

Collections of Vascular Plants from Five Southern Appalachian Fens in and around Shady Valley, Johnson and Carter Counties, Tennessee

C. T. Carter and M. G. McIntosh

Department of Biology, Tennessee Technological University, Cookeville, TN 38505

Abstract—Southern Appalachian fens are unique habitats that possess characteristics of both bogs and fens. Although such wetlands display some of the highest diversity values in the Southern Appalachian region and provide habitat for many rare plant species, they are frequently under-surveyed. The flora of five montane fens was surveyed in and around Shady Valley in Johnson and Carter counties, Tennessee. The resulting checklist contains 98 species representing 69 genera and 32 families, including eight species of ferns and 90 species of flowering plants. Four species are non-native. Two taxa represent new listings for Carter County and 16 taxa represent new listings for Johnson County. Ten species are currently listed as endangered, threatened, or of special concern in Tennessee.

Introduction

Southern Appalachian fens are unique habitats and possess characteristics of both bogs and fens. These wetlands typically have hydrologic regimes that resemble southern fens whereas their soil and water chemistry and plant communities resemble those of northern bogs. Moorhead and Rossell (1998) assert that fewer than 500 montane wetland sites exist in the southern Appalachian Mountains, with only eight known sites found in the Blue Ridge Province of eastern Tennessee. Although they display some of the highest diversity values within the Southeast United States, these wetlands are frequently overlooked and consequently under-surveyed because of their small size (typically 1 ha). Many of these areas are home to rare and endangered taxa that may be northern disjuncts, coastal plain species, or endemic to the Southern Blue Ridge. The purpose of this investigation was to document the flora of five fens in and around Shady Valley in northeastern Tennessee.

Materials and Methods

Study Areas—Shady Valley, Tennessee, is positioned within the Unaka mountain chain of the Blue Ridge Province at an elevation ranging from 847 m (2780 ft) at the valley floor to

approximately 914 m (3000 ft) (Fig. 1). The valley itself is surrounded by Iron, Holston, and Cross mountains and is approximately 4 km wide and just over 11 km long (Fig. 1). Historically, the area was once a prime site for the natural occurrence of large cranberry (*Vaccinium macrocarpon*). Killebrew (1874) found Shady Valley a prime site for potential large-scale cranberry production. He noted the boggy soils and mentioned that “cranberries grow wild in every portion” of the valley. But in 1963, in an effort to promote agriculture, the valley was drained by the U.S. Army Corps of Engineers through a series of large-scale channelization projects that facilitated quick removal of water from the landscape. Cranberries and other plant species disappeared along with their habitat, but persisted in isolated fens not disturbed by the channelization projects. More recent fen restoration efforts within the valley are due to the efforts of the Tennessee Chapter of The Nature Conservancy (TNC).

Five fens were selected for this investigation. These areas included John’s Bog, Orchard Bog, Osborne Bog, Stoney Creek Bog, and Quarry Bog (Table 1; Fig. 1). (Although these sites are fens, we retain the use of the term “bog” as it reflects the actual name of these five sites.) Orchard Bog restoration area was once a natural

