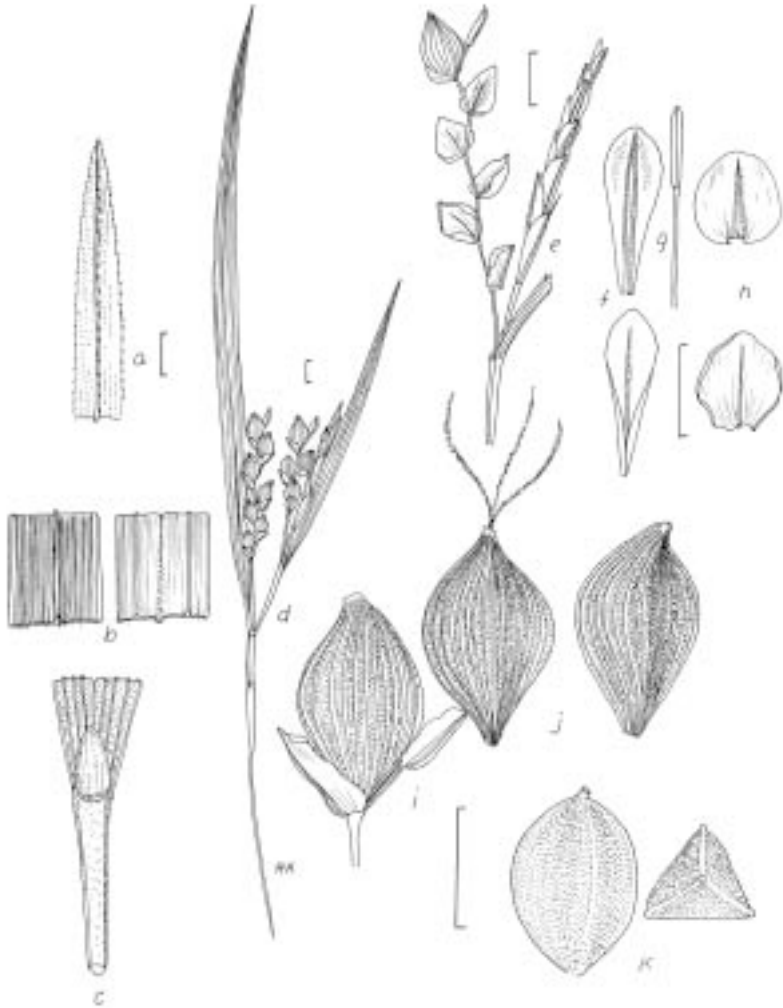


FIG. 2. *Carex cumberlandensis*. a. Tip of leaf blade, abaxial surface. b. Portions of leaf midblade, abaxial surface (left) and adaxial surface (right). c. Sheath-blade junction of bract, with culm removed, adaxial surface. d. Distal portion of culm. e. Pair of spikes from apex of culm, with a lateral (pistillate) spike from which all but one perigynium has been shed (left), and a terminal (staminate) spike (right). f. Staminate scales, abaxial surface (upper) and adaxial surface (lower). g. Stamen. h. Pistillate scales, abaxial surface (upper) and adaxial surface (lower). i. Apex of lateral spike showing a perigynium with subtending scale and, distally, a scale subtending an undeveloped perigynium. j. Perigynia, front (abaxial) view (left) and lateral view (right). k. Achenes, lateral view (left) and top view (right). Scale bars equal 2 mm, with the scale the same for each illustration within each group for a–c, f–h, and i–k. Drawn by Robert Kral from the holotype.

0.8–1.3 mm long, withering with age. *Perigynia* 2.9–3.8 mm long, 1.5–2.1 mm wide, 1.6–2.3 times as long as wide, 1.4–1.5 times as long as achene bodies, ascending, acutely triangular in cross section, abaxial faces slightly convex to flat, adaxial face slightly concave to flat, nerves shallowly impressed in living perigynia and slightly raised in dry perigynia, nerves 43–54, glabrous, green to brown, dull, ellipsoid or obovoid, gradually tapered from widest point to truncate base, gradually or abruptly tapered to subacute or acute apex, beakless or with minute beak; beaks 0–0.2 mm long, 0–7% of perigynium length, bent abaxially, smooth, entire. *Achenes* 2.2–2.9 mm long, 1.4–1.8 mm wide, tightly enveloped by perigynia, obovoid to ovoid, acutely trigonous, faces slightly concave to flat, brown, basally abruptly contracted to stipe, apically abruptly contracted to beak; stipe 0.1–0.2 mm long, vertical or slightly bent; body 1.9–2.7 mm long, with widest point 0.9–1.5 mm from body apex; beak 0.1 mm long, bent abaxially 30–60° from vertical.

Previously, herbarium specimens of *Carex cumberlandensis* have been identified as *C. digitalis* and *C. abscondita*. However, *C. cumberlandensis* and *C. digitalis* are only superficially similar. The most obvious similarity for them is their sharing of proximal spikes borne on long peduncles, a plesiomorphy in the section (Naczi, unpubl. phylogenetic analysis of sect. *Careyanae*). Thus, the similarity between *C. cumberlandensis* and *C. digitalis* is not indicative of a close relationship between these two species. Four features distinguish *C. cumberlandensis* and *C. digitalis*. *Carex cumberlandensis* has vegetative shoots much taller than the culms [tallest vegetative shoot per specimen/tallest culm per specimen = (1.4–)1.7–3.3], very narrow staminate spikes (0.6–1.3 mm wide), short staminate scales [2.6–3.5(–3.8) mm long], and obtuse staminate scales. *Carex digitalis* differs from *C. cumberlandensis* in having vegetative shoots shorter than to slightly exceeding the culms [tallest vegetative shoot per specimen/tallest culm per specimen = 0.5–1.3(–1.8)], wider staminate spikes [(1.0–)1.2–2.7 mm wide], longer staminate scales (3.6–5.5 mm long), and acute staminate scales. A scatter plot of measurements for two of the differences between *C. cumberlandensis* and *C. digitalis*, vegetative shoot height/culm height vs. width of staminate spike, provides complete separation of these two species (Fig. 3, with specimens measured for this plot indicated in the asterisked citation of the holotype of *C. cumberlandensis*, asterisked citations of representative specimens of *C. cumberlandensis*, asterisked specimens cited in Appendix A, and specimens cited in Appendix B).

*Carex cumberlandensis* is most similar to *C. abscondita*, which is the species with which *C. cumberlandensis* is most often confused. These two species share vegetative shoots much taller than culms, very narrow staminate spikes, short staminate scales, and obtuse staminate scales, the same four features that distinguish *C. cumberlandensis* from *C. digitalis* (Fig. 3). Each of these features is a synapomorphy within sect. *Careyanae* and possessed by only *C.*

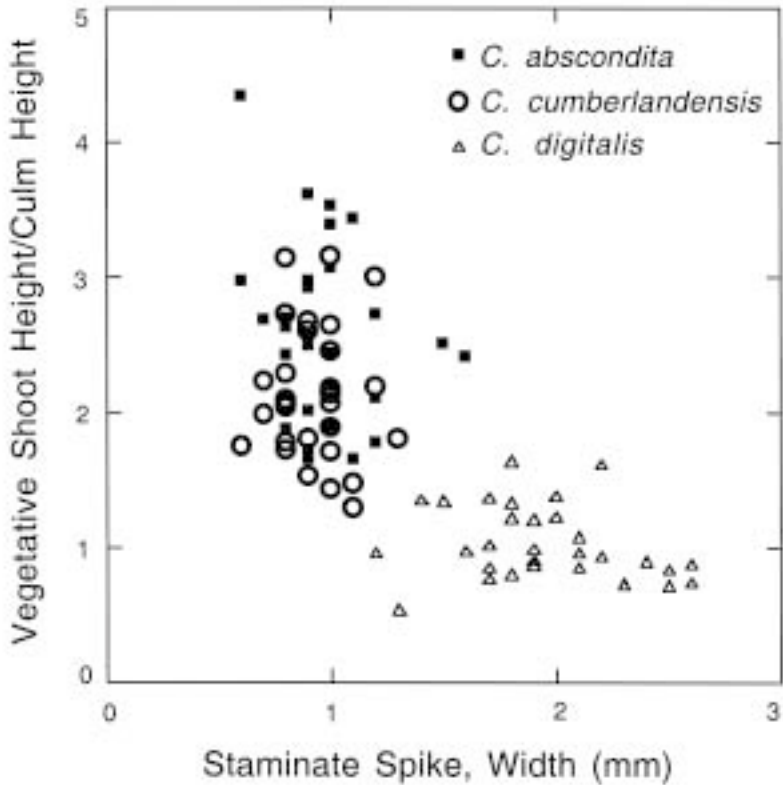


FIG. 3. Scatter plot of tallest vegetative shoot per specimen/tallest culm per specimen vs. width of longest staminate spike per specimen for *Carex abscondita*, *C. cumberlandensis*, and *C. digitalis*.

*cumberlandensis* and *C. abscondita*. Thus, *C. cumberlandensis* and *C. abscondita* appear to be sister species (Naczi, unpubl. phylogenetic analysis of sect. *Careyanae*).

