An Introduction To The Sedges Of Georgia

Figure 1. Capitate inflorescence of *Rhynchospora colorata* subtended by showy, green-tipped, white bracts.

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Photography by Richard Carter unless otherwise indicated

Introduction

The sedge family, or Cyperaceae, is the third largest monocot family, consisting of an estimated 5000 species in 104 genera (Fig.1).[1, 2] The largest genera with approximate numbers of species are *Carex*, 2000 spp.; *Cyperus*, 550 spp. (excluding *Kyllinga* and *Pycreus*); *Fimbristylis*, 300 spp.; *Rhynchospora* and *Scleria*, 250 spp. each; *Eleocharis*, 200 spp.; and *Bulbostylis*, *Pycreus* and *Schoenus*, 100 spp. each.[1] Sedges are grass-like flowering plants with linear leaves, parallel venation, and small, mostly wind-pollinated flowers. Although sedges have traditionally been viewed as close relatives of the grasses (Poaceae),[3] recent cladistic analysis using molecular and morphological data shows they are more closely allied with the Juncaceae and Thurniaceae.[4]

Sedges, grasses, rushes and other similar

Table 1. A comparison of the graminoid families *Cyperaceae*, *Poaceae* and *Juncaceae*.[3]

Cyperaceae **The Sedge Family**	*Poaceae* **The Grass Family**	*Juncaceae* **The Rush Family**
• Stems usually three-angled (but sometimes terete, quadrangular, or lenticular)	• Stems terete	• Stems terete
• Stems usually with solid pith	• Stems with solid nodes and hollow internodes	• Stems with solid pith
• Leaf sheaths closed	• Leaf sheaths open	• Leaf sheaths open
• Inflorescence a complex of spikelets (simple spikelet in *Eleocharis*)	• Inflorescence a complex of spikelets	• Inflorescence a complex of cymes
• Perianth of 1–many bristles or hairs, or absent	• Perianth hardly evident, apparently reduced to scale-like palea (outer series?) and tiny lodicule (inner series)	• Perianth of six scale-like parts in two series
• Stamens 3 (1-2, rarely 6)	• Stamens 3 or 6 (rarely 1-2)	• Stamens 6 (rarely 3)
• Pistil of 2-3 fused carpels	• Pistil of 2(3) fused carpels	• Pistil of 3 fused carpels
• Fruit an achene	• Fruit a caryopsis (grain)	• Fruit a capsule

kinds of monocot plants with small, inconspicuous flowers and linear leaves are grouped informally as graminoids. Although exceptions do occur, the anonymous rhyme "sedges have edges, rushes are round, grasses are hollow right up from the ground" does have value in enabling beginners to grasp general differences in vegetative structure among these families (Table 1). Although most sedges have three-angled stems, hence "sedges have edges," some do not. For example, the stems of *Dulichium arundinaceum* (L.) Britt. and many *Eleocharis* species are round in cross section.

Common Names Can Be Confusing!

Common names are often derived uncritically and can be confusing, especially for grasses, rushes and sedges. The so-called bulrushes (*Scirpus* spp., *Schoenoplectus* spp.), spike-rushes (*Eleocharis* spp.), and beak-rushes (*Rhynchospora* spp.) are actually sedges. Likewise, the cotton-grasses (*Eriophorum* spp.), umbrella-grasses (*Fuirena* spp.), and sawgrass (*Cladium jamaicense* Crantz) are sedges, and the nut-sedges (*Cyperus esculentus* L., *C. rotundus* L.) are often called "nut-grasses." Universality and relative lack of ambiguity are major advantages of scientific names. Because many graminoids, sedges included, are relatively inconspicuous and escape all but passing notice, most do not have common names. Therefore, scientific names are employed liberally in this article.

Uses of Sedges by Humans

Although not generally recognized for their economic importance and beneficence, sedges have been used by humans for thousands of years. The English word "paper" is derived from "papyrus," the Latin name for the sedge *Cyperus papyrus* L., first exploited ca. 4500 years ago by the ancient Egyptians to manufacture paper.[5] Another sedge, *Schoenoplectus corymbosus* (R. & S.) Raynal was employed in funeral wreaths by the ancient Egyptians.[6]

Chinese water-chestnuts, widely consumed in oriental cuisine, are the edible starchy tubers of the aquatic spikerush, *Eleocharis dulcis* L., grown in paddies in Asia.[7] *Cyperus esculentus*

Figure 2. A portion of the stem of *Dulichium* showing nodes, internodes, closed leaf sheaths, and leaf blades.

var. *sativus* Boeck., yellow-nutsedge, one of the oldest crops in Egypt, is cultivated in Africa, Asia and southern Europe for its tubers called *chufas, tiger nuts, Zulu nuts* or *earth almonds*, which are rich in starch, sugar and fat and have a nutty flavor when roasted.[6] Chufas are also made into flour and the Spanish drink *horchata de chufa*[6] and are the source of a non-drying oil of some economic value.[7] Yellow nut-sedge is also planted for its tubers to provide food for wildlife.[8] The rhizomes of bulrushes (*Schoenoplectus* spp.) were eaten by native Americans, and robust bulrushes, like *Schoenoplectus californicus* (C.A. Mey.) Soják, have been exploited to construct houses and boats.[6] Stems, leaves, or fibers of many sedges are used as materials for weaving, especially in undeveloped parts of the world.[2] For example, the stems and leaves of various bulrushes (*Scirpus* spp., *Schoenoplectus* spp.) including *Scirpus americanus* Pers., commonly called chairmaker's rush, are woven into baskets, mats, and chair seats, and fibers from *Fimbristylis umbellaris* (Lam.) Vahl are used as material for weaving in Asia.[6]

A surprising number of sedges are cultivated as ornamentals. Umbrella sedge (*Cyperus alternifolius* subsp. *flabelliformis* Kük.) has been grown in water gardens and as a pot-plant for more than 200 years, and papyrus (*Cyperus papyrus*), dwarf papyrus (*Cyperus prolifer* Kunth), and certain bulrushes (*Scirpus* spp., *Schoenoplectus* spp.) are cultivated in water gardens and ponds.[9] A number of *Carex* spp. are planted in woodland gardens, and *Cyperus albostriatus* Schrad. and *Isolepis cernuus* (Vahl) Roem. & Schult are used in pots and hanging baskets.[9] The bulrush *Schoenoplectus lacustris* (L.) Palla has been employed in Germany and the Neth-

Figure 3. Habit of *Eleocharis tuberculosa* showing apparently leafless stems.

erlands for water purification, and certain *Fimbristylis* species are indicators of copper deposits in Australia.[6] Bryson and Carter[10] have accumulated a list of more than 150 species of Cyperaceae cultivated as ornamentals or otherwise, which they attribute to be an important factor in their dispersal as weeds, and Simpson and Inglis[2] have compiled a comprehensive checklist of sedges exploited by humans.

Sedges as Weeds

Many sedges are adapted to open, sunny sites with reduced competition from taller shading trees and shrubs. Such plants are called heliophytes, and their habitats are often dependent upon natural or artificial disturbance. These sedges have intrinsic characteristics such as high reproductive output, rapid growth, vegetative proliferation, and extended seed dormancy that promote population expansion after disturbance, and they probably originally evolved as colonizers following disturbance.[11, 12, 13] Although there is a tendency to think in terms of catastrophic perturbations, more subtle and continual natural processes provide open areas for colonization by such species, e.g., exposed bars and banks along streams and coasts.[12]

The same characteristics that make sedges successful colonizers following natural disturbance enable them to occupy habitats artificially disrupted and maintained by humans, such as agricultural fields, lawns, and gardens.[12] Such opportunistic plants, often called weeds, are usually not problems so long as they are elements of their naturally co-evolved communities. However, when dispersed by humans from their native ranges and communities, they can adversely affect natural ecosystems, agriculture, and other societal interests. Moreover, habitat destruction and disturbance of natural ecosys-

Figure 4. Inflorescence of *Cyperus strigosus* showing stem, leafy bracts, and inflorescence rays.

Figure 5. Close-up of inflorescence of *Cyperus difformis* with six spikes visible, each composed of numerous small spikelets.

tems by humans creates the conditions necessary for such plants to survive and establish a "beach head" for subsequent dispersal during the early stages of naturalization and invasion.

Holm et al.[14] cited purple nut-sedge (*Cyperus rotundus*) as the world's worst weed and listed other sedges among the forty worst weeds: *Cyperus esculentus* (16th), *C. difformis* L. (32nd), *C. iria* L. (33rd), and *Fimbristylis miliacea* (L.) Vahl (40th), all of which have been introduced into Georgia. Additionally, a number of other native and introduced sedges are considered by many to be weeds of agriculture, lawns and gardens, turfgrass, or natural areas.[15]

General Structure

Sedges are widely believed to be taxonomically challenging. This is largely due to extreme reduction of flowers and associated structures in both number and size and the inherent difficulty in handling and describing such small, specialized parts. Based mainly upon the organization of complex inflorescences and small fruits (achenes) and associated parts (e.g., perianth, tubercle), reliable identification requires reproductively mature specimens with fully developed spikelets and achenes, the use of a good hand lens or a dissecting microscope, and the ability to manipulate and dissect fine structures. A glossary is provided at the end of this article to assist readers with some of the specialized terminology of sedges.