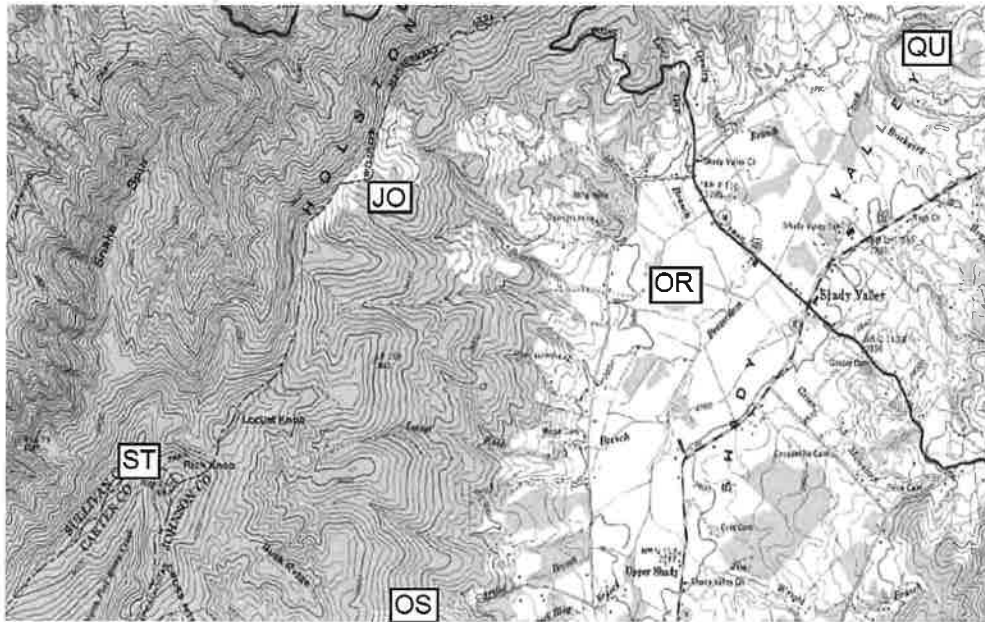


Fig. 1. Topographic map indicating the locations of five fens in and around Shady Valley, Tennessee, including John's Bog (JO), Orchard Bog Restoration (OR), Osborne Bog (OS), Stoney Creek Bog (ST), and Quarry Bog (QU).

cranberry fen but was heavily impacted by draining in the 1960s and by the development of agricultural farms across the valley. One section of Orchard Bog is referred to as "Orchard Bog Preserve." This small area, which maintains a thick *Sphagnum* sp. mat with a herbaceous plant community along its perimeter, is the area where we focused this investigation. Similarly, Quarry Bog has also been extremely impacted by agricultural run-off during the last century. Both Orchard Bog and Quarry Bog are owned or managed by TNC and are part of restoration efforts by TNC. Osborne Bog and John's Bog are located in the Cherokee National Forest and are managed cooperatively by the United States Department of Agriculture (USDA)—Forest

Service and TNC. Osborne Bog is situated on a former cattle farm. It, like the other sites, has also been impacted by nutrient input from agricultural run-off and was affected by grazing cattle until the area was fenced in the mid-1980s (Stewart and Nilsen, 1993). John's Bog is maintained by the implementation of periodic controlled burns to further inhibit establishment of woody vegetation. Stoney Creek Bog is also found within the Cherokee National Forest and is managed by the USDA—Forest Service. Of the five fens we survey, it is located at the highest elevation.

Specimen Collection and Preparation—The vascular flora was observed and collected when in flower or fruit during walk-throughs at each site throughout the growing season from March to

Table 1. Locations and elevations for five fens in and near Shady Valley, Johnson and Carter counties, Tennessee. Coordinates are given in decimal degrees.

Bog	County	Quadrangle	Latitude	Longitude	Elevation (m)	Size (ha)
John's Bog	Johnson	Shady Valley	36.5288 N	-81.9643 W	1060	0.61
Orchard Bog	Johnson	Shady Valley	36.5109 N	-81.9446 W	853	0.40*
Osborne Bog	Johnson	Doe	36.4881 N	-81.9651 W	1010	0.16
Stoney Creek Bog	Carter	Doe	36.2958 N	-81.5959 W	1255	< 1.0
Quarry Bog	Johnson	Shady Valley	36.5289 N	-81.9203 W	853	2.53

* Orchard Bog restoration area encompasses 67.6 ha. The area sampled in this investigation was a smaller section referred to as the "Orchard Bog Preserve" located within the restoration area.

Table 2. Species included as new listings for Carter and Johnson counties, Tennessee.

Species
Carter County
Dicots
<i>Eupatorium altissimum</i>
<i>Solidago lancifolia</i>
Johnson County
Ferns
<i>Woodwardia virginica</i>
Dicots
<i>Achillea millefolium</i>
<i>Circaea lutetiana</i>
<i>Gillenia trifoliata</i>
<i>Lycopus uniflorus</i>
<i>Mimulus alatus</i>
<i>Myosoton aquaticum</i>
<i>Polygonum hydropiper</i>
<i>Polygonum lapathifolium</i>
<i>Potentilla canadensis</i>
<i>Vernonia gigantea</i>
Monocots
<i>Carex tribuloides</i>
<i>Eleocharis acicularis</i>
<i>Juncus subcaudatus</i>
<i>Scirpus atrovirens</i>
<i>Sorghastrum nutans</i>

* Barclay (1957: 105) also documented *Lycopus uniflorus* in the ground cover from a Hemlock-White Pine forest type in Shady Valley, Johnson County, Tennessee.

