CASTANEA 63(2): 165–173. JUNE 1998

A Status Survey of *Dirca palustris* L. (Leatherwood, Thymelaeaceae) in South Carolina

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ABSTRACT

A status survey to determine population size and describe community structure was conducted during 1995 at each of seven sites where *Dirca palustris* (leatherwood) has been known to grow in South Carolina. Populations ranged in size from eleven to over 400 plants with a typical population size being about 100 plants. Vegetation analyses using transect lines throughout the population were used to determine the importance values of tree species. The surveyed populations were located in mesic mixed forests where *Pinus taeda* (loblolly pine) and *Liquidambar styraciflua* (sweetgum) were prevalent. Plants grew along stream floodplains and levees in well drained sandy to sandy loam soils which were slightly acidic.

INTRODUCTION

Leatherwood, *Dirca palustris* Linnaeus (Thymelaeaceae), is a deciduous shrub which grows in the eastern half of North America from Quebec to Ontario and Minnesota, south to Florida, Louisiana, and Oklahoma (Steyermark 1963). Although its geographical range is large, populations are infrequent.

The typical habitat of the species has been variously described, but it was consistently associated with woodland streams or rivers. Fernald (1950) stated that populations were typically found in rich, alluvial soils in beech and sugar maple forests. However, Cooperrider (1995) described the habitat in Ohio as extending from rich mesic forests to dry uplands. Steyermark (1963) stated that most populations were located on east or north facing slopes of ravines near small streams in Missouri. Nevling (1962) suggested that leatherwood is a facultative calciphile. Clearly, there was no specific habitat in which leatherwood had been found to grow. More importantly, no known ecological study of the species had been completed.

The species is described as being rare, infrequent, or uncommon in a number of floristic treatments (Clewell 1985, Cooperrider 1995, Radford et al. 1968, Wofford 1989). Since South Carolina is in the southeastern portion of the species range, the individual populations are few and widely scattered. Leatherwood is listed as a plant of concern in South Carolina (South Carolina Heritage Trust 1996). All known populations are located in the piedmont physiographic region (Figure 1). The purpose of this project is to complete a status survey of known populations in South Carolina and to describe the typical habitat in which the plant grows, including an analysis of both vegetation and soils.

METHODS

Study sites

Initially, location information for *Dirca palustris* in South Carolina was collected from the state's Heritage Trust Program (South Carolina Department of Natural Resources), and the Herbaria at Newberry College (NBYC), The University of South Carolina, Columbia

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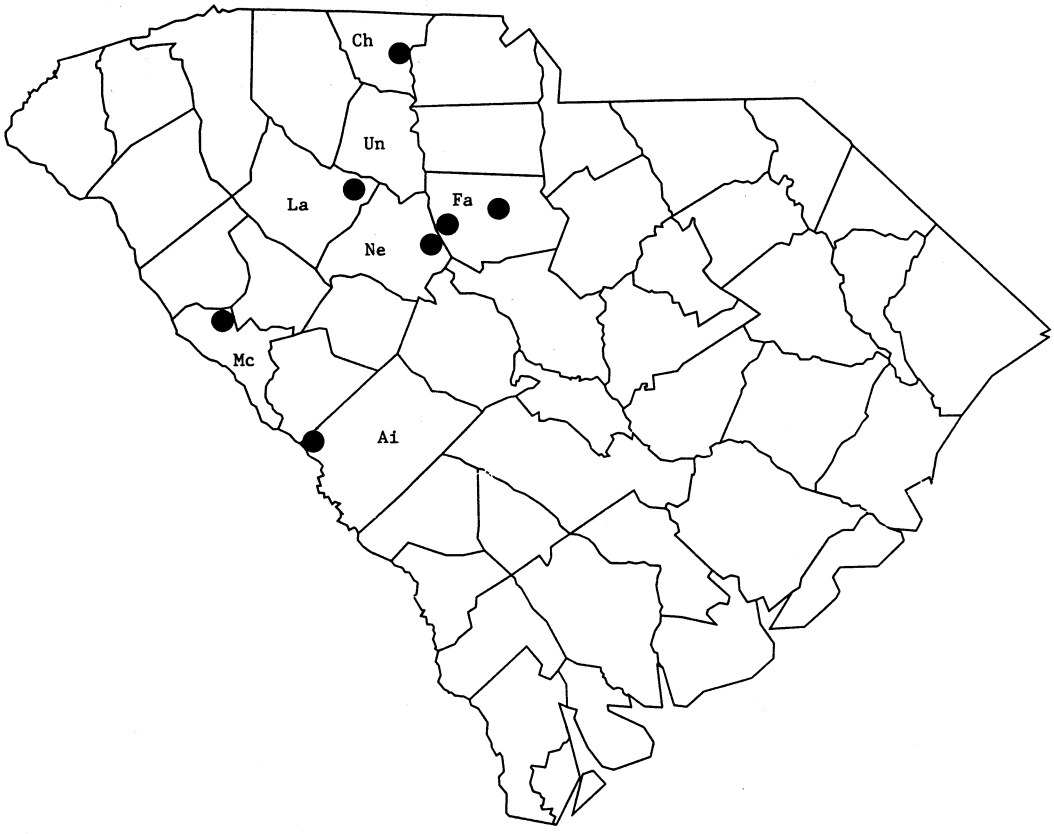