Figure 6. Solitary, terminal spikelet of *Eleocharis equisetoides* showing spiral scales.

Habit. Sedges are morphologically diverse and, depending upon the species, may have annual or perennial habits. Most species are perennial herbs persisting and spreading vegetatively by rhizomes, stolons, corms, or tubers.

Stems and leaves. Typically, stems are trigonous with three sides and three angles; however,

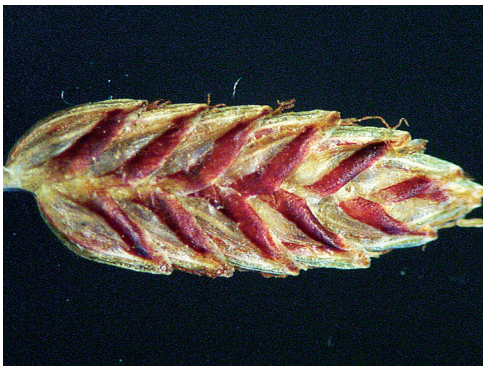

Figure 7. Individual spikelet of *Cyperus sanguinolentus* isolated to show distichous scales.

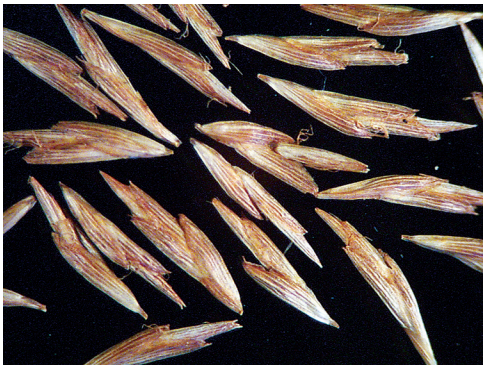

Figure 9. In *Cyperus echinatus* the spikelets fall intact—achenes, scales and all—and the entire spikelet is dispersed as a unit. Note scattered, intact spikelets.

Figure 10. In *Cyperus odoratus* the spikelets break apart into one-fruited segments, the unit of dispersal.

Figure 8. Portion of inflorescence of *Cyperus haspan* showing the sequential separation of scales and fruits from base to apex of spikelet. In this species the fruits are dispersed individually. Note two white fruits of central spikelet, exposed after separation of their subtending scales.

in *Dulichium* stems are round in cross section (terete), and in *Eleocharis* they can be terete or two-, three-, four- or more-angled. Leaves of sedges arise at intervals along a leafy stem (e.g., *Dulichium*, *Scirpus, Bolboschoenus*) or are clustered near the base of the plant (e.g., *Cyperus, Kyllinga*). They have closed sheaths (Fig. 2) with generally lanceolate to linear, grass-like blades. Unique within the family, plants of *Eleocharis* have leaves reduced to bladeless sheaths and, thus, appear leafless (Fig. 3).

Inflorescence. Some genera such as *Cyperus* and *Kyllinga* have prominent leafy bracts positioned below the inflorescence (Fig. 4). This feature is perhaps best developed in the white-topped sedges (*Rhynchospora* section *Dichromena*), characterized by dazzling white bracts with contrasting green tips (Fig. 1). The basic unit of the sedge inflorescence is

Figure 11. A fertile stem of *Carex glaucescens* showing plume-like, terminal staminate spikelet and three pistillate spikes below; each pistillate spike consists of numerous perigynia with each perigynium enveloping a pistillate flower. The exposed stamens of the staminate spikelet facilitate pollination by wind.

the spikelet. Generally, spikelets are organized into paniculate, cymose, umbellate or spicate clusters (Fig. 5), except *Eleocharis* with the inflorescence reduced to a single spikelet (Fig. 6). Essentially, each spikelet consists of one or more tiny flowers subtended by small bracts called scales. The scales and flowers may be spirally arranged (Fig. 6) or distichous (Fig. 7). In some sedges, the fruits are dispersed individually as they fall away one-by-one with their associated scales from the base to the apex of the spikelet (Fig. 8). In others, the spikelets separate as intact units—scales, fruits and all (Fig. 9), or the spikelet axis breaks apart into one-fruited segments, each segment having a portion of the axis, a scale, and a fruit (Fig. 10). The flowers in most genera of Cyperaceae are perfect (bisexual) with both stamen and pistil. However, *Carex*, *Cymophyllus* and *Scleria* have imperfect (unisexual) flowers that are usually borne in separate pistillate (female) and staminate (male) inflorescences on the same plant (monoecious) (Fig. 11). *Carex* and *Cymophyllus* are also unique among our sedges in having each pistillate flower enclosed within a small, sac-like perigynium (Fig. 11).

Flowers. The small flowers of many sedges are devoid of perianth segments (e.g., *Bulbostylis, Carex, Cymophyllus, Cyperus, Fimbristylis, Kyllinga*). However, others have a perianth of tiny bristles (Figs.12, 13) or hairs (Fig. 14). *Fuirena* has the most elaborate perianth, which is usually differentiated into two series—the outer three bristles and the inner three paddle-

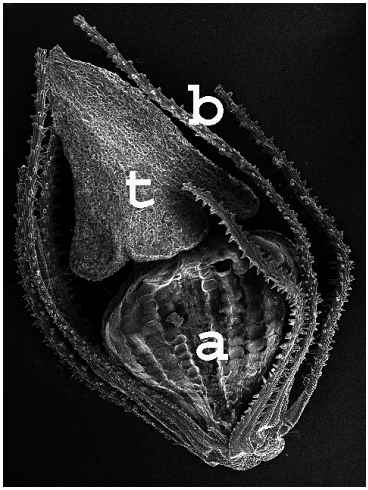

Figure 12. Scanning electron micrograph of achene-tubercle-perianth complex in *Eleocharis tuberculosa*. Note the tubercle (t) seated like a dunce-cap on the summit of the achene (a) and toothed perianth bristles (b) attached at the base of the achene.

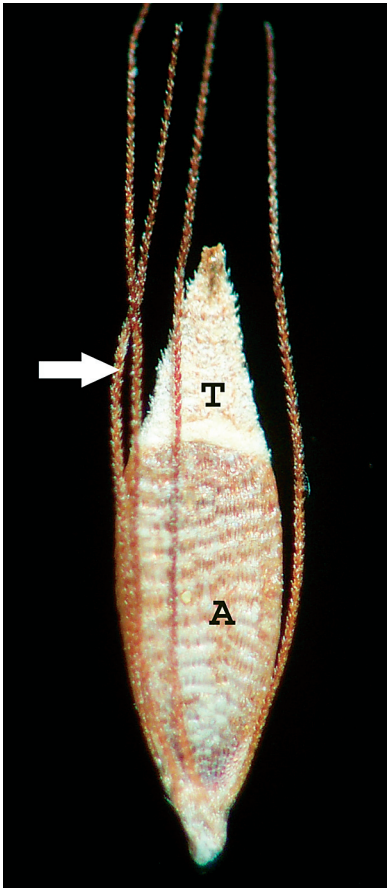

Figure 13. The achene-tubercle-perianth complex in *Rhynchospora inexpansa*. Note the whitish triangular tubercle (T) attached to the summit of the achene (A) and four toothed perianth bristles (arrow) attached at the base of the achene.

shaped segments (Fig. 15). When present, the perianth normally persists attached to the mature fruit (Figs. 12–15) and facilitates its dispersal. Perianth bristles generally have teeth along their edges that attach to fur or feathers of animals, and a perianth of long hairs undoubtedly promotes dispersal of the tiny fruits by wind. The numbers and kinds of perianth segments are useful in distinguishing among genera and species.

Achenes and Associated Structures. The small fruits of sedges, called achenes, have only one seed. Mature achenes are usually necessary for reliable identification. Achene shape is correlated with the number of carpels in the pistil. Pistils with two carpels normally have two-branched (bifid) styles and develop into biconvex (lenticular) or plano-convex achenes. Pistils derived from three carpels have three-branched (trifid) styles and form trigonous or terete achenes. The terete achenes of *Scleria* species are bony white (Fig. 16), and, in *Scleria* and other genera, the surface ornamentation of the achene is useful in distinguishing among species (Figs. 16–18). In *Fimbristylis,* the style is usually fringed with hairs (Figs. 19, 20), and, in a number of genera (e.g., *Bulbostylis, Eleocharis, Rhynchospora*), an enlarged style-base persists as a distinct tubercle (Figs. 12, 13, 21) attached to the summit of the achene. In *Scleria,* the achene usually has a rudimentary perianth adhering to its base in the form of a discoid or lobed hypogynium (Fig. 16).

Generic Survey of the Sedges of Georgia

In the following survey, the genera are classified into groups that correspond more or less with tribes of the *Cyperaceae*. However, in electing

Figure 14. A portion of the overly mature inflorescence of *Scirpus cyperinus* showing scattered tiny, white achenes with persistent perianth. Note the entangled and dangling, curly perianth hairs.