October 2008. Frequency of site visits increased during periods of increased flowering. All sites were visited once in March, twice each month from April to June, and three times each month from July through October at one- to two-week intervals. After collection, voucher specimens were prepared according to standard herbarium practice (Bridson and Forman, 1998), and then accessioned and deposited in the herbarium of Tennessee Technological University (HTTU). Three species, including *Caltha palustris*, *Cypripedium acaule*, and *Platanthera ciliaris*, were documented with photographs only. One specimen, *Sparganium* sp., was determined only to genus because it was collected while in flower but mature fruits are necessary to distinguish between species. We originally keyed this individual to *S. chlorocarpum* (now known as *S. emersum*) using Wofford (1989). The specimen

was then sent to Dr. Robert Kaul at the University of Nebraska for verification. He agreed that it could potentially be *S. emersum* or *S. americanum*, but that it would be impossible to distinguish without mature fruit. Taxa were determined using Wofford (1989) and Radford et al. (1968). Nomenclature follows USDA, NRCS (2011) and synonyms from Wofford (1989) or Radford et al. (1968) are provided in the species list. Specifically, Radford et al. (1968) was used to determine the following: *Carex gynandra* Schwein., *Carex lurida* Wahlenberg, *Carex scoparia* Schkuhr ex Willd., *C. tribuloides* Wahlenberg, *C. vulpinoidea* Michaux., *Echinochloa crusgalli* (L.) Beauvois, *Eleocharis acicularis* (L.) R. & S., *Eleocharis tenuis* (Willd.) Shultes var. *tenuis*, *Eriophorum virginicum* L., *Glyceria canadensis* (Michx.) Trin. var. *laxa* (Scribner) Hitchcock, *Glyceria striata* (Lam.) Hitchcock, *Habenaria ciliaris* (L.) R. Br., *Holcus lanatus* L., *Houstonia serphyllifolia* Michx., *Juncus subcaudatus* (Engelm.) Coville and Blake, *Leersia oryzoides* (L.) Swartz, *Panicum dichotomum* L., *Scirpus atrovirens* Willd., and *S. cyperinus* (L.) Kunth.

Results and Discussion

Floristic Summary—A total of 98 species representing 69 genera and 32 families were collected from the five fen sites. There were eight species of ferns and 90 species of flowering plants, 29 of which were monocots and 61 of which were dicots. Four species were non-native, representing 4% of the total species collected. Three families, Asteraceae (14 species), Cyperaceae (10 species), and Poaceae (9 species) accounted for 34% of the flora with 33 species total. The largest genus was *Carex* with seven species. The genera *Lycopus*, *Polygonum*, and *Solidago* each contained four species. Most species were found at only a single bog site, and only three species were found at two sites. Two taxa represented new listings for Carter County and 16 taxa represented new listings for Johnson County, based on data from the herbarium at the University of Tennessee at Knoxville (TENN) (Table 2).

Noteworthy Species—Ten species are currently listed as endangered, threatened, or of

Table 3. Species listed as endangered (E), threatened (T), or special concern (S) found in northeast Tennessee based on the Tennessee Natural Heritage Program rare plant list.

Species	Collection Site*	State Status† ¹	State Rank† ²	Global Rank† ³
Ferns				
<i>Dryopteris cristata</i>	OS	T	S2	G5
<i>Woodwardia virginica</i>	OR	S	S2	G5
Dicots				
<i>Caltha palustris</i>	QU	E	S1	G5
<i>Hypericum ellipticum</i>	OS	E	S1	G5
<i>Solidago lancifolia</i>	ST	E	S1	G3/G4 Q
<i>Stellaria longifolia</i>	QU	E	S1	G5
<i>Vaccinium macrocarpon</i>	OR	T	S2	G4
Monocots				
<i>Cyripedium acaule</i>	JO	S	S4	G5
<i>Eriophorum virginicum</i>	OR	E	S1/S2	G5
<i>Glyceria laxa</i>	JO	S	S1	G5

* John's Bog (JO), Orchard Bog (OR), Osborne Bog (OS), Stoney Creek Bog (ST), Quarry Bog (QU)

† Information for state status, state rank and global rank is based on the Tennessee Natural Heritage Program rare plant list (Tennessee Division of Natural Heritage, 2008).