Figure 1. Map of South Carolina showing the location of investigated *Dirca palustris* populations. County abbreviations are Ai = Aiken, Ch = Cherokee, Fa = Fairfield, La = Laurens, Mc = McCormick, Ne = Newberry, and Un = Union.

(USCH), University of South Carolina, Spartanburg (USCS), and Clemson University (CLEMS). Records from these four sources indicated that ten populations existed. Seven of these were visited for study during the spring and summer of 1995 (Figure 1). The three other reported population locations were, one each, in Fairfield, Newberry, and Union Counties; however, these populations were not located by the authors.

At each site studied, leatherwood plants were counted and categorized as adults, juveniles, and seedlings. Adults were denoted as being over 0.75 meters tall. Seedlings were set to be those plants in their first year as indicated by the lack of bud scale scars. All other plants were considered juveniles. Population boundaries were determined by walking up to 50 meters beyond the last observed individual in a particular habitat. Notes were also recorded on the general distribution of individual plants relative to the stream and to each other.

Vegetation analysis

To describe the community in which *Dirca palustris* grew, woody vegetation was surveyed in the surrounding area using the random pairs method (Cottam and Curtis 1956). A transect line was fixed through the survey area and points were randomly selected along the line. At each point the species name of the tree closest to the survey point and a second tree opposite the transect line were recorded. Both trees were measured for the diameter at breast height (DBH) and the distance between the two trees was recorded. Trees with a DBH of less than

five centimeters were omitted. The procedure was repeated for thirty points. Importance values as a sum of the relative density, relative frequency, and relative dominance were calculated as described by Cottam and Curtis (1956).

In addition, all associated vascular plants at each site were recorded. Taxonomy followed that of Kartesz (1994). Communities were characterized using the classifications of Barry (1980) and Nelson (1986).

Soil analysis

Soil samples were collected to determine the soil texture and pH at each site. At least three samples were taken from within the boundaries of the population, generally adjacent to a clump of plants. After leaf litter was removed, samples were taken with a trowel down to fifteen centimeters depth and placed in a plastic bag for return to the lab.

Soils were analyzed using modified procedures of USDA (1951). Each soil sample was air dried overnight, then passed through a #20 sieve (0.84 mm) to extract the large particles (gravel, leaves, and stems). The soil texture was determined by mixing one part soil, three parts water, and a dispersing agent of 2% sodium pyrophosphate (3 drops for each 10 ml of water) in a graduated cylinder and shaking the cylinder vigorously for two minutes. The volume of the sediment was taken after thirty seconds, thirty minutes, and twenty four hours which indicated the percentages of sand, silt, and clay, respectively. Soil texture was determined using a soil texture triangle (USDA 1951). The pH of the soil was measured by mixing one part soil and two parts distilled water on a stir plate for five minutes. An Orion Model 610 pH meter accurate to two decimal places was used to determine pH.

County soil maps (USDA 1960, 1962, 1980, 1982a, 1982b, 1985) were used to obtain general information on soil porosity, permeability, and pH in the area of each population.

RESULTS

Population status

At all of the South Carolina sites, plants grew under a canopy of trees and were associated with a stream. Individual plants were located on banks at least one meter above mean water level and typically were on a floodplain or levee. Population sizes ranged from 11 plants along Long Cane Creek in McCormick County to over 400 plants along Beaver Creek in Fairfield County (Table 1). Generally, plants were clumped in clusters of 20 to 50 plants over an area of about 25 square meters.

