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The Vascular Flora of Steele Creek Park and a Quantitative Study of Vegetation Patterns in Canopy Gaps, Sullivan County, Tennessee

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Master of Science in Biology

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by

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December 2014

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Dr. Foster Levy

Dr. Tom Laughlin

James T. Donaldson

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ABSTRACT

The Vascular Flora of Steele Creek Park and a Quantitative Study of Vegetation Patterns in Canopy Gaps, Sullivan County, Tennessee

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An inventory of vascular plants was conducted in Steele Creek Park in Sullivan County, Tennessee from March 2013 to September 2014. The park covers an area of 892 ha and lies within the Ridge and Valley Province. The inventory of vascular plants documented 547 species of 323 genera and 101 families. Two hundred sixteen taxa were newly reported for Sullivan County. Tennessee Special Concern Species included *Cardamine rotundifolia*, *Castanea dentata*, *Lonicera dioica, Allium tricoccum*, *Cypripedium acaule*, and *Panax quinquefolius*. A single species, *Juglans cinerea* L., is considered a Tennessee Threatened Species. Vegetation patterns were studied quantitatively by installing 10 study plots within forest canopy gaps and a comparable set of 10 in areas with intact canopy. Plots within a canopy gap recorded more vascular plant diversity when compared to plots of intact canopy when unshared species were considered. Steele Creek Park provides a botanically rich area for future studies.

DEDICATION

This thesis is dedicated to the following:

Hepatica americana (DC.) KerGawl, the first species I collected and the beginning of a wonderful two years spent exploring a section of the Southern Appalachians.

Rhododendron canescens (Michaux) Sweet, a species encountered while surviving in the woods.

Phoradendron leucarpum (Rafinesque) Reveal & M.C. Johnston, a peculiar plant.

Arundinaria gigantea (Walter) Walter, my favorite collection from the family Poaceae.

Sabatia angularis (Linnaeus) Pursh, my 1111th specimen, which was found by my partner and wife, Sarah Elizabeth Alberta Knapp Klahs.

ACKNOWLEDGEMENTS

I am thankful for the opportunity to do this research, which was provided to me by Dr. Tim McDowell. The shared interest in plants and the resulting conversations confirmed that botany was the right path for me. His advice and guidance during the writing of this manuscript is greatly appreciated. His support as my advisor has been “far out”.

The help from my Committee Members, Dr. Foster Levy, Dr. Tom Laughlin, and James T. Donaldson, has also been crucial in the completion of this research. Their encouragement to tackle difficult taxonomic groups has promoted my growth as a botanist. I truly learned from their expert reviews of my collection.

The Department of Biological Sciences at ETSU has been an enjoyable home while living in Tennessee. The experience that I gained from research and teaching will be used in my future career. The funding from the Marcia Davis Research Award ensured that I did not get lost in the woods.

The Writing Lab at Sherrod Library, and specifically Katy Lea, greatly assisted the writing process. The Geosciences Department at ETSU provided the training needed to produce the maps included as figures.

Steele Creek Park has been an ideal office for my research. A big thank you to Park Naturalist, Jeremy Stout, and staff, Don Holt, for imparting valuable field botany skills and knowledge of the park. The research grant provided by the Friends of Steele Creek for Herbarium mounting supplies was critical to the completion of the floristic inventory.

My wife Sarah Knapp Klahs is deserving of an amateur botanist certificate after the completion of this research. Her perspective led to the discovery of many new collections, and her assistance in every aspect of my life has kept me on track. She is a wonderful partner and my best friend.

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CHAPTER 1

INTRODUCTION

The primary objective of this study is to document the diversity in vascular plant species of Steele Creek Park (SCP). A second objective is to investigate the spatial patterns of the flora in an ecological context by using a standard sampling method. The study site, Steele Creek Park is located in the City of Bristol, Sullivan County, in upper northeast Tennessee, within the Ridge and Valley physiographic province in the Eastern United States (Fenneman 1938). The current study increases our understanding of the ecosystems and flora within the park, provides records of species present in Sullivan County, increases our knowledge of species distributions within the State of Tennessee, and generates plot data that are readily comparable to other botanical studies of the Appalachian Mountains (Peet et al. 1998).

Investigating the diversity of plants living in an area increases the understanding of that terrestrial ecosystem's mechanics (Domangue and McMullen 2013, Himes and Rentch 2013). A checklist of vascular plants provides a standard level of awareness of the study area's floristic composition (Palmer et al. 1995). A species checklist is generated by intensively exploring the study area and identifying the vascular plants encountered. This process may lead to the discovery of plants living in the study area that were not previously known to occur there (Poindexter and Murrell 2008).

An inventory of floristic diversity can also assist in the management of the study area (Blyveis and Shaw 2012). Knowing the identities of the plant taxa living in the study area to the taxonomic level of species increases awareness of the content of that area (Huskins and Shaw 2010). Some plants may be considered endangered, rare, or threatened. A population of imperiled plants must be known in order to be protected by those managing the land. Other plants may be considered exotic or invasive and could pose a threat to native plants. Floristic studies lead to the detection of these important plant populations.

A floristic inventory is also valuable at a larger scale of management by providing species locations to increase our understanding of species distributions. A comprehensive floristic survey includes the creation of voucher specimens to be stored in herbaria (Palmer et al. 1995). These are made by collecting and preserving the entire plant at a time when flowers or

fruit are present. Fertile plant specimens are critical for proper taxonomic identification (Gleason and Cronquist 1991). Herbarium specimens allow verifications of species identification and a record of a plant's physical presence in space and time, as well as an immediate source of material for future studies (Rocha et al., 2014).

In Tennessee the Herbarium at University of Tennessee in Knoxville (acronym: TENN) keeps a record of the species locations at the geopolitical level of counties. Producing a local floristic inventory leads to the discovery of new plant species locations for inclusion in wider indices of species distributions. The documentation of new county occurrences is considered a county record and increases the completeness and resolution of species distribution maps at the state and national level.

Steele Creek Park is an 892 hectare (2,204 acre) park in Sullivan County, Tennessee that is owned and managed by the city of Bristol, TN. The reference maps in Figure 1a, 1b, and 1c show the park and the distinct areas within its boundary. The SCP Nature Center oversees the management of the biota within the park and will benefit from an updated floristic inventory. The park is an interesting location to perform a botanical study. It is easily accessible because it is a city park and has road access with parking lots at the entrance to the park. A network of hiking trails stretches into the interior of the park that can be used to assist exploration. Dates of significant disturbances such as logging and fires have been recorded (Buchanan 1981). Previous work 40 years ago by an East Tennessee State University graduate student produced a preliminary species list for Steele Creek Park (Howard 1972). This list can be used as an initial approximation of what species may be present as well as a point of reference for detecting changes in the park's flora over the past decades. The interior of SCP has not been as intensively managed as some federally or state owned lands because it is a city park. Steele Creek Park provides an accessible example of ecosystem recovery over a 40-year timespan in a large urban forest and is a worthy study site for botanically focused ecological questions.

In addition to floristic surveys, another means to acquire information on the health of ecosystems and address ecological questions is to install vegetation study plots. An ecological study plot provides sample data for the quantitative measurement of plants within a subset area of the land being studied. Study plots can answer questions about the spatial dynamics of plants

by measuring species' occurrences, relative abundance, frequency within the study area, and ecological importance.

It was observed while exploring the park on collecting trips during the current study that openings produced by fallen trees were areas of high plant diversity. The habitat within Steele Creek Park is predominantly forested knobs with little direct sunlight reaching the forest floor. This is a common habitat in the eastern deciduous forest of the United States (Braun 1950). Some mature trees have fallen in places within the park, and these fallen trees create gaps in the canopy. It is most common to find fallen trees in areas with shaley substrate and excessively steep slopes (Himes and Rentch 2013). Shade intolerant plants can be found under gaps in the canopy caused by fallen trees.

The questions to be investigated with the current research fall into two main categories. One set of questions pertains to the vascular plant diversity within the park, and the other set of questions concerns ecologically interesting patterns of plant distributions. Questions pertaining to overall plant species diversity include the following:

(1) What is the diversity of vascular plants within the natural, noncultivated areas of the park?

(2) Which species present in the park are considered rare, endangered, or threatened?

(3) Which species present in the park are considered nonnative and invasive?

(4) What has been the change in plant diversity since the 1972 study by Louise Howard?

Questions pertaining to ecological patterns of species distributions include the following:

(5) What are the vegetation types and plant communities present in the park?

(6) What patterns of plant species distributions occur within particular microhabitats in the park?

(7) What are the differences in plant assemblages between areas within a canopy gap and those with full canopy?

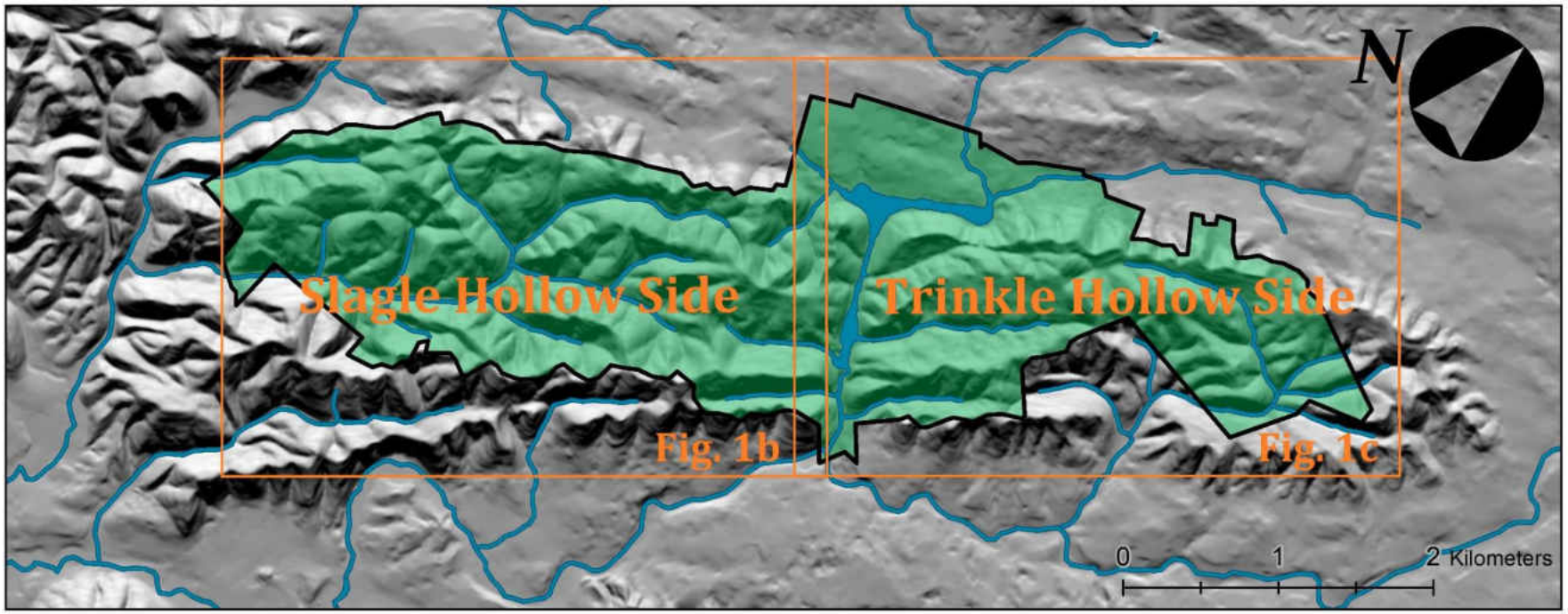


Figure 1a. A hill-shade map of Steele Creek Park (black line indicates boundary) in Sullivan County, Tennessee

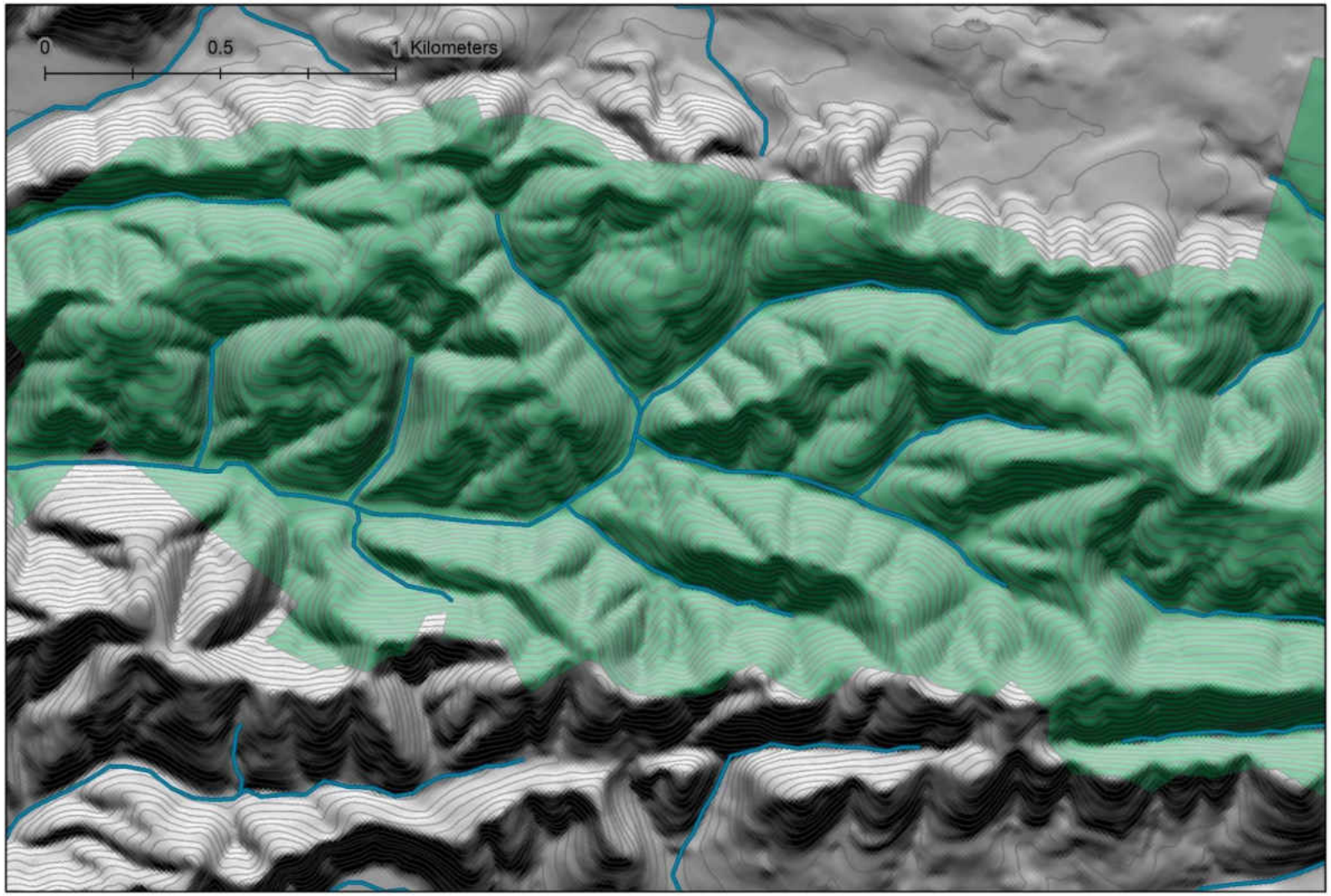


Figure 1b. Slagle Hollow Area (Land within the Park is Colored Green) in Detail with Contour Lines Showing 10 m Increases in Elevation

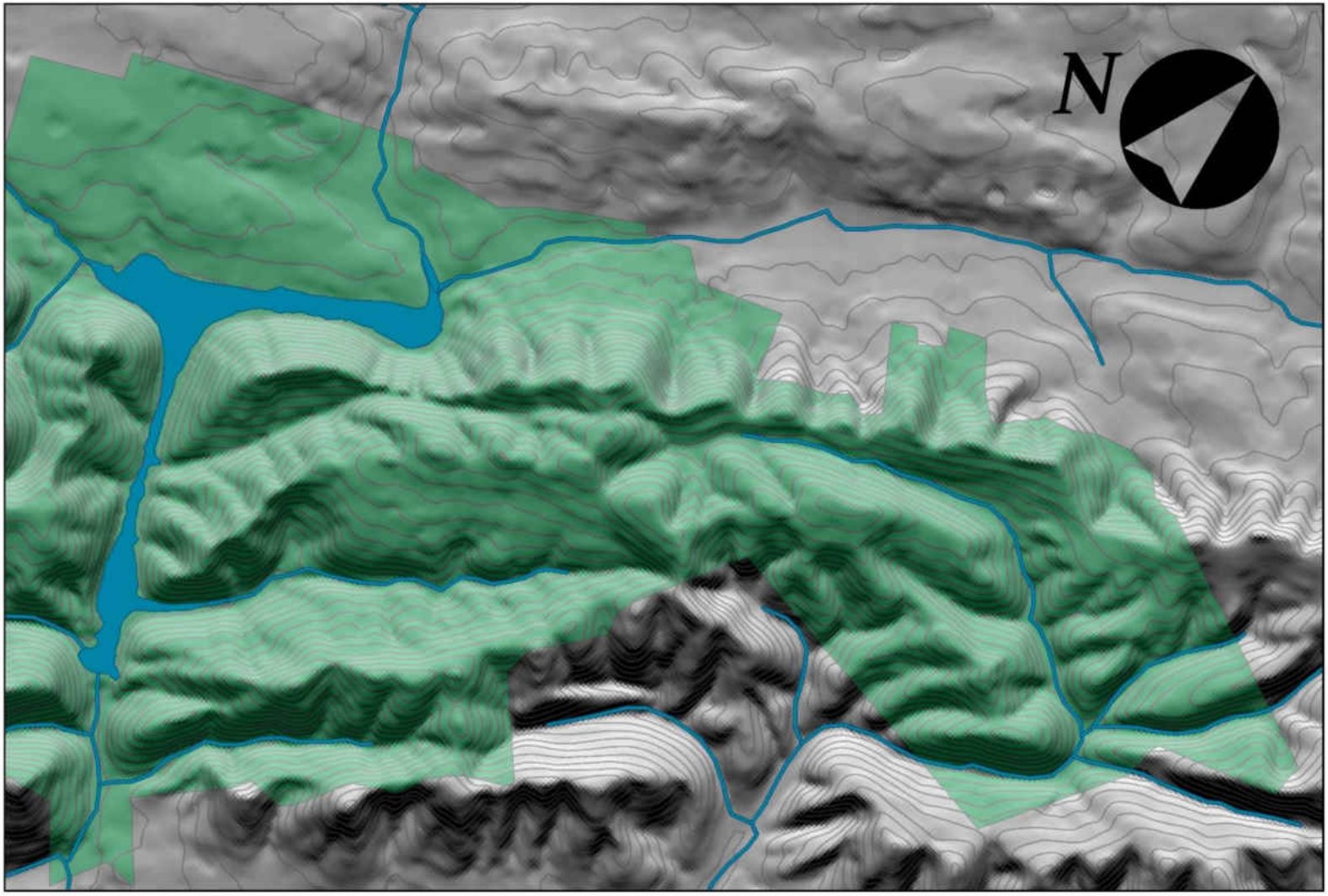


Figure 1c. Trinkle Hollow Area (Land within the Park is Colored Green) in Detail with Contour Lines Showing 10 m Increases in Elevation

CHAPTER 2

THE STUDY AREA

The Appalachian Highlands extend along the eastern portion of North America and are divided into several physiographic provinces by geologic characteristics. The Ridge and Valley Province lies within the Appalachian Highlands and includes a region of valleys 1930 kilometers (1200 miles) long with varying width, oriented in a southwest to northeast direction. The Ridge and Valley Province in Eastern Tennessee is approximately 64 km (40 miles) wide and bordered by the Cumberland Plateau Province to the west and the Blue Ridge Province, a range of mountains, to the east (Fenneman 1938). The map in Figure 2 shows these regions, with the locations for a set of floristic inventories that have been conducted around the current study site indicated.