¹ State Status: E = Endangered; T = Threatened; S = Special Concern

² State Rank: S1 = "Extremely rare and critically imperiled in the state with five or fewer occurrences, or very few remaining individuals, or because of some special condition where the species is particularly vulnerable to extirpation from Tennessee."; S2 = "Very rare and imperiled within the state, six to twenty occurrences and less than 3000 individuals, or few remaining individuals, or because of some factor(s) making it vulnerable to extirpation from Tennessee" (Tennessee Division of Natural Heritage, 2008).

³ Global Rank: G3 = "Very rare and local throughout its range or found locally in a restricted range, or, because of other factors, vulnerable to extinction throughout its range. Generally between 21 and 100 occurrences and fewer than 10,000 individuals."; G4 = "Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery. Thus, the plant is of long-term concern."; G5 = "Demonstrably secure globally, though it might be quite rare in parts of its range, especially at the periphery."; Q = "Taxonomic status is questionable, numeric rank may change with taxonomy" (Tennessee Division of Natural Heritage, 2008).

special concern in Tennessee (Table 3). Five—*Caltha palustris*, *Eriophorum virginicum*, *Hypericum ellipticum*, *Solidago lancifolia*, and *Stellaria longifolia*—are endangered. *Dryopteris cristata* and *Vaccinium macrocarpon* are threatened, while *Cyripedium acaule*, *Glyceria laxa* and *Woodwardia virginica* are of special concern

(Table 3). No species is federally listed, but *Solidago lancifolia* is potentially rare and has a G3 global ranking (Tennessee Division of Natural Heritage, 2008).

Several investigations have documented ferns from northeastern Tennessee. Smith and Pearman (1971) reported *Dryopteris cristata*, *Osmunda cinnamomea*, *Osmunda regalis*, *Polystichum acrostichoides*, and *Thelypteris noveboracensis* occurring in Carter and Johnson counties, Tennessee. *Thelypteris palustris* was documented by Jennison (1935) (*Thelypteris palustris* (Salisb.) Schott var. *pubescens* (Lawson) Fernald) from a collection by A. J. Sharp and J. K. Underwood in Shady Valley, Johnson County, in 1933. It was also reported to occur in Hunter Bog in Carter County by Smith and Pearman (1971) from a collection made by Grindstaff in 1956. Stewart and Nilsen (1993) listed *Osmunda cinnamomea* as having an importance value of 22 from a boggy site adjacent to Shady Valley in Johnson County. Even though they do not provide the name of this site, we are certain that it is the same area that we refer to as Osborne Bog given their site description, and we also report *O. cinnamomea* from Osborne Bog in this investigation.

Several investigators have also documented flowering plants for Johnson and Carter counties. Jennison (1935) includes *Caltha palustris* as having been collected from Shady Valley swamp by A. J. Sharp and J. K. Underwood in 1934 and *Vaccinium macrocarpon* as also being collected from Shady Valley swamp by A. J. Sharp and J. K. Underwood in 1933. Again, *Vaccinium macrocarpon* is noted in Shady Valley as early as 1874 by Killebrew (Killebrew, 1874). *Hypericum ellipticum* was collected by A. J. Sharp and J. K. Underwood near Elizabethton in Carter County in 1933 (Jennison, 1935), but we found it in Osborne Bog in Johnson County in this investigation. Stewart and Nilsen (1993) include *Rubus hispidus* and *Vaccinium macrocarpon* as important shrubs and vines from their fen site near Shady Valley in Johnson County. They also include the graminoids *Carex lurida*, *Eleocharis tenuis*, and *Holcus lanatus*. We also found *Rubus hispidus*, *Carex lurida*, and *Holcus lanatus* in Osborne Bog. However, *Eleocharis*

tenuis was collected from John's Bog in this study. Tabor (1976) reports finding *Kalmia latifolia*, *Eriophorum virginicum*, *Scirpus atrovirens*, and *Vaccinium macrocarpum* among a few other species growing on a *Sphagnum* sp. mat in the understory of a fen in Shady Valley. We observed all of these species in Orchard Bog except for *K. latifolia*, which we found in Osborne Bog.