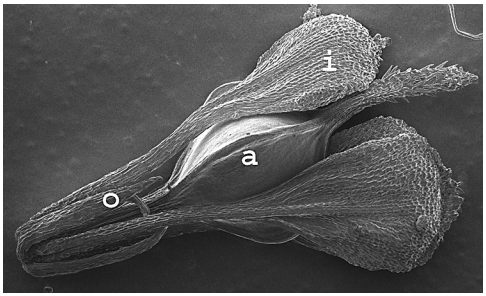

Figure 15. Scanning electron micrograph of achene-perianth complex in *Fuirena breviseta*. Note short, outer perianth segments (o); large, paddle-shaped, inner perianth segments (i); and the achene (a) with its stipitate base and its bristly, peg-like apex.

to emphasize form relationships instead of phylogeny, I have departed from recent tribal classifications[1, 16] in placing *Lipocarpha* and retaining the segregates of *Scirpus* in the same informal group with *Scirpus*. It is my belief that, in doing this, a more practical grouping of genera is achieved. English derivations of genus names are provided in order to make the Latin more approachable.[17, 18, 19]

The Spike-rush Sedge Group: *plants apparently leafless, with bladeless leaves reduced to sheathing bases; inflorescence a single, terminal, unbranched spikelet; flowers perfect*

Eleocharis (from Greek *elos*, marsh, and *charis*, grace)—**Spike-rushes**

The spike-rushes are the most structurally reduced sedges, consisting of little more than an apparently leafless stem terminated by an unbranched spikelet. However, the taxonomy of *Eleocharis* is complex, with marked variation in perianth, tubercles, and surface ornamentation of the achenes. *Eleocharis acicularis* (L.) R. & S., *E. microcarpa* Torr. and *E. parvula* (R.& S.) Link ex Bluff, Nees & Schauer are delicate plants with diminutive, cespitose habits; whereas others, such as *E. equisetoides* (Ell.) Torr. and *E. quadrangulata* (Michx.) R. & S., are graceful, stoloniferous perennials forming extensive stands sometimes dominating the shallows of ponds (Fig. 22). Tips of the arch-

Figure 16. The achene-hypogynium complex in *Scleria reticularis*; proximal (bottom) view on left showing three-lobed hypogynium and lateral/distal (top) view on right. Note reticulate-pitted achene surface and greenish hypogynium.

Figure 17. The achene of *Scleria georgiana*. Note smooth, whitish, bony surface and absence of hypogynium in this species.

Figure 18. The spikelet of *Scleria reticularis* showing intact achene. Note three scales and reticulate-pitted surface of achene.

Figure 19. Achene with attached style in *Fimbristylis caroliniana* showing fringed, bifid style and two terminal stigmas.

Figure 20. Portion of inflorescence of *Fimbristylis puberula* showing spikelets with spirally arranged scales and fuzzy stigmas.

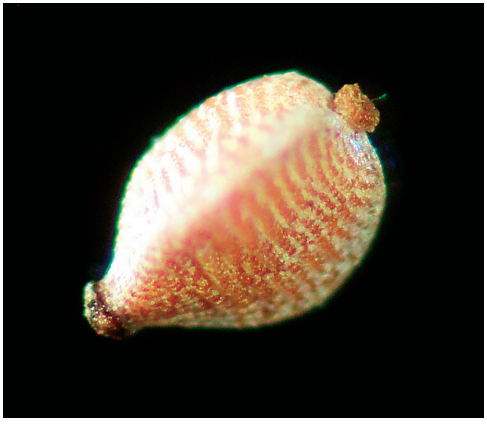

Figure 21. Achene of *Bulbostylis barbata* showing tubercle at upper right. Note transverse lines of cells on achene surface.

Figure 22. A stand of the graceful, emergent spikerush, *Eleocharis equisetoides*, in a shallow pond in Echols County, Georgia.

ing, aerial stems of *Eleocharis melanocarpa* Torr. and *E. baldwinii* (Torr.) Chapm. take root when they touch the ground, effecting a kind of "walking" asexual proliferation. Thusly, *E. baldwinii* forms dense mats on exposed hydric, sandy or peaty soils in flatwoods of the coastal plain.

A number of our species are adept colonizers following disturbance, especially in hydric soils of wetlands and floodplains and seasonally wet sites in fields and pastures, and some are listed as weeds, e.g., *E. obtusa* (Willd.) Schult., *E. montevidensis* Kunth and *E. quadrangulata.*[15] *Eleocharis albida* (Torr.) Torr. and *E. parvula* are particularly common and weedy in disturbed brackish soils along the Georgia coast, where they may be locally abundant.

Websteria (commemorating G. W. Webster, American botanist and farmer, 1833–1914)

Websteria consists of a single species, *Websteria confervoides* (Poir.) Hooper, widely distributed in tropical, subtropical and warm temperate regions around the world.[20] In the United States, *Websteria* is infrequently collected and known only from Florida and Georgia, where it is found submersed in ponds and lakes.[20, 21] It has one-fruited spikelets and capillary stems and is vegetatively similar to and sometimes confused with *Eleocharis vivipara* Link.

The Bulrush Sedge Group: *plants usually leafy; scales spiral; flowers perfect; perianth of bristles or hairs, or absent; style base indistinct; tubercle absent*

Scirpus (classical Latin name for the bulrush)—**Bulrushes**

Traditionally, *Scirpus* has been defined broadly to encompass species more recently segregated into the genera *Bolboschoenus, Isol-*

Figure 23. The highly branched, compound inflorescence of *Scirpus cyperinus*. Note the individual spikelets with spirally arranged scales.

epis, Oxycaryum and *Schoenoplectus*.[22, 23, 24, 25] Although others[1, 16] have placed the *Scirpus* segregates variously, and sometimes questionably, in the tribes Cypereae, Fuireneae or Scirpeae, I have pragmatically grouped them with *Scirpus* (tribe Scirpeae), because all have spiral arrangement of scales, indistinct style bases, and etuberculate achenes.

Scirpus is characterized by leafy stems; a large, compound, cymose inflorescence of many spikelets; and glabrous scales with usually acute to acuminate tips. There are about eight species in Georgia, inhabiting a variety of hydric sites including floodplain forests, swamps, marshes, stream banks, wet meadows, and ditches.[22] *Scirpus divaricatus* Ell. haunts shaded floodplain forests and swamps, and *S. lineatus* Michx. and *S. pendulus* Muhl. are often associated with open, wet calcareous sites. *Scirpus cyperinus* (L.) Kunth, called wooly bulrush or wooly bully, is one of the most common and widespread bulrushes in Georgia (Fig. 23). This robust sedge has leaves with harsh, cutting edges and is sometimes a weed of disturbed, hydric sites, occurring in a variety of marshy and wetland habitats. The wooly perianth of *S. cyperinus* persists, attached to its tiny achene, and thus promotes wind dispersal (Fig. 14). Interestingly, two of the native *Scirpus* species occurring in Georgia are introduced in other parts of the world: *S. pendulus* in Australia and *S. georgianus* Harper in New Zealand.[22] Because of its epithet and the origin of its type in Clarke County, Georgia, *S. georgianus* deserves special note. It is widely distributed in the eastern United States and in Georgia is most common in the piedmont and mountain provinces. *Scirpus georgianus* has been treated as a variety[17] or synonym[21, 26] of *S. atrovirens* Willd. but more recently has been restored to the rank of species based upon its brownish scales and rudimentary or absent perianth.[22]

Figure 24. The pseudolateral inflorescence of nine sessile spikelets in *Schoenoplectus pungens*. The structure below the inflorescence is the stem. The paler greenish structure above is an erect, terminal leaf, not a continuation of the stem!

Figure 25. The dense carpet of green in this photograph is actually a floating mass of *Oxycaryum cubense* in an impounded bayswamp in Lowndes County, Georgia.

Schoenoplectus (from Greek, *schoinos,* rush, and *plectos*, plaited, referring to use of stems in weaving of mats, etc.)—**Naked-stem Bulrushes**

The bulrushes with leafless, wand-like stems and ciliate scales are separated from *Scirpus* as *Schoenoplectus*, of which there are about ten species in Georgia.[24] *Schoenoplectus pungens* (Vahl) Palla, a common associate of the coastal salt-marsh community, is well marked by its pseudolateral clusters of sessile spikelets (Fig. 24) subtended by an erect bract that appears to be a continuation of the stem. *Schoenoplectus etuberculatus* (Steud.) Soják is found as an emergent in shallow ponds of the coastal plain or laxly submersed in swiftly flowing blackwater streams.