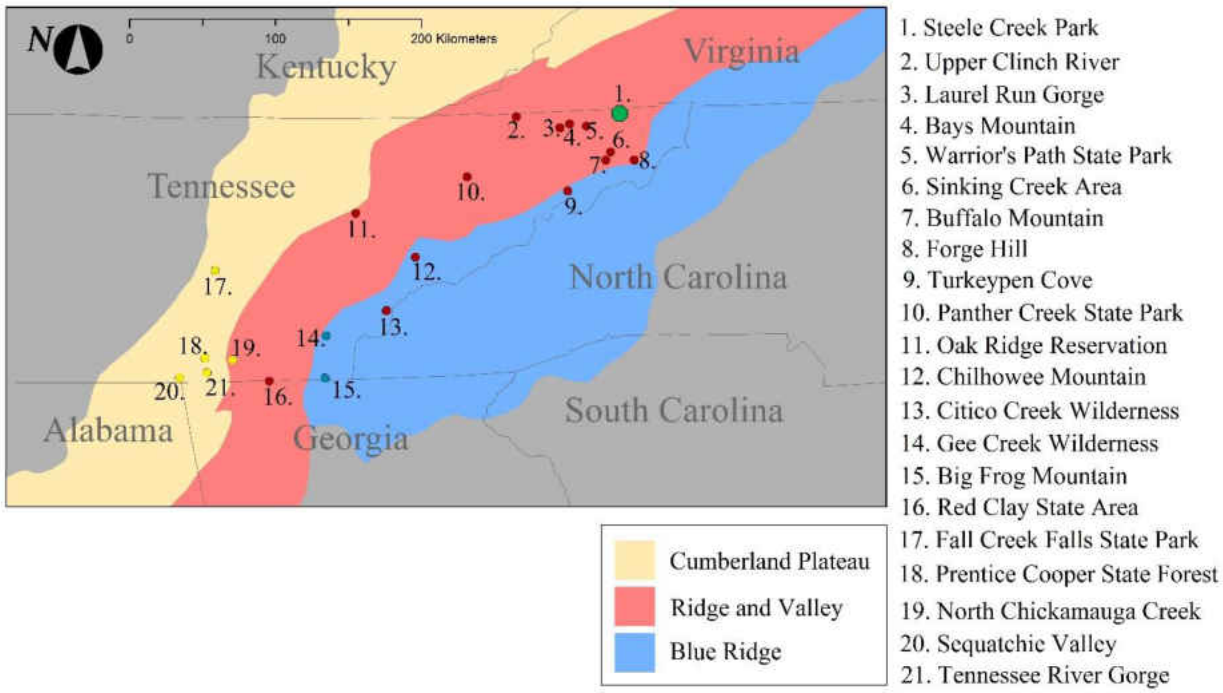


Figure 2. Steele Creek Park (Green) within the Ridge and Valley Province (Red) with Adjacent Cumberland Plateau (Yellow) and Blue Ridge (Blue) Provinces are Shown along with a Set of Floras Used as a Comparison to the Current Study

Within the central shale hills section of the Ridge and Valley Province, a series of knobs are orientated southwest to northeast. Knobs are defined as isolated, rocky projections with rounded hilltops (Luther 1977). One chain of knobs in Sullivan County, Tennessee runs along the northern side of Beaver Creek, a tributary of the South Fork Holston River. These knobs are only 1.2 km (0.75 mile) south of the Tennessee and Virginia border and are named the Beaver Creek Knobs. The City of Bristol, TN owns 892 hectares of this formation and manages the land as a city park: Steele Creek Park. The park contains 61 hectares (150 acres) of developed recreational space, a 22-hectare (54-acre) man-made lake, and 809 hectares (2000 acres) of uncultivated interior area. This vast interior area of the park is composed of Slagle (Figure 1b) and Trinkle (Figure 1c) Hollows and will be referred to as the wilderness area. The wilderness area is predominantly steep knobs covered in mesic oak-hickory hardwood forest interspersed with hardwood cove forests in the moist valleys. The park boundaries fall between N 36.5870 degrees and N 36.5427 degrees latitudes and W -82.2668 degrees and W -82.1980 degrees longitudes. The map in Figure 3 shows the park's location within the state of Tennessee. Figure 4 shows the Beaver Creek Knobs that span the border of the Bristol and Blountville USGS quadrangles and comprise the majority of the park. The map in Figure 5 shows the topography of the park, which ranges in elevation from 404.5 m (1327 ft) above sea level in the lowest valley to 670.6 m (2200 ft) at the highest knob. A map showing the degree of slope incline within the park is given in Figure 6. The average slope within the park boundary is 21.52 degrees. The steepest slope in the park is 53.39 degrees (TNGIS 2014). Soils found in the park are show in Figure 7.

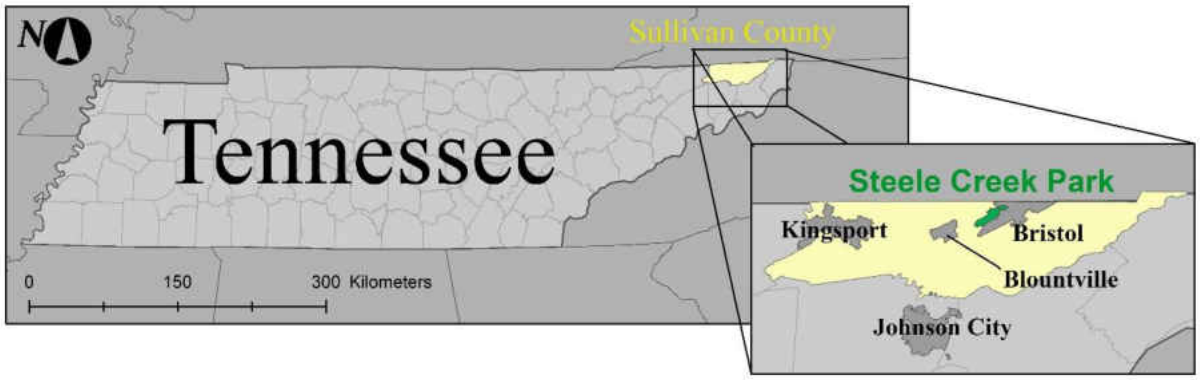


Figure 3. The Geopolitical Location of Steele Creek Park (Green) within Bristol, in Sullivan County, Tennessee

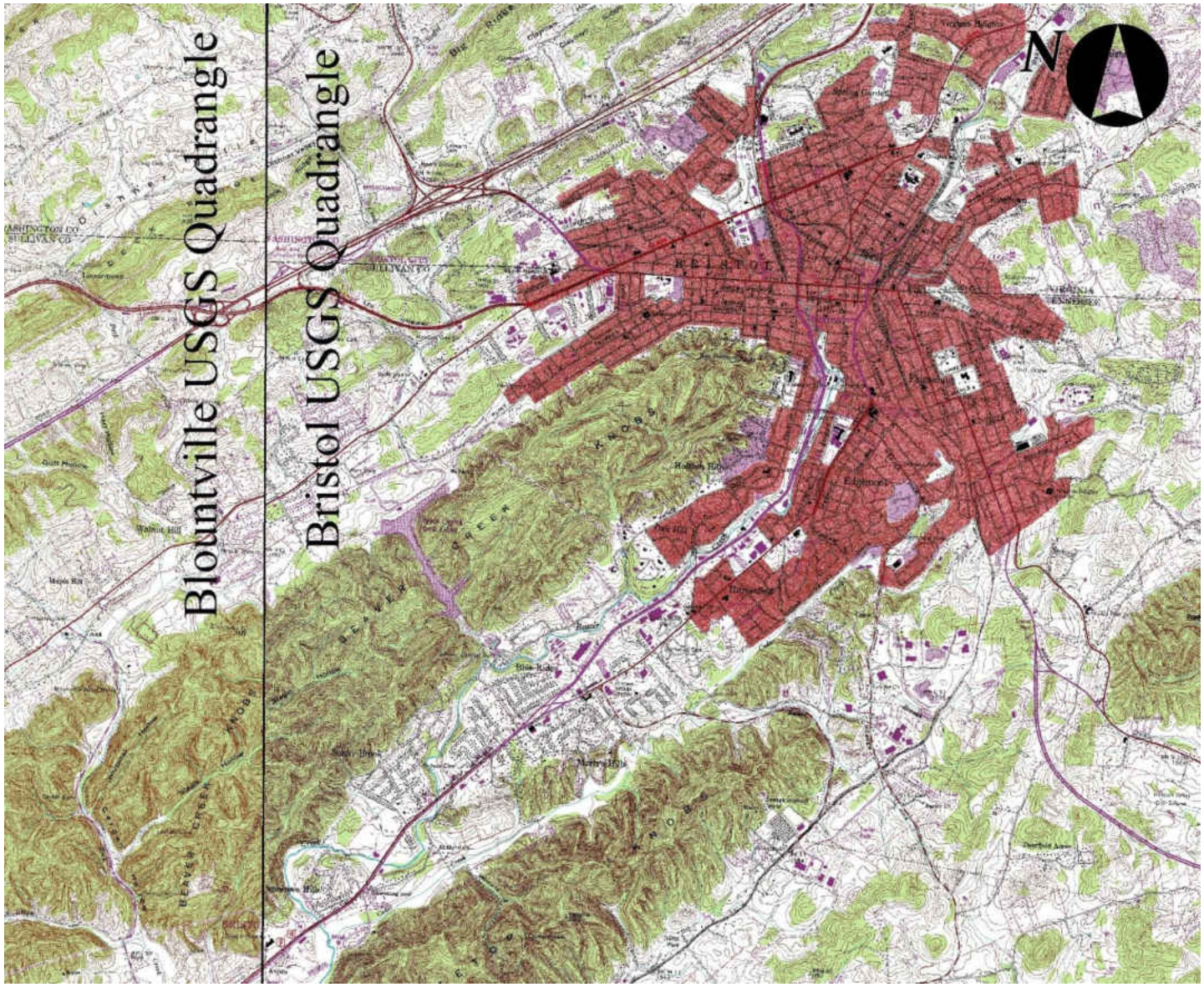


Figure 4. The Beaver Creek Knobs Occurring in the Blountville and Bristol USGS Quadrangles along with the City of Bristol (Red), which is divided by the Virginia and Tennessee Border

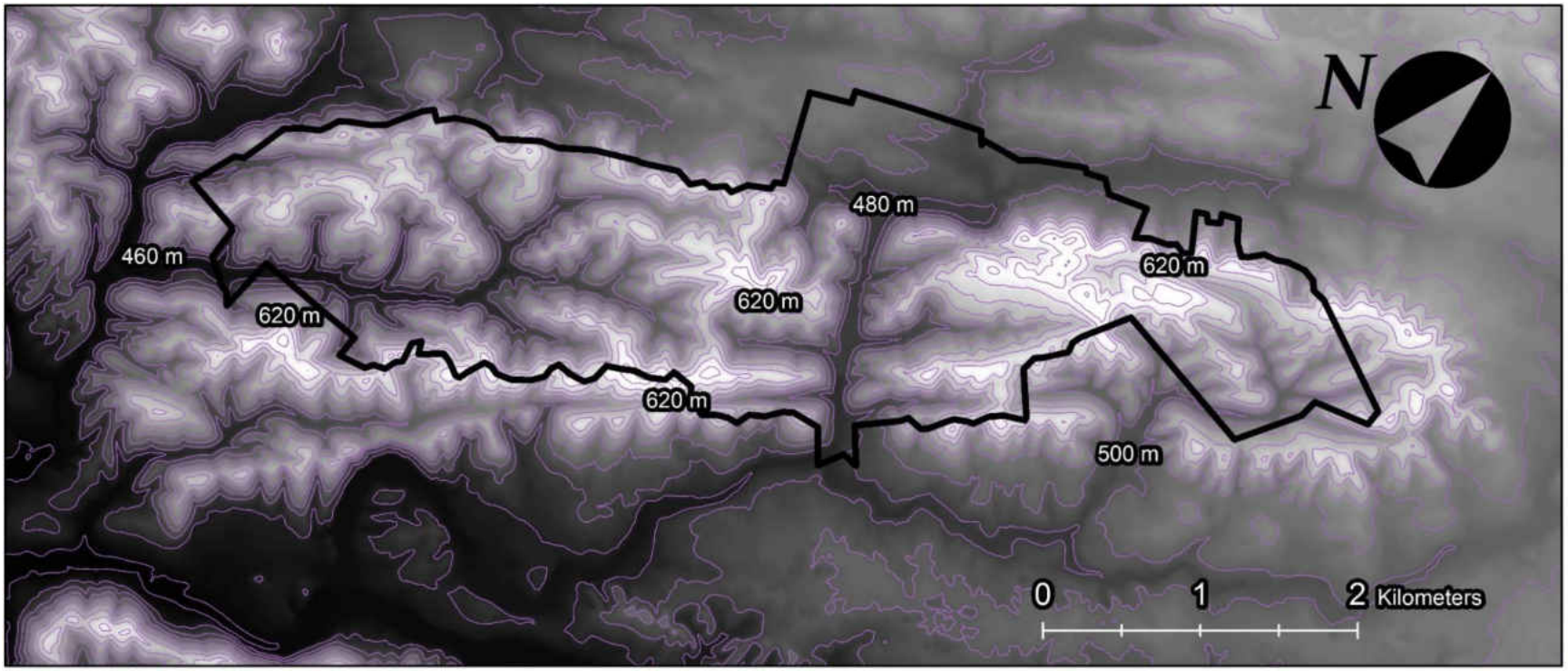


Figure 5. The Topology of Steele Creek Park (Black Line Indicates Boundary) with Purple Contours Showing 20 m Increases in Elevation