*Carex cumberlandensis* differs from *C. abscondita* in several ways. First, *C. cumberlandensis* is always densely caespitose, whereas *C. abscondita* is often loosely caespitose. The growth form of *C. abscondita* appears to vary clinally, with plants from the southern portions of its range having a looser habit than those from the north. In fact, plants of *C. abscondita* from the northernmost portion of its range (northern Virginia and northward) are usually densely caespitose. Second, the proximal peduncles of *C. cumberlandensis* are much longer than those of *C. abscondita* [longest (per plant) peduncle of a proximal spike (28–)44–84(–91) mm long in *C. cumberlandensis* vs. (7.0–)15–42(–49) mm long in *C. abscondita*]. Third, the peduncles of *C. cumberlandensis* usually droop or

nod (the proximal spikes are usually pendulous), but those of *C. abscondita* are usually erect or, at most, spreading (the spikes have their apices pointing upward). The distichously imbricate perigynia of *C. cumberlandensis* versus spirally imbricate ones of *C. abscondita* constitute a fourth difference between the two species. Fifth, *C. cumberlandensis* has fewer perigynia per spike than does *C. abscondita* [longest spike per plant with 4–8(–9) perigynia, including undeveloped or aborted ones, in *C. cumberlandensis* vs. (6–)8–13 perigynia in *C. abscondita*]. Finally, the value of the length/width ratio of the blade of the bract of the distalmost lateral spike is greater in *C. cumberlandensis* than it is in *C. abscondita* [(12–)17–51 for *C. cumberlandensis* vs. 5.6–17(–26) for *C. abscondita*]. On a scatter plot of greatest number of perigynia per spike vs. length of longest peduncle of lateral spike, specimen clusters for *C. abscondita* and *C. cumberlandensis* are well resolved (Fig. 4, with specimens measured for this plot the same as measured for Fig. 3). Although measurements overlap for each of these features, simultaneous consideration of them allows unambiguous identification of all specimens except for a few depauperate ones. Specimens that are somewhat difficult to identify based on these two features can be determined with certainty through consideration of additional features, such as habit (densely caespitose vs. loosely caespitose), arrangement of the perigynia (distichous vs. spiral), and length/width ratio of bract blades.

Thus, *Carex cumberlandensis* is a species with several diagnostic features that distinguish it from morphologically similar taxa. Despite the slight overlap of measurements of some key characters among *C. cumberlandensis*, *C. abscondita*, and *C. digitalis*, we have seen no specimens that simultaneously overlap in more than one or two key characters between *C. cumberlandensis* and *C. abscondita* or *C. cumberlandensis* and *C. digitalis*.

The chromosome number of *C. cumberlandensis* is  $2n = 23$  II, determined from metaphase I of pollen mother cells (methods in Naczi 1999). Though the studied plants were from two populations, they yielded the same count [vouchers: Alabama, Winston Co., ca. 10 mi. N of Double Springs, Naczi 2966 (DOV, MICH); Georgia, Stephens Co., ca. 3 mi. N of Toccoa, Naczi 2965 (DOV, MICH)]. *Carex abscondita* (one plant studied) has a chromosome number of  $2n = 24$  II (Naczi, 1999). Because *Carex* species commonly exhibit intraspecific variability in chromosome number, it is premature to conclude the chromosome numbers of *C. cumberlandensis* and *C. abscondita* do not overlap.

*Carex cumberlandensis* inhabits mesic forests. The forests are deciduous or sometimes mixed with hemlock. These forests usually have diverse herbaceous floras. Frequent vascular plant associates of *C. cumberlandensis* include *Anemone acutiloba* (DC.) G. Lawson, *Carex amphibola* Steud., *C. laxiflora* Lam., *C. rosea* Willd., *Circaea lutetiana* (L.) Asch. & Magnus, *Galium circaezans* Michx., *Hexastylis arifolia* (Michx.) Small, *Houstonia purpurea* L., *Lindera benzoin* (L.) Blume, *Podophyllum peltatum* L., *Polystichum acrostichoides* (Michx.)



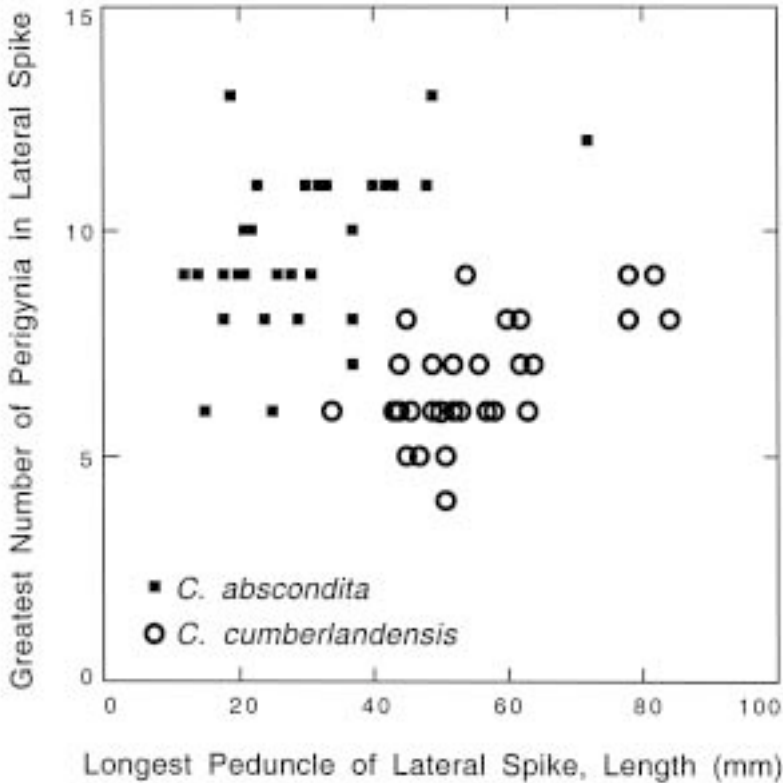


FIG. 4. Scatter plot of greatest number of perigynia in lateral spike (including undeveloped or aborted perigynia) vs. length of longest peduncle of lateral spike for *Carex abscondita* and *C. cumberlandensis*.

Schott, *Sanicula canadensis* L., *Scutellaria elliptica* Muhl., and *Tiarella cordifolia* L. The substrates of *C. cumberlandensis* are slightly acidic to circumneutral loams, sandy loams, loamy sands, and clays (Naczi, unpubl. data).

*Carex cumberlandensis* ranges from southwestern Pennsylvania south to Georgia and west to Arkansas (Fig. 5). The range of this species is entirely within unglaciated terrain, though *C. cumberlandensis* closely approaches the southern limits of glaciation (Flint 1971) in southern Ohio, northern Kentucky, and southern Indiana. A substantial disjunction appears to exist in the range of *C. cumberlandensis*. A population in Franklin County, Arkansas (Naczi 2155) is about 400 km (250 mi) from the nearest known population in the main portion of the species' range (Naczi 4846 & Reznicek, Tennessee, Dyer County). The Arkansas population, in the Boston Mountains subdivision of the Ozark Mountain physiographic region (Robison & Allen 1995), is the only one known

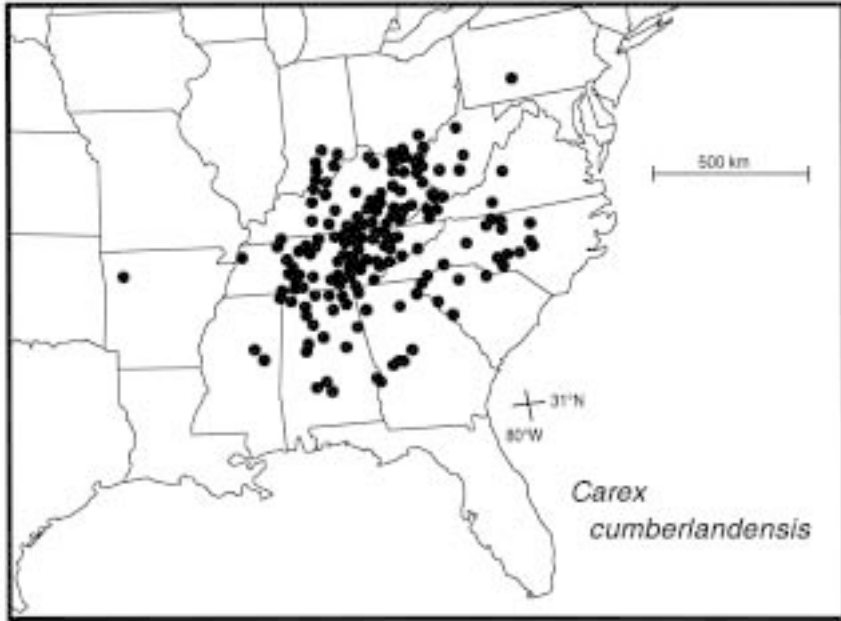


FIG. 5. Geographic distribution of *Carex cumberlandensis*.

west of the Mississippi River. Several other flowering plant species of forests and forest edges exhibit a similar disjunction between the Ozark Mountains and regions east of the Mississippi River, including *Carex ouachitana* Kral, Manhart, & Bryson (Naczi & Bryson 1990; McNeilus 1992), *C. willdenowii* Willd. (Naczi et al. 1998), *Castanea ozarkensis* Ashe (Johnson 1988; Nixon 1997), *Cotinus obovatus* Raf. (Little 1977), *Fothergilla major* Lodd. (Smith 1988; Meyer 1997a), *Leptopus phyllanthoides* (Nutt.) G.L. Webster (Clark 1967; Smith 1988), *Magnolia tripetala* L. (Little 1977; Meyer 1997b), *Monarda virgata* Raf. (Scora 1967; Smith 1988), *Neviusia alabamensis* A. Gray (Long 1989), and *Trillium pusillum* Michx. var. *ozarkanum* (Palmer & Steyerm.) Steyerm. (Cabe & Werth 1995).