At the Beaver Creek site in Fairfield County plants were situated along the creek mainly on floodplain levees. This population contained over 400 individuals along 0.8 km of the stream. About half of the plants were juveniles and the remainder adults, with the largest plant being almost two meters tall. Most plants were densely clustered on levees adjacent to the stream bed. The other site in Fairfield County was located on Minton Creek. The majority of the 358 counted plants (125 adults, 157 juveniles, and 76 seedlings) were found on a floodplain beside the stream. One location had a clump of 50 seedlings within a 30 cm^2 area. The Newberry County population was within the Sumter National Forest. Plants were growing in a ravine and on the adjacent floodplain, both being less than two kilometers from the Enoree River. No seedlings were discovered, but 38 adults, some up to two meters tall, and 71 juveniles were seen (a total of 109 plants). The Duncan Creek site in Laurens County also was located within the Sumter National Forest and on the floodplain of a tributary to Duncan Creek. The population was small with 36 seedlings and 27 adult plants. In Aiken County, a small population was found along Fox Creek. The population contained 42 adult plants and five juvenile plants. The site in Cherokee County was situated one half mile downstream of a dam on a floodplain of the Broad River. The population of 118 juveniles and 153 adults (271 total) was distributed along about 300 m of river bank and within 30 m of the river. About 20 of the plants were in full afternoon sun as a result of a recent logging operation. The McCormick County site was a slope above Strom Thurmond Lake at the mouth of Long Cane Creek. Eleven plants (3 adult, 8 juvenile) were counted, seven in a small clump on a steep slope while the other four plants were located about 10 m away on a slightly sloping hillside.

Associated vegetation

A survey revealed 97 species of associated vascular plants (Appendix I) which were characteristic of a mesic mixed forest as described by Nelson (1986). Trees considered to be most important in the community, based on importance values (Table 2), were *Carpinus caroliniana* Walter (ironwood), *Carya glabra* (P. Miller) Sweet (pignut hickory), *Cornus florida* Linnaeus (flowering dogwood), *Liquidambar styraciflua* Linnaeus (sweet gum), *Pinus taeda* Linnaeus (loblolly pine), *Quercus nigra* Linnaeus (water oak), and *Ulmus alata* Michaux (winged elm). In addition, five species were occasional in association with leatherwood, but not at all of the sites: *Acer leucoderme* Small (chalk maple), *Acer rubrum* Linnaeus (red maple), *Liriodendron tulipifera* Linnaeus (tulip poplar), *Ostrya virginiana* (P. Miller) K. Koch (hop hornbeam), and *Oxydendron arboreum* (Linnaeus) de Candolle (sourwood).

Shrubs and vines commonly associated with *Dirca palustris* (Appendix I) included *Asimina parviflora* (Michaux) Dunal (dwarf paw paw), *Bignonia capreolata* Linnaeus (cross vine), *Lonicera japonica* Thunberg (Japanese honeysuckle), *Parthenocissus quinquefolia* (Linnaeus) Planchon (Virginia creeper), *Toxicodendron radicans* (Linnaeus) Kuntze (poison ivy), and *Vitis rotundifolia* Michaux (muscadine). No herbs were consistently associated with *Dirca palustris*. Only one of the above mentioned species, *Lonicera japonica*, is an introduced taxon.

Soil analysis

A review of soil maps revealed that the population sites included soils of the Congaree, Gundy, Toccoa, and Wilkes series and their textures varied from a loam to a sandy loam (USDA 1960, 1962, 1980, 1982a, 1982b, 1985). These soils were described as being well drained, of moderate to moderately rapid permeability, and slightly to strongly acid. The analysis of the soil samples for texture generally agreed, but tended to have more sand (Table 3). At each population site at least two samples had a sand texture. Loamy sand or sandy loam also were found at a majority of the sites.

The pH of the soils ranged from 4.2 to 6.7 (Table 3). All populations revealed a slight variation in values from one sample to another of about one pH unit. The higher values were present in the more eastern populations located along the Broad River or its tributaries in Newberry, Fairfield, and Laurens Counties. The lowest values tended to be recorded along tributaries to the Savanna River in Aiken and McCormick Counties.