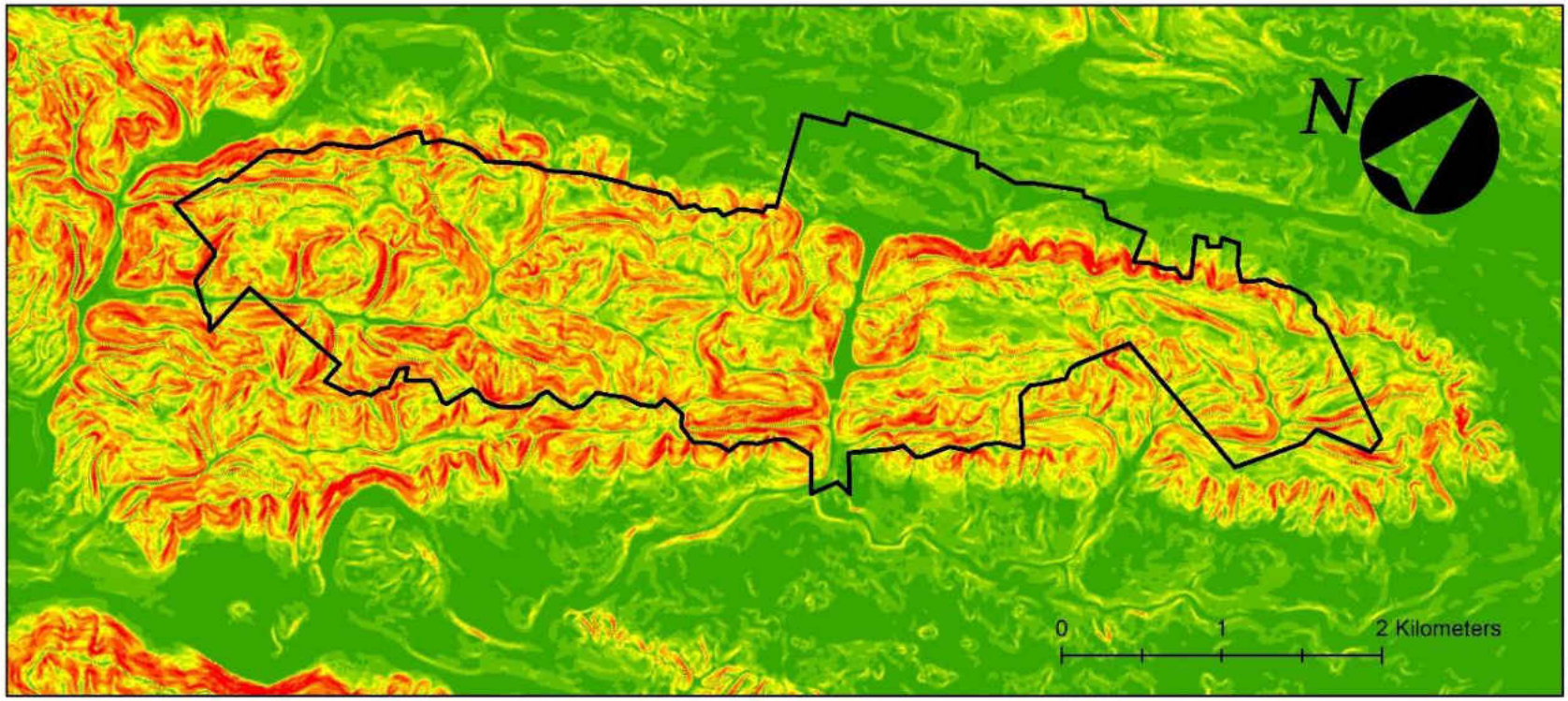
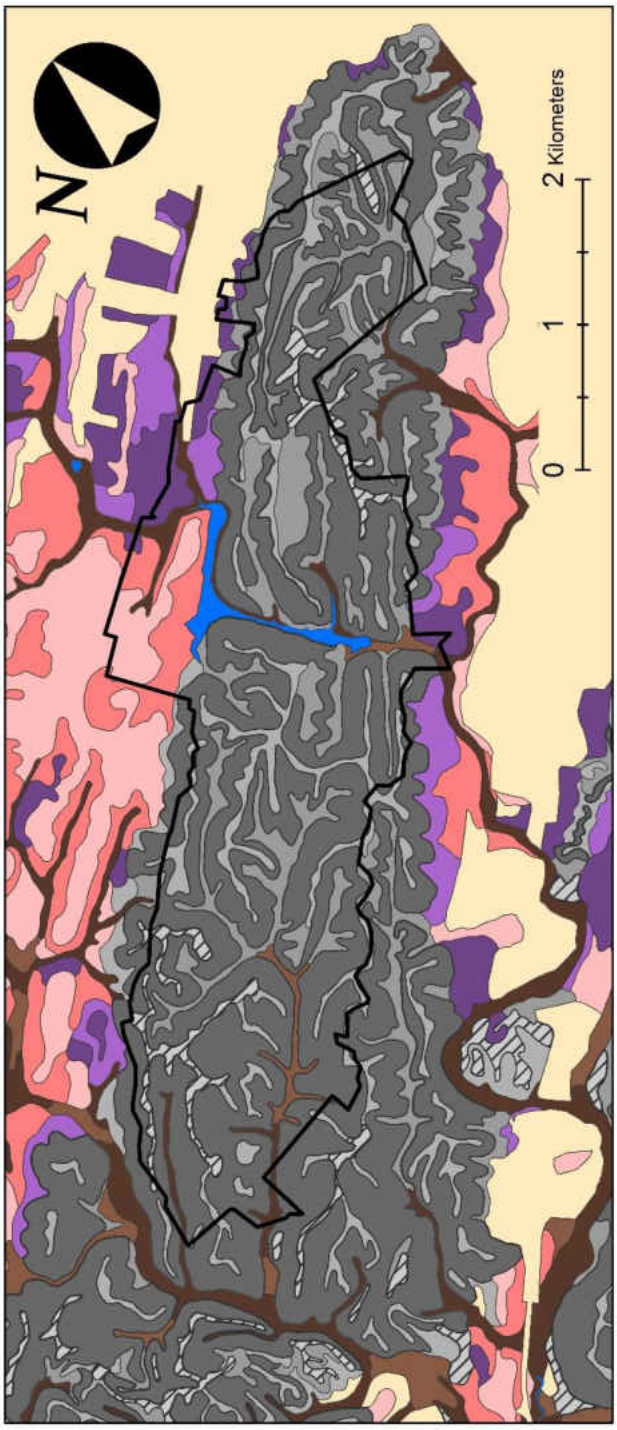


Figure 6. Steepness of Slopes in Steele Creek Park (Black Line Indicates Boundary) with a Color Gradient Fitted to 5-Degree Increases in Slope



Legend

Steele Creek Park Boundary

Soil Types

Bloomingdale silty clay loam
Steadman silt loam

Collegedale-Etowah complex eroded
Collegedale-Etowah complex severly eroded

Montevallo Channery silt loam 12 - 20% slope
Montevallo Channery silt loam 20 - 35% slope
Montevallo Channery silt loam 35 - 50% slope
Montevallo Channery silt loam 50 - 80% slope

Talbott-Bradyville complex 12 - 20% slope
Talbott-Bradyville complex 20 - 35% slope

Water

Figure 7. Soils in the Vicinity of Steele Creek Park (Black Line Indicates Boundary) with USDA Recognized Names

Geology

The Ridge and Valley province is characterized by many parallel ridges oriented southwest to northeast. These ridges were formed from the compressed eastern margin of the Paleozoic Interior Sea (Fenneman 1938). Evidence of this geologic history is present within Steele Creek Park in the form of fossilized Graptolites. These fossils of marine micro-organisms were occasionally observed among the exposed shale at fallen trees. The park is underlain by the Ordovician Sevier shale formation. The shale is also exposed on steep slopes where sufficient erosion has occurred. The shale in these areas is broken into small quarter-sized pieces and creates mats of rubble. Sevier shale is characterized by calcareous, bluish-gray shale that weathers to a yellowish-brown. It may contain layers of thin gray limestone, sandstone, siltstone, and conglomerate (Nandi 2009). The Ordovician Sevier shale formation is associated with limestone bedrock.

Soils

The land comprising Steele Creek Park is covered by several soils recognized by the United States Department of Agriculture (USDA). The map in Figure 7 shows the spatial distribution of theses soils within the study area. In most cases the slopes and ridges are covered by thin, rocky soils, and the valleys and coves are covered in deeper soils. Rock outcrops were observed in several locations within the interior of the park and provide unique micro-habitats for some plants.

The majority of the park is covered in Montevallo Channery silt loam (USDA Soil Conservation Service 1987). This is a well-drained soil with a loamy and clayey subsoil that is found on the steep shale ridges within the Ridge and Valley Province. It is characterized by shallow soils that form in shale residuum on the ridge tops and the upper slopes. Deep soils formed from clayey limestone residuum are present on the lower slopes. Permeability is moderate, but available water capacity and organic matter content are low. This soil is strongly acidic, and erosion hazard is severe on slopes and ridge tops (USDA Soil Conservation Service 1987).

Steadman silt loam and Bloomingdale silty clay loam are found intermingled in the larger creek channels as in Trinkle Creek and Slagle Creek (USDA Soil Conservation Service 1987). These soils are nearly level and poorly drained. They are moderately permeable. The water table is within a depth of 12 inches in these areas and available water capacity is high. They have low organic matter content and range from medium acidic to moderately alkaline (USDA Soil Conservation Service 1987).

The perimeter of the Beaver Creek Knobs contains strips of Talbott rock outcrop associated with the Bradyville complex (USDA Soil Conservation Service 1987). These soils are well-drained with a clayey subsoil and possible limestone bedrock outcrops. An example of the limestone bedrock outcrops can be observed on the margin of the northern shore of Steele Creek Park Lake. The permeability and organic matter content are low. The soil is slightly acidic to mildly alkaline, and erosion hazard is severe (USDA Soil Conservation Service 1987).

Hydrology

The southwest to northeast ridges within the park run parallel with intervening valleys that contain many small coves that drain into three tributaries of Beaver Creek. The northeast section of the park drains to form Trinkle creek. The drainage basin of Trinkle Creek covers an area of 248 ha. Approximately 140 ha of this drainage basin falls within the park and accounts for 16% of the total land in Steele Creek Park. The park is bisected near the middle by Steele Creek, which was dammed in 1972 to create the 22 ha (54 acre) Steele Creek Park Lake. The lake surface is normally at an elevation of 480 m (1575 ft). The lake was originally 8.2 m (27 ft) deep at the deepest point just northwest of the dam but is now only 5 m at its deepest point from sediment accumulation. An area of 271 ha drains directly into the lake and 64 ha drains to joins Steele Creek Park below the dam. These drainage basins are completely within the boundaries of SCP and together cover an area of 335 ha (34% of the park). The southwest section of the park contains the drainage basin of Slagle Creek, which covers an area of 439 ha. Approximately 380 ha of Slagle Creek's drainage basin is within the park and accounts for 43% of the land within the park. Figure 8 shows the areas that drain into each creek within the park. Trinkle Creek and Slagle Creek rely heavily on precipitation and are typically nearly dry during periods of limited precipitation.

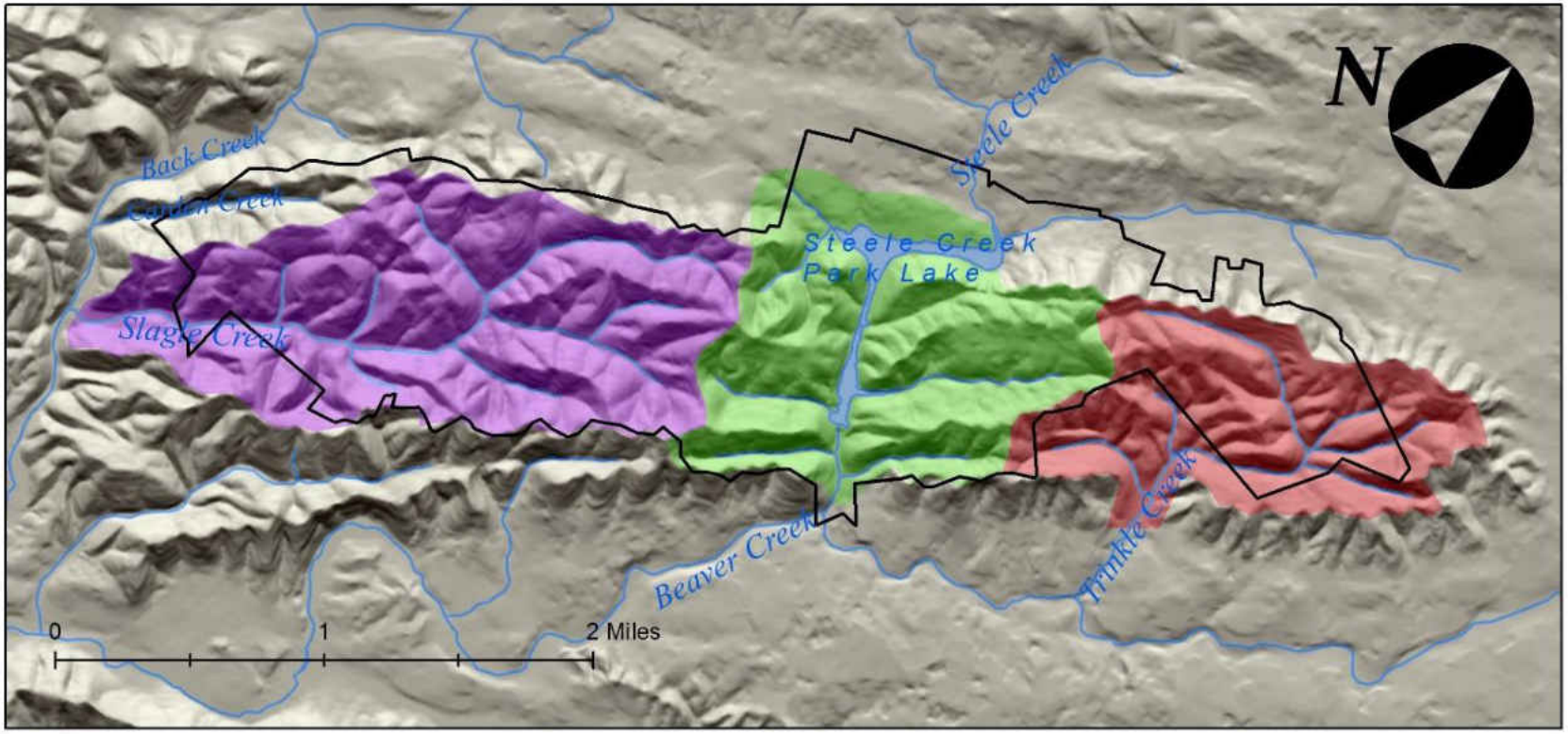


Figure 8. Hydrology Map of Steele Creek Park (Black Line Indicates Boundary) Showing the Three Drainage Basins Occurring within the Park: Slagle Creek (Purple), Steele Creek (Green), and Trinkle Creek (Red)

Climate

Climate data for the years 1954 to 2010 were obtained from the National Oceanic and Atmospheric Administration (NOAA 2014). The nearest weather station is at Tri-Cities Regional Airport, TN/VA (TRI) located 18.5 km (11.5 miles) to the southwest at 36.4849 longitude and −82.4071 latitude. Monthly normals were calculated from the last 30 years. Mean annual temperature over the last 30 years is 13.1 degrees C. In winter the average temperature is 3.89 degrees C and the average daily minimum temperature is −1.67 degrees. The month with the coldest average temperature is January with an average temperature of 1.8 degrees C. In summer the average temperature is 23.33 degrees C, and the average daily maximum temperature is 30 degrees C. The month with the warmest average temperature is July with an average temperature of 23.7 degrees C. Figure 9 gives a visual representation of the annual temperature data.

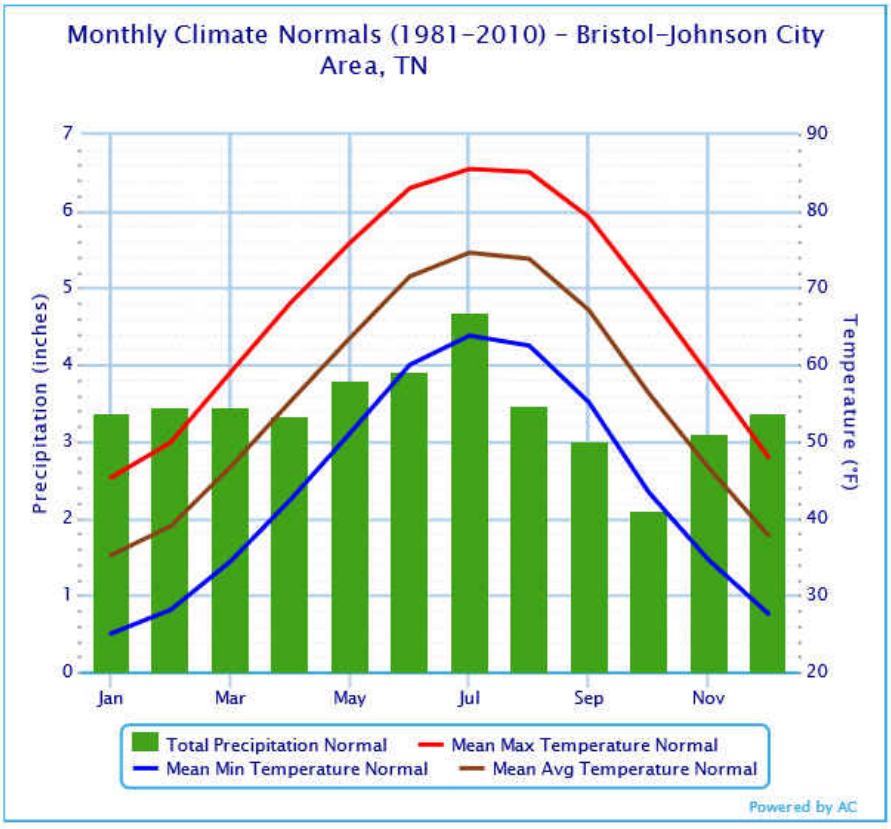


Figure 9. Average Annual Temperatures and Precipitation at TRI Weather Station

National Oceanic and Atmospheric Administration (NOAA). Accessed 2014. Officials of the National Oceanic and Atmospheric Administration, United States Department of Commerce. Climatological data from 1954 - 2010. National Climatic Data Center (NCDC), Asheville, North Carolina.

Average annual precipitation for the TRI weather station is 104.2 cm. On average the driest month is October with 5.33 cm, and the wettest is July with 11.9 cm of precipitation. The average seasonal snowfall is about 40 cm. Figure 9 also gives a visual representation of the annual precipitation data.

Park History

The majority of the property that would later become Steele Creek Park was purchased in 1941 by the United States Soil Conservation Service under the direction and funding of the Bankhead Jones Farm Tenant Act (Bankhead-Jones Farm Tenant Act 1937, Buchanan 1981). In January of 1954 the administration of the property was transferred to the United States Forest Service (USFS). The USFS owned the land but never actively managed it. It was not considered an "efficient management unit" because it was separated from Cherokee National Forest by 9 km (5.6 miles) of privately owned land (Buchanan 1981). During the late 1950s the creation of a Tennessee State Park on the land was considered. The name Watauga State Park was given to the concept, but funding from the Tennessee state government could not be secured for the project.