Floristic List—The following floristic list documents 98 species collected by Mark McIntosh across the five fens sampled. The list is arranged by division. The classes Magnoliopsida and Liliopsida further distinguish dicots and monocots, respectively, within the Magnoliophyta. Within each division and/or class, species are listed alphabetically by family followed by genus and specific epithet. An asterisk (*) preceding a scientific name indicates a non-native species. Each species listing is followed by the site of collection, county, and collector number. Synonyms are listed in parentheses. Abbreviations for the five fen sites follow in parentheses: John's Bog (JO), Orchard Bog (OR), Osborne Bog (OS), Stoney Creek Bog (ST), and Quarry Bog (QU). Even though they were not collected, *Parnassia asarifolia* Vent. was noted in Stoney Creek Bog during September 2008, as well as *Medeola virginiana* L. and *Trautvetteria carolinensis* (Walt.) Vail. *Phalaris arundinacea* L. was a dominant species in Orchard Bog. These species are not included in the floristic list and so are not included in the total list of taxa.

FLORISTIC LIST

POLYPODIOPHYTA

Polypodiopsida

BLECHNACEAE

Woodwardia virginica (L.) J. E. Smith, OR, Johnson, 56

DRYOPTERIDACEAE

Dryopteris cristata (L.) A. Gray, OS, Johnson, 33
Polystichum acrostichoides (Michx.) Schott, ST, Carter, 75

OSMUNDACEAE

Osmunda cinnamomea L., OS, Johnson, 89
Osmunda regalis L., OS, Johnson, 29

THELYPTERIDACEAE

Thelypteris noveboracensis (L.) Nieuwl., OS, Johnson, 34; ST, Carter, 74

Thelypteris palustris Schott., OR, Johnson, 22

WOODSIACEAE

Athyrium filix-femina (L.) Roth subsp. *asplenoides* (Michx.) Hulten., ST, Carter, 88

MAGNOLIOPHYTA

Magnoliopsida (Dicots)

APIACEAE

Oxypolis rigidior (L.) Raf., JO, Johnson, 62

ASTERACEAE

Achillea millefolium L., OR, Johnson, 13

Aster puniceus L., QU, Johnson, 71

Bidens frondosa L., OR, Johnson, 90

Erechtites hieracifolia (L.) Raf., JO, Johnson, 91

Eupatorium altissimum L., ST, Carter, 80

Eupatorium perfoliatum L., JO, Johnson, 45

**Hypochoeris radicata* L., OS, Johnson, 93

Prenanthes roanensis (Chickering) Chickering, ST, Carter, 77

Solidago caesia L., ST, Carter, 73

Solidago canadensis L., QU, Johnson, 72

Solidago lancifolia (T. & G.) Chapman, ST, Carter, 79

Solidago rugosa Miller, JO, Johnson, 65

Verbesina alternifolia (L.) Britton, QU, Johnson, 42

Vernonia gigantea (Walt.) Trelease ex Branner & Coville, JO, Johnson, 47

BALSAMINACEAE

Impatiens capensis Meerb. QU, Johnson, 68

CAPRIFOLIACEAE

Sambucus canadensis L., OS, Johnson, 12

CARYOPHYLLACEAE

Myosoton aquaticum (L.) Moench (syn: *Stellaria aquatica* (L.) Scopoli), OS, Johnson, 37