Bolboschoenus (from Greek *bolbos,* bulb, and *schoinos,* rush, referring to the enlarged, cormous stem bases)—**Tuberous Bulrushes**

Bulrushes with leafy stems, cormous stem bases, large spikelets, and puberulent scales are included in *Bolboschoenus*. *Bolboschoenus robustus* (Pursh) Soják, seacoast bulrush, is the only well documented tuberous bulrush from Georgia.[23]

Isolepis (from Greek, *isos,* equal, and *lepis,* scale, referring to the uniform floral scales)

Isolepis is a genus of mostly low, cespitose plants with basal leaves and terminal or pseudolateral capitate or solitary inflorescences. There are only two species of *Isolepis* in Georgia, both annuals. The native *Isolepis carinata* Hook. ex Arn. Ex Torr. [=*Scirpus koilolepis* Steud.] is an ephemeral inhabitant of intermittently wet depressions of fields and open woods during spring. *Isolepis pseudosetacea* (Dav.) Gand. [=*Scirpus molestus* M.C. Johnst.], an introduced species, has a similar habitat and phenology.[25]

Oxycaryum (from Greek, *oxys,* sharp, and *carya,* nut, referring to the sharp-pointed achene)

The only species of the monotypic genus *Oxycaryum* is widespread in tropical, subtropical, and warm temperate regions of the Eastern and Western Hemispheres.[27] In the United States, *Oxycaryum cubense* (Poepp. & Kunth) Lye [=*Scirpus cubensis* Poepp. & Kunth] ranges from eastern Texas into Georgia and southward into peninsular Florida. It is apparently recently introduced into Georgia, first reported in 1996.[28] Spreading locally by stolons and forming extensive floating batteries in lakes, ponds, and wetlands (Fig. 25), this aquatic sedge could threaten freshwater aquatic communities in warmer parts of the southeastern

Figure 26. Subtended by leafy bracts, the terminal, capitate inflorescence of *Oxycaryum cubense* resembles *Kyllinga*.

Figure 27. Subtended by leafy bracts, the terminal, capitate inflorescence of *Lipocarpha maculata* resembles *Kyllinga*. Note the spiral scale arrangement of the spikelets.

United States. Its terminal, umbellate or monocephalous inflorescence subtended by whorls of leafy bracts gives *O. cubense* a superficial resemblance to some *Cyperus* and *Kyllinga* species (Fig. 26).

Lipocarpha (from Greek *leipo*, to fall, and *carpha*, chaff, referring to the deciduous inner scales of certain species)

Georgia's only species, *Lipocarpha maculata* (Michx.) Torr., is somewhat ruderal. It is occasional to common in the coastal plain, where it is found in wet ditches, disturbed hydric soils of depressions in the flatwoods, and along the exposed margins of ponds. This species superficially resembles *Kyllinga* with its cespitose habit and terminal inflorescence of tightly clustered spikelets subtended by a whorl of leafy bracts (Fig. 27). The classification of *Lipocarpha* as more closely allied with either *Scirpus* (Tribe Scirpeae) or *Cyperus* (Tribe Cypereae) depends on how one interprets the various kinds of scales in the inflorescence and, thus, whether one views the inflorescence as a simple spikelet or a compound spike. Although the current, prevailing view is to interpret the inflorescence as a spike of reduced spikelets,[1, 16] I employ the simpler interpretation here and informally group *Lipocarpha* with *Scirpus* and other sedges with spikelets of spirally arranged scales and flowers, since this relationship of gross form is easier for non-specialists to see and grasp. This conundrum illustrates well the struggle inherent in two fundamental purposes of taxonomy to provide stable and ultimately useful means of identifying and naming plants and to construct classification schemes that reflect phylogenetic (evolutionary) relationships.

The Umbrella-grass Sedge Group: *plants mostly leafy; leaf blades or sheaths usually pubescent; scales spiral, usually pubescent; flowers perfect; perianth differentiated into two series, 3 outer bristles and 3 inner paddle-like segments; achene with stipitate base and peg-like apex; tubercle absent*

Fuirena (commemorating Georg Fuiren, Danish Botanist, 1581–1628)—**Umbrella-grasses**

Five species of *Fuirena* are known to occur in Georgia: *Fuirena breviseta* (Cov.) Cov., *F. longa* Chapm., *F. pumila* (Torr.) Spreng., *F. scirpoidea* Michx., and *F. squarrosa* Michx. All are heliophytes of wetland habitats, including bogs, marshes, interdunal swales, ditches, margins of ponds, and wet depressions in savannas[29, 30] Robert Kral's[29] thorough treatment of *Fuirena* for North America provides a dichotomous key for identification, technical descriptions, distribution maps, and illustrations. The umbrella-grasses are well marked by their usually leafy

Figure 28. A portion of the inflorescence of *Fuirena breviseta* showing large spikelets with spiral scales and pubescent bract.

Figure 29. The terminal, head-like cluster of spikelets with reddish brown scales in *Bulbostylis barbata.*

stems; pubescent leaves; large spikes; spirally arranged scales; perianth in two distinct series; and distinctive achene with stipitate base and peg-like apex (Figs. 15, 28). Although most species have conspicuously leafy stems, the coastal species *F. scirpoidea* and *F. longa* have reduced leaf blades and a wand-like habit, unusual in *Fuirena*.

The Fringe-sedge Group: *plants leafy; leaves basal; inflorescences terminal; scales spiral; flowers perfect; perianth absent; style-base distinct; tubercle present* (Bulbostylis) *or absent* (Fimbristylis) ***Fimbristylis*** (from Latin *fimbria*, fringed, and *stylus*, style)—**Fringe-sedges**

Fimbristylis and *Bulbostylis* are distributed mostly in tropical and warm temperate regions around the world, and Kral's[31] thorough account of the North American species of these genera provides a dichotomous key for identification, technical descriptions, distribution maps, and illustrations. As the genus name suggests, most *Fimbristylis* species have a fringed style with its base clearly distinct from the summit of the attached achene (Figs. 19, 20). Our species include a number of weeds widely distributed in both the Old and New Worlds: *Fimbristylis schoenoides* (Retz.) Vahl, *F. tomentosa* Vahl, *F. dichotoma* (L.) Vahl, *F. annua* (All.) R. & S., and *F. miliacea*. *Fimbristylis annua, F. dichotoma, F. miliacea,* and *F. tomentosa* have long been associated with rice agriculture and were probably brought into the southeastern United States from Asia as contaminants of rice seed shortly after colonization by Europeans.[31, 32] Most *Fimbristylis* species have branched, umbellate inflorescences of several to many spikelets. However, in *F. schoenoides* the inflorescence is usually reduced to a single spikelet, imparting an *Eleocharis* look to the plants until a closer inspection of the tufted stems reveals narrow basal leaves.

Fimbristylis perpusilla Harper was first collected by Roland M. Harper from Sumter County, Georgia[33] and is endangered in Georgia.[34] This diminutive sedge is endemic to the southeastern United States, where it occurs sporadically along the exposed shores of ponds and reservoirs from Georgia to Delaware and is sometimes locally abundant.[31, 32, 35] Robert Kral's long-term observations, suggesting sporadic occurrences of this species, are of interest.[35] In 1962, he noted that *F. perpusilla* was locally abundant but apparently restricted to only one pond in Seminole County, Georgia, despite there being other similar ponds in the area. He also observed only a few plants upon revisiting the site a year later and a great abundance again ten years later! *Fimbristylis brevivaginata* Kral, described as a new species in

Figure 30. Cespitose habit of the annual weed *Cyperus difformis* in McIntosh County, Georgia.

1992 and narrowly endemic on granitic and sandstone outcrops in the Cumberland Plateau of Alabama and the Piedmont of Georgia, is of possible conservation concern.[32, 36]

Bulbostylis (from Latin *bulbus*, bulbous, and *stylus*, style, referring to the enlarged bulbous style bases of many species)

As the genus name suggests, in most *Bulbostylis* species the swollen base of the style forms a distinct tubercle on the summit of the achene (Fig. 21). *Bulbostylis barbata* (Rottb.) C. B. Clarke is widely distributed in both Old and New Worlds.[31, 37] With its reddish-brown inflorescences (Fig. 29), this diminutive sedge is often locally abundant and conspicuous en masse in the coastal plain during late summer and autumn especially in open, disturbed, sandy areas and along the edges of agricultural fields. *Bulbostylis warei* (Torrey) C. B. Clarke, endemic to the Atlantic and Gulf coastal plain of the southeastern United States, inhabits open sands in longleaf pine-scrub oak communities; this tufted perennial has hemispherical, head-like clusters of spikelets and distinctive inflorescence bracts with beautifully fringed basal sheaths.

The Flat-sedge Group: *plants leafy; leaves basal; leafy bracts subtending inflorescence; inflorescence terminal, umbellate with pedunculate rays or capitate cluster of sessile spikes; scales distichous; flowers perfect; perianth absent; style base indistinct; tubercle absent*

Cyperus (from Greek *cyperus*, edge, referring to the sharp-edged leaves or perhaps the three-edged stems)—**Flat-sedges or Umbrella Sedges**

Cyperus is distinguished by spikelets with distichous (two-ranked) floral scales, usually two

or more flowers and fruits per spikelet, and the absence of a perianth. Some *Cyperus* species (e.g., *C. flavescens* L., *C. polystachyos* Rottb., *C. sanguinolentus* Vahl) have pistils with two stigmas and lenticular achenes. Others have pistils with three stigmas and trigonous achenes. *Cyperus* species also differ in how the spikelets, scales and achenes separate from the inflorescence at maturity. In *C. odoratus* L., the spikelets break apart into one-fruited segments (Fig. 10). In other species, like *C. flavescens, C. polystachyos,* and *C. haspan* L., the achenes and scales fall away one by one from the base to the apex of the spikelet axis (Fig. 8), and in another group that includes *C. croceus* Vahl, *C. echinatus* (L.) Wood, *C. retrorsus* Chapm., and *C. strigosus* L. the entire spikelet drops off intact—achenes, scales and all (Fig. 9).