DISCUSSION

All South Carolina populations occur within the piedmont physiographic region. Piedmont populations are also common in Virginia (Harvill et al. 1986) and North Carolina (Radford et al. 1968). Only one piedmont location is recorded in Georgia (Jones and Coile 1988). No records exist of population locations within the coastal plain or mountain regions of South Carolina. Populations are also absent from the coastal plain of North Carolina (J. Amoroso, North Carolina Heritage Trust Program, pers. comm.), but are occasionally found in that portion of Virginia (Harvill et al. 1986) and Georgia (Jones and Coile 1988). The reason for its absence in the coastal plain of the Carolinas is uncertain. Populations are occasional in the mountains of Virginia (Harvill et al. 1986), North Carolina (Radford et al. 1968), and Georgia (Jones and Coile 1988), but have not been discovered in South Carolina.

The smallest population occurs along Long Cane Creek at its confluence with an arm of Strom Thurmond Lake (impounded Savannah River). The population may have been larger, but drowned by the lake. The three largest population sites are along extensive portions of stream or river where large floodplains exist. Within these populations are numerous subpopulations of 20–40 densely clumped plants, these being either on levees or along stream banks.

All populations include individuals of a variety of heights, suggesting a variety of ages. This evidence of reproduction and recruitment of new individuals into the population is a good sign of population maintenance. At all population sites evidence of flowering and fruiting were present except at the McCormick County site where the population is small and plants were not observed until July, after the time fruits typically become mature and drop. Even at the time of fruit maturity, no fruits were found under the parent plants. Since the fruits are drupes,

Table 1. County, watershed, stream width, and size for known *Dirca palustris* populations in South Carolina. Populations marked with an asterisk (*) were not located until after the project was completed

Location	Stream/ River Width	Population Size and Area Covered
Aiken Co., Fox Creek	5 meters	47 plants along 400 meters of floodplain
Cherokee Co., Broad River	100 meters	271 plants along 300 meters of floodplain
Fairfield Co., Minton Creek	4 meters	358 plants along 50 meters of floodplain
Fairfield Co., Beaver Creek	5 meters	over 400 palnts along ca. 1 kilometer of floodplain
Laurens Co., tributary to Duncan Creek	1 meter	36 plants along 25 meters of floodplain
McCormick Co., Long Cane Creek	15 meters	11 plants along 20 meters of east facing slope
Newberry Co., tributary to Enoree River	2 meters	109 plants along 25 meters of ravine and floodplain
*Newberry Co., small tributary to Enoree River	1 meter	8 plants along 5 meters of two adjacent ravines
*Newberry Co., tributary to Duncan Creek	3 meters	5 plants along 10 meters of floodplain terrace

one would expect seeds to drop directly under the parent plant even though Nevling (1962) suggested they are eaten by birds. In several cases fruits easily dropped off when touched. A plausible explanation for the lack of observable fruits on the ground is that a rodent eats and/or stores these fruits soon after they fall. Interestingly, a clump of about 50 seedlings was located in a small area along Minton Creek, suggesting that the seeds had been placed there, further evidence of a biological transport mechanism. An alternate explanation is that seeds are water dispersed during floods.

The results of the vegetation analyses reveal that plants grow under the closed canopy of a mesic mixed forest dominated by *Liquidambar styraciflua* and *Pinus taeda*. At some of the sites, canopy dominants also included *Acer rubrum, Liriodendron tulipifera,* and *Quercus nigra*. The subcanopy is typically dominated by *Carpinus caroliniana,* even though *Ostrya virginiana* is sometimes of importance. This association of species is a typical successional floodplain forest seen throughout the piedmont of South Carolina (Barry 1980). The relatively closed canopy may be important in maintaining moist soil (especially during summer droughts) and may be critical for seedling establishment. Within the Cherokee County population, which was impacted by recent lumbering operations, the exposed plants should serve as a good experiment to determine the effect of survival in full sun.