*Carex cumberlandensis* occurs in several physiographic provinces, but most of its range lies in the Appalachian Plateaus (including the Cumberland Plateau), Interior Low Plateaus, and Piedmont. It is most common in eastern Kentucky, central and eastern Tennessee, and northern Alabama. *Carex cumberlandensis* is rare and local on the Coastal Plain. For the Coastal Plain, only eight populations are known, from Alabama (Butler, Lowndes, Russell, and Wilcox counties), Georgia (Stewart County), Mississippi (Choctaw and Winston counties), and Tennessee (Dyer County). The specimens cited below are a

representative sample of about 280 records (about 810 total specimens) of *C. cumberlandensis* we have studied. Collections of *C. cumberlandensis* date from at least 1844 (Rugel 108, Tennessee, Sevier County). Long-standing confusion of *C. cumberlandensis* with *C. abscondita* and *C. digitalis* accounts for why the relatively well-collected, widespread, and common *C. cumberlandensis* had escaped recognition for so long.

Because of past confusion of *C. cumberlandensis* with *C. digitalis* and *C. abscondita*, the distributions of the latter two species need clarification. The range of *C. digitalis* includes the entire region inhabited by *C. cumberlandensis* and is quite extensive: southern Nova Scotia, central Maine, and southern Ontario west to southern Wisconsin and south to central peninsular Florida and eastern Texas (Bryson 1980; Oldham & Zinck 1997). Bryson (1980) provides a map of the range of *C. digitalis*, including its varieties. Since *C. cumberlandensis* has been confused most often with *C. abscondita*, we provide a map of the range of *C. abscondita* (Fig. 6) and cite representative specimens of it (Appendix A). *Carex abscondita* occurs mostly east and south of the range of *C. cumberlandensis*: eastern Massachusetts, southwestern Kentucky, and southeastern Missouri south to northern Florida and eastern Texas (Figs. 6, 7). *Carex abscondita* is most frequent on the Coastal Plain. Since *C. abscondita* is absent from Indiana, Ohio, and West Virginia, reports of this species from these states (e.g. Mackenzie 1935; Deam 1940; Fernald 1950; Manhart 1986; Cusick 1988; Gleason & Cronquist 1991; Ohio Division of Natural Areas and Preserves 2000) almost certainly refer to *C. cumberlandensis*. In addition, though *C. abscondita* occurs in Kentucky and Tennessee, many of the previous reports of this species from these states (e.g. Manhart 1986; Cusick 1989; Chester et al. 1993; McKinney et al. 2000) refer to *C. cumberlandensis*.

Though *C. abscondita* is absent from most of the range of *C. cumberlandensis*, the two species are sympatric in southeastern and southern portions of the range of *C. cumberlandensis* (Fig. 7). Infrequently, plants of these two species do grow syntopically. We have observed *C. cumberlandensis* and *C. abscondita* growing together in Butler, Coosa, Tuscaloosa, Wilcox, and Winston counties, Alabama; Jasper and Monroe counties, Georgia; and Winston County, Mississippi. In localities of syntopy, *C. abscondita* tends to grow in moister soils than *C. cumberlandensis*. We have never observed hybrids or intermediates between *C. cumberlandensis* and *C. abscondita*.

We have selected *cumberlandensis* as an epithet for this new species because the Cumberland Plateau of eastern Kentucky, eastern Tennessee, and northern Alabama is the center of its distribution, the area in which it is most common, and the region in which it is a very characteristic element of the understory of mesic forests.

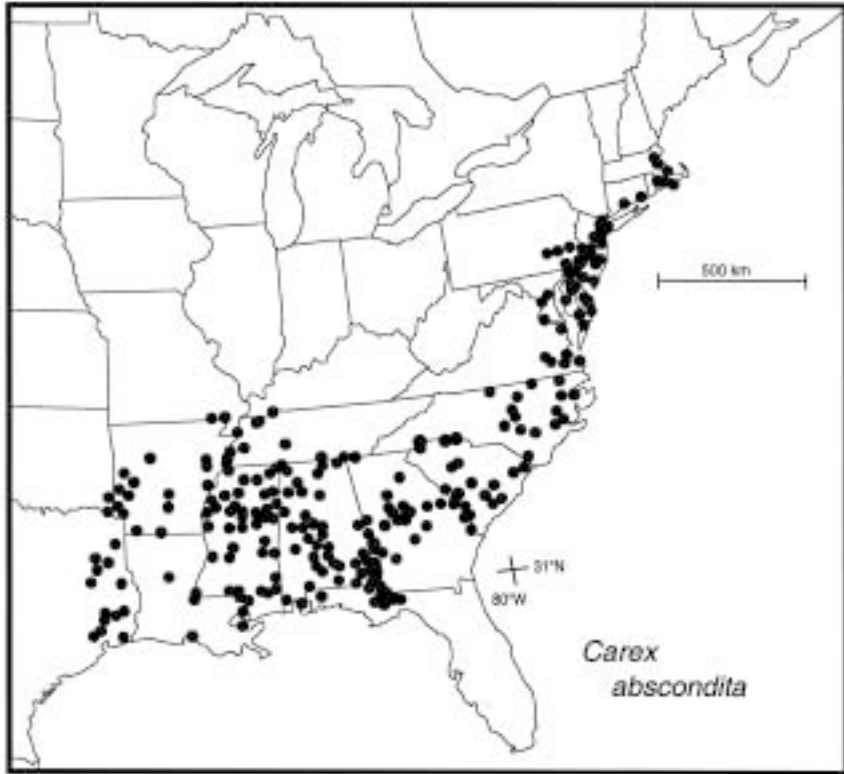


FIG. 6. Geographic distribution of *Carex abscondita*.

#### IDENTIFICATION KEY FOR MEMBERS OF CAREX SECTION CAREYANAE

This key is designed for identification of complete and ample specimens bearing mature and healthy perigynia. Occasionally, insects induce galls in the perigynia of members of *Carex* section *Careyanae*. Because these galls distort the morphology of the perigynia, one should avoid considering affected perigynia when identifying these taxa. Relative to healthy perigynia, perigynia with galls are usually paler (especially basally), more elongate, more excurved, much less likely to contain mature achenes, and shed earlier.

The terminal spike is entirely staminate. The lateral spikes are entirely pistillate, except in *C. laxiculmis* (with the basal scales of the lateral spikes sterile or subtending staminate flowers). In addition, plants of some of the taxa (especially *C. digitalis* var. *macropoda*) occasionally have a few staminate flowers terminating the otherwise pistillate lateral spikes.

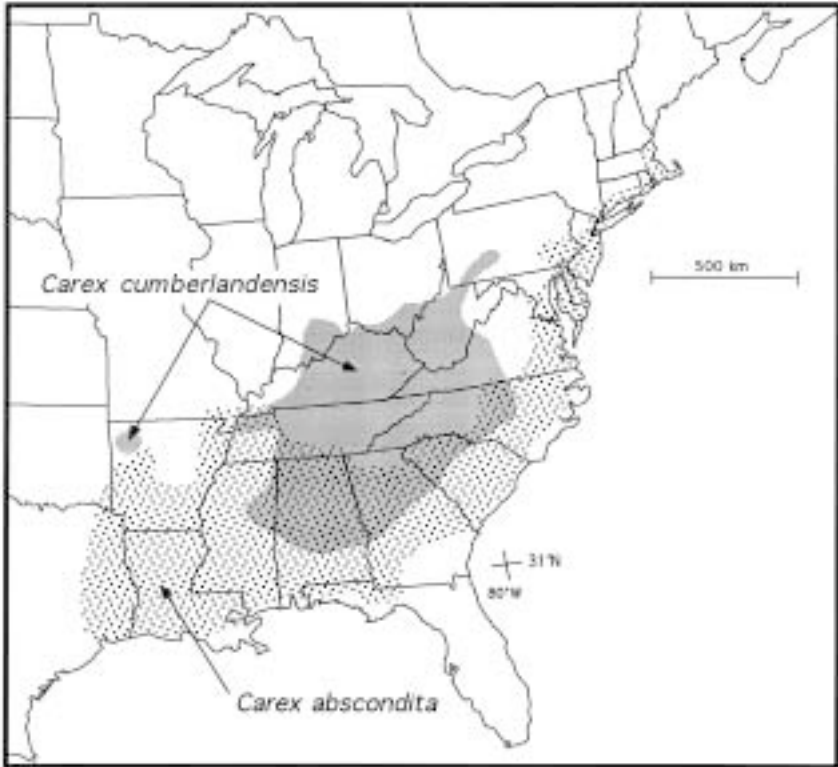


FIG. 7. Regions of sympatry and allopatry of *Carex cumberlandensis* and *C. abscondita*.