Stellaria longifolia Willd., QU, Johnson, 36

CLUSIACEAE

Hypericum ellipticum Hook., OS, Johnson, 21

Hypericum mutilum L., OS, Johnson, 97

Triadenum virginicum (L.) Raf., OR, Johnson, 44

ERICACEAE

Kalmia latifolia L., OS, Johnson, 20

Lyonia ligustrina (L.) DC., OS, Johnson, 30

Rhododendron maximum L., OS, Johnson, 19

Vaccinium macrocarpon Ait., OR, Johnson, 32

LAMIACEAE

- Collinsonia canadensis* L., ST, Carter, 78
Lycopus americanus Muhl. ex Barton, OR,
 Johnson, 98
Lycopus rubellus Moench, OS, Johnson, 54
Lycopus uniflorus Michx., JO, Johnson, 27
Lycopus virginicus L., JO, Johnson, 25

LAURACEAE

- Lindera benzoin* (L.) Blume, JO, Johnson, 63

LINACEAE

- Linum striatum* Walt., JO, Johnson, 64

NYSSACEAE

- Nyssa sylvatica* Marsh., OR, Johnson, 57

ONAGRACEAE

- Circaea lutetiana* (L.) A. & M. subsp. *canadensis*
 (L.) A. & M., JO, Johnson, 60
Epilobium coloratum Biehler, OR, Johnson, 48;
 OS, Johnson, 53

OXALIDACEAE

- Oxalis montana* Raf. (syn: *Oxalis acetosella*
 L.), OS, Johnson, 11
Oxalis stricta L., JO, Johnson, 59

POLYGONACEAE

- Polygonum hydropiper* L., QU, Johnson, 69
Polygonum lapathifolium L., OS, Johnson, 39
Polygonum punctatum Ell., JO, Johnson, 46
Polygonum sagittatum L., OR, Johnson, 31
 **Rumex acetosella* L., JO, Johnson, 26

PRIMULACEAE

- Lysimachia ciliata* L., QU, Johnson, 40

RANUNCULACEAE

- Anemone quinquefolia* L., OS, Johnson, 95
Caltha palustris L., QU, Johnson, no voucher/
 picture only

ROSACEAE

- Aronia melanocarpa* (Michx.) Ell., JO, Johnson, 61
Gillenia trifoliata (L.) Moench (syn: *Porter-
 anthus trifoliatus* (L.) Britt.), OS, Johnson, 52
Potentilla canadensis L., JO, Johnson, 7
Potentilla simplex Michx., ST, Carter, 15
Rosa palustris Marsh., JO, Johnson, 92
Rubus hispidus L., OS, Johnson, 38
Spiraea tomentosa L., OR, Johnson, 43

RUBIACEAE

- Galium tinctorium* L. QU, Johnson, 70
Houstonia serpyllifolia Michx., JO, Johnson, 3

SALICACEAE

- Salix sericea* Marsh., OR, Johnson, 28

SCROPHULARIACEAE

- Chelone lyonii* Pursh, OS, Johnson, 50
Mimulus alatus Ait., QU, Johnson, 67

VIOLACEAE

- Viola cucullata* Aiton, JO, Johnson, 1
Viola hastata Michx., JO, Johnson, 10
Viola macloskeyi var. *pallens* (Banks ex Ging)
 M. S. Baker, JO, Johnson, 2

Liliopsida (Monocots)

CYPERACEAE

- Carex atlantica* Bailey, JO, Johnson, 94
Carex gynandra Schwein., JO, Johnson, 23
Carex leptalea Wahlenberg, ST, Carter, 82
Carex lurida Wahlenberg, OS, Johnson, 24
Carex scoparia Schkuhr ex Willd., OR,
 Johnson, 4; JO, Johnson, 8
Carex tribuloides Wahlenberg, OR, Johnson, 83
Carex vulpinoidea Michaux., QU, Johnson, 41
Eleocharis acicularis (L.) R. & S., OS, Johnson, 55
Eleocharis tenuis (Willd.) Shultes var. *tenuis*,
 JO, Johnson, 5
Eriophorum virginicum L., OR, Johnson, 87
Scirpus atrovirens Willd., OR, Johnson, 84
Scirpus cyperinus (L.) Kunth., OR, Johnson, 86

JUNCACEAE

- Juncus effusus* L., QU, Johnson, 14
Juncus gymnocarpus Coville, ST, Carter, 76
Juncus subcaudatus (Engelm.) Coville and
 Blake, JO, Johnson, 6