Cyperus species are among the world's most notorious weeds, and some of the diverse characteristics and strategies that make plants competitive weeds are illustrated well by these sedges.

In Georgia, *Cyperus* species are found in diverse habitats. Some, like *Cyperus distinctus* Steud., *C. erythrorhizos* Muhl., *C. flavescens*, *C. haspan*, *C. lanceolatus* Poir., *C. odoratus*, *C. ovatus* Baldw., *C. polystachyos*, *C. pseudovegetus* Steud., *C. strigosus*, and *C. surinamensis* Rottb., and *C. virens* Michx., inhabit open, hydric soils along stream banks or shores of ponds and lakes or in ditches. Other species, like *C. filiculmis* Vahl, *C. grayii* Torr., *C. hystricinus* Fern., *C. plukenetii* Fern. and *C. nashii* Britt. ex Small, tend toward more xeric sites and are often associates of longleaf pine-scrub oak communities in the coastal plain. *Cyperus croceus*, *C. retrorsus* and *C. echinatus* are occasional to common in well drained soils, along roadsides or in poorly kept lawns or other disturbed sites. *Cyperus tetragonus* Ell. is endemic to the coastal plain of the southeastern United States (Florida, Georgia, South Carolina), and in Georgia it is found on well drained, sandy soils in the maritime live oak forest on barrier islands or the immediately adjacent mainland. *Cyperus granitophilus* McVaugh is endemic to granitic and sandstone outcrops in the piedmont of Georgia and adjacent states.

Cyperus species are among the world's most notorious weeds, and some of the diverse characteristics and strategies that make plants competitive weeds are illustrated well by these sedges. *Cyperus rotundus* (purple nut-sedge) and *C. esculentus* (yellow nut-sedge), the world's *worst* and *sixteenth worst* weeds, respectively, are distributed around the world in tropical, subtropical, and warm-temperate regions.[14] Their common names derive from the colors of their floral scales. Although both species are major agricultural, lawn, and garden pests in Georgia, they infrequently set viable seeds. Instead their reproduction and dispersal is primarily asexual, through tubers formed at the tips of rhizomes.[38] In contrast with the sweet, edible tubers (*chufas*) of yellow nut-sedge, those of purple nut-sedge are bitter and inedible.[38, 39] Although reproduction and dispersal in these sedges is mostly asexual, they rarely reproduce sexually, forming small achenes that are readily dispersed. This combination of asexual and sexual reproduction, has enabled purple and yellow nut-sedge to be among the world's most successful weeds and to colonize agricultural areas throughout much of the world.

The annual sedges *Cyperus difformis* and *C. iria*, also among the world's worst pests, have evolved a very different strategy, in which individual plants produce tremendous numbers of tiny, readily dispersed achenes and have very short life cycles. A single plant of *C. iria* can produce more than 5,000 viable seeds, and an individual of *C. difformis* can set 50,000 seeds.[14] *Cyperus difformis* and *C. iria* can produce multiple generations each growing season, with *C. difformis* completing its life cycle in only four to six weeks.[14] In the southeastern

Figure 31. The terminal, capitate inflorescence of *Kyllinga odorata*. Note the yellow anthers extending from white scales of spikelets.

Figure 32. The solitary, terminal spike of *Kyllinga squamulata* in Lowndes County, Georgia.

United States, *C. difformis* (Fig. 5, 30) and *C. iria* are primarily weeds of ditches, rice fields, and poorly drained sites in other agricultural fields or disturbed areas. *Cyperus iria* is common and widespread throughout much of the state. *Cyperus difformis* was first reported from Georgia in Lanier County in 1996[28] and has been found more recently in McIntosh County.[40] Despite its tremendous reproductive potential, *C. difformis* does not yet appear to be widespread or common in Georgia.

Cyperus entrerianus Boeck. (deeprooted sedge) is native to temperate regions of South America and was first reported from the United States in 1990.[41] It ranges from eastern Texas into Georgia and Florida in the southeastern United States, where flooding, construction equipment, mowing, and soil moving activities, especially along highways, disperse its small achenes.[41, 42] An individual plant of deeprooted sedge can set more than 100,000 achenes per year,[42, 43] and, in addition to producing tremendous numbers of seeds, it is a perennial with short, deeply set rhizomes and corms that persist through the winter. Thus, *Cyperus entrerianus* will likely continue to spread in the coastal plain of Georgia, where it occupies ditches and other low, disturbed sites in the flatwoods.

Kyllinga (commemorating Peter Kylling, seventeenth century Danish botanist)—**Green Sedges**

Kyllinga is distinguished by its terminal, capitate inflorescence (Fig. 31, 32); two-scaled, one-fruited spikelets (Fig. 33, 34); and lenticular achenes. The roots of fresh *Kyllinga* plants have a characteristically pleasant fragrance. *Kyllinga* is closely related to and probably derived from *Cyperus*, and some modern authors treat it within *Cyperus* as a subgenus or section.[21, 27, 44] Five species of *Kyllinga* are known to occur in Georgia, including *K. squamulata* Thonn. ex Vahl not previously reported from the state. *Kyllinga brevifolia* Rottb. and *K. gracillima* Miq. are rhizomatous perennials, and *K. odorata* Vahl and *K. pumila* Michx. are cespitose annuals or short-lived perennials.

Kyllinga pumila was initially described by Michaux[45] in the first North American flora and is evidently our only native *Kyllinga* species. The naturalized species *K. brevifolia* and *K. odorata* were introduced long ago, with *K.*

Figure 33. Spikelets of *Kyllinga odorata* with backlighting to show single brownish achene enclasped by paired translucent floral scales.

brevifolia being reported initially in the United States in 1821 by Stephen Elliott[46] and *K. odorata* in 1836 by John Torrey.[47] Bryson et al.[48] provide an illustrated account of *Kyllinga* species present in the southeastern United States, all of which can be weeds of lawns or turf-grass. Although previously known in the United States only from Florida and South Carolina,[48] *Kyllinga squamulata* (Figs. 32, 34) has been found recently as a weed in turf-grass on athletic fields in Lowndes and Chatham counties, Georgia.[40]

The Three-Way Sedge Group: *plants leafy; stem terete; leaves cauline; upper leaves with well-developed lanceolate blades, conspicuously three-ranked; inflorescences axillary; scales distichous; flowers perfect; perianth of 6–9 bristles*
Dulichium (Latin name for a kind of sedge)—**Three-way Sedge**

The only species in this distinctive, monotypic genus is *Dulichium arundinaceum.* The following combination of characteristics makes even sterile plants easy to identify: rhizomes; terete stems; well developed and conspicuously three-ranked, cauline leaves; and axillary inflorescences (Fig. 35). Also, the combination of perianth bristles and distichous scales is found elsewhere among Georgia sedges only in *Eleocharis baldwinii* and *Websteria confervoides*. The descriptive common name, three-way sedge, is derived from the delightfully tristichous (three-ranked) leaves, best observed in

Figure 34. The spikelet of *Kyllinga squamulata* consists of two scales enclasping a single achene. Note distinct tips and lacerate keels of paired scales.

Figure 35. The upper portion of the culm of *Dulichium arundinaceum* showing lanceolate leaf blades and axillary inflorescences.

Figure 36. A sterile culm of *Dulichium arundinaceum*, three-way sedge, looking from tip toward base of stem, showing tristichous (three-ranked) leaves.

Figure 37. A globose, axillary spike of *Rhynchospora cephalantha* Gray showing bract with sheathing base.

the field by looking straight down the stem (Fig. 36). In Georgia, the three-way sedge is found in acidic soils of depressions along blackwater streams and shallows along ponds associated with such streams.

The Beak-rush Sedge Group: *plants leafy; scales spiral; flowers perfect; perianth of few to many bristles or absent in sections* Dichromena *and* Psilocarya; *stigmas 2 (–3); achene biconvex to subterete; tubercle present*

Rhynchospora (from Greek *rhyncho*, snout or beak, and *spora*, seed, referring to the beaked achenes of many species)—**Beak-rushes** *Rhynchospora* is a taxonomically complex genus, well represented in the coastal plain of the southeastern United States, where remarkable numbers of beak-rush species can occur together in bogs, seeps, or wet savannas (Fig. 37). Although most beak-rushes inhabit hydric soils in bogs, wet savannas, margins of ponds, seeps, and depressions in flatwoods, *R. megalocarpa* Gray and *R. grayi* Kunth are found in open, xeric, sandy pinelands or sandscrub.