Length of the peduncle for lateral spikes is measured from the base of the peduncle (at the node of its subtending bract) to its summit (at the base of the lowest scale in the spike surmounting the peduncle). Thus, peduncle length includes the portion of the peduncle included in the bract sheath.

1. Shoot bases brownish, with purplish coloration completely absent.
2. Foliage green or glaucous; leaf blades of vegetative shoots 1.0–3.5 times as wide as bract blades; widest leaf blade 0.2–1.4 cm wide; bract blades from middle and proximal portions of culms 4.5–24 cm long.
3. Proximalmost scale of each lateral spike subtending a perigynium.
4. Terminal spikes 0.6–1.4(–1.6) mm wide; staminate scales obtuse, those from middle region of terminal spike 2.6–3.6(–3.8) mm long; vegetative shoots much taller than culms, tallest vegetative shoot (1.4–)1.7–3.7(–4.9) times as tall as tallest culm.
5. Perigynia distichously imbricate; longer lateral spikes with 4–8(–9) perigynia; peduncles of proximal spikes usually drooping or nodding,

- the longest (per plant) peduncle (28–)44–84(–91) mm long; bract blade of distalmost lateral spike (12–)17–51 times as long as wide; densely caespitose \_\_\_\_\_ **Carex cumberlandensis**
5. Perigynia spirally imbricate; longer lateral spikes with (6–)8–13 perigynia; peduncles of proximal spikes usually erect, the longest (per plant) peduncle (7.0–)15–42(–49) mm long; bract blade of distalmost lateral spike 5.6–17(–26) times as long as wide; loosely or densely caespitose \_\_\_\_\_ **Carex abscondita**
4. Terminal spikes (1.0–)1.2–2.7 mm wide; staminate scales acute, those from middle region of terminal spike 3.6–5.5 mm long; vegetative shoots shorter than or slightly taller than culms, tallest vegetative shoot 0.5–1.3(–1.8) times as tall as tallest culm.
6. Terminal spike usually surpassing bract blade of distalmost lateral spike; longest (per plant) peduncle of terminal spike (6.3–)8.1–15.9 cm long; widest leaf blade 2.0–2.9(–3.5) mm wide; each perigynium face 7–10-nerved \_\_\_\_\_ **Carex digitalis** var. **macropoda**
6. Terminal spike usually surpassed by bract blade of distalmost lateral spike; longest (per plant) peduncle of terminal spike 0.9–7.2(–11.4) cm long; widest leaf blade 2.7–4.5(–5.3) mm wide; each perigynium face (8–)11–15-nerved.
7. Perigynia 2.5–3.3 mm long, apex barely excurved \_\_\_\_\_ **Carex digitalis** var. **digitalis**
7. Perigynia 3.2–4.2 mm long, apex noticeably excurved \_\_\_\_\_ **Carex digitalis** var. **asymmetrica**
3. Proximalmost scale of each lateral spike sterile or subtending a staminate flower.
8. Foliage usually glaucous; longest (per plant) terminal spike (1.0–)1.2–2.5 cm long; widest leaf blade 6.4–11.8 mm wide \_\_\_\_\_ **Carex laxiculmis** var. **laxiculmis**
8. Foliage usually bright green; longest (per plant) terminal spike 0.6–2.0 (2.3) cm long; widest leaf blade 5.3–8.3 mm wide \_\_\_\_\_ **Carex laxiculmis** var. **copulata**
2. Foliage glaucous; leaf blades of vegetative shoots 3.8–9.0 times as wide as bract blades; widest leaf blade 1.1–2.5 cm wide; bract blades from middle and proximal portions of culms 2.0–6.2 cm long \_\_\_\_\_ **Carex platyphylla**
1. Shoot bases purplish, with purplish coloration ranging from slight tinging of brown background in basal 1.5 cm of shoots to strong staining that obscures brown background and extends to 10 cm high.
9. Widest leaf blade 1.0–2.5 cm wide; peduncles of lateral spikes usually erect or spreading.
10. Bracts from middle and proximal portions of culms bladeless or with blades 0.1–1.9 cm long; perigynia 3.7–4.9 mm long; longest (per plant) lateral spike with 9–13 perigynia \_\_\_\_\_ **Carex plantaginea**
10. Bracts from middle and proximal portions of culms with blades 2.1–9.2 cm long; perigynia 5.0–6.6 mm long; longest (per plant) lateral spike with 4–9 perigynia \_\_\_\_\_ **Carex careyana**
9. Widest leaf blade 0.3–0.6 cm wide; peduncles of lateral spikes usually drooping \_\_\_\_\_ **Carex austrocaroliniana**

Representative specimens of *Carex cumberlandensis*. Specimens marked with an asterisk are those measured for scatter plots (Figs. 3, 4). **U.S.A. ALABAMA. Butler Co.:** ca. 0.5 mi. N of Oaky Streak, 17 May 1995, *Naczi 4686* (DOV). **Cleburne Co.:** ca. 10 mi. S of Borden Springs, 23 Apr 1990, *Kral 77370* (VDB). **Colbert Co.:** ca. 4 mi S of Allsboro, 27 May 1986, *Bryson 4399* (MICH, ctb\*). **Coosa Co.:** 1.8 mi S of Marble Valley, along N side of Paint Creek, 29 Apr 2000, *Naczi 8526 & Ford* (DOV\*, MICH, ctb). **Jackson Co.:** 9 mi. S of Huntland, by Alabama 65, 28 Apr 1972, *Kral 45814* (MO, VDB, ctb\*). **Jefferson Co.:** just W of Tafford, 2 May 1980, *Kral 64863* (VDB). **Lawrence Co.:** Bankhead National Forest, Thompson Creek, 1 Jun 1978, *Bryson 2099* (MO, TENN, ctb\*). **Limestone Co.:** NE of Athens, ca. 1 mi. W of I-65, Hays Mill Road, 19 May 1995, *Kral 84718* (DOV, VDB). **Lowndes Co.:** 4.5 mi. E of Braggs, Alabama 21, 6 Apr 1993, *Kral 81988* (DOV, VDB). **Madison Co.:** Monte Sano Mountain, 9 May 1981, *Manhart 265 & Bryson* (MICH, TENN, ctb), 22 May 1983, *Bryson 3529* (MICH, ctb), 6 May 1991, *Naczi 2876* (DOV\*). **Marshall Co.:** ca. 1 mi. W of Grant, in Fletcher's Hollow, 19 Apr 1935, *Harper 3348* (GH, MO, NY, PH\*, US). **Russell Co.:** 2 mi. SW of Holy Trinity, 3 May 1996, *Naczi 5209* (DOV, VDB, ctb). **Talladega Co.:** NW of Chandler Springs, off Alabama 77, 8 May 1984, *Kral 71344* (VDB). **Tuscaloosa Co.:** ca. 8 mi. ESE of Windham Springs, E side of Black Warrior River, 22 May 1996, *Naczi 5459* (DOV, ctb). **Walker Co.:** ca. 30 mi NW of Northport, 4 Jun 1971, *Kral 42893* (VDB, ctb\*); Sipsey, along W side of Sipsey Fork of Black Warrior River, 2 Jun 1997, *Naczi 6442* (DOV). **Wilcox Co.:** ca. 4.5 mi. SW of Camden, E of route 41, 24 May 1993, *Naczi 3096* (DOV). **Winston Co.:** ca. 5 mi. W of Grayson, Bankhead National Forest, Sipsey River Recreation Area, 5 May 1978, *Bryson 1892* (TENN, VDB, ctb). **ARKANSAS. Franklin Co.:** ca. 3 mi. E of Cass, Redding Recreation Area, 13 May 1989, *Naczi 2155* (DOV\*, ctb). **GEORGIA. Jasper Co.:** 3.5 mi. E of Ocmulgee, 6 Apr 1949, *Smith 4873 & Duncan* (NA); ca. 14 mi. SW of Monticello, 19 May 1997, *Naczi 6054* (DOV, MICH, VDB, ctb). **Monroe Co.:** ca. 2.5 mi SW of Russellville, 25 Apr 2000, *Naczi 8398 & Ford* (DOV\*, VDB, ctb). **Stephens Co.:** ca. 3 mi. N of Toccoa, along Toccoa Creek, 3 May 1991, *Naczi 2855* (GA, DOV\*, MICH). **Stewart Co.:** ca. 5 mi. NE of Omaha, 22 May 1997, *Naczi 6121* (DOV, ctb). **Talbot Co.:** ca. 4 mi NE of Pleasant Hill, 25 Apr 2000, *Naczi 8425 & Ford* (DOV, VDB, ctb). **Upson Co.:** ca. 3 mi SW of Thomaston, 25 Apr 2000, *Naczi 8414 & Ford* (DOV). **Walker Co.:** NW of junction of routes 136 & 27, along route 136, 9 May 1981, *Manhart 243* (MICH, TENN, US, VDB); In the Pocket of Pigeon Mountain, 1 May 1982, *Manhart 444 & Muzzy* (DOV\*, FLAS, TENN, US, ctb). **INDIANA. Brown Co.:** Brown County State Park, 16 Jun 1982, *Manhart 515 & Muzzy* (MICH, MO, TENN, US). **Crawford Co.:** ca. 0.5 mi. N of English, 26 May 1911, *Deam 8463* (NY); 1.5 mi. S of Grantsburg, slope of Little Blue River, 9 Jun 1919, *Deam 27807* (GH); ca. 1 mi S of Wyandotte Cave, 13 May 1922, *Deam 35617* (PH\*). **Harrison Co.:** 2.5 mi. SE of Corydon, 26 May 1919, *Deam 27673* (NY). **Jennings Co.:** ca. 0.75 mi. above Vernon, along N fork of Muscatatuck River, 23 Jun 1912, *Deam 11305* (GH, NY). **Lawrence Co.:** ca. 2 mi. NE of Tunnelton, bluffs of Guthrie Creek, 17 May 1918, *Deam 24852* (US). **Orange Co.:** ca. 1 mi. SE of Orangeville, 1 Jun 1926, *Deam 43219* (NY, PH\*); 6 mi. E of Baden Springs, 16 Jun 1982, *Manhart 518 & Muzzy* (MO, US). **Perry Co.:** ca. 2.5 mi. SW of St. Croix, 29 Apr 1927, *Deam 44130* (NY); 4.9 mi. N of Bristow, along E side of route 145, 27 May 1990, *Naczi 2503* (DOV\*, PH, US, VDB, ctb). **Scott Co.:** 1 mi. N of Lexington, 20 May 1919, *Deam 27584* (NY). **KENTUCKY. Adair Co.:** ca. 9 mi. S of Columbia, along W side of route 704, 16 Jun 1998, *Naczi 7387 & Reznicek* (DOV). **Barren Co.:** ca. 3 mi. SSW of Haywood, Brigadoon State Nature Preserve, 14 Jun 1997, *Naczi 6460 & Heeg* (DOV, KNK, ctb). **Bell Co.:** ca. 5 mi. NW of Pineville, along E side of route 92, 29 May 1993, *Naczi 3149* (DOV, MICH, VDB, ctb). **Boyd Co.:** S of Ashland, above Hurricane Fork Road, 24 May 1993, *Cusick 30901* (MICH). **Boyle Co.:** Central Kentucky Wildlife Refuge, 13 May 1992, *McKinney 4991 & Gladu* (KNK). **Casey Co.:** 2.9 mi. S of Ellisburg, 18 Jun 1998, *Naczi 7451 & Reznicek* (DOV). **Clay Co.:** Benge, S of route 472 and S of Mill Creek, 28 May 1993, *Naczi 3135 & Reznicek* (DOV, MICH, VDB, ctb). **Clinton Co.:** ca. 3.3 mi. WNW of Albany, 23 May 1998, *Naczi 7186 & Ford* (DOV). **Cumberland Co.:** 3.0 mi. SW of Amandaville, along W side of route 704, 9 May 1991, *Naczi 2893* (DOV\*, MICH, US, VDB, ctb). **Estill Co.:** ca. 8.5 mi SW of Irvine, 12 May 1999, *Naczi 7784* (DOV). **Fleming Co.:** ca. 4 mi. E of Hillsboro, 28 May 1998, *Naczi 7325 & Ford* (DOV, WIN, ctb). **Hardin Co.:** 3.2 mi. W of Summit, Meeting Creek (Hoover Branch) Gorge, 26 May