Populations in South Carolina seem to grow best along floodplains of streams and rivers where associated soils, from our analyses, contain mostly sand and are classified as sand, loamy sand, or sandy loam. The soil pH is mildly acidic (pH 4.2–6.7) and is not unusual for South Carolina. No correlation was detected between population size and soil texture or pH, hence these parameters could not be suggested as a limiting factor in plant distribution. More likely, plants are limited locally by soil moisture. Visually, it is clear that populations in Laurens, McCormick and Newberry Counties were limited by the presence of saturated soils further downstream, as evidenced by low flat terrain and pockets of standing water within the floodplain. The largest populations are along streams or rivers with long stretches of well drained soil near water.

In comparing the habitat of leatherwood populations in South Carolina to those in other states, some differences were observed. A much greater diversity of habitats has been recorded in the literature for states to the northwest, including rich moist woods (Wofford 1989), rich

Table 2. Importance value (IV) of trees associated with *Dirca palustris*. No IV was calculated at the McCormick County site since so few plants were present. Values are based on a 300 point scale. Abbreviations are as follows: AIK = Aiken County, CHER = Cherokee County, F-BEA = Beaver Creek in Fairfield County, F-MIN = Minton Creek in Fairfield County, LAUR = Laurens County, NEWB = Newberry County

Species	AIK	CHER	F-BEA	F-MIN	LAUR	NEWB
Acer barbatum	22.85	—	40.05	3.44	—	11.85
Acer rubrum	—	30.03	—	7.98	42.15	13.94
Amelanchier arborea	—	3.72	3.64	—	—	—
Betula nigra	—	—	13.79	—	3.52	—
Carpinus caroliniana	26.11	54.32	58.40	81.27	3.36	—
Carya alba	—	—	3.58	—	—	—
Carya glabra	18.76	4.88	—	19.01	3.53	96.47
Cercis canadensis	—	—	3.67	3.58	—	—
Cornus florida	—	11.87	3.66	8.13	26.60	16.84
Fagus grandifolia	—	—	—	3.60	—	—
Fraxinus americana	3.32	3.91	10.53	—	—	—
Halesia tetraptera	—	8.68	—	—	—	—
Ilex opaca	—	—	11.36	—	—	—
Juniperus virginiana	—	8.40	16.00	4.22	—	—
Liquidambar styraciflua	21.43	16.20	19.92	42.55	47.63	16.33
Liriodendron tulipifera	—	6.44	—	20.59	49.65	—
Magnolia acuminata	—	15.71	—	8.67	—	3.64
Nyssa sylvatica	—	—	—	3.72	15.94	—
Ostrya virginiana	44.95	—	33.95	—	—	—
Oxydendron arboreum	—	—	—	56.99	24.79	—
Pinus taeda	39.36	4.11	28.69	25.91	17.36	55.94
Quercus alba	27.79	—	9.03	—	11.87	20.68
Quercus falcata	—	—	—	6.77	—	17.66
Quercus nigra	39.01	120.99	8.00	—	49.85	16.05
Quercus rubra	41.28	—	—	—	—	—
Quercus velutina	—	—	—	—	3.78	17.57
Robinia pseudoacacia	—	3.68	—	—	—	—
Tilia americana	3.76	—	—	—	—	7.87
Ulmus alata	7.75	6.87	31.00	3.54	—	5.16
Ulmus americana	3.66	—	4.78	—	—	—

mesic to dryish woodlands (Cooperrider 1995), and even rocky wooded bluffs (Steyermark 1963). The sparse populations in South Carolina may well be related to plants being restricted to the moister habitats of floodplains.

After the survey was completed, two additional sites for leatherwood were located in Newberry County by Horn (see Table 1). Along Mulberry Branch, a tributary of Duncan Creek (same stream as in Laurens County), five plants (all adult) were located along the stream bank. The adjacent floodplain was dominated by *Fraxinus americana* Linnaeus (American ash), *Carpinus caroliniana, Liquidambar styraciflua,* and *Quercus nigra.* At a second location a total of eight plants (all adult) were discovered along two parallel narrow ravines south of the Enoree River and about 3 km east of a studied site. The ravines were an open woodland dominated by *Carya glabra, Quercus alba* Linnaeus (white oak), *Pinus taeda* and *Cornus florida.* This second site was unusually dry, as determined by the open canopy, ephemeral nature of the ravine, species composition, and location adjacent to clearcut uplands. However, the leatherwood population was probably surviving as adult plants in a habitat which, at the time of observation, would not normally allow for seedling establishment.