LILIACEAE

- Maianthemum canadense* Desf., OS, Johnson, 96

ORCHIDACEAE

- Cypripedium acaule* Ait., JO, Johnson, no
 voucher/picture only
Platanthera ciliaris (L.) Lindl. (syn: *Habenaria
 ciliaris* (L.) R. Br.), JO, Johnson, no
 voucher/picture only
Spiranthes lacera (Raf.) Raf. var. *gracilis*
 (Bigel.) Luer, JO, Johnson, 58

POACEAE

- Echinochloa crus-galli* (L.) Beauvois, OS,
 Johnson, 49
Glyceria laxa (Scribn.) Scribn. (syn: *Glyceria
 canadensis* (Michx.) Trin. var. *laxa* (Scrib-
 ner) Hitchcock), JO, Johnson, 9
Glyceria melicaria (Michx.) Hubbard, ST, Carter, 81
Glyceria striata (Lam.) Hitchcock, OS, Johnson, 17

**Holcus lanatus* L., OS, Johnson, 18
Leersia oryzoides (L.) Swartz, OR, Johnson, 85
Dichanthelium dichotomum (L.) Gould var. *dichotomum* (syn: *Panicum dichotomum* L. var. *ramulosum* (Torr.) Lelong), OS, Johnson, 51 (variety *ramulosum* determined using Wofford, 1989)

**Phleum pratense* L., OS, Johnson, 16
Sorghastrum nutans (L.) Nash, QU, Johnson, 66

SPARGANIACEAE

Sparganium L., QU, Johnson, 35 (probably *S. emersum* Rehmman or *S. americanum* Nutt.)

Acknowledgments

The authors thank G. Call, C. McQueen, and L. Eastin of The Nature Conservancy and J. McGuiness of the USDA—Forest Service. We are grateful to R. Kaul for reviewing our *Sparganium* sp. specimen and to three anonymous reviewers for their helpful comments regarding the manuscript.

Literature Cited

Barclay, F. H. 1957. *The Natural Vegetation of Johnson County, Tennessee: Past and Present*. PhD dissertation, University of Tennessee, Knoxville, Tennessee.

- Bridson, D., and L. Forman (eds.). 1998. *The Herbarium Handbook*. 3rd ed. Royal Botanic Gardens, Kew, England.
- Jennison, H. M. 1935. Notes on some plants of Tennessee. *Rhodora* 37: 309–323.
- Killebrew, J. B. 1874. *Introduction to the Resources of Tennessee*. Tavel, Eastman, and Howell, Nashville, Tennessee.
- Moorhead, K. K., and I. M. Rossell. 1998. Southern mountain fens. Pp. 379–403 in *Southern Forested Wetlands: Ecology and Management* (M. G. Messina and W. H. Conner, eds.). Lewis Publishers/CRC Press, Boca Raton, Florida.
- Radford, A. E., H. E. Ahles, and C. R. Bell. 1968. *Manual of the Vascular Flora of the Carolinas*. The University of North Carolina Press, Chapel Hill, North Carolina.
- Smith, C. R., and R. W. Pearman. 1971. A survey of the pteridophytes of Northeastern Tennessee. *Castanea* 36: 181–191.
- Stewart, C. N., Jr., and E. T. Nilsen. 1993. Association of edaphic factors and vegetation in several isolated Appalachian peat bogs. *Bulletin of the Torrey Botanical Club* 120: 128–135.
- Tabor, R. L. 1976. Notes on a small cranberry bog in Northeast Tennessee. *Castanea* 41: 88.
- Tennessee Division of Natural Heritage. 2008. *Tennessee Natural Heritage Program Rare Plant List*. Tennessee Department of Environment and Conservation, Nashville, Tennessee.
- USDA, NRCS. 2011. *The PLANTS Database* (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, Louisiana. Accessed 4 March 2011.
- Wofford, B. E. 1989. *Guide to the Vascular Plants of the Blue Ridge*. The University of Georgia Press, Athens, Georgia.

Submitted 17 May 2011; accepted 29 September 2011.