The city of Bristol, Tennessee began intensely developing its park system in the early 1960s. A Parks Commission for the city was created in 1961 (Buchanan 1981). In 1964 the mayor of Bristol, Stacey J. Grayson, declared the knobs to the southwest of the city a park. To do this, he extended the city limits so that 6.8 km (4.25 miles) of knobs were included within the city limits of Bristol, TN. The United States Forest Service maintained ownership during the early years of park development. The land was leased from the Federal Government until 1971 when ownership of the land was transferred to the municipality of Bristol, TN. Steele Creek Park is recognized as the second largest city park in the State of Tennessee and the 46th largest in the United States (The Trust for Public Land 2010). A trail map of the park that is available at the Nature Center and Friends of Steele Creek website (The City of Bristol 2012) is shown in Figure 10. It has remained a city park of Bristol to the present and is celebrating its 50th anniversary in 2014.

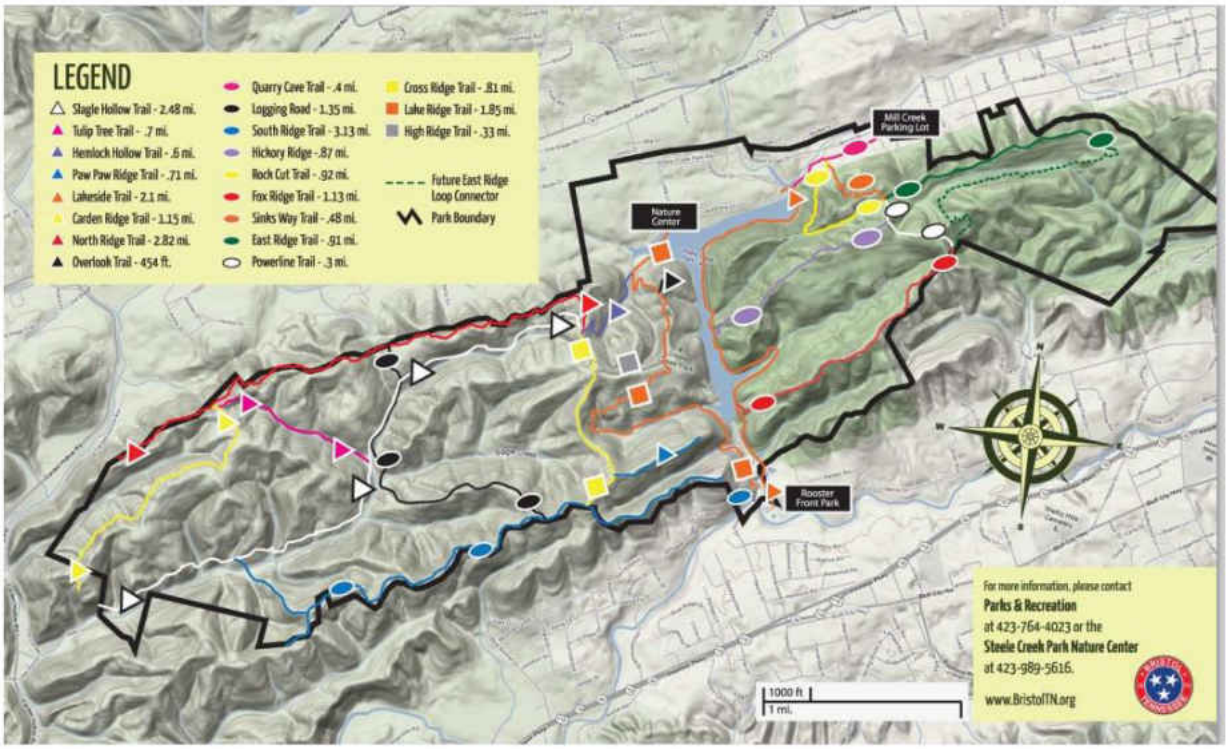


Figure 10. Map of Recreational Trails throughout Steele Creek Park (Black Line Indicates Boundary) Available at Nature Center or on Friends of Steel Creek Website.

The City of Bristol, Tennessee. 2012. Steele Creek Park Trail Map. Department of Parks and Recreation.

Disturbance History

The land within Steele Creek Park was privately owned and sections were logged for much of its modern history. The most recent account of intensive logging was in the 1940s when a sawmill was constructed near the mouth of Slagle Creek Hollow on Carden Hollow Road by R.E. Woods Lumber Company. It is reported that the land was extensively logged during that time (Buchanan 1981).

In 1956 a significant portion of the land was severely damaged by fire (Buchanan 1981). A general study and field inspection was made in September of 1959 and revealed that most of the larger trees were badly fire scarred, resulting in stunted growth (Buchanan 1981). A second,

smaller fire was recorded in 1963. A copy of the field report conducted in 1959 and any records of either fire were sought, but no details were found (USFS pers. comm. 2014).

A tornado caused severe damage to trees in the park on October 1, 1977. The tornado was moving southeast and crossed Slagle Hollow (Wallace Coffey pers. comm. 2014).

Previous Floristic Surveys at Steele Creek Park

During the initial years of establishing a park for the city of Bristol no records existed of the vascular plant diversity. The first naturalist hired by the city to assist the park in this endeavor was Brent Rowell. Rowell conducted two studies to create a primitive natural survey of the park (Rowell 1970 and 1972). An additional study was conducted by Joe Jackson, who camped in Slagle Hollow and catalogued the plants growing there for a weekend (Jackson 1971). Neither list contained more than 100 species. Species determinations cannot be confirmed because no voucher specimens were made during these studies.

In 1972 Louise Howard, a masters student of the Department of Biological Sciences at East Tennessee State University conducted a plant inventory of the park for her thesis. Her survey produced a list of 334 species occurring within the western half of the park, at that time known as Slagle Hollow Area (Howard 1972). Her list is the first substantial inventory of the vascular plant diversity within the park. She collected voucher specimens of the majority of species on her list, and these specimens reside in the ETSU herbarium.

In 1997 Anna Hess, a Swarthmore College student, conducted a study to update Louise Howard's species list. The report listed a total of 423 species with 307 species compatible with Louise Howard's list (92% of the species collected by Howard in 1972). An additional 116 species (Hess 1997) were newly reported as occurring in Steele Creek Park. No voucher specimens were taken, and species determinations were made by Hess using the Manual of the Vascular Flora of the Carolinas (Radford 1965) with no assistance from a professional botanist. Although the species determinations of Hess are questionable, her study provides an additional list of species potentially in the park. It was not, however, used in quantitative comparisons to the current study.

Comparable Floristic Surveys

Floristic inventories have been produced for two other parks in Sullivan County, Tennessee. These surveys of the vascular flora at Bays Mountain Park (Roller 1954) and Warriors Path State Park (Begley 1987) were both carried out by graduate students of East Tennessee State University.

Bays Mountain Park covers an area of 485 ha and is located approximately 30 km (18.5 miles) west of SCP. Roller recorded the presence of 92 families, 226 genera, and 336 species at Bays Mountain in 1954. The purpose of the study was to inventory the vascular plant diversity and create a species checklist for Bays Mountain Park. Although changes over the past 60 years in the flora of Bays Mountain Park have been noticed by park naturalists, no additions have been made to Roller's vascular plant inventory, and it is still used as the species checklist of the park (park naturalist Fred Hilton pers. comm. 2014).

Warriors Path State Park covers an area of 607 ha and is located approximately 20 km (12.5 miles) west-southwest of SCP. The park ranges in elevation from 385 m (1263 ft) to 500 m (1640 ft) above sea level. Begley recorded 107 families, 345 genera, and 575 species present in Warriors Path State Park in 1987. The objective of this study was to compile an inventory of vascular plants within Warriors Path State Park. Begley's unabridged inventory remains the species checklist in use currently at Warriors Path State Park (park naturalist Marty Silver pers. comm. 2014).

Additional floristic inventories were reviewed to evaluate the flora of Steele Creek Park as an element of the Ridge and Valley Province. Studies that took place within the Ridge and Valley Province as well as the adjacent Blue Ridge and Cumberland Plateau provinces were considered. Floristic inventories that were conducted in areas of forested hills, knobs, or small mountains were considered pertinent. A list of 20 of these selected floristic studies is provided in Table 1.

Table 1. Selected Floristic Surveys Conducted in the Ridge and Valley Province and Adjacent Provinces

Physiographic Province		Author	Date	Location Name	Counties	Size (ha)	Size (acres)	Families	Genera	Species
	Blue Ridge	Murrell, Z.E. and B.E. Wofford	1987	Big Frog Mountain	Polk County, TN	2,843	7,025	93	266	476
		Wyrick, D. and B.E. Wofford	1993	Gee Creek Wilderness	Polk and Monroe Counties, TN	1,009	2,493	93	230	365
	Cumberland Plateau	Fleming, C.A. and B.E. Wofford	2004	Fall Creek Falls State Park	Van Buren and Bledsoe Counties, TN	8,900	21,992	131	445	879
		Beck, J.T. and G.S. Van Horn	2007	Prentice Cooper State Forest	Marion County, TN	10,300	25,452	137	536	1,070
		Huskins, S.D. and J. Shaw	2010	Chickamauga Creek Gorge	Hamilton and Sequatchie Counties, TN	2,862	2,862	110	329	604
		Evans, J.R.	2011	Sequatchie Valley	Sequatchie County, TN	14,763	36,480	116	379	767
		Blyveis, E.R. and J. Shaw	2012	Tennessee River Gorge	Hamilton and Marion Counties, TN	4,970	12,281	123	392	700
	Ridge & Valley	Roller, J.E.	1954	Bays Mountain	Sullivan and Hawkins Counties, TN	485	1,200	92	226	336
		Pearman, J.R.	1956	Sinking Creek Area	Carter County, TN	202	500	86	237	347
		Grindstaff, A.B.	1956	Forge Hill	Carter County, TN	283	700	98	271	378
		Hut, A.C.	1972	Panther Creek State Park	Hamblen County, TN	769	1,900	97	255	341
		Thomas, R.D.	1976	Chilhowee Mountain	Blount and Sevier Counties, TN	25,900	64,000	116	433	953
		Malter, J.L.	1977	Citico Creek Wilderness Study Area	Monroe County, TN	6,716	15,596	91	288	536
		Howe, R.T.	1978	Turkeypen Cove	Greene County, TN	125	310	64	141	192
		Bentley, B.N.	1984	Laurel Run Gorge	Hawkins County, TN	182	452	89	199	269
		Mann, L. K., T.S. Patrick, and H. R. DeSelm	1985	Oak Ridge Reservation	Anderson and Roane Counties, TN	15,000	37,065	114	458	842
		Begley, B.C.	1987	Warriers Path State Park	Sullivan County, TN	607	1,500	107	345	575
		Houck, D.F.	1990	Red Clay State Historical Area	Bradley County, TN	105	259	97	297	494
		Hamilton, A.R.	1991	Buffalo Mountain	Washington County, TN	293	723	54	123	158
		Bullington, B.C.	1997	Upper Clinch River	Claiborne, Grainger, and Hancock Counties, TN	5,000	12,355	108	338	526

Need for Study

Steele Creek Park has not been intensively surveyed for vascular plant diversity in recent decades. It has been over 40 years since a floristic inventory was produced, and the study by Louise Howard (1972) surveyed only a portion of the land that now comprises SCP. There are some determinations in the previous study that have been questioned. Moreover, those in plant groups difficult to identify (Asteraceae, Cyperaceae, Poaceae) were not rigorously inventoried in Howard's study. Completing an updated checklist of vascular plants in the park and comparing it to the 1972 study facilitates an understanding of the change in vascular flora over this time span. Howard stated in her thesis that she "hoped further floristic studies of this area will follow" (Howard 1972).

The park recently created a herbarium at the Steele Creek Park Nature Center in 2010. The herbarium's total collection at the beginning of this project included 286 specimens representing 68 families, 151 genera, and 190 species. A large number of these were planted herbs or other ornamental plants in close proximity to the nature center. Voucher specimens produced in the current study and donated to the SCP herbarium will provide a more thorough documentation of the vascular diversity within the park. It would serve the nature center to have a record of all species present within the park and voucher specimens on site for future identifications. The SCP Herbaria will be an educational tool for the surrounding community and for conservation management within the park after the completion of the current study.

A quantitative study of patterns involving the flora living within the park could elucidate the vegetative mechanics of canopy gaps. The literature of research on canopy gaps in the deciduous forests of Southern Appalachian Mountains is mainly focused on woody plant succession because a dominant focus in conservation of forest stands is timber production management (Himes and Rentch 2013). The current study is intended to draw attention to the herbaceous species that shape a canopy gap microhabitat. Study plots can provide reliable measurements to document change within ecosystems over long term studies (Brown 1941). If future studies aim to repeat the findings of the current study or locate documented species, it is important to record the areas and plant communities that allowed them to live there. The documentation of canopy gaps in the surrounding sea of forested knobs is validation that shade intolerant species were collected within the interior area of the park.

Study plots that involve recording the dominant species in all strata aid in the determination of plant communities. The documentation of plant communities gives context to the species collected in the study area. The use of a standard vegetation study plot methodology permits wider comparison of vegetation data across geographical regions, vegetation types, and time periods (Peet et al. 2011).

CHAPTER 3

METHODS

Botanical Inventory

An inventory of the vascular plants living within SCP was conducted from March of 2013 until September of 2014. Collecting trips were made within the park approximately once a week. Distribution maps from the UT Herbarium website (TENN), vascular plant checklists from nearby parks (Roller 1954, Begley 1987), and previous studies of plants in SCP (Howard 1972, Hess 1997) were consulted to create a list of vascular plant species that may be present. The park naturalist, Jeremy Stout, issued a collecting permit to allow for botanical collections to be made for this study (Collecting Permit 2013). Specimens were taken in duplicate to make identifications and produce two sets of voucher specimens.

Field Work and Collections

Collecting was conducted entirely within the boundaries of Steele Creek Park. The vast majority of specimens were collected from within the wilderness area, with a few exceptions collected on the edges of the manicured recreational space. Trips were made into the wilderness area with the objective of exploring a new ridge or cove each time, until all notable topographic areas were surveyed. Notes on the presence of juvenile plants encountered were made, and subsequent collecting trips were designed to resurvey areas after the development of reproductive material.

The current inventory of plant diversity within Steele Creek Park was restricted to vascular plants. Mosses and liverworts were not sampled. The most basal taxonomic plant groups inventoried included the cryptograms of Lycopodiophyta (clubmosses), Equisetophyta (horsetails or scouring rushes), and Polypodiophyta (ferns).

The collecting strategy included pressing specimens in the field of every vascular plant encountered that was blooming or fruiting and was not known to have been represented in the previous collections. Specimens were collected in duplicate if the population size allowed it. The "1 in 20" rule of thumb for botanists was used while collecting (Wagner 1991). Taxa that were too rare to be safely collected were photographed. This method was employed for threatened or rare species, some species of orchids, and plants with low numbers of individuals in the

population. Information was collected in the field to supplement herbaria specimens. High resolution photos (at least 14 MP per image) were taken of a plant before it was collected (Klahs.Botany Flickr Account 2014). Global Positioning System (GPS) coordinates were taken in the field with a Garmin eTrex 30 handheld GPS device for every collection site. Plants were pressed in the field to ensure that collected material was not damaged and to produce high quality mounted specimens. Drying and mounting were done at the ETSU herbarium and followed standard herbarium procedures.

Species Determinations

Species determinations were primarily made using the Manual of Vascular Plants of Northeastern United States and Adjacent Canada (Gleason and Cronquist 1991) in the ETSU herbarium with a 7x – 45x Omano dissecting stereo microscope. Additional taxonomic manuals and references were used to confirm identifications. These included Flora of the Carolinas, Virginia, Georgia, Northern Florida, and Surrounding Areas (Weakley draft 2008), select editions of the Flora of North America (1993, 2002, 2007), specimens from the ETSU herbarium, and photos from the UT Herbarium's website. The species concepts and all nomenclature pertaining to families, genera, and species for the species checklist (Appendix A) follow Flora of Virginia (Weakley et al. 2012). This identification manual was chosen for nomenclature and species concepts because it is recent and uses modern treatments of taxa. The close proximity of Steele Creek Park to the border of Virginia and the range of the Ridge and Valley Province make it likely that all vascular plants collected in SCP would be described in this manual. The geographic scope of taxa included is relatively narrow, which assists determinations and increases the functionality of the species checklist for future botanical studies in the local area. Rare species designations were derived from the Tennessee Rare Plant List (2014).

Specimens Residing in Herbaria

The herbarium specimens produced by this study are being labeled with the collection name Steele Creek Park Project (SCPP). The primary set of this collection will be deposited in the ETSU herbarium. Duplicate specimens will be deposited in the newly formed herbarium at Steele Creek Park. Additional noteworthy specimens will be donated to the University of

Tennessee, Knoxville Herbarium (TENN) and Herbarium of the U.S. Museum of Natural History (Smithsonian Institution).

Comparison to Other Floristic Surveys

The species checklist produced for SCP in the current study was compared to historical lists for the park as well as nearby parks. A species comparison was conducted between the present study and Howard's survey (1972). This compares the documented diversity by each species and reports the amount of overlap. The same method of species comparison was also used to compare the current study to Warriors Path State Park in Sullivan County, Tennessee, the closest park with a floristic inventory on record.