1979, *Cranfill 4336* (MICH). **Harrison Co.:** ca. 1.5 mi. NE of Sunrise, Quiet Trails State Nature Preserve, 21 Jun 1997, *Naczi 6628* (DOV, KNK, ctb). **Hart Co.:** ca. 2.3 mi. NNE of Canmer, 17 Jun 1998, *Naczi 7425 & Reznicek* (DOV, MICH, ctb). **Jackson Co.:** near South Tree Recreation Area, 16 Jun 1982, *Manhart 503 & Muzzy* (MO). **Knott Co.:** SE of Cody, 20 May 1994, *McKinney 6192* (TENN). **Knox Co.:** ca. 3 mi. NNE of Barbourville, 29 May 1993, *Naczi 3143* (DOV). **Laurel Co.:** ca. 5.5 mi. WNW of Bernstadt, 19 Jun 1997, *Naczi 6521 & Heeg* (DOV, ctb). **Lawrence Co.:** NE of Fallsburg, above route 707, 24 May 1993, *Cusick 30922* (CM, MICH). **Leslie Co.:** along highway 421, W from Hyden, ca. 7 mi. E of Clay County line, 21 May 1992, *McKinney 5035* (EKY, KNK). **Lewis Co.:** Laurel Fork, 19 May 1988, *Cusick 27393* (NY, VDB). **McCreary Co.:** Barthell SW Quadrangle, Rock Creek (west), 19 May 1989, *Campbell s.n.* (KY). **Martin Co.:** 1 mi. NW of Add, along Pack Branch above Martin County Lake, 1 Jun 1993, *Cusick 30967* (MICH). **Monroe Co.:** ca. 8 mi. SE of Tompkinsville, 23 May 1998, *Naczi 7208 & Ford* (DOV\*, WIN). **Ohio Co.:** L. B. Davidson Wildlife Management Area, 4 May 1992, *McKinney 4953* (EKY, KNK). **Pendleton Co.:** 2 road mi. ESE of eastern edge of Falmouth, 3 Jun 1994, *Naczi 4053 & Thieret* (DOV, MICH, PH, VDB, ctb). **Powell Co.:** ca. 2 mi. SSE of Slade, Natural Bridge State Nature Preserve, 22 Jun 1997, *Naczi 6663* (DOV, KNK). **Pulaski Co.:** General Burnside State Park, 16 Jun 1982, *Manhart 510 & Muzzy* (MICH, TENN). **Rockcastle Co.:** 2.5 mi. N of junction of routes 490 and 89, 16 Jun 1982, *Manhart 509 & Muzzy* (MICH, TENN). **Rowan Co.:** N of Triplett, Burnt House Branch, 15 May 1987, *Cusick 26398* (VDB). **Russell Co.:** SW end of Cave Springs Road (between forks), 20 Jun 1993, *Campbell s.n.* (KY). **Warren Co.:** ca. 11.5 mi. NNE of Bowling Green, along S side of Clay Lick Creek, 15 Jun 1997, *Naczi 6500 & Heeg* (DOV). **Wayne Co.:** 1.75 mi. N of Kentucky-Tennessee line, along route 167, 15 Jun 1982, *Manhart 499 & Muzzy* (MICH, TENN). **Whitley Co.:** ca. 8 mi. E of Williamsburg, 29 May 1993, *Naczi 3150* (DOV, MICH, US, VDB, ctb). **MISSISSIPPI. Choctaw Co.:** ca. 4 mi. NNE of Ackerman, near Horse Branch, 4 May 1981, *McDaniel 25006* (ctb\*). **Tishomingo Co.:** Yellow Creek Quad., Burns Hollow, 15 May 1979, *Rogers 46684* (TENN). **Winston Co.:** 3.5 mi. NW of Louisville, Tombigbee National Forest, 26 Apr 1977, *Byson 1523* (ctb\*) ca. 6.3 mi. NNW of Louisville, 29 May 1997, *Naczi 6277 et al.* (DOV). **NORTH CAROLINA. Alexander Co.:** 5 mi. E of Vashti, 13 May 1956, *Radford 11194* (NCU). **Anson Co.:** 8 mi. S of Lilesville, near Pee Dee River, 20 May 1961, *Radford 43609* (NCU, US). **Lee Co.:** 2 mi. W of Moncure, near Deep River, 3 Jun 1960, *Radford 43209* (NCU, TENN). **Madison Co.:** ca. 5 mi. W of Hot Springs, along Mine Hollow Branch, 22 May 1971, *Leonard 4788* (MICH, NCU, NY, VDB, WVA). **Montgomery Co.:** Uwharrie National Forest, along W fork of McLean Creek, Park's Place Road, 18 May 1970, *Leonard 3201 & Radford* (MO, NCU). **Orange Co.:** Chapel Hill, [no date], *Ashe 2062* (OS, PH, US). **Polk Co.:** R.R. Melrose, 19 May 1899, *Churchill s.n.* (GH). **Stanly Co.:** NE of Richfield, along Yadkin River, 6 May 1951, *Godfrey 51129 & Fox* (MO, NY). **Yadkin Co.:** near Yadkin River bridge, route 67, 30 May 1981, *Manhart 323 & Smith* (MICH). **OHIO: Adams Co.:** 3/5 mi. S of Lynx, 6 May 1991, *Reznicek 8745 & Reznicek* (MICH). **Gallia Co.:** ca. 10 mi. SW of Gallipolis, valley of upper part of Claylick Run, 25 May 1988, *Reznicek 8170 & Reznicek* (MICH). **Scioto Co.:** Nile Twp., W side of Rock Lick, 20 May 1985, *Carr 6538* (MICH). **Vinton Co.:** Knox Twp., sect. 31, 13 May 1991, *Cusick 29517* (ctb). **PENNSYLVANIA. Blair Co.:** E of Altoona, Brush Mountain, 15 Jun 1929, *Bright 1905* (CM), *Bright 1906* (CM), *Bright 1908* (CM). **SOUTH CAROLINA. Abbeville Co.:** Sumter National Forest, E-facing slopes at Johns Creek, 21 Jun 1992, *Hill 23443 & Wilson* (GH, MICH). **Lancaster Co.:** 13.7 mi. NNW of Lancaster, overlooking Catawba River, 21 Apr 1953, *Duncan 15630 & Hardin* (PH\*). **McCormick Co.:** 3.2 km W of Edgefield County line, Sumter National Forest, NW of junction of S-204 and SC 28, 18 Apr 1996, *Nelson 17142* (MICH, USCH). **Oconee Co.:** ca. 4 mi. W of Walhalla, 3 May 1990, *Naczi 2358* (DOV\*). **Pickens Co.:** ca. 5 mi. S of Rocky Bottom, 3 May 1989, *Naczi 2092* (DOV\*, ctb). **Union Co.:** ca. 9 mi. WSW of Union, 8 May 1993, *Horn 6588* (MICH). **TENNESSEE. Anderson Co.:** Norris Dam State Park, near Clear Creek, 12 May 1987, *McNeilus 87-794* (MICH, TENN). **Bledsoe Co.:** NW of Pikeville, 16 May 1934, *Harger 7827* (GH, TENN). **Blount Co.:** Great Smoky Mountains, White Oak Sink area, 12 May 1980, *Bryson 2945 & Bryson* (ctb\*). **Campbell Co.:** 1 mi. S of Morley on route 25W, 13 May 1980, *Bryson 2956 & Bryson* (ctb\*). **Cannon Co.:** N side of North Short Mountain Road, 3 May 1989, *Orzell & Bridges 9438* (MICH\*). **Cheatham Co.:** Pegrarn, 16 Jul 1939, *Svenson 10346* (GH). **Clay Co.:** Along Turkey Creek, 29 Apr 1991, *McNeilus 91-190*