Species that are opportunistic colonizers of pastures, lawns, pond margins, and ditches, are treated as weeds, and one of our natives, *Rhynchospora caduca* Ell., is recently naturalized and spreading rapidly in Hawaii,[49, 50] suggesting other native beak-rushes could be invasive if introduced to other parts of the world. Although none is officially protected, a number of Georgia beak-rushes are of conservation concern: *R. crinipes* Gale, found on banks and bars of blackwater streams; *R. harveyi* var. *culixa* (Gale) Kral, found in ecotones between sandhills and bogs; *R. solitaria* Harper, inhabiting hillside bogs; and *R. thornei* Kral, growing along margins of limesink ponds.[35, 51, 52]

Historically, species with conspicuous, green-tipped, white bracts have been treated in the segregate genus *Dichromena*; however, a compelling case has been made for including these white-topped sedges in *Rhynchospora*.[53] These are striking plants in the field (Fig. 1), and two species are found in Georgia: *R. colorata* (L.) Pfeiff., an inhabitant of basic or circumneutral soils in seeps or swales, and *R. latifolia* (Baldw.) Thomas, a more robust plant of acidic soils of bogs and wet savannas. *Psilocarya,* formerly a small genus of annuals lacking perianth bristles, is also now treated within *Rhynchospora*.[52]

The Sawgrass Sedge Group: *plants leafy; scales spiral; flowers perfect; perianth absent; stigmas 3; achene terete*

Cladium (from Greek *clados*, branch, alluding to the branched inflorescence)—**Sawgrass**

There are two species of *Cladium* in the southeastern United States: *C. jamaicense* Crantz and *C. mariscoides* (Muhl.) Torrey. Only *Cladium jamaicense*, sawgrass, is known to oc-

cur in Georgia. The predominant species of the Everglades marshes of southern Florida, this robust perennial with graceful, delicate inflorescences and lacerating foliage inhabits brackish and freshwater marshes along the Georgia coast and occasionally inland.[21]

The Nut-rush Sedge Group: *plants leafy; flowers imperfect; spikelet generally with pistillate flowers below staminate and with several empty basal scales; achenes whitish, bony; hypogynium usually present*

Scleria (from Greek *scleros*, hard, referring to the bony achene)—**Nut-rushes**

In *Scleria,* the spikelets generally have both pistillate and staminate flowers with pistillate flowers below the staminate and several empty scales below the pistillate flowers at the base of the spikelet. The whitish, bony surfaces of the achenes are variously smooth, pitted, reticulate or pubescent (Figs. 16–18), and fused to the base of the achene there is usually a discoid, tuberculate, or lobed structure called the hypogynium (Fig. 16). There are about twelve species of *Scleria* in Georgia. Although most of our species (e.g., *S. baldwinii* (Torr.) Steud., *S. georgiana* Core, *S. minor* (Britt.) Stone, *S. muehlenbergii* Steud., *S. reticularis* Michx., *S. verticillata* Muhl. ex Willd.) are found on fairly wet sites such as open, moist, sandy or peaty soils of seepage slopes, bogs, depressions in flatwoods, and pond margins, *S. triglomerata* Michx. and *S. oligantha* Michx. are more often found on mesic to subxeric sites in shaded woods, open prairies, and pineland savannas. *Scleria ciliata* Michx. and *S. pauciflora* Muhl. ex Willd. both exhibit ample variation with several named varieties each and substantial ranges in habitat from dry to hydric sites.[54]

The Caric Sedge Group: *plants leafy; flowers imperfect; staminate (male) and pistillate (female) flowers often borne in separate inflorescences or one type above the other in the same inflorescence; sac-like perigynium enclosing each pistillate flower and achene*

Carex (from Greek *cairo*, to cut, referring to sharp edges of leaves in certain species)—**Caric Sedges**

Figure 38. A portion of the leaf of *Cymophyllus fraserianus* showing finely toothed margin and absence of midrib.

Carex is well marked by imperfect flowers and, its most distinctive feature, the perigynium enveloping each pistillate flower and fruit (Fig. 11). Most *Carex* species occur in the northern temperate zone where they are primarily found in mesic, woodland habitats. With more than 2000 species, *Carex* is the largest genus of Cyperaceae and one of the largest genera of the world's flora. *Carex* is also the largest genus of plants in Georgia and includes a number of recently named species found in the state: *Carex acidicola* Naczi, described in 2002; *C. appalachica* Webber & Ball, 1979; *C. calcifugens* Naczi, 2002; *C. cumberlandensis* Naczi, Kral & Bryson, 2001; *C. gholsonii* Naczi & Cochrane, 2002; *C. godfreyi* Naczi, 1993; *C. kraliana* Naczi & Bryson, 2002; *C. manhartii* Bryson, 1985; *C. pigra* Naczi, 1997; *C. planispicata* Naczi, 1999; *C. superata* Naczi, Reznicek & Ford, 1998; and *C. thornei* Naczi, 2002. Of these, *Carex acidicola, C. calcifugens* and *C. thornei* are of possible conservation concern.[19]

Figure 39. *Cymophyllus fraserianus* at author's left. Photograph by Sharon Carter

The majority of Georgia's officially listed rare and protected sedges are *Carex* species.[34] *Carex baltzellii* Chapm. ex Dewey, endangered in Georgia, is a rare plant of beech-magnolia forests on steep slopes of ravines, ranging from southern Mississippi to southwestern Georgia and northern Florida.[35] Other rare caric sedges with official legal status in Georgia as threatened species are Biltmore sedge, *Carex biltmoreana* Mack., restricted to steep, sunny, granitic seeps in the Blue Ridge Province of northeastern Georgia, South Carolina and North Carolina;[35] *Carex manhartii* Bryson, a denizen of moist deciduous or mixed deciduous evergreen forests in the Appalachians from West Virginia southward to northern Georgia;[55] wretched sedge, *Carex misera* Buckley, whose leaves droop forlornly from shaded granitic cliffs and balds in the Blue Ridge from northeastern Georgia, eastern Tennessee and western North Carolina;[35, 56] and *Carex purpurifera* Mack., found in rocky, moist, deciduous forests in the southern Appalachians, usually associated with limestone.[35, 55] *Carex dasycarpa* Muhl., an inhabitant of sandy, hardwood forests and hammocks in the coastal plain from Mississippi to South Carolina, has rare status in Georgia and is considered to be rare elsewhere in its range.[57]

Cymophyllus (from Greek *kyma*, wave, and *phyll*, leaf, referring to wavy leaf margins)

The monotypic genus *Cymophyllus* differs from *Carex* primarily in having a single (rarely two) basal leaf. Its evergreen leaf has a broad flattened blade with finely toothed margins and lacks a midrib (Figs. 38, 39). The only species, Fraser's sedge, *Cymophyllus fraserianus* (Ker-Gawl.) Kartesz & Gandhi, inhabits rocky, mesic woods in the Appalachians from West Virginia into northeastern Georgia.[35, 58] Plants have striking white inflorescences and are probably pollinated by insects.[59] Fraser's sedge has threatened status in Georgia[34] and is sometimes cultivated as an ornamental in woodland gardens. [9, 60]

Dichotomous Key to the Sedge Genera of Georgia

1a. Achenes enclosed within a loosely or tightly fitting sac-like perigynium 2

1b. Achenes not enclosed within sac-like perigynium 3

2a. Basal leaves more than 2; leaf blades folded with keeled midrib and basal sheath . . . . . ***Carex***

2b. Basal leaves 1(-2); leaf blades flattened without midrib or sheath . . . . . ***Cymophyllus***

3a. Leaves bladeless, reduced to sheaths, thus plants appearing essentially leafless; culm terminated by a single, unbranched spikelet. . . . . ***Eleocharis***

3b. Plants usually with some bladed leaves evident; culm usually terminated by a compound inflorescence of multiple spikelets variously arranged.. 4

4a. Scales two-ranked (distichous) 5

4b. Scales spirally arranged 7

5a. Leaves cauline; stems terete; perianth present . . . . . ***Dulichium***

5b. Leaves basal; stems mostly trigonous; perianth absent. 6

6a. Spikelets usually with more than two scales and two or more achenes; inflorescence usually with pedunculate rays . . . . . ***Cyperus***

6b. Spikelets with two scales and one achene; inflorescence a terminal cluster of one to several sessile heads. . . . . ***Kyllinga***

7a. Style-base persistent, forming distinct tubercle atop achene 8

7b. Style base not persistent, tubercle absent 9

8a. Sheath summit or juncture of blade and sheath with tufts of lines of hairs; perianth absent; tubercle forming small bulbous structure atop achene . . . . . ***Bulbostylis***

8b. Sheath summit and juncture of blade and sheath glabrous; perianth bristles present or absent; tubercle usually larger, conicle, subulate, or otherwise shaped, rarely small and bulbous . . . . . ***Rhynchospora***

9a. Perianth absent or present as a single series of bristles or hairs. 10

9b. Perianth in two series, differentiated into three outer stout bristles and three inner bladed and paddle-like segments . . . . . ***Fuirena***