Overall, populations in South Carolina are not in immediate danger of extirpation. Five

Table 3. Analysis of soils associated with *Dirca palustris* including USDA Soil Survey type (from literature), soil texture, and soil pH. For the Laurens County location no additional information was given in the literature for soil type

Location	USDA Soil Type	Texture (# Samples)	pH Range
Aiken County	Gundy Loam	Sand (2); Sandy Loam (1)	4.2–5.5
Cherokee County	Congaree Silt Loam	Sand (2), Loamy Sand (1), Silt Loam (1)	4.9–5.5
Fairfield County–Beaver Creek	Toccoa Loam	Sand (2), Sandy Loam (1)	5.6–6.7
Fairfield County–Minton Creek	Toccoa Loam	Sand (4)	5.4–5.7
Laurens County	Wilkes Soils	Sand (3), Loamy Sand (1)	5.1–6.4
McCormick County	Wilkes Fine Sandy Loam	Sand (2), Loamy Sand (2)	4.8–5.7
Newberry County	Wilkes Sandy Loam	Sand (3)	5.2–6.0

of the seven studied populations are at least partially located within the Sumter National Forest where the current Forest Service practice is to minimize cutting of trees along streams (South Carolina Forestry Commission 1994). The populations in South Carolina are not restricted by unusual community structure or soil conditions. Seed viability and dispersal may be the restricting factors. Clearly, plants do produce viable seeds in South Carolina and they appear to be dispersed only short distances from the parent plant. Further studies on seed production, dispersal, and germination would lead to a better understanding of this species distributional patterns.

APPENDIX I. VASCULAR PLANTS ASSOCIATED WITH *DIRCA PALUSTRIS*

Nomenclature follows Kartesz (1994). Introduced species are marked with an asterisk to the left of the entry. The locations are noted as: B = Beaver Creek, Fairfield County; C = Broad River, Cherokee County; D = Duncan Creek, Laurens County; F = Fox Creek, Aiken County; Mc = Long Cane Creek, McCormick County; Mi = Minton Creek, Fairfield County; N = tributary to Broad River, Newberry County.

Acer leucoderme Small—B, F, Mc, Mi, N
Acer rubrum Linnaeus—C, D, Mc, Mi, N
Aesculus sylvatica Bartram—B, Mi, N
Amelanchier arborea (Michaux f.) Fernald—B, C
Amorpha fruticosa Linnaeus—C
Amphicarpaea bracteata (Linnaeus) Fernald—Mc
Arnoglossum atriplicifoilium (Linnaeus) H. E. Robinson—C, F
Arundinaria gigantea (Walter) Muhlenberg—C, F, Mc
Asimina parviflora (Michaux) Dunal—B, C, D, F, Mi, N
Betula nigra Linnaeus—B, D
Bignonia capreolata Linnaeus—B, C, F, Mc, Mi, N
Botrychium virginianum (Linnaeus) Swartz—C, F, N
Brachyelytrum erectum (Schreber ex Sprengel) Beauvois—F, N
Bromus kalmii Gray—F
Callicarpa americana Linnaeus—F
Calycanthus floridus Linnaeus—Mi
Carex flaccosperma Dewey—C, N
Carex willdenowii Schkuhr ex Willdenow—C, F
Carpinus caroliniana Walter—B, C, D, F, Mc, Mi
Carya alba (Linnaeus) Nuttall ex Elliott—B
Carya glabra (P. Miller) Sweet—B, C, D, F, Mc, Mi, N
Celtis laevigata Willdenow—C, Mc
Cercis canadensis Linnaeus—B, Mc, Mi, N
Chasmanthium laxum (Linnaeus) Yates—C, F
Chimaphila maculata (Linnaeus) Pursh—C, F, N
Chionanthus virginicus Linnaeus—C
Cocculus carolinus (Linnaeus) de Candolle—C, N
Cornus florida Linnaeus—B, C, D, F, Mc, Mi, N
Decumaria barbara Linnaeus—B, D, Mi
Desmodium nudiflorum (Linnaeus) de Candolle—C, Mc
Desmodium rotundifolium de Candolle—C
Dichanthelium laxiflorum (Lamarck) Gould—F, N
* *Elaeagnus umbellata* Thunberg—F
Elephantopus nudatus Gray—C
Elymus virginicus Linnaeus—Mc
Eupatorium maculatum Linnaeus—C
Euphorbia corollata Linnaeus—C, Mc, N
Evonymus americana Linnaeus—Mi, N
Fagus grandifolia Ehrhart—Mi
Fraxinus americana Linnaeus—B, C, F, Mc, N
Galium uniflorum Michaux—C
Gelsemium sempervirens St. Hillaire—B, C, N
Geranium maculatum Linnaeus—F
Goodyera pubescens (Linnaeus) R. Brown ex Aiton f.—C, F, N
Halesia tetraptera Ellis—C
Hamamelis virginiana Linnaeus—F
Hepatica nobilis P. Miller—F
Hexastylis arifolia (Michaux) Small—F, Mc, N
Hypercium hypericoides (Linnaeus) Crantz—C, N