(TENN). **Coffee Co.:** W outskirts of Manchester in Oakwood subdivision, 6 May 1989, *Kral 76195* (VDB). **Cumberland Co.:** 3.0 mi. on Hinch Mountain Road S of its junction with old route 127, 8 May 1986, *Wofford 86-43 & Ma* (ctb\*). **Davidson Co.:** ca. 5 mi. NE of junction of Tennessee 12 and Marrowbone Creek Road, 16 May 1971, *Kral 42612* (MO, VDB, ctb). **DeKalb Co.:** E of Spencer, along upper King Creek by road to Fall Creek Falls, 3 May 1986, *Kral 73349* (VDB). **Dickson Co.:** 2.8 mi. W of White Bluff by route 70, 13 May 1975, *Kral 55379* (MICH). **Dyer Co.:** ca. 6 mi. NW of Dyersburg, N of route 182, 27 Jun 1995, *Naczi 4846 & Reznicek* (DOV, MICH). **Franklin Co.:** Sewanee, Lost Creek Cove, 24 Jun 1989, *Svenson 9689* (GH, VDB). **Grundy Co.:** Fiery Gizzard Gorge, along Big Gizzard Creek, 15 May 1965, *Clark 1771* (NCU\*). **Hardin Co.:** 6.8 mi. SE of Savannah on Tennessee 69, 2 May 1970, *Kral 38916* (VDB). **Hickman Co.:** 4–4.5 mi. W of Centerville, by Tennessee 50, 4 May 1993, *Kral 82267* (DOV, TENN, VDB). **Humphreys Co.:** ca. 5 mi. NNW of Bucksnot, by Tennessee 230, 19 May 1989, *Kral 76304* (VDB). **Jackson Co.:** NW of Gainesboro, above Cumberland River, 14 May 1992, *Kral 80515 & Rust* (DOV, VDB). **Lawrence Co.:** ca. 8 mi. WSW of Lawrenceburg, Knob Creek, by Tennessee 242, 5 May 1990, *Kral 77462* (VDB). **Lewis Co.:** Meriwether Lewis Park, 17 May 1971, *Kral 42648* (MO, VDB). **Loudon Co.:** ca. 1.5 mi. E of Centerville Store, along Big Hill Road, 4 May 1993, *McNeilus 93-406* (MICH, TENN). **Macon Co.:** S of and below Lafayette by route 10, 5 May 1975, *Kral 55211* (MICH). **Maury Co.:** along Big Bigby Creek at E side of Sandy Hook, 19 May 1993, *Kral 82294* (DOV, VDB). **Monroe Co.:** SE of Pumpkin Center, between Chilhowee Lake and junction of routes 129 and 72, 15 May 1980, *Bryson 2987 & Bryson* (ctb\*). **Moore Co.:** ca. 3 mi. W of Motlow State Campus and SW of Tullahoma, 26 Apr 1989, *Kral 76096* (VDB). **Morgan Co.:** Rugby, 18 Jun 1938, *Svenson 9331* (GH, NY). **Overton Co.:** 3.4 mi. E of Alpine, 31 Apr 1971, *Kral 42328* (VDB, ctb). **Perry Co.:** SE of Linden on old SR 13, on E side of Buffalo River, 4 May 1993, *Kral 82278* (DOV, TENN, VDB). **Putnam Co.:** ca. 8 mi. SE of Cookeville, 10 May 1988, *McKinney 2843-3* (ctb\*). **Scott Co.:** Along Low Gap Road, 24 May 1994, *McNeilus 94-304* (TENN). **Sequatchie Co.:** NW of Dunlap, along Little Brush Creek, 29 May 1990, *Naczi 2512 & Kral* (DOV\*, MICH, VDB). **[Sevier Co.]:** between Sevierville and the French Broad River, May 1844, *Rugel 108* (MICH, NA, VDB). **Stewart Co.:** Land Between the Lakes, along Bee Creek, tributary of Bear Creek, 14 May 1982, *Patrick 4256 & DeSelm* (VDB). **Sumner Co.:** 2.5 mi. S of Westmoreland, Taylor Hollow, 17 May 1979, *Carter 1816* (ctb). **Union Co.:** ca. 7 mi. W of Maynardville, Big Ridge State Park, 30 May 1995, *Naczi 4747 & Naczi* (DOV, MICH, VDB, ctb). **Van Buren Co.:** 6–7 mi. E of Spencer, by Tennessee 30, 1 May 1971, *Kral 42364* (VDB). **Warren Co.:** Rock Island, Rock Island State Park, 27 May 1993, *Naczi 3115 & Reznicek* (DOV, MICH, VDB, ctb). **Wayne Co.:** ca. 5 mi. W of Iron City, just E of Cypress Creek bridge, 5 May 1990, *Kral 77494* (VDB). **White Co.:** ca. 3.9 mi. E of Sparta, along highway 70, 12 May 1986, *McKinney 2135* (VDB). **VIRGINIA. Buchanan Co.:** NE of Slate, 20 May 1993, *Wieboldt 8545* (DOV). **Franklin Co.:** ca. 10.5 km SW of Ferrum, 11 May 1995, *Wieboldt 9202* (DOV). **Rockbridge Co.:** Natural Bridge, 28 May 1909, *Bartram s.n.* (PH\*). **Scott Co.:** ca. 6 mi. NE of Gate City, W of route 669 crossing of Copper Creek, 21 Jun 1993, *Naczi 3171 et al.* (DOV, MICH). **Wise Co.:** ca. 1.75 mi. SW of Norton, Powell Mountain, 2 Jun 1988, *Wieboldt 6675* (MICH). **WEST VIRGINIA. Nicholas Co.:** U.S. highway 41, above Meadow River, 28 May 1987, *Brant 1116 & O'Donnell* (MO). **Ritchie Co.:** ca. 2 mi. NW of Ellenboro, 8 May 1985, *Cusick 24199 & Ortt* (MICH, NCU). **Wayne Co.:** mouth of Big Creek, 6 May 1938, *McFarland 4355 & Plymale* (NA).

## APPENDIX A

**Representative Specimens of *Carex abscondita*.** Specimens marked with an asterisk are those measured for scatter plots (Figs. 3, 4). **U.S.A. ALABAMA. Autauga Co.:** ca. 5.5 mi ENE of Autaugaville, 28 May 1997, *Naczi 6274* (DOV\*). **Baldwin Co.:** 1 mi. SE of Spanish Fort, 24 Apr 1964, *McDaniel 4257* (IBE). **Barbour Co.:** Blue Springs, Choctawhatchee River, 7 Jun 1976, *Kral 58187* (DOV, VDB). **Bibb Co.:** near Lightsey's Mill, Cahaba River bottoms, 6 Jun 1935, *Harper 3395* (GH, NY); ca. 6 mi SE of Centerville, 5 May 1987, *Naczi 1527* (DOV\*). **Butler Co.:** ca. 0.5 mi. N of Oaky Streak, 17 May 1995, *Naczi 4689* (DOV). **Coosa Co.:** 1.8 mi S of Marble Valley, along N side of Paint Creek, 29 Apr 2000, *Naczi 8529 & Ford* (DOV\*). **Dale Co.:** Just NW of Ozark, 24 May 1975, *Kral 55862* (TENN). **Dallas Co.:** ca. 9 mi. SE of

Selma, 16 May 1995, *Naczi 4653* (DOV). **Geneva Co.:** 5 mi. NW of Hartford, bottoms of Choctawhatchee River, 18 May 1966, *McDaniel 7552* (IBE, VDB). **Jackson Co.:** 1 mi. W of Scottsboro, 3 May 1939, *Svenson 10193* (GH, MO, NY, PH, TENN). **Lee Co.:** Auburn, 10 May 1901, *Earle s.n.* (NY). **Madison Co.:** Ardmore, Limestone Creek, 19 May 1995, *Kral 84677* (MICH, VDB). **Marion Co.:** ca. 3 mi. N of Guin, 25 Apr 1941, *Harper 3845* (GH, NY). **Mobile Co.:** Mobile, 23 Apr 1968, *LeLong 4386* (USAM). **Monroe Co.:** 1.8 mi N of routes 47-83 junction in Midway, 28 Apr 1991, *Naczi 2819* (DOV\*). **Morgan Co.:** 1.6 mi. N of Florette, along Cotaco Creek, 9 May 1986, *Naczi 1030A* (DOV\*). **Tuscaloosa Co.:** ca. 8 mi. ESE of Windham Springs, E side of Black Warrior River, 22 May 1996, *Naczi 5454* (DOV). **Wilcox Co.:** ca. 4.5 mi. SW of Camden, E of route 41, 24 May 1993, *Naczi 3095* (DOV). **Winston Co.:** ca. 10 mi. N of Double Springs, Sipsey River Recreation Area of Bankhead National Forest, 4 May 1991, *Naczi 2870* (DOV\*, MICH).