10a. Leaves cauline. 11

10b. Leaves entirely basal, or mostly basal with only 1 (-2) cauline leaves, or reduced to inconspicuous rudimentary blades 13

11a Achene subterete . . . . . ***Cladium***

11b. Achenes trigonous, biconvex or plano-convex. 12

12a. Spikelets mostly less than 3.5 (-5) mm in diameter; scale glabrous, apex rounded to acute; culms without cormous bases; achene minutely papillose. . . . . ***Scirpus***

12b. Spikelets mostly more than 4 mm in diameter; scale pubescent, apex notched and awned; culms with cormous bases; achene smooth . . . . . ***Bolboschoenus***

13a. Style base markedly distinct from achene summit; style usually fringed with hairs . . . . . ***Fimbristylis***

13b. Style base not distinct from achene summit; style not fringed. 14

14a. Infloresence bracts usually conspicuous and leaf-like, mostly spreading to divaricate and exceeding the inflorescence 15

14b. Inflorescence bracts inconspicuous or few with at most only the lowest exceeding the inflorescence, sometimes largest bract appearing as continuation of the stem 16

15a. Cespitose annual; achene trigonous or terete . . . . . ***Lipocarpha***

15b. Stoloniferous perennial; achene plano-convex with corky margins and apex . . . . . ***Oxycaryum***

16a. Achene rugose (sometimes faintly so), transversely ridged or smooth . . . . . ***Schoenoplectus***

16b. Achene papillose. . . . . ***Isolepis***

Glossary [61, 62, 63]

Achene—a small, single-seeded, dry fruit

Acuminate—abruptly narrowing to a sharp-pointed apex

Acute—gradually and consistently narrowing to a sharp-pointed apex

Annual—a plant that persists for no more than one year, going from seed to seed within a period of one year or less

Apex—the summit or tip of a structure

Asexual reproduction—reproduction without sexual union of gametes; usually involving growth from a vegetative organ such as a rhizome, stolon, corm or bulb

Axil—the angle formed by leaf and stem at the node

Axillary—developing from and attached at the leaf axil

Basal—developing from and attached to the base of the plant or structure

Biconvex—a structure such as an achene with two convex faces and two edges

Bifid—with two branches

Bisexual—having both male (stamen) and female (pistil) parts; usually with reference to the flower

Blade—the expanded, flattened portion of the leaf arising from the rim of the sheath

Bract—a modified leaf positioned below a flower or an inflorescence

Bulbous—bulb-shaped

Capillary—a slender, hair-like structure

Capitate—compact and head-like

Carpel—the fundamental unit of the pistil bearing the immature seeds (ovules) of the flowering plant; thought to be a highly modified leaf

Cauline—of or on the stem; cauline leaves are stem leaves, as opposed to basal leaves

Cespitose—with the stems basally clumped or tufted

Compound—branched

Conical—cone-shaped

Corm—a modified stem, usually subterranean, usually broader than high, with a series of ring-like nodes and internodes; its functions include asexual reproduction and food storage

Cormous—corm-shaped or bearing corms

Culm—the stem of a grass or sedge

Cyme—a compound inflorescence based upon sets of three flowers each, with the central, sessile flower developing first

Cymose—an inflorescence of cymes or one resembling cymes; in context of sedges, an inflorescence with spikelets in branched sets of three, the central spikelet being sessile and the two lateral ones pedunculate

Dioecious—with male (staminate) and female (pistillate) flowers on separate plants; opposite of monoecious

Discoid—disc-shaped

Distichous—in two ranks; two-ranked

Divaricate—spreading at a wide angle

e-—prefix meaning without; for example, *etuberculate* "without a tubercle"

Erect—vertical

Fimbriate—fringed

Glabrous—smooth; without pubescence

Habit—general appearance, posture, and manner of growth; for example, annual herb, shrub, tree, vine

Habitat—where the organism grows

Head—a very compact, tight inflorescence

Hydric—wet; usually descriptive of a habitat or soil; see *mesic, xeric*

Hypogynium—the lobed or discoid structure fused with the base of the achene in *Scleria* (Fig. 16)

Imperfect—unisexual flowers having either male (stamen) or female (pistil) parts

Inflorescence—a group or cluster of flowers

Keel—a structure shaped like a boat's keel

Keeled—like a keel or with a keel

Lanceolate—lance-shaped

Lateral—developing and attached along the sides of the stem

Lenticular—lens-shaped; compressed and two-angled in cross section

Linear—long and narrow with more or less parallel sides

Mesic—moderately moist; usually descriptive of a habitat or soil; see *hydric, xeric*

Monoecious—having both staminate and pistillate flowers on the same plant; opposite of dioecious

Monocephalous—having one head

Monotypic—a taxonomic group with only one representative; for example, a genus with only one species

Panicle—a highly branched inflorescence, with the branches usually alternately arranged

Paniculate—having a panicle or like a panicle

Papillose—covered with tiny, pimple-like protuberances

Peduncle—a stalk-like stem bearing an inflorescence

Pedunculate—with peduncles

Perennial—a plant that persists for more than two years

Perfect—a flower with both male (stamen) and female (pistil) parts

Perianth—the outer series of floral parts peripheral to the stamens and the pistil; in the typical flower, the perianth consists of sepals and petals collectively; in sedges the perianth segments, when present, are reduced to bristles, hairs, scales, or similar structures

Perigynium (perigynia, plural)—a sac-like structure enveloping the pistillate flower and achene in species of *Carex* and *Cymophyllus*

Pistil—the "female" floral structure composed of basal ovary; slender, neck-like style; and terminal stigma

Pistillate—having one or more pistils but lacking a stamen; referring to the unisexual "female" flower or the inflorescence or plant

Pitted—covered with tiny depressions

Plano-convex—a structure with two faces and two angles, with one face flattened and the other curved (convex)

Pseudolateral—appearing to be lateral, but actually terminal

Puberulent—minutely pubescent

Pubescent—covered with hairs

Ray—a major branch of an inflorescence

Reticulate—netted

Rhizomatous—producing or having a rhizome

Rhizome—elongated, horizontal, subterranean stem with nodes, buds and scale-like leaves

Rugose—with a wrinkled surface

Scale—a small bract associated with the flowers of sedges

Sessile—without a stalk

Sheath—the modified base of the sedge leaf enveloping the stem

Simple—unbranched

Solitary—borne singly

sp.—an abbreviation for *species* (singular), often used after the genus name to denote a single species not specifically named

spp.—an abbreviation for *species* (plural), often used after the genus name to denote multiple species not specifically named

Spicate—in the form of a spike or like a spike

Spike—a simple, indeterminate inflorescence with sessile flowers

Spikelet—the fundamental unit of the sedge inflorescence; a small spike with highly reduced, sessile flowers, each normally subtended by a scale

Spreading—outstretched

Stamen—the "male" floral structure consisting of slender, supporting filament and terminal anther, with pollen produced in the anther

Staminate—having one or more stamens but lacking a pistil; referring to the unisexual "male" flower or the inflorescence or plant

Sterile—lacking functional sexual organs

Stigma—the terminal portion of the pistil, which is receptive to pollen

Stipitate—with a stalked base

Stolon—elongated, horizontal stems arising from the plant base, usually growing at or just below the soil surface

Stoloniferous—bearing stolons or having a stolon

Style—the slender, neck-like portion of the pistil above its basal ovary; sometimes with branches

Subulate—awl-shaped; a stiffish structure that tapers from base to apex

Subterete—almost circular in cross-section; see *terete*

Subxeric—somewhat xeric; transitional from xeric to mesic; see *mesic, xeric*

Terete—round in cross-section

Terminal—developing and attached at the tip of the stem

Trifid—with three branches

Trigonous—three-angled

Tristichous—in three ranks; three-ranked

Tuber—a thickened subterranean stem, usually developing at the apex of a rhizome

Tubercle—an enlarged style base that persists attached to the summit of the mature achene; characteristic of certain species of *Bulbostylis, Eleocharis, Rhynchospora*

Umbel—a simple inflorescence with many well developed pedicels all arising from near the same point at the distil end of the peduncle; inflorescence spherical, or with a convex or flat top

Umbellate—in the form of an umbel; descriptive of the inflorescences of many *Cyperus* spp.

Unisexual—having either male (stamen) or female (pistil) parts, but never both; usually with reference to the flower

Voucher—a dried plant specimen with collection data on its label, preserved in an herbarium as a permanent record documenting the occurrence of a species at a particular geographical location

Xeric—dry; usually with reference to a habitat or soil; see *hydric, mesic*

References

1. Goetghebeur, P. 1998. Cyperaceae, pp. 141–190 in: K. Kubitzki (ed.), *The families and genera of vascular plants IV.* Springer-Verlag. Berlin.

2. Simpson, D. A. and C. A. Inglis. 2001. Cyperaceae of economic, ethnobotanical, and horticultural importance: a checklist. Kew Bulletin 56: 257–360.

3. Cronquist, A. 1981. *An integrated system of classification of flowering plants.* Columbia University Press. New York.