A species area curve analysis was also conducted to compare the number of families, number of genera, and species versus size of study site documented in 20 floristic surveys conducted at locations comparable to Steele Creek Park. The 20 floristic surveys used for this comparison were conducted within the Ridge and Valley Province (13 floristic surveys), Blue Ridge Province (2 floristic surveys), and Cumberland Plateau Province (5 floristic surveys). A taxon vs. area scatter plot was created to compare the area of each study site with the recorded abundance of taxonomic diversity. The size of each study site and the number of reported taxa was $\log_{10}$ –transformed to create a diversity per area graph. The use of $\log_{10}$ –transformed data to construct a regression line is commonly used and appropriate for this region of the eastern United States (Qian et al. 2007). This was done for three levels of taxonomic diversity: family, genus, and species. Species-to-area meta-comparisons were used to approximate the diversity per area within a physiographic province or region with enough comparable floristic surveys (Wade and Thompson 1991, Qian et al. 2007). A regression line was fit to the scatter plot of floristic survey data and used to evaluate the reported diversity of Steele Creek Park.

To estimate the intensity or thoroughness of the current study a comparison was conducted between the numbers of reported species in select genera among the floristic inventories used for previous comparisons (Table 1). Several genera containing numerous species with distributions prevalent in the area and representing a range in difficulty of determination were chosen as indicators of botanical effort. The genera used for this analysis were *Carex* (a graminoid sedge), *Quercus* (a tree), and *Viola* (a perennial herb). The number of reported species in these genera was recorded for each floristic study.

Canopy Gap Vegetation Study Plots

Study Plot Locations

A set of study plots was installed and analyzed to investigate the difference in diversity between areas with full canopy and areas with canopy gaps. Ten study sites were chosen throughout the park based on the following criteria: (1) presence of a canopy gap created by one or more fallen trees, (2) availability of nearby areas with similar topographical conditions, (3) accessibility to install a 10 m x 10 m square plot. The sites used for the current study were chosen subjectively to represent as many canopy gaps meeting the criteria as possible in the time available and to sample fairly evenly throughout the forested area of the park. The locations of the 10 study sites and a zoomed window of the topography of each are presented in Figure 11.

Plot Protocol and Installation

Within each study site two 10 m x 10 m square plots were established. The first plot was situated within the gap of an area receiving direct sunlight. The second plot was positioned in a nearby area that was similar to the first plot in physical site parameters (elevation, slope, aspect, forest type, etc.) except that it had full canopy cover. In total, 20 study plots were installed as 10 pairs of canopy gap and no gap. All study plots were installed in the month of June 2014. Descriptions and notes on each study plot are provided in Appendix C.

The Carolina Vascular Survey Standardized Plot Protocol was used to create data that would be readily comparable to those of other studies (Peet et al. 1998). In the current study each plot consisted of a single 10 m x 10 m square module. A compass was used in the field to determine magnetic north, and all study plots were orientated so that the borders of the square ran directly north/south and perpendicular to north/south. Nested subplots were used to extract spatial information. These consist of square plots with decreasing sizes (10 m, 3.16 m, 1 m, 0.32 m, and 0.1 m) sharing a common corner. Subplots were installed in all four corners of every plot. The diagram in Figure 12 illustrates the layout of a study plot.

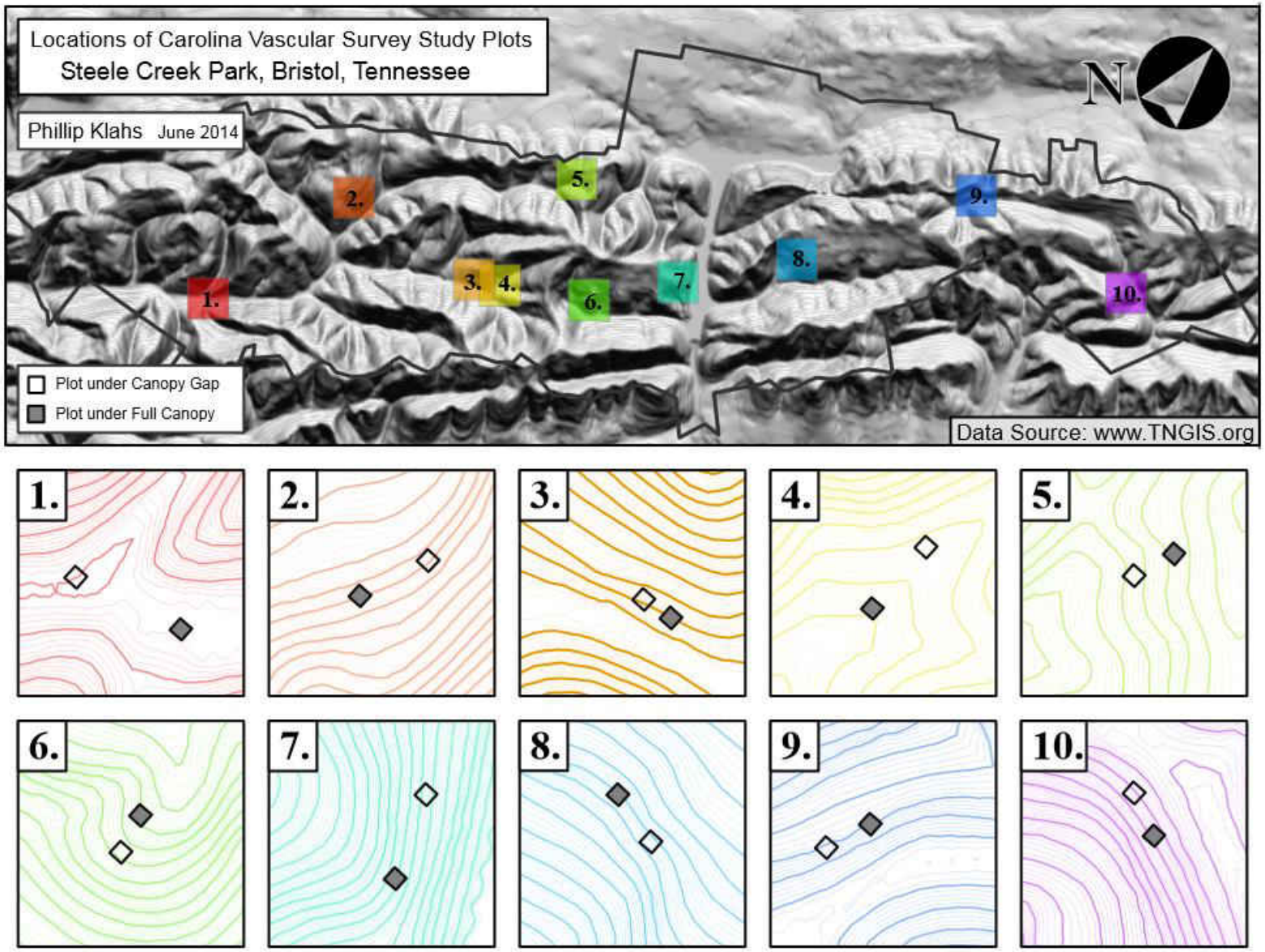


Figure 11. Locations of Carolina Vascular Survey Study Plots within Steele Creek Park (Black Line Indicates Boundary) with Colored Squares Representing Study Sites and the Corresponding Windows Below Showing Magnified Topographic Contours at 5 m Elevation Intervals

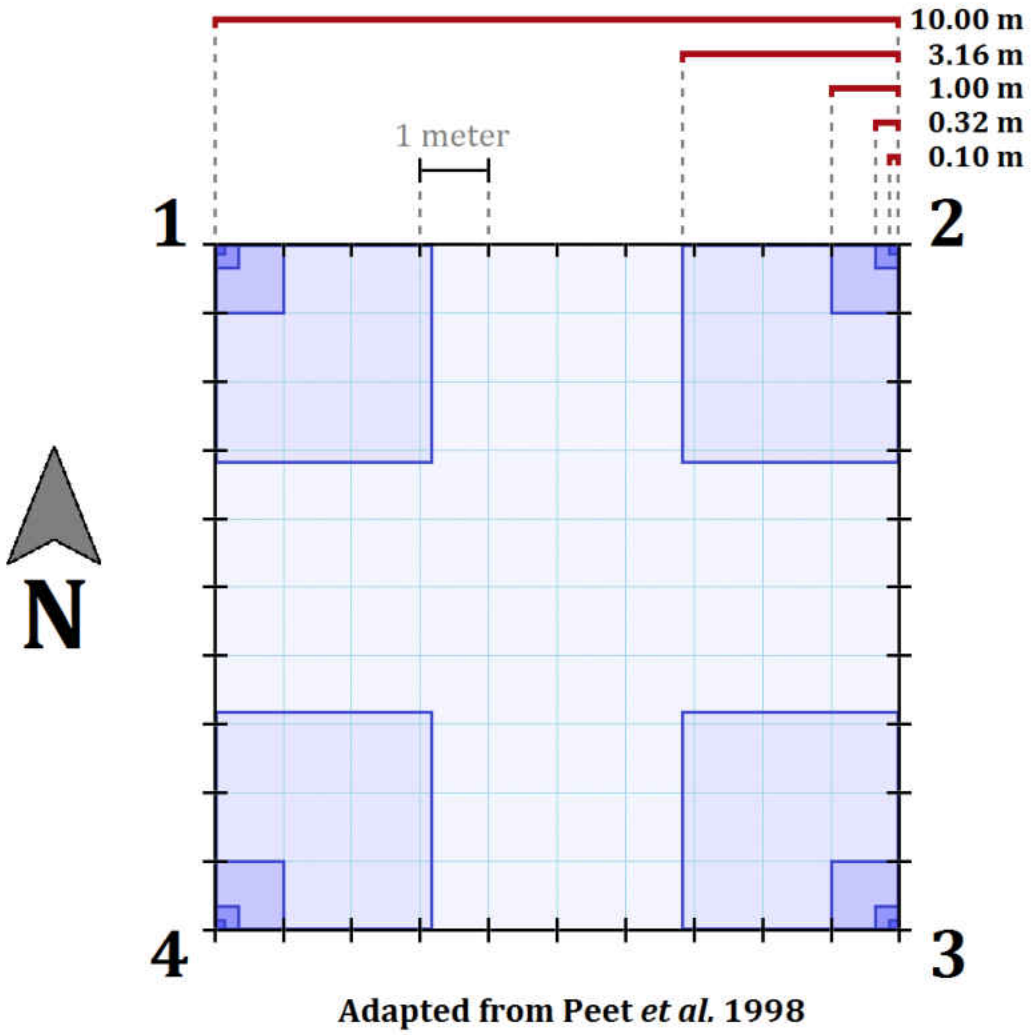


Figure 12. Diagram of the Carolina Vascular Survey Plot Protocol with Numbered Corners and Corresponding Subplots of Decreasing Side Lengths

Peet, RK, TR Wentworth, and P.S. White. 1998. A Flexible Multipurpose Method for Recording Vegetation Composition and Structure. Castanea 63(3):262-274.

Information collected about the vascular plants within each plot included presence of species, spatial distribution, and percent cover. A species was considered present in the plot if it was rooted within the boundary. Presence of species was checked for each level of subplot to address spatial distribution within the plot. Percent cover was measured as a visual estimate of the total space occupied by a species within the plot and was therefore a representation of the

magnitude of a species physical presence. The species presence data from all 20 study plots were used to calculate frequency of species occurrences for the current study.

Analysis of Recorded Data

To investigate whether canopy gaps support greater diversity than nongap areas, the reported diversity of canopy gap plots as compared to that of full canopy plots using a paired Student's t-test. A one-tailed Student's t-test was used, because the hypothesis for this study is canopy gaps support more diversity than similar areas with intact canopy by the increased amount of direct sunlight. The one-tailed Student's t-test was used to compare the means of recorded diversity within gap plots to the recorded diversity in intact canopy plots. An additional comparison of these data was made using a one-tailed Student's t-test after shared species were removed. Shared species were present in both plots of a study site. The removal of these species from the comparison allows a direct analysis of the unique taxa inhabiting canopy gaps.

CHAPTER 4

RESULTS

Botanical Inventory

A total of 1,120 separate collections (numbers) were made during the 2013 and 2014 collecting seasons. A total of 740 collections were made in 2013, of which 726 were considered quality specimens and kept in the collection. A total of 380 collections were made in 2014, of which 364 were kept. A list of collecting trips, the number of specimens collected, the general area surveyed, and people who accompanied me are given in Table 2. Collections made but not kept as specimens were discarded for various reasons. In most cases they lacked fertile material and represented a species that had previously been collected in better condition. Some collections were made in the field as a reminder to return when the plant was flowering or fruiting. This was often done with a photo, but in some instances a leaf was taken and pressed to ensure I had a GPS location and some documentation of the plant.

Table 2. Collecting Trips Made to Steele Creek Park During the Current Study

2013 Collecting Season

Date	Specimens Collected	General Area	Accompanied By
3/21/2013	1	Slagle Hollow	
3/28/2013	3	Slagle Hollow	
4/6/2013	5	Slagle Hollow	Sarah Knapp
4/11/2013	11	Slagle Hollow	
4/14/2013	13	Slagle Hollow	Sarah Knapp
4/18/2013	17	Slagle Hollow	
4/25/2013	17	Slagle Hollow	
4/27/2013	21	Slagle Hollow	
5/2/2013	0	Slagle Hollow	
5/21/2013	9	Slagle Hollow / SCP Lake	
5/29/2013	19	SCP Lake	
6/1/2013	34	Slagle Hollow	Sarah Knapp
6/12/2013	12	Slagle Hollow	
6/17/2013	23	Slagle Hollow	
6/28/2013	21	Slagle Hollow	
7/9/2013	38	Slagle Hollow / SCP Lake	
7/12/2013	37	Trinkle Hollow	
7/16/2013	22	Trinkle Hollow	
7/23/2013	43	Slagle Hollow	
7/28/2013	36	SCP Lake	Sarah Knapp
7/30/2013	28	Slagle Hollow / SCP Lake	
8/1/2013	66	Slagle Hollow	Dr. Tim McDowell
8/12/2013	42	Trinkle Hollow / SCP Lake	
8/15/2013	12	Slagle Hollow	
8/20/2013	30	Trinkle Hollow	
8/30/2013	42	Recreational Area	
9/1/2013	22	SCP Lake	Sarah Knapp
9/6/2013	36	Slagle Hollow	
9/13/2013	16	Trinkle Hollow	
9/27/2013	23	Slagle Hollow / Lake	
10/6/2013	12	Trinkle Hollow	Sarah Knapp
10/8/2013	15	Slagle Hollow	

Total

Number of Dates	Specimens Collected
32	726

2014 Collecting Season

Date	Specimens Collected	General Area	Accompanied By
4/5/2014	6	Trinkle Hollow	Sarah Knapp
4/7/2014	6	Slagle Hollow	
4/10/2014	6	Trinkle Hollow	
4/17/2014	12	SCP Lake	
4/19/2014	6	Slagle Hollow	Sarah Knapp
4/24/2014	9	Slagle Hollow / SCP Lake	Chris and Anita Dennert
5/1/2014	20	Slagle Hollow	
5/3/2014	10	Trinkle Hollow	Sarah Knapp
5/11/2014	35	Trinkle Hollow	Sarah Knapp
5/16/2014	23	Slagle Hollow	
5/18/2014	22	Slagle Hollow	
5/25/2014	22	SCP Lake	Sarah Knapp
5/27/2014	7	Slagle Hollow	Kelvin Smith
5/29/2014	7	Trinkle Hollow	
6/6/2014	28	Trinkle Hollow / SCP Lake	
6/8/2014	8	Slagle Hollow	
6/10/2014	12	Slagle Hollow / SCP Lake	
6/13/2014	12	Slagle Hollow	
6/15/2014	2	Trinkle Hollow / SCP Lake	
6/16/2014	4	Trinkle Hollow	Kelvin Smith
6/20/2014	3	Slagle Hollow	
6/22/2014	6	Trinkle Hollow	Sarah Knapp
6/24/2014	8	Slagle Hollow	
6/27/2014	10	Trinkle Hollow	
7/8/2014	13	Slagle Hollow	
7/17/2014	7	Trinkle Hollow / SCP Lake	
7/21/2014	10	Slagle Hollow	
7/26/2014	3	Trinkle Hollow	Bret and Debra Klahs
8/14/2014	25	SCP Lake	
8/22/2014	12	Trinkle Hollow	
8/26/2014	1	Slagle Hollow	
8/28/2014	4	Trinkle Hollow	
9/7/2014	5	SCP Lake	Sarah Knapp

Total

Number of Dates	Specimens Collected
33	364

Taxonomic Summary

The current floristic inventory documented the presence of 547 species representing 323 genera and 101 families within Steele Creek Park. The complete list of species collected is given in Appendix A. The collection includes two species of *Equisetum* (0.36% of the current collection) in the monotypic family Equisetaceae of the monotypic division Equisetophyta. Three species of Lycopodiophyta (0.55% of the current collection) were documented growing in the park. Nineteen species of ferns (3.45% of the current collection) representing 16 genera in division Polypodiophyta were documented. Gymnosperms were represented by seven species (1.27% of the current study) from three families in the division Pinophyta. Magnoliaphyta contained 94.36% of the current study's documented vascular plant diversity. The class Liliopsida, considered the monocots, includes 129 documented species (23.45% of the current study). The class Magnoliopsida, considered the dicots, includes 390 documented species (70.91% of the current study). A taxonomic summary is provided in Table 3.

Table 3. Numbers of Vascular Plant Species Collected at Steele Creek Park, Sorted by Taxonomic Divisions

Division	Families	Genera	Species	% of Current Collection	Native	Exotic
Lycopodiophyta	1	3	3	0.55%	3	0
Equisetophyta	1	1	2	0.36%	2	0
Polypodiophta	9	16	19	3.45%	19	0
Pinophyta	2	4	7	1.27%	7	0
Magnoliophyta	88	299	516	94.36%	430	86
Liliopsida	16	66	129	23.45%	106	23
Magnoliopsida	72	233	387	70.91%	324	63
Totals	**101**	**323**	**547**	**100%**	**461**	**86**

The five largest families by number of species documented were Asteraceae (69 species), Poaceae (49 species), Cyperaceae (33 species), Rosaceae (30 species), and Fabaceae (26 species). A depiction of recorded diversity by family is given in Table 4. This table shows the number of genera, species, and Sullivan County records produced for each family. The same five families also contributed the most county records.