**ARKANSAS. Cross Co.:** W of Birdeye, 20 May 1990, *Naczi 2448* (DOV\*). **Howard Co.:** ca. 8 mi. W of Umpire, 17 May 1988, *Naczi 1924* (MICH, ctb). **Lafayette Co.:** Bodcow Bayou, 6 May 1995, *Hyatt 6366 & Hyatt* (DOV\*, MICH). **Montgomery Co.:** 1.2 mi. E of Pine Ridge, 11 May 1989, *Naczi 2142* (MICH, UARK). **Phillips Co.:** 1.5 mi. N of West Helena, 15 May 1987, *Naczi 1598* (MICH, UARK, ctb). **Pope Co.:** N of Dover, 20 May 1980, *Davis 2231* (VDB). **Scott Co.:** ca. 2 mi. N of Y City, 10 May 1989, *Naczi 2131* (MICH, UARK), 20 May 1994, *Naczi 3937 & Ford* (DOV\*). **Sevier Co.:** 8 mi. E of DeQueen, 10 May 1989, *Naczi 2126* (MICH, UARK, ctb). **CONNECTICUT. [New Haven County]:** Milford, 27 Jun 1901, *Eames s.n.* (NY). **[New London County]:** Waterford, 13 Jun 1896, *Graves s.n.* (GH). **DELAWARE. New Castle Co.:** ca. 3 mi. NW of Glasgow, 4 Jun 1986, *Naczi 1313* (DOV); SW of McKays Corner, 7 Jun 1988, *Naczi 2008* (DOV\*); 0.4 mi S of Townsend, 31 May 1999, *Naczi 8089* (DOV\*). **Kent Co.:** ca. 2.5 mi SSW of Blackiston, 5 May 2001, *Naczi 8710* (DOV). **Sussex Co.:** between Georgetown and Millsboro, 21 Jun 1926, *True 200a* (PH). **DISTRICT OF COLUMBIA. Washington,** 9 Jun 1901, *Steele s.n.* (NY). **FLORIDA. Calhoun Co.:** 15 mi. N of Wewahitchka, 18 May 1965, *McDaniel 6234* (IBE, MO, NY, VDB). **Gadsden Co.:** S side of Chattahoochee, Apalachicola River, 18 Mar 1975, *Kral 57343* (DOV, MICH, TENN, VDB); Chattahoochee, 27 May 1997, *Naczi 6223* (DOV\*). **Jackson Co.:** Floodplain of Apalachicola River between U.S. 90 and Jim Woodruff Dam, 14 Apr 1982, *Manhart 425 & Gholson* (DOV\*); ca. 1 mi. N of Marianna, along W side of Chipola River, 6 May 1989, *Naczi 2109* (DOV). **Santa Rosa Co.:** W of Jay, 27 Mar 1956, *Godfrey 54609* (GH). **GEORGIA. Burke Co.:** 7 mi. NE of Shell Bluff, near Savannah River, 18 May 1989, *Naczi 2190* (DOV\*). **Chattahoochee Co.:** ca. 9 mi W of Cusseta, 23 May 1997, *Naczi 6133* (DOV\*). **Early Co.:** ca. 1.5 mi. NW of Hilton, along Chattahoochee River, 18 May 1995, *Naczi 4713* (DOV, MICH). **Effingham Co.:** ca. 2.5 mi N of Cloy, 2 May 1991, *Naczi 2832* (DOV\*). **Hancock Co.:** ca. 13 mi. E of Sparta, 20 May 1996, *Naczi 5385* (DOV). **Harris Co.:** ca. 6 mi. W of Mulberry Grove, along S side of Mulberry Creek, 24 May 1997, *Naczi 6151* (DOV\*). **Jasper Co.:** ca. 14 mi. SW of Monticello, 21 May 1997, *Naczi 6055* (DOV). **Monroe Co.:** just S of Dames Ferry, W side of Ocmulgee River, 19 May 1997, *Naczi 6059* (DOV); ca. 2.5 mi SW of Russellville, 25 Apr 2000, *Naczi 8400 & Ford* (DOV). **Screven Co.:** Blue Springs, 2 May 1991, *Naczi 2839* (DOV\*). **KENTUCKY. Calloway Co.:** along Dalton Road off KY 280, 22 May 1990, *McKinney 4198 & Hamilton* (EKY, VDB). **LOUISIANA. Grant Parish:** 1.0 mi. S of Packton on US 167, 19 May 1995, *Hyatt 6434* (MICH). **Iberia Parish:** Weeks Island, 15 Apr 1983, *Wofford 83-6 & Murrell* (TENN). **Washington Parish:** ca. 2 mi E of Franklinton, 13 May 1972, *Rogers 8067* (TENN). **West Feliciana Parish:** ca. 4 mi. NW of Saint Francisville, 2 May 1988, *Naczi 1820* (DOV\*). **MARYLAND. Anne Arundel Co.:** Patuxent Research Refuge, 1 Jun 1945, *Hermann 11437* (GH). **Prince Georges Co.:** 1.5 mi. SE of Suitland, 1 Jun 1939, *Hermann 10331* (PH). **Somerset Co.:** 2 mi. N of Princess Anne, 23 May 1938, *Tatnall 3798* (GH, PH). **Talbot Co.:** 4.25 mi. WNW of Easton, 5 Jul 1941, *Earle 3414* (PH). **Worcester Co.:** 1.6 mi. SW of Public Landing, along Tanhouse Creek, 7 Jun 1988, *Naczi 2012* (DOV\*). **MASSACHUSETTS Bristol Co.:** Dighton, 24 Jun 1957, *Seymour 17122* (GH). **[Dukes County]:** Martha's Vineyard, between Town Hall and Menemsha, Chilmark, 19 Jun 1917, *Seymour 1882* (GH). **Norfolk Co.:** Dedham, 23 Jun 1879, *Faxon s.n.* (US). **MISSISSIPPI. Bolivar Co.:** ca. 3 mi. SE of Choctaw, 23 Apr 1992, *Bryson 11358 & Newton* (DOV, ctb). **Carroll Co.:** N of Vaiden, along a tributary of Hurricane Creek, 5 Jun 1996, *Bryson 15309* (DOV, MICH, ctb). **Forrest Co.:** ca. 10 mi. SE of Hattiesburg, 30 Apr 1988, *Naczi 1818* (DOV). **Holmes Co.:** 6.2 mi. E of Thornton, 14 Apr 1992, *Bryson*