Ilex decidua Walter—B, C, Mc, Mi
Ilex opaca Aiton—B, C, Mi, N
Juniperus virginiana Linnaeus—B, C, Mc, Mi
Kalmia latifolia Linnaeus—C
Leucothoe axillaris (Lamarck) D. Don—C, F
Liquidambar styraciflua Linnaeus—B, C, D, F, Mc, Mi, N
Liriodendron tulipifera Linnaeus—C, Mi, N
* *Lonicera japonica* Thunberg—B, C, F, Mc, Mi, N
Luzula echinata (Small) F. J. Hermann—F
Magnolia acuminata (Linnaeus) Linnaeus—C Mi, N
Maianthemum racemosum (Linnaeus) Link—C
Mitchella repens Linnaeus—C, F
Nyssa sylvatica Marshall—C, D, Mi, N
Ostrya virginiana (P. Miller) K. Koch—B, F, Mc
Oxydendrum arboreum (Linnaeus) de Candolle—D, Mi, N
Parthenocissus quinquefolia (Linnaeus) Planchon—B, C, D, F, Mc, Mi, N
Passiflora lutea Linnaeus—F
Pinus taeda Linnaeus—B, C, D, F, Mc, Mi, N
Poa autumnalis Muhlenberg ex Elliott—C, F, N
Podophyllum peltatum Linnaeus—F, Mc
Polygonatum biflorum (Walter) Elliott—C
Polystichum acrostichoides (Michaux) Schott—C, F, Mc, N
Prunus serotina Ehrhart—C, N
Quercus alba Linnaeus—B, C, D, Mc, Mi, N
Quercus falcata Michaux—Mi, N
Quercus nigra Linnaeus—B, C, D, F, Mc, N
Quercus phellos Linnaeus—C
Quercus rubra Linnaeus—F
Quercus velutina Lamarck—F, N
Rhododendron sp. (vegetative)—B
Robinia pseudoacacia Linnaeus—C
Sambucus canadensis Linnaeus—Mi
Sanicula canadensis Linnaeus—C, Mc
Sassafras albidum (Nuttall) Nees—C
Smallanthus uvedalia (Linnaeus) Mackenzie ex Small—F
Smilax bona-nox Linnaeus—C, Mc
Stylisma humistrata (Walter) Chapman—C
Thaspium barbinode (Michaux) Nuttall—C
Tilia americana Linnaeus—F, Mc, N
Toxicodendron radicans (Linnaeus) Kuntze—B, C, D, Mc, Mi, N
Ulmus alata Michaux—B, C, F, Mc, Mi, N
Ulmus americana Linnaeus—B, F
Ulmus rubra Muhlenberg—Mc
Vaccinium arboreum Marshall—B, C, Mc, N
Vaccinium elliottii Chapman—B
Viburnum acerifolium Linnaeus—C, Mi
Vitis rotundifolia Michaux—B, C, F, Mc, Mi, N
Xanthorhiza simplicissima Marshall—C
Yucca filamentosa Linnaeus—C, F

ACKNOWLEDGMENTS

This project was completed in partial fulfillment of graduation requirements from the South Carolina Governor's School for Science and Mathematics by the primary author. Thanks are sent to Dr. Katherine Kellam at the Governor's School whose advising and critique made this paper easier to write. We are grateful to individuals at Clemson University herbarium, University of South Carolina herbarium, South Carolina Heritage Trust Program, Gillian Newberry, and James Hardin for information on population locations. Special thanks to Steven Hill and an anonymous reviewer for comments which improved the quality of this paper.

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Received January 8, 1997; Accepted August 20, 1997.