4. Chase, M. W., D. E. Soltis, P. S. Soltis, P. J. Rudall, M. F. Fay, W. H. Hahn, S. Sullvan, J. Joseph, M. Molvray, P. J. Kores, T. J. Givnish, K. J. Sytsma and J. C. Pires. 2000. Higher-level systematics of the monocotyledons: an assessment of current knowledge and a new classification, pp. 3–16 in: Wilson, K. L. and D. A. Morrison (eds.), *Monocots: systematics and evolution*. CSIRO Publishing. Collingwood, Victoria.

5. Levitin, E. and K. McMahon. 2003. *Plants and society.* McGraw-Hill Companies, Inc. New York.

6. Mabberley, D. J. 1997. *The plant book.* Cambridge University Press. Cambridge.

7. Schery, R. W. 1972. *Plants for man.* Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

8. DeFelice, M. S. 2002. Yellow nutsedge *Cyperus esculentus* L.—snack food of the gods. Weed Technol. 16: 901–907.

9. Bailey, L. H. and E. Z. Bailey. 1976. *Hortus third.* Macmillan Publishing Company, Inc. New York.

10. Bryson, C. T. and R. Carter. In press. The significance of Cyperaceae as weeds. Monog. Syst. Bot. Missouri Bot. Garden.

11. Baker, H. G. 1965. Characteristics and modes of origin of weeds, pp. 147–172 in: H. G. Baker and G. L. Stebbins (eds.), *The genetics of colonizing species.* Academic Press. New York.

12. Baker, H. G. 1974. The evolution of weeds. Annual Rev. Ecol. Syst. 5: 1–24.

13. McNaughton, S. J. and L. L. Wolf. 1973. *General ecology.* Holt, Rinehart and Winston, Inc. New York.

14. Holm, L.G., D. Plucknett, J. V. Pancho, and J. P. Herberger. 1977. *The world's worst weeds: distribution and biology*. University Press of Hawaii. Honolulu.

15. Anonymous. 1989. *Composite list of weeds*. Weed Science Society of America. Champaign, Illinois.

16. Bruhl, J. 1995. Sedge genera of the world: relationships and a new classification of the Cyperaceae. Australian Systematic Botany 8: 125–305.

17. Fernald, M. L. 1950. *Gray's manual of botany.* 8th edition (reprint). Dioscorides Press. Portland, Oregon.

18. Hyam, R. and R. Pankhurst. 1995. *Plants and their names: a concise dictionary.* Oxford University Press Inc. New York.

19. Ball, P. W., K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother. 2002. *Flora of North America,* vol. 23, Oxford University Press. New York.

20. Bruhl, J. 2002. *Websteria,* pp. 120-121 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

21. Godfrey, R. K. and J. W. Wooten. 1979. *Aquatic and wetland plants of southeastern United States: monocotyledons.* University of Georgia Press. Athens.

22. Whittemore, A. T. and A. E. Schuyler. 2002. *Scirpus,* pp. 8-21 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

23. Smith, S. G. 2002. *Bolboschoenus,* pp. 37-44 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

24. Smith, S. G. 2002. *Schoenoplectus,* pp. 44-60 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

25. Smith, S. G. 2002. *Isolepis,* pp. 137-140 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

26. Radford, A. E., H. A. Ahles and C. R. Bell. 1968. *Manual of the vascular flora of the Carolinas* .The University of North Carolina Press. Chapel Hill.

27. Haines, R. W. and K. A. Lye. 1983. *The sedges and rushes of east Africa.* East African Natural History Society. Nairobi.

28. Bryson, C. T., J. R. MacDonald, R. Carter, and S. D. Jones. 1996. Noteworthy *Carex*, *Cyperus*, *Eleocharis*, *Kyllinga*, and *Oxycaryum*

(Cyperaceae) from Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, Tennessee, and Texas. Sida 17: 501–518.

29. Kral, R. 1978. A synopsis of *Fuirena* (Cyperaceae) for the Americas north of South America. Sida 7: 309–354.

30. Kral, R. 2002. *Fuirena,* pp. 32-37 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

31. Kral, R. 1971. A treatment of *Abildgaardia, Bulbostylis,* and *Fimbristylis* (Cyperaceae) for North America. Sida 4: 58–277.

32. Kral, R. 2002. *Fimbristylis,* pp. 121–131 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

33. Small, J. K. 1903. *Flora of the southeastern United States.* Published by the author, New York.

34. Patrick, T. S., J. R. Allison and G. A. Krakow. 1995. *Protected plants of Georgia.* Georgia Department of Natural Resources. Social Circle.

35. Kral, R. 1983. *A report on some rare, threatened, or endangered forest-related vascular plants of the South: vol. 1, Isoetaceae through Euphorbiaceae.* Technical Publication R8-TP 2. USDA Forest Service. Atlanta, Georgia.

36. Kral, R. 1992. A new species of *Fimbristylis* (Cyperaceae) from the sandstone and granitic outcrops of Alabama and Georgia. Sida 15: 317–321.

37. Kral, R. 2002. *Bulbostylis,* pp. 131–136 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

38. Wills, G. D. 1987. Description of purple and yellow nutsedge (*Cyperus rotundus* and *C. esculentus*). Weed Technol. 1: 2–9.

39. Garg, D. K., L. E. Bendixen, and R. S. Anderson. 1967. Rhizome differentiation in yellow nutsedge. Weed Sci. 15: 124–128.

40. Carter, R. Unpublished data.

41. Carter, R. 1990. *Cyperus entrerianus* (Cyperaceae), an overlooked species in temperate North America. Sida 14: 69–77.

42. Carter, R. and C. T. Bryson. 1996. *Cyperus entrerianus*: a little known aggressive sedge in the southeastern United States. Weed Technol. 10:232–235.

43. Bryson, C.T., R. Carter, and D. J. Rosen. 2003. Deeprooted Sedge (*Cyperus entrerianus*). Proc. South. Weed Sci. Soc. 56: CD-ROM.

44. Kern, J. H. 1974. Cyperaceae 1, pp. 435–753 in: C.G.G.J. van Steenis (ed.), *Flora Malesiana*, Vol. 7. Noordhoff. Leyden.

45. Michaux, A. 1803. *Flora boreali-americana*. Vol. I. Paris.

46. Elliott, S. 1821. *A sketch of the botany of South-Carolina and Georgia.* Vol. 1. J. R. Schenck. Charleston, South Carolina.

47. Torrey, J. 1836. Monograph of North American Cyperaceae. Ann. Lyceum Nat. Hist. New York 3: 249–288.

48. Bryson, C. T., R. Carter, L. B. McCarty, and F. H. Yelverton. 1997. *Kyllinga*, a genus of neglected weeds in the continental United States. Weed Technol. 11: 838–842.

49. Wagner, W. L., D. R. Herbst and S. H. Sohmer. 1990. *Manual of the flowering plants of Hawaii.* Vol. 2. University of Hawaii Press, Bishop Museum. Honolulu.

50. Wagner, W. L. and D. R. Herbst. 1995. Contributions to the flora of Hawaii. IV. New records and name changes. Bishop Mus. Occas. Pap. 42: 13–27.

51. Kral, R. 1996. Supplemental notes on *Rhynchospora crinipes* and related species in sect. *Fuscae* (Cyperaceae). Sida 17: 385–411.

52. Kral, R. 2002. *Rhynchospora,* pp. 200–239 in: P. W. Ball, K. Gandhi, R. W. Kiger, D.

Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

53. Thomas, W. W. 1984. Systematics of *Rhynchospora* sect. *Dichromena*. Mem. New York Bot. Gard. 37: 1-116.

54. Reznicek, A. A., J. E. Fairey and A. T. Whittemore. 2002. *Scleria,* pp. 242–251 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

55. Bryson, C. T. and R. F. C. Naczi. 2002. *Carex* sect. *Laxiflorae,* pp. 431–440 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

56. Waterway, M. J. 2002. *Carex* sect. *Hymenochlaenae,* pp. 461–475 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

57. Ball, P. W. 2002. *Carex* sect. *Hallerianae,* pp. 487–489 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

58. Reznicek, A. A. 2002. *Cymophyllus,* p. 573 in: P. W. Ball, K. Gandhi, R. W. Kiger, D. Murray, J. L. Zarucchi, A. A. Reznicek and J. L. Strother, *Flora of North America*, vol. 23, Oxford University Press. New York.

59. Thomas, W. W. 1984. Insect pollination of *Cymophyllus fraseri* (Andrews) Mackenzie. Castanea 49: 94–95.

60. Turner, R. J. Jr. and E. Wasson (eds.). 1998. *Botanica.* Random House Australia Pty. Ltd. Milsons Point.

61. Jackson, B. D. 1928. *A glossary of botanic terms with their derivations and accents.* Hafner Publishing Co., Inc. New York.

62. Lawrence, G. H. M. 1951. *The taxonomy of vascular plants.* Macmillan Publishing Co., Inc. New York.

63. Stearn, W. T. 1992. *Botanical Latin.* 4th Ed. David & Charles. Newton Abbot, Devon, England.

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