Table 4. Numbers of Genera and Species Collected at Steele Creek Park, Sorted by Plant Family and Descending by Number of Species, with Counts for New County Records for Sullivan County, TN

Family	Number of Genera	Number of Species	Sullivan County Records
Asteraceae	38	69	37
Poaceae	32	49	17
Cyperaceae	6	32	9
Rosaceae	13	29	15
Fabaceae	19	26	12
Ranunculaceae	7	17	5
Brassicaceae	7	15	7
Lamiaceae	11	15	4
Apiaceae	10	12	4
Ericaceae	8	12	7
Rubiaceae	5	12	6
Orchidaceae	8	11	2
Fagaceae	3	10	6
Plantaginaceae	5	9	5
Violaceae	1	9	1
Apocynaceae	2	6	3
Campanulaceae	3	6	2
Convolvulaceae	3	6	6
Juglandaceae	2	6	4
Juncaceae	2	6	3
Orobanchaceae	5	6	1
Polygonaceae	2	6	4
Boraginaceae	5	5	2
Caryophyllaceae	5	5	1
Pinaceae	2	5	2
Sapindaceae	2	5	1
Amaryllidaceae	2	4	1
Anacardiaceae	2	4	2
Aristolochiaceae	3	4	-
Caprifoliaceae	2	4	-
Euphorbiaceae	2	4	4
Hypericaceae	1	4	2
Magnoliaceae	2	4	2
Primulaceae	2	4	1
Saxifragaceae	4	4	1
Smilacaceae	1	4	4
Vitaceae	2	4	2
Berberidaceae	2	3	2
Betulaceae	3	3	2
Cornaceae	1	3	1
Dryopteridaceae	2	3	-
Iridaceae	2	3	-
Liliaceae	3	3	2
Lycopodiaceae	3	3	1
Oxalidaceae	1	3	1
Pteridaceae	3	3	-
Ruscaceae	3	3	1
Urticaceae	3	3	2
Woodsiaceae	3	3	-
Adoxaceae	2	2	-

Table 4. Continued

Alismataceae	1	2	2
Aquifoliaceae	1	2	-
Araceae	2	2	1
Araliaceae	2	2	2
Aspleniaceae	1	2	-
Balsaminaceae	1	2	-
Bignoniaceae	2	2	-
Colchicaceae	1	2	-
Cupressaceae	2	2	-
Dennstaedtiaceae	2	2	-
Dioscoreaceae	1	2	1
Equisetaceae	1	2	-
Gentianaceae	2	2	-
Geraniaceae	1	2	1
Lauraceae	2	2	-
Moraceae	1	2	1
Oleaceae	2	2	1
Onagraceae	2	2	-
Ophioglossaceae	2	2	-
Phrymaceae	2	2	1
Rhamnaceae	2	2	-
Scrophulariaceae	1	2	2
Solanaceae	1	2	-
Trilliaceae	1	2	-
Verbenaceae	1	2	2
Acanthaceae	1	1	-
Altingiaceae	1	1	1
Annonaceae	1	1	-
Celastraceae	1	1	-
Commelinaceae	1	1	-
Crassulaceae	1	1	-
Diapensiaceae	1	1	-
Diplaziopsidaceae	1	1	-
Hamamelidaceae	1	1	1
Hydrangeaceae	1	1	-
Malvaceae	1	1	-
Montiaceae	1	1	-
Nyssaceae	1	1	-
Onocleaceae	1	1	-
Papaveraceae	1	1	-
Passifloraceae	1	1	-
Paulowniaceae	1	1	1
Penthoraceae	1	1	-
Phytolaccaceae	1	1	1
Platanaceae	1	1	-
Salicaceae	1	1	-
Santalaceae	1	1	-
Simaroubaceae	1	1	1
Thelypteridaceae	1	1	-
Ulmaceae	1	1	1
Xanthorrhoeaceae	1	1	-
Totals	323	547	216

The species documented were grouped into six common descriptions of growth form. The current floristic survey included 26 pteridophytes (ferns and allies), 93 graminoids, 309 forbs, 33 shrubs, 25 vines, and 61 trees. This is also shown in Table 5 and illustrated in Figure 13.

Table 5. Number of Species Collected from Steele Creek Park According to Growth Form

Ferns	Graminoids	Forbs	Shrubs	Trees	Vines	Total
26	93	309	33	61	25	547

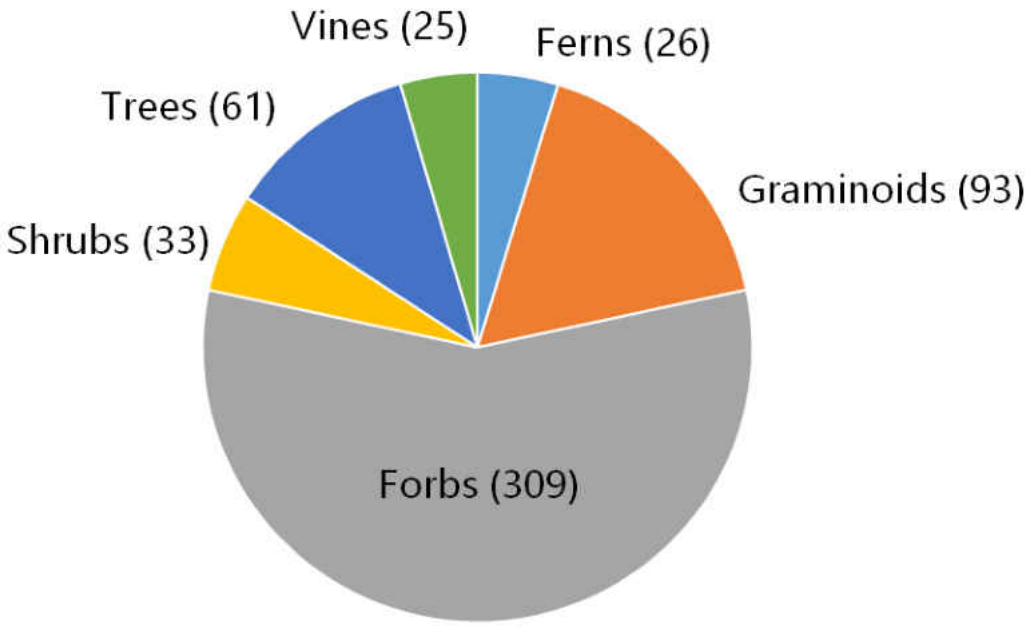


Figure 13. Representation of Species Collected from Steele Creek Park According to Growth Form

The current study produced 216 county records for Sullivan County, Tennessee that were reported to UT Herbarium (Wofford pers. comm. 2014). The current study raised the number of vascular plants found in Sullivan County from 606 species to 822 species, a 36% increase in documented diversity. Sullivan County records are denoted in the species checklist in Appendix A.

Noteworthy Collections

The Tennessee Rare Plants List (2014) classifies seven of the currently documented species as special concern, threatened, endangered, or commercially exploited. *Cardamine rotundifolia*, *Castanea dentata*, and *Lonicera dioica* are listed as Tennessee Special Concern Species. *Allium tricoccum*, *Cypripedium acaule*, *and Panax quinquefolius* are designated as Tennessee Special Concern Species and Commercially Exploited. *Juglans cinerea* was found in the park and is a Threatened Species in Tennessee. *Magnolia virginiana* was documented as growing south of the dam in Steele Creek Park but not included in this count because it was likely a planted individual. A list of these noteworthy species is provided in Table 6 and described in more detail in the Discussion.

Table 6. Summary of Noteworthy Species Collected in Steele Creek Park (Tennessee Threatened Species or of Special Concern)

Family	Scientific Name	Authority	Level of Concern	
Araliaceae	*Panax quinquefolius*	L.	TN Special Concern Species	Commercially Exploited
Brassicaceae	*Cardamine rotundifolia*	Michx.	TN Special Concern Species	
Caprifoliaceae	*Lonicera dioica*	L.	TN Special Concern Species	
Fagaceae	*Castanea dentata*	(Marsh.) Borkh.	TN Special Concern Species	
Juglandaceae	*Juglans cinerea*	L.	TN Threatened Species	
Amaryllidaceae	*Allium tricoccum*	Ait.	TN Special Concern Species	Commercially Exploited
Orchidaceae	*Cypripedium acaule*	Ait.	TN Special Concern Species	Commercially Exploited

Eighty-six introduced species (16% of the current collection) were documented occurring within SCP (see Appendix A). Thirty-five species found within the park were considered invasive by the Tennessee Exotic Pest Plant Council (2009). A list of invasive exotic species organized by family is given in Table 7.

Table 7. Species Classified as an Invasive Exotic Documented within Steele Creek Park, Sorted by Species

Family	Species	Authority
Simaroubaceae	*Ailanthus altissima*	(Mill.) Swingle
Fabaceae	*Albizia julibrissin*	Durazz.
Brassicaceae	*Alliaria petiolata*	(M.Bieb.) Cavara & Grande
Amaryllidaceae	*Allium vineale*	L.
Poaceae	*Arthraxon hispidus*	(Thunb.) Makino
Berberidaceae	*Berberis thunbergii*	DC.
Asteraceae	*Cichorium intybus*	L.
Asteraceae	*Cirsium vulgare*	(Savi) Ten.
Ranunculaceae	*Clematis terniflora*	DC.
Apiaceae	*Daucus carota*	L.
Dioscoreaceae	*Dioscorea polystachya*	L.
Lamiaceae	*Glechoma hederacea*	L.
Araliaceae	*Hedera helix*	L.
Aquifoliaceae	*Ilex crenata*	Thunberg
Iridaceae	*Iris pseudoacorus*	L.
Brassicaceae	*Lepidium campestre*	(L.) R. Br.
Fabaceae	*Lespedeza cuneata*	(Dum.Cours.) G. Don
Asteraceae	*Leucanthemum vulgare*	Lam.
Oleaceae	*Ligustrum sinense*	Lour.
Caprifoliaceae	*Lonicera japonica*	Thunb.
Caprifoliaceae	*Lonicera maackii*	(Rupr.) Maxim.
Primulaceae	*Lysimachia nummularia*	L.
Lamiaceae	*Mentha spicata*	L.
Poaceae	*Microstegium vimineum*	(Trin.) A. Camus
Paulowniaceae	*Paulownia tomentosa*	(Thunb.) Steud.
Polygonaceae	*Polygonum caespitosum*	Blume
Polygonaceae	*Polygonum persicaria*	L.
Ranunculaceae	*Ranunculus bulbosus*	L.
Rosaceae	*Rosa multiflora*	Thunb. ex Murr.
Rosaceae	*Rubus phoenicolasius*	Maxim.
Asteraceae	*Sonchus arvensis*	L.
Poaceae	*Sorghum halepense*	(L.) Pers.
Asteraceae	*Tussilago farfara*	L.
Scrophulariaceae	*Verbascum thaspus*	L.
Apocynaceae	*Vinca minor*	L.

Comparisons to Local and Regional Floras

The species checklist produced by this study shared 247 species (45% of the current collection) with Louise Howard's list (1972). The other 300 species (55% of the current collection) were additions to the list of vascular plant species within Steele Creek Park. Howard's species checklist contained 86 species that were not documented in the current study. A list of these species with notes pertaining to the existence of voucher specimens and misidentifications is given in Appendix B. It was found that of the missing 86 species 16 were not verified with voucher specimens. The remaining 70 reported species with existing voucher specimens were reviewed at the ETSU herbarium. Annotations, made by John C. Warden after Howard's thesis was conducted, indicate that 8 of these were misidentified. It is likely that other specimens were also misidentified by Howard in 1972. Some examples of these corrected determinations are given in the Discussion. Regardless, the 86 species listed in Appendix B were previously reported as occurring within the park (Howard 1972) but were not found during the current study.

A comparison of the floristic inventory for Warriors Path State Park (Begley 1987) and the current study of Steele Creek Park showed that 306 species are reported as occurring in both parks. A total of 269 vascular plant species reported in the Warriors Path State Park species list are not documented in the current study of SCP. The reported shared diversity accounted for 53% of the species recorded by Begley in Warriors Path State Park and 56% of the current study's checklist.

The intensity index showed that for the chosen exemplar genera, the documented species diversity of Steele Creek Park was close to, if not above, the mean reported diversity among comparable floras. The current study reported above the mean reported diversity for *Carex* (mean = 16, current study = 23), slightly below the average reported diversity of *Quercus* (mean = 8, current study = 7), and exactly on the mean number of reported *Viola* species (mean = 9, current study = 9).

Canopy Gap Vegetation Study Plots

Carolina Vascular Survey Plots

Within the 20 study plots, 135 vascular plant species were recorded. Descriptions of each study site and the corresponding recorded diversity are given in Appendix C. A summary of the data is provided in Table 8. Forty-five species were observed exclusively in plots within a canopy gap during the study. One of these species, *Phytollacca americana* L., was found in five of the 10 canopy gap plots but absent from all of the full canopy plots. *Phytollacca americana* (pokeweed or inkberry) thrives in direct sunlight and is known to be an early colonizer of disturbed areas (Sauer 1952). The presence of species within multiple plots was used to calculate the frequency of occurrence during the current study. Species occurring in half of the plots or more (frequency ≥ 50%) are given in Table 9.

Table 8. Comparison of Number of Species Occurrences in Canopy Gap Versus Full Canopy Study Plots

Site Number	Number of Species: Canopy Gap Plot	Number of Species: Full Canopy Plot	Unique to Canopy Gap	% of Site Total	Unique to Full Canopy	% of Site Total	Shared	% of Site Total	Total Species
1	35	30	18	37.5%	13	27.08%	17	35.42%	48
2	36	27	12	30.77%	3	7.69%	24	61.54%	39
3	31	33	11	25.%	13	29.55%	20	45.45%	44
4	38	35	15	30.%	12	24%	23	46%	50
5	35	21	19	47.5%	5	12.50%	16	40%	40
6	25	27	10	27.03%	12	32.43%	15	40.54%	37
7	44	19	27	58.7%	2	4.34%	17	36.96%	46
8	28	30	11	26.83%	13	31.71%	17	41.46%	41
9	26	19	16	45.72%	9	25.71%	10	28.57%	35
10	26	35	10	28.58%	9	25.71%	16	45.71%	35
$\bar{X}$ =	32.4	27.6							

An analysis of the study plot data was performed to examine differences in plant assemblages between areas with a canopy gap and those with full canopy. A one-tailed, paired Student's t-test was used to compare the means of reported diversity (species occurrences) within canopy gap study plots ($\bar{x}$ = 32.4) versus plots in full canopy ($\bar{x}$ = 27.6). The t-test of this comparison produced a p value of 0.0761, which lies just above a 0.05 significance level. An additional t-test was performed with study site 3 data excluded, because the gap within this site was very recently formed (See Appendix C.). This t-test produced a p value of 0.0666, which is

considered marginally significant. A second analysis was performed with the removal of shared species. A one-tailed, paired Student's t-test was used to compare the number of unique species in canopy gap plots to unique species of intact canopy plots. This t-test produced a p value of 0.0306, which is significant. This indicates that canopy gaps can support more occurrences of particular species as an additional component to an area's vascular plant composition beyond the normally present species. The number of vascular plant species within a study site that exclusively occur in the canopy gap is greater than the number of species only found within a nearby plot of intact canopy.

Table 9. Numbers of Occurrences for Species Found in Half or More Than One-Half of the Study Plots

Species	Canopy Gap Plots	Full Canopy Plots	Total Plots	Frequency
Smilax rotundifolia	9	9	18	90%
Polystichum acrosticoides	9	8	17	85%
Quercus rubra	8	9	17	85%
Parthenocissus quinquefolia	6	10	16	80%
Betula lenta	7	8	15	75%
Acer rubrum	7	7	14	70%
Nyssa sylvatica	6	8	14	70%
Liriodendron tulipifera	7	6	13	65%
Fraxinus americana	6	7	13	65%
Galium circaezans	6	6	12	60%
Acer saccharum	5	7	12	60%
Prosartes lanuginosum	6	5	11	55%
Quercus montana	6	5	11	55%
Thaspium barbinode	6	5	11	55%
Cercis canadensis	6	4	10	50%
Amelanchier arborea	5	5	10	50%
Polygonatum biflorum	5	5	10	50%
Sassafras albidum	5	5	10	50%

A species' frequency value can be an estimate of prevalence within the study site. The accuracy of this estimate increases as the area included in plots approaches a significant portion of the land within the study site. During the current study, 20 plots, covering 100 square meters each, were installed. Together these included 2,000 square meters or 0.2 ha of land, which represents 0.0002% of the land with Steele Creek Park. Gaps in the canopy provide sparse islands of direct sunlight within the forested habitats that cover the majority of the park and are microhabitats for shade intolerant plant species.

Species Recorded in Plots

The number of occurrences of the 135 species recorded within the gap and canopy study plots is provided in Figure 14. The orange line indicates the difference in the number of occurrences in canopy gap plots versus the number of occurrences in full canopy plots. This provides a simple estimate of shade or canopy gap affinity for the various species reported. The black brackets group species with similar gap versus canopy affinities or occurrence differences. The majority of the species documented in study plots were versatile in their habit location, at least within the scope of the current study.

For more detailed information on the occurrences of species within plots see Appendix C.

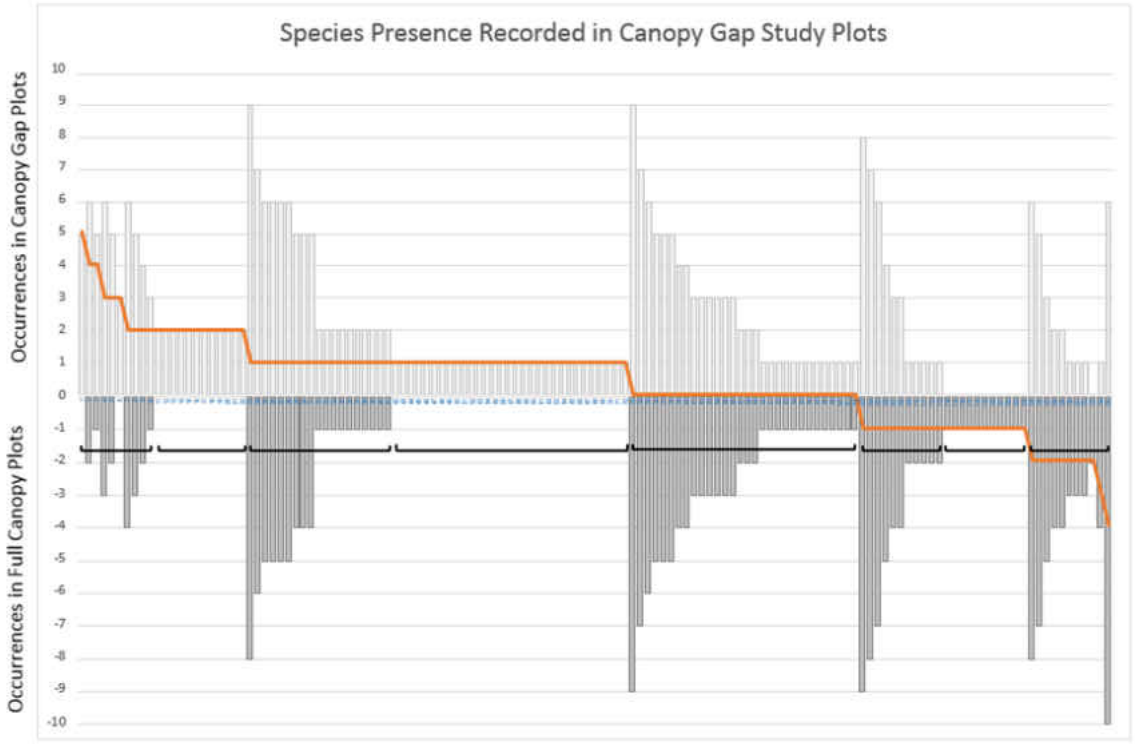


Figure 14. Species Presence Recorded in Canopy Gap Study Plots Versus Intact Canopy Plots

Plant Communities

Six distinct plant communities were found in Steele Creek Park. The Carolina Vascular Survey was used to document these communities with plots. The locations of canopy gap study plots were strategically placed throughout the park to represent the diversity of the apparent plant communities. Some plant communities within the park did not contain a canopy gap and were separately observed for description purposes while conducting the floristic inventory.

The following plant communities are named using informal descriptions loosely based on NatureServe's list of plant communities (NatureServe 2008). Codominant species and general locations are used as a general name for each plant community. A descriptive name that includes the dominant species by strata is given in brackets "[ ]". The plant communities are listed in Table 10 and described below in order of most common to least common in terms of area coverage within the park.

Table 10. Plant Communities Observed in Steele Creek Park, Sorted by Coverage Area

Order	Informal Name	General Location
1	Ridge and Valley Montane Oak Hickory Forest	Ridges and Slopes
2	Ridge and Valley Cove Forest (Typical)	Moist Coves
3	Ridge and Valley Cove Forest (Rich Type)	Moist Coves
4	Appalachian Montane Alluvial Forest	Creek Valley
5	Ridge and Valley White Pine - Mesic Oak Forest	Dry Slopes
6	Ridge and Valley Small Hemlock Forest	Moist Slopes

COMMUNITY 1. Ridge and Valley Montane Oak Hickory Forest

[*Quercus rubra – Quercus montana - Carya* spp. */ Oxydendrum arboreum – Cornus florida / Sassafras albidum – Vaccinium pallidum / Hylodesmum nudiflorum*] The canopy of this plant community is dominated by *Quercus rubra* and *Carya spp.* with *Oxydendrum arboreum* and *Cornus florida* present. The shrub layer is comprised of *Sassafras albidum* saplings*, Kalmia latifolia,* and *Vaccinium pallidum.* Vines commonly found growing in this community within Steele Creek Park are *Smilax rotundifolia* and *Vitis aestivalis.* The herbaceous layer includes C*himaphila maculata, Hylodesmum nudiflorum, Dichanthelium boscii, Dioscorea villosa, Houstonia purpurea, Lysimachia quadrifolia, Polystichum acrostichoides, Uvularia perfoliata,* and *Viola spp.* in various abundances throughout the park. This community is abundant on ridges within the interior of the park. In some places this community varies from the normal assemblage as stated above. On the ridge south of Slagle Hollow Trail between Logging Road Trail and Cross Ridge Trail, the shrub layer was dominated by *Rhododendron arborescens.*

COMMUNITY 2. Ridge and Valley Cove Forest (Typical)

[*Liriodendron tulipifera – Magnolia acuminata – Fraxinus americana / Betula lenta – Acer rubrum / Maianthemum racemosum – Prosartes lanuginosa*] The canopy of this plant community is dominated by *Liriodendron tulipifera, Magnolia acuminata,* and *Fraxinus americana.* The subcanopy includes *Aesculus flava* and *Tilia americana var. heterophylla*. The shrub layer is composed of saplings of *Betula lenta, Acer rubrum,* and occasional *Tsuga canadensis.* The herbaceous layer contains *Anemone acutiloba, Maianthemum racemosum, Prosartes lanuginosa,* and *Adiantum pedatum.* The description by NatureServe lists 610 m (2000 ft) as a lower elevation for this community. Within Steele Creek Park this community is found in the tributary creek coves that occur between 579 m (1900 ft) and 640 m (2100 ft) elevations.

COMMUNITY 3. Ridge and Valley Cove Forest (Rich Type)

[*Quercus rubra - Fraxinus americana – Liriodendron tulipifera / Rhododendron maximum – Lindera benzoin / Sanguinaria canadensis – Asarum canadense*] The canopy is dominated by *Quercus rubra, Fraxinus americana,* and *Liriodendron tulipifera* with the

common occurrence of *Tilia americana var. heterophylla.* The shrub layer is composed of varying densities of *Rhododendron maximum.* Herbaceous plants found in this plant community include *Sanguinaria canadensis, Asarum canadense, and Viola canadensis.* This community is only found within the Trinkle Hollow portion of the park and lies deep within the interior of the park away from any trails.

COMMUNITY 4. Appalachian Montane Alluvial Forest

[*Liriodendron tulipifera – Platanus occidentalis – Fraxinus americana / Betula lenta – Carpinus caroliniana – Acer rubrum / Hamamelis virginiana / Packera aurea*] This plant assemblage is found near the western edge of the park and resembles an Appalachian Montane Alluvial Forest. This community is found in Slagle Hollow in the most downstream region of Slagle Creek still contained in the park boundary. These strata include a canopy dominated by *Liriodendron tulipifera, Platanus occidentalis,* and *Fraxinus americana,* a subcanopy of *Betula lenta, Carpinus caroliniana,* and *Acer rubrum,* a shrub layer containing *Hamamelis virgiana* and some *Euonymus americana,* and predominantly *Packera aurea* in the herbaceous layer.

COMMUNITY 5. Ridge and Valley White Pine – Mesic Oak Forest

[*Pinus strobus – Quercus alba / Nyssa sylvatica / Sassafras albidum – Amelanchier arborea / Polystichum acrostichoides*] The canopy of this plant community is dominated by *Pinus strobus* and *Quercus alba* with *Liriodendron tulipifera, Carya spp., and Quercus rubra* present as well. The subcanopy and saplings include *Oxydendrum arboreum, Cornus florida,* and *Nyssa sylvatica.* The shrub layer is composed of saplings of *Sassafras albidum* and *Amelanchier arborea.* The herbaceous layer contains *Polystichum acrostichoides, Goodyera pubescens, Monotropa uniflora, Hylodesmum nudiflorum, Galium circaezans,* and *Houstonia purpurea.* Within Steele Creek Park this community is found sporadically on ridge tops and slopes.

COMMUNITY 6. Ridge and Valley Small Hemlock Forest

[*Tsuga canadensis – Pinus strobus / Betula lenta / Thaspium barbinode / Goodyera pubescens*]This plant community occurs on the slopes bordering the western shore of Steele Creek Park Lake and the cove referred to as Hemlock Hollow by the Steele Creek Park Nature Center Map (see Figure 10). Classification of this intermediate plant community was difficult because it lacks a definitive shrub layer. The initial determination using NatureServe (2008) was a Southern Appalachian Eastern Hemlock Forest (White Pine Type), but the absence of *Rhododendron maximum* from these sites is inconsistent with this community description. The canopy of this plant community is very dense and little light reaches the forest floor. Few plants occur in the understory, but *Thaspium barbinode* and *Goodyera pubescens* were found relatively frequently.

CHAPTER 5

DISCUSSION

The Vascular Plant Diversity of Steele Creek Park

The purpose of conducting a vascular plant inventory is to document the diversity within the study area. Diversity can be understood as the actual species richness of the study area and realistically varies from the reported diversity. The reported diversity is the list of species determined to be represented by the collections and rare species observations. The documented diversity is a set of voucher specimens that may be annotated by future botanist as new taxonomic groupings emerge.

This type of research can have errors in the difference between the actual species richness or diversity within the study area and the reported diversity. These errors may result from species occurring within the study area remaining uncollected/unobserved or from misidentification of species collected. Attempts have been made to be thorough in every stage of the research, including thoroughly exploring the study area, collecting quality specimens, and making correct determinations to approach an accurate inventory.

The reported diversity can also vary from the documented diversity due to taxonomic differences such as different species concepts or generic circumscriptions recognized by different technical floras (manuals). Taxonomic synonymy was not evaluated in comparisons between Steele Creek Park diversity and the set of floristic surveys, and only the reported numbers of families, genera, and species were used. Taxonomic categorization and compartmentalization of species into an accurate phylogenetic system produces new treatments of taxonomic groups as new botanical information is learned. The precise numbers of reportable diversity in regards to varying species concepts fluctuates over time as different manuals and taxonomic definitions change. A delineated species may retain recognition by different eras of botanists and associated identification manuals but change in binomial nomenclature with advancements in cladistics. This makes comparisons of species, even if the species concepts remain constant, difficult if synonymy is drastically varied.

Diversity Documented in the Current Study

The central components of this research project were to document the vascular plant diversity occurring within Steele Creek Park, produce an inventory, and compare this reported diversity with other studies conducted in the surrounding physiographic provinces. The land within SCP is covered in a forest ecosystem recovering from intensive logging. Commercial use of the park for timber has ended, and the land is now managed as a city park. The current human use is not as disruptive as logging, but is still a disturbance that may influence vascular plant diversity. It might not be expected that the second-growth forest in this city park would yield substantial diversity; however, the current inventory of Steele Creek Park produced a total of 547 documented species within an 892 ha study site.

Noteworthy Collections

The seven species collected in Steele Creek Park that are listed as rare, threatened, endangered, or of special concern (Table 6, above) are given below with brief comments on their occurrences in the park.

Panax quinquefolius (American ginseng) locations were reported to the park and state. *Panax quinquefolius* is classified as a Tennessee Special Concern Species and a Commercially Exploited Species.

Cardamine rotundifolia (American bitter cress) was found in a remote section of Trinkle Hollow. The area could be considered mucky and was covered in a thick layer of dark muddy soil with very high water content. Sarah Knapp initially noticed the white flowers and was able it identify it to the family Brassicaceae. The namesake leaves stood out to me at the time as being different from other members of Brassicaceae previously collected. *Cardamine rotundifolia* is classified as a Tennessee Special Concern Species.

Lonicera dioica was documented with photos during the current study and previously collected in flower by Louise Howard in 1972. Her specimen has been confirmed as *Lonicera dioica* by John C. Warden in 1977. *Lonicera dioica* is a Tennessee Special Concern Species in the family Caprifoliaceae. *Lonicera dioica* blooms from May to early June. It was not found during the 2013 collecting season due to the absence from collecting in May because of my leg

injury. In 2014 several individuals were found with the aid of directions from Steele Creek Park Nature Center staff, Don Holt, who reported seeing this plant along the Lake Ridge Trail. I explored this area and found a shrub that resembled the leaf morphology of *Lonicera dioica*, but it was not blooming. I could not properly document this species with a fertile voucher specimen, so multiple pictures were taken and the location recorded for future monitoring of this species.

Castanea dentata (American chestnut) is included as a Tennessee Special Concern Species although it is common in forested areas of the region as persistent root saplings. The largest individual found within the park measured nearly 10 cm diameter at breast height (dbh) and was infected by *Cryphonectria parasitica* (Chestnut blight).

Juglans cinerea (butternut or white walnut) fruits had been found in the lake and along several of the trails and is a Tennessee Threatened Species. *Juglans cinerea* fruits are distinguished from *Juglans nigra* by a more elongate nut shape. The Nature Center had several of these fruits on display and was attempting to locate an individual in the park. A juvenile individual was encountered on Lake Ridge Trail on a dry ridge with partially sandy soil. Determination without fruit was made on the basis of the dark chambered pith within the branches. Other individuals, including the elusive mature specimen, are suspected to be in this area.

Allium tricoccum (wild ramp) was collected along a stream bank in a small cove on the Trinkle Hollow side of the park. A Nature Center employee knew the location of the population and gave directions to find it (Don Holt pers. comm. 2014). The plants were restricted to an area of three to five square meters but were densely abundant within this space. The first encounter was too early in the flowering season, and subsequent trips were made until they bloomed. They were observed reproducing so they were collected and reported. The origin of the population is unknown, but it is likely that a homestead existed in this area of the park at one time and that the population could be a remnant of planted and cultivated individuals. They were not found anywhere else within the park. *Allium tricoccum* is classified as a Tennessee Special Concern Species and a Commercially Exploited Species.

Cypripedium acaule (pink lady slipper) was observed in two locations within the park and was photographed but not collected. Populations are known to exist along the newly expanded section of the East Ridge Trail as well as on a remote ridge above Slagle Hollow. Light

inspection suggests that both populations had around 10 individuals. The population along the East Ridge Trail should now be monitored. Increased human traffic within the proximity could lead to the interference with or destruction of this population. *Cypripedium acaule* is classified as a Tennessee Special Concern Species and a Commercially Exploited Species.

Diversity/Area Comparisons of Steele Creek Park with Similar Floristic Surveys

A species area curve was used to compare the species diversity documented at Steele Creek Park with species diversity reported in 20 studies from somewhat similar sites. These studies are listed in Table 11 below. Thirteen of these studies were conducted in the Ridge and Valley Province, five from the Cumberland Plateau Province, and two from the Blue Ridge Province. The dates of these studies span 60 years, during which multiple taxonomic systems were employed. Synonymy was not examined in the compilation of these species counts, and there has certainly been considerable change in the taxonomy for various groups during the interval covered by these studies.

Table 11. Floristic Surveys Included in the Diversity/Area Comparisons

	Author	Location	Date	Size (ha)	Families	Genera	Species
1	Houck, D.F.	Red Clay State Historical Area	1990	105	97	297	494
2	Howe, R.T.	Turkeypen Cove	1978	125	64	141	192
3	Bentley, B.N.	Laurel Run Gorge	1984	182	89	199	269
4	Pearman, J.R.	Sinking Creek Area	1956	202	86	237	347
5	Grindstaff, A. B.	Forge Hill	1956	283	98	271	378
6	Hamilton, A.R.	Buffalo Mountain	1991	293	54	123	158
7	Roller, J.E.	Bays Mountain	1954	485	92	226	336
8	Begley, B.C.	Warriers Path State Park	1987	607	107	345	575
9	Hut, A.C.	Panther Creek State Park	1972	769	97	255	341
10	Klahs, P.C.	Steele Creek Park	2014	892	101	323	547
11	Wyrick, D. and B.E. Wofford	Gee Creek Wilderness	1993	1009	93	230	365
12	Murrell, Z.E. and B.E. Wofford	Big Frog Mountain	1987	2843	93	266	476
13	Huskins, S.D. and J. Shaw	Chickamauga Creek Gorge	2010	2862	110	329	604
14	Blyveis, E.R. and J. Shaw	Tennessee River Gorge	2012	4970	123	392	700
15	Bullington, B.C.	Upper Clinch River	1997	5000	108	338	526
16	Malter, J.L.	Citico Creek Wilderness Study Area	1977	6716	91	288	536
17	Fleming, C.A. and B.E. Wofford	Fall Creek Falls State Park	2004	8900	131	445	879
18	Beck, J.T. and G.S. Van Horn	Prentice Cooper State Forest	2007	10300	137	536	1070
19	Evans, J.R.	Sequatchie Valley	2011	14,763	116	379	767
20	DeSelm	Oak Ridge	1985	15000	114	458	842
21	Thomas, R.D.	Chilhowee Mountain	1976	25900	116	433	953

To allow for a more robust comparison of the amount of documented plant diversity across these disparate studies, not only is the number of reported species considered, but separate comparisons are made for reported numbers of genera and families of vascular plants. The reported species, generic, and family diversity from Table 11 are presented as a graph in Figure 15a. A comparison of $\log_{10}$ -transformed study site area and $\log_{10}$ –transformed taxa richness was conducted (Qian 2007). Visualizations of this comparison for families [Figure 15b], genera [Figure 15c], and species [Figure 15d] are given below. The species area curve was also given in Figure 15e with province of study site indicated by color. In all cases the reported diversity of Steele Creek Park was at or above the regression line for the diversity generated by local floras. This indicates that the documented species diversity at Steele Creek Park is relatively high on a per-area basis when compared to similar floristic surveys, particularly with regard to species and genus level diversity.

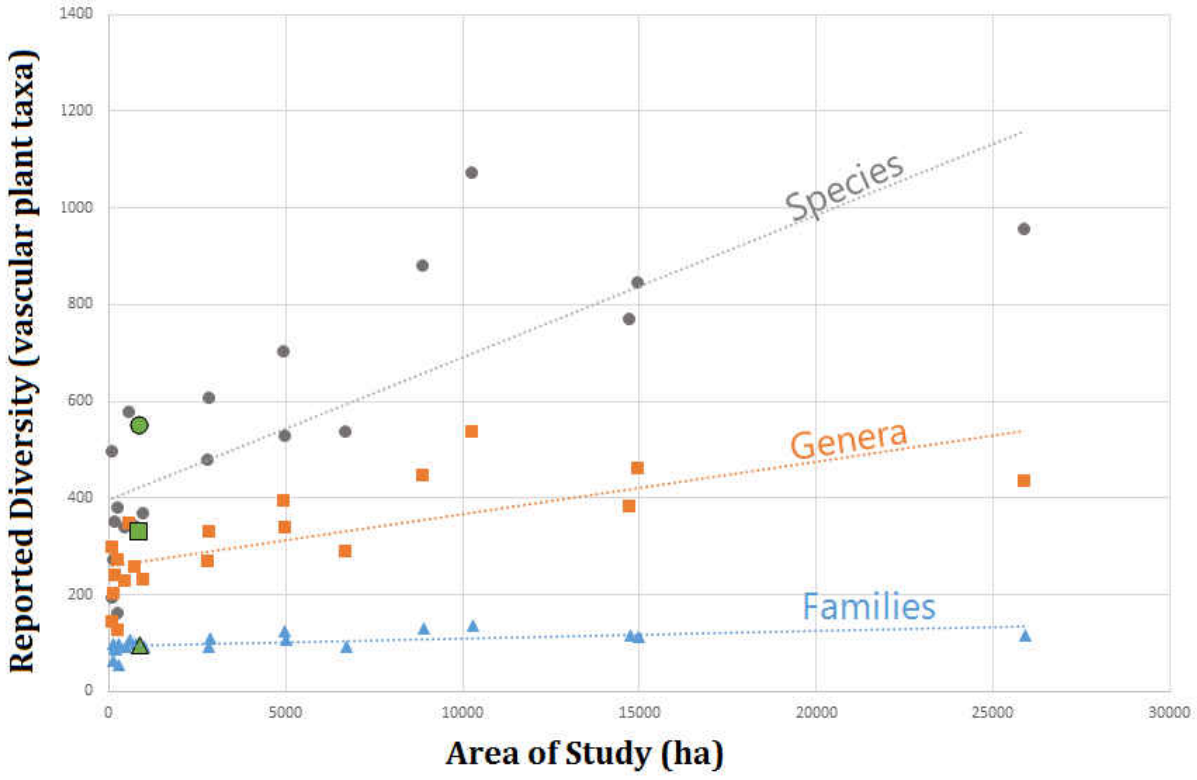


Figure 15a. Untransformed Reported Taxa-Richness/Area Curve of Steele Creek Park (Green) and the Set of Floras Used for Comparison

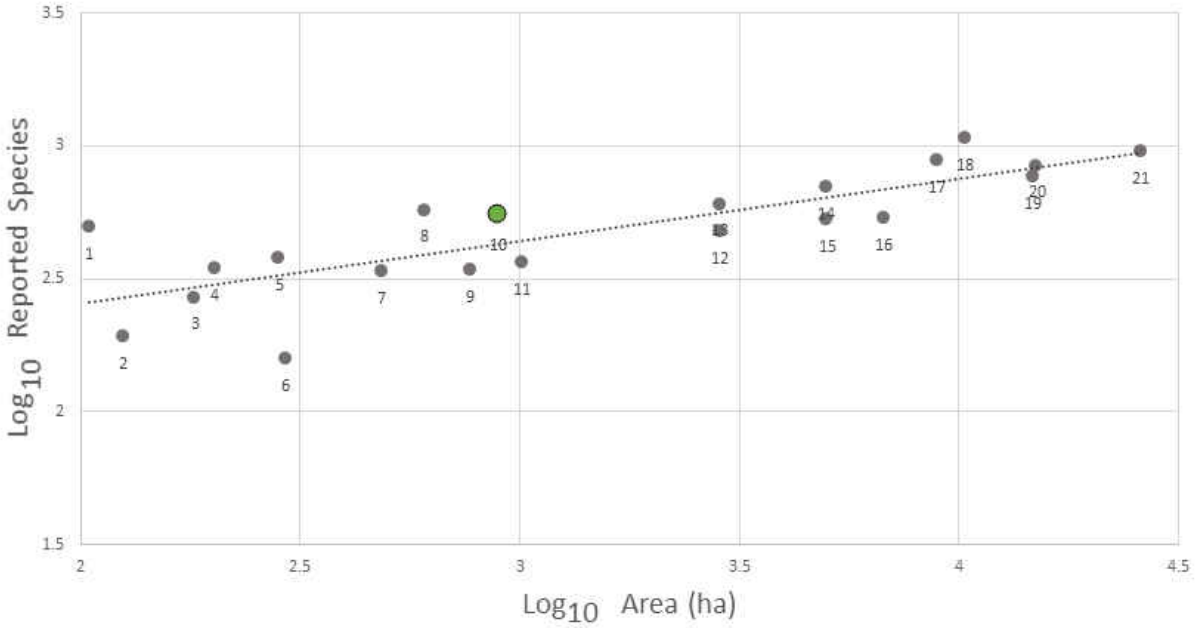


Figure 15b. Log_{10} Transformed Reported Species Richness by Log_{10} Transformed Size of Study Area

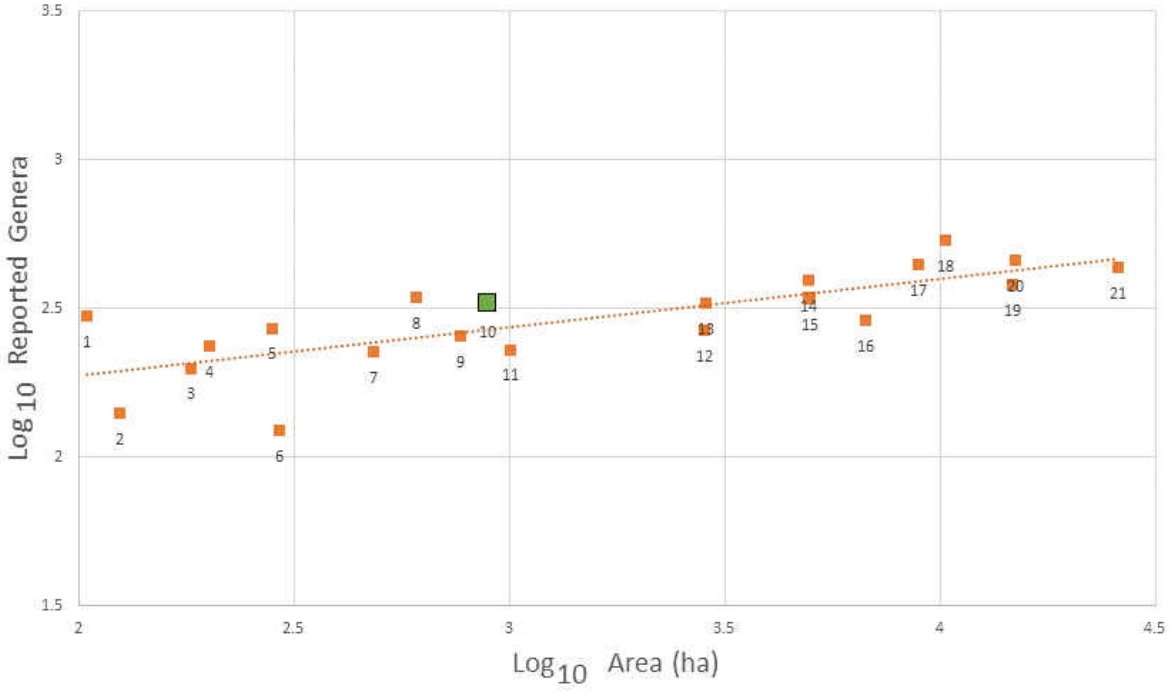


Figure 15c. Log_{10} Transformed Reported Genera Richness by Log_{10} Transformed Size of Study Area

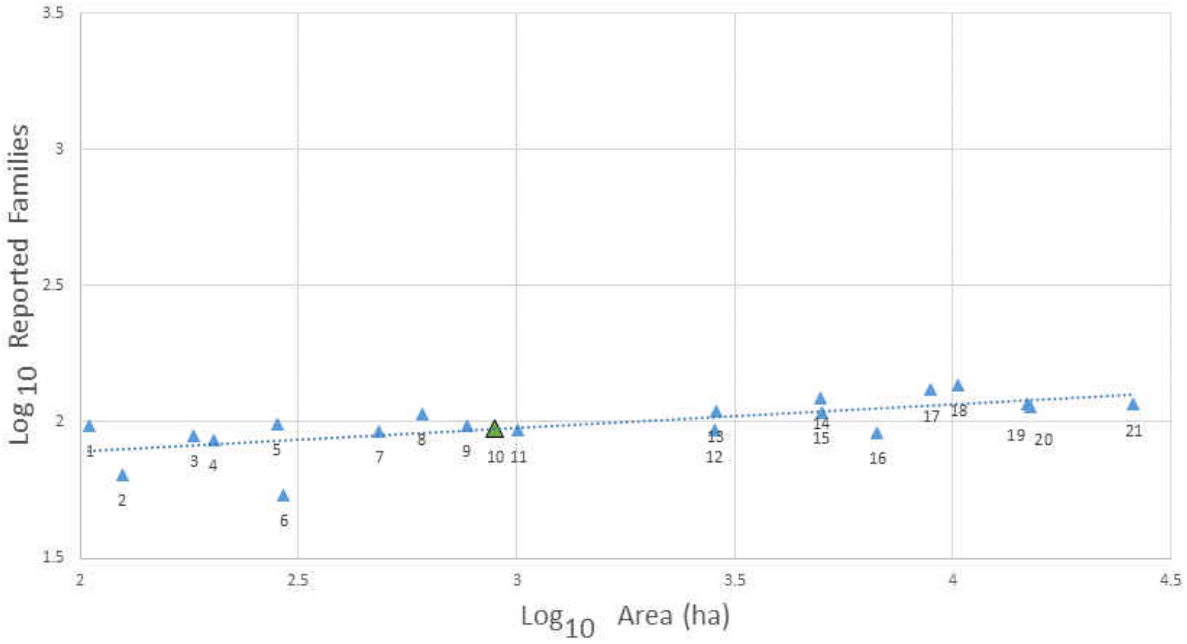


Figure 15d. Log_{10} Transformed Reported Family Richness by Log_{10} Transformed Size of Study Area

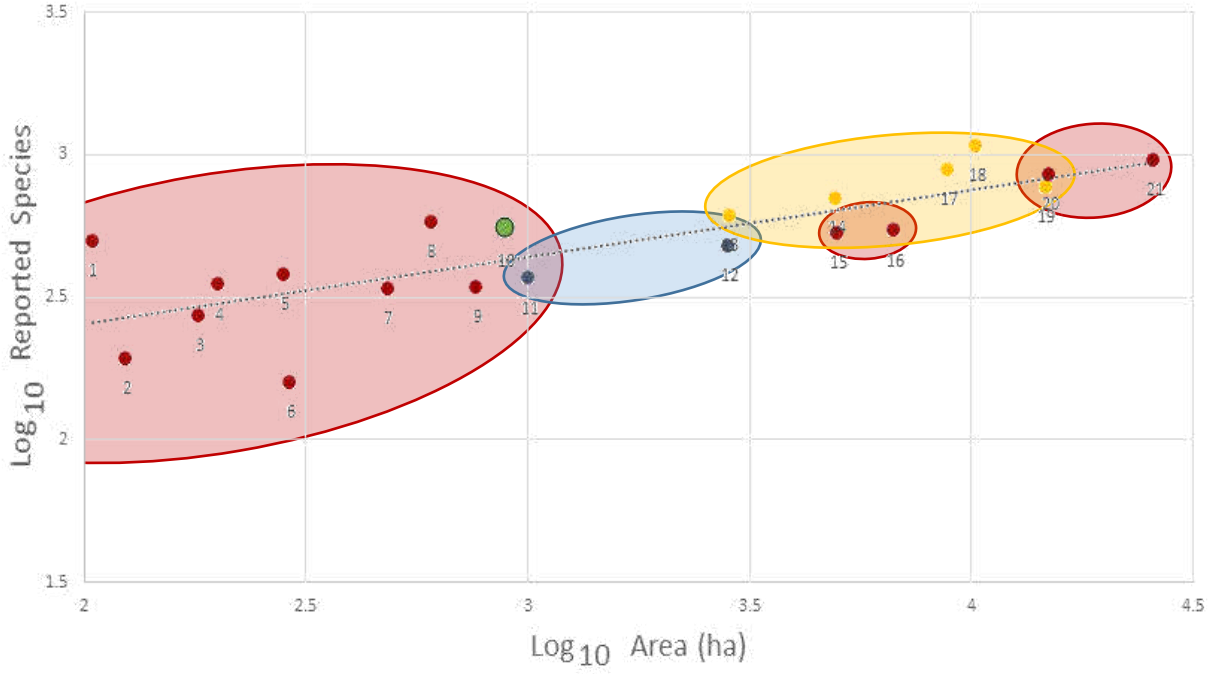


Figure 15e. Log_{10} Transformed Reported Species Richness by log_{10} Transformed Size of Study Area with Floras from the Ridge and Valley (Red), Blue Ridge (Blue), and Cumberland Plateau (Yellow) Colored and Grouped

Comparison to Louise Howard's Study and Local Floras

Howard's 1972 species list represents collections from only the area immediately surrounding Slagle Hollow. The description of locations on her specimens only states that the plant was collected in "Slagle Hollow Area, Sullivan County, TN". The lack of precise locality data made it difficult to repeat her collections and to accomplish the goal of finding as many of the species reported in her list as possible. Her list contained several species that have attracted the attention of local and regional botanist. The most notable of these is a grape specimen that was determined to be *Vitis rupestris*, a Tennessee Endangered Species.

A voucher specimen that Louise Howard determined to be *Vitis rupestris* does exist in the ETSU herbarium. The specimen is without flowers or fruit and consists of a single large leaf glued to the sheet of paper with the adaxial side up and some branch attached. Several botanists have questioned the validity of the identification because *Vitis* determination relies heavily on features of the abaxial leaf hairs and the way these hairs mature. Dwayne Estes was certain the specimen was not *Vitis rupestris* when he visited the ETSU Herbarium (Dwayne Estes *pers com.* with Jamey Donaldson). *Vitis* plants were inspected in the field with extra effort and collected frequently, but *Vitis rupestris* was not found during the current study. A total of nine collections were made in the genus, which included three different *Vitis* species.

Louise Howard's collection contained four different specimens for the genus *Fraxinus.* She determined these as *Fraxinus americana* L.*, F. americana* var. *biltmoreana* (Bead.) J. Wright, *F. americana* var. *pennsylvanica* Marsh, and *F. pennsylvanica* var. subintegerrima (Vahl.) Fern. None of the voucher specimens include fertile material. The samara fruit is a key diagnostic characteristic of species within this genus, and without fruits the determination of infraspecific taxa is questionable.

Louise Howard reported 334 species when she conducted a floristic inventory of the Slagle Hollow Area in 1972. Her species determinations in some cases were likely flawed. Voucher specimens are important to ensure that mistakes in identification can be corrected by experts on later examination. The example of Louise Howard's putative *Vitis rupestris* shows that collecting specimens is not enough to provide robust determinations and reliable species counts. It highlights the necessity of creating voucher specimens of high quality by containing pertinent diagnostic characteristics. While the current study could not resolve the determination

and recollection of all of Louise Howard's listed species, it did confirm the continued presence of 73% of the species reported by Howard in 1972.

A comparison to the nearest park showed that Warriors Path State Park had an additional 260 species not represented at Steele Creek Park. This is a considerable amount of variation in diversity over such a short distance. A major factor increasing the diversity of Warriors Path is the South Fork of the Holston River that runs through the park. It is dammed to create the Fort Patrick Henry Lake and creates a greater amount of riparian habitat than exists in Steele Creek Park.

Influences on Reported Diversity

Reported diversity can be influenced by many factors. Several aspects of a study site, including size and location, contribute to potential diversity. Disturbances may allow for an increase in invasive or exotic species while decreasing native species. Collecting voucher specimens provides the researcher a sample of the diversity within the site. The accuracy of this sample depends on the frequency, thoroughness, and extent of collecting. The rigor and precision of species determinations may alter the reported diversity.

Steele Creek Park was close to the median in terms of size for the set of studies chosen but fell below the 4867 ha average for that group of 20 floristic studies. The relatively smaller size of this study site may correspond to a reduced number of distinct habitat types. Steele Creek Park had a limited number of distinct habitats occurring in a rather limited elevational range of 700 feet. The principal habitats within SCP were cove hardwood forest, mixed Oak-Hickory forest on dry ridge