11224 & *Newton* (DOV, ctb). **Lafayette Co.:** ca. 5 mi. ENE of Oxford, 8 Jun 1996, *Bryson 15324* (DOV, ctb). **Lee Co.:** W of Tupelo, 17 Apr 1992, *Bryson 11328* (DOV, ctb). **Lowndes Co.:** ca. 10 mi. S of Columbus, 11 Apr 1987, *Bryson 5336* (DOV, MICH, ctb). **Oktibbeha Co.:** ca. 15 mi. S of Starkville, Noxubee Wildlife Refuge, 26 May 1980, *Bryson 3053 & Mathies* (ctb). **Pearl River Co.:** just S of Carriere, 10 Apr 1936, *Harper 3477* (NY); ca. 3.2 mi S of Marion-Pearl River Co. line, 26 Apr 1991, *Bryson 10750 et al.* (DOV\*, ctb). **Tallahatchie Co.:** ca. 8 mi. N of Charleston, 21 Apr 1988, *Bryson 7345 & Morris* (DOV, MICH, ctb). **Tishomingo Co.:** ca. 1.2 mi. S of Mingo, along Cedar Creek, 17 May 1992, *Bryson 11707 & Warren* (DOV, ctb). **Union Co.:** 6 mi. SE of New Albany, E branch of Okannatie Creek, 18 May 1990, *Bryson 9954* (DOV\*, MICH, ctb). **Wilkinson Co.:** 1.2 mi. W of Lessley, 11 May 1990, *Naczi 2392* (DOV). **Winston Co.:** ca. 6.3 mi. NNW of Louisville, 29 May 1997, *Naczi 6283 et al.* (DOV). **Yalobusha Co.:** ca. 6 mi NE of Oakland, 9 Apr 1991, *Bryson 10621* (DOV\*, ctb). **MISSOURI. Dunklin Co.:** ca. 7 mi. NW of Campbell, along old channel of Saint Francis River, 22 May 1993, *Reznicek 9431 et al.* (DOV\*, MICH). **Ripley Co.:** SW of Neelyville, 24 May 1989, *Yatskievych 89-131 et al.* (MO). **NEW JERSEY. Bergen Co.:** Paramus, 25 Jun 1935, *Svenson 6655* (GH). **Cumberland Co.:** ca. 2 mi. N of Newport, 21 Jun 1994, *Naczi 4389 & Thieret* (DOV\*, MICH). **Mercer Co.:** Imlaystown, 30 Jun 1926, *Long 32985* (GH). **Salem Co.:** 1 mi. S of Pittsgrove, 26 May 1923, *Dreisbach 1329* (CM). **NEW YORK. Nassau Co.:** Glen Cove, 15 Jun 1907, *Bicknell 2046* (PH). **NORTH CAROLINA. Columbus Co.:** ca. 2 mi. NE of Whiteville, 21 May 1992, *Reznicek 8967 & Reznicek* (DOV, MICH). **Craven Co.:** 1 mi. NW of Vanceboro, 13 May 1950, *Blomquist 14961 & Batson* (NY). **Pitt Co.:** 2 mi. E of Winterville, 14 Jun 1958, *Radford 34985* (GH). **OKLAHOMA. McCurtain Co.:** ca. 9 mi. NE of Broken Bow, 12 May 1987, *Naczi 1575* (DOV\*). **PENNSYLVANIA. Bucks Co.:** Tullytown, 31 May 1899, *Williamson s.n.* (PH). **Dauphin Co.:** 1.75 mi. E of Lykens, 10 Jun 1952, *Berkheimer 13006* (PH). **Lehigh Co.:** 1.25 mi. W by slightly NW of Lehigh Furnace, 25 Jun 1922, *Pretz 11382* (MSC). **Philadelphia Co.:** near Cedar Grove, 8 Jul 1926, *Benner s.n.* (GH). **Schuylkill Co.:** ca. 1.3 mi. WSW of Summit Station, 5 Jul 1938, *Wagner 7401* (PH). **RHODE ISLAND. Bristol Co.:** Bristol, 11 Aug 1961, *Seymour 19460* (MO). **SOUTH CAROLINA. Cherokee Co.:** 6.2 mi. NW of Gaffney, 2 May 1990, *Naczi 2355* (DOV\*). **Clarendon Co.:** Manning, 23 May 1914, *Stone 311* (NY, PH). **Edgefield Co.:** Sumter National Forest, 3.2 air mi. SSE of Lick Fork Dam, 22 May 1997, *Nelson 18240* (DOV, USCH). **Greenville Co.:** E of Caesars Head, 31 May 1995, *Naczi 4761 & Naczi* (DOV\*, MICH). **Newberry Co.:** ca. 8 mi. NW of Newberry, 14 May 1996, *Horn 10310* (DOV, NBYC). **Richland Co.:** Congaree Swamp National Monument, ca. 2 km N of Weston lake, 29 Apr 1998, *Nelson 19096* (DOV\*, USCH). **TENNESSEE. Dyer Co.:** ca. 6 mi. S of Dyersburg, 27 Jun 1995, *Naczi 4839 & Reznicek* (DOV, MICH). **Hamilton Co.:** Behind Tennessee Welcome Center, I-75, 30 Apr 1996, *McNeilus 96-197* (TENN). **Lincoln Co.:** just E of New Hope, 4 Apr 1983, *Sommers s.n.* (VDB). **Marion Co.:** ca. 2 mi. S of Jasper, 29 May 1990, *Naczi 2509 & Kral* (DOV). **Perry Co.:** Mousetail Landing State Park, E side of Tennessee River, 17 May 1990, *Kral 77633* (VDB). **Tipton Co.:** ca. 2.5 mi. NW of Gilt Edge, 27 Jun 1995, *Naczi 4827 & Reznicek* (DOV, MICH). **Weakley Co.:** ca. 5 mi. NW of Greenfield, 28 Jun 1995, *Naczi 4868 & Reznicek* (DOV, MICH). **TEXAS. Harris Co.:** ca. 3 mi. N of US 90 at Sheldon, 5 Apr 1989, *Orzell & Bridges 9018* (MICH\*). **Jasper Co.:** ca. 14 mi. W of Kirbyville, 3 May 1988, *Naczi 1830* (MICH, ctb). **Marion Co.:** ca. 3 mi. S of Jefferson, 12 May 1988, *Naczi 1871* (MICH, ctb). **Smith Co.:** ca. 15 mi. N of Tyler, 7 May 1987, *Naczi 1539* (MICH, PH, TEX, ctb). **VIRGINIA. Princess Anne Co.:** Little Neck, 17 Jun 1935, *Fernald et al. 4593* (GH, PH). **Sussex Co.:** 3.8 mi. WNW of Sussex, 4 Jun 1986, *Wieboldt 6019* (DOV\*). **Westmoreland Co.:** 0.5 mi. S of Nomini Grove, 8 Jun 1940, *Hermann 10504* (PH).

## APPENDIX B

**Specimens of *Carex digitalis* measured for scatter plot (Fig. 3).** Equal numbers of specimens were measured for *C. digitalis* var. *digitalis* (d), *C. digitalis* var. *asymmetrica* (a), and *C. digitalis* var. *macropoda* (m). All vouchers are at DOV. **U.S.A. ALABAMA. Butler Co.:** ca. 0.5 mi N of Oaky Streak, 17 May 1995, *Naczi 4687* (m). **Conecuh Co.:** ca. 5 mi SSE of center of Evergreen, 17 May 1995, *Naczi 4696* (a). **Coosa Co.:** ca. 6 mi SW of Unity, 29 Apr 2000, *Naczi 8504 & Ford* (a). **Lawrence Co.:** Borden Creek, Bankhead National Forest, 15 May 1992, *Bryson 11612* (m). **Madison Co.:** Huntsville, Monte

Sano State Park, 6 May 1991, *Naczi 2881* (d). **MARION Co.:** S of Bear Creek, 15 May 1992, *Bryson 11592* (a). **MONROE Co.:** 1.8 mi N of route 47-83 junction in Midway, 28 Apr 1991, *Naczi 2817* (m). **ARKANSAS. Cross Co.:** W of Birdeye, 20 May 1990, *Naczi 2441* (m). **Stone Co.:** ca. 3 mi ENE of Fifty Six, 20 May 1986, *Naczi 1204* (d). **FLORIDA. Hamilton Co.:** Holton Creek Wildlife Management Area, 3 Apr 2000, *Abbott 13392* (a). **Leon Co.:** ca. 1 mi W of Bloxham, 5 May 1989, *Naczi 2099* (a). **GEORGIA. Effingham Co.:** ca. 2.5 mi N of Cloy, 2 May 1991, *Naczi 2831* (a). **Screven Co.:** Blue Springs, 2 May 1991, *Naczi 2838* (a). **Talbot Co.:** ca. 4 mi NE of Pleasant Hill, 25 Apr 2000, *Naczi 8428 & Ford* (m). **Towns Co.:** 0.3 mi W of Rabun Co. border, W of route 76, 3 May 1991, *Naczi 2859* (d). **INDIANA. Perry Co.:** 4.9 mi N of Bristow, 27 May 1990, *Naczi 2504* (d). **KENTUCKY. Adair Co.:** ca. 9 mi S of Columbia, 16 Jun 1998, *Naczi 7399 & Reznicek* (d). **Boone Co.:** 3 mi S of Petersburg, 12 Jun 1994, *Naczi 4106* (d). **Campbell Co.:** ca. 2 mi S of Alexandria, 5 Jun 1996, *Naczi 5646 et al.* (d). **Hardin Co.:** ca. 8.5 mi ENE of center of Elizabethtown, 15 Jun 1997, *Naczi 6507 & Heeg* (d). **Laurel Co.:** ca. 5.5 mi WNW of Bernstadt, 19 Jun 1997, *Naczi 6540 & Heeg* (m). **McLean Co.:** ca. 0.6 mi SSW of Beech Grove, 14 Jun 1997, *Naczi 6484 & Heeg* (m). **MICHIGAN. St. Clair Co.:** ca. 2 mi WNW of Blaine, 17 Jun 1988, *Naczi 2025* (d). **MISSISSIPPI. Pearl River Co.:** ca. 3.2 mi S of Marion-Pearl River Co. line, 26 Apr 1991, *Bryson 10749 et al.* (a). **Winston Co.:** ca. 5 mi NW of Louisville, 11 Apr 2000, *Naczi 8338 et al.* (m). **OKLAHOMA. McCurtain Co.:** ca. 9 mi NE of Broken Bow, 12 May 1987, *Naczi 1574* (m). **PENNSYLVANIA. Clinton Co.:** ca. 2.3 mi NE of Rosecrans, 4 Jul 1995, *Naczi 4894 & Naczi* (d). **SOUTH CAROLINA. Dorchester Co.:** W of Givhans, 19 Apr 1991, *Naczi 2763* (a). **York Co.:** ca. 3 mi NW of Bethany, 3 May 1989, *Naczi 2080* (m). **TEXAS. Jasper Co.:** ca. 14 mi W of Kirbyville, 3 May 1988, *Naczi 1831* (a). **VIRGINIA. Halifax Co.:** 5 mi SW of Republican Grove, 30 Apr 1986, *Wieboldt 5944* (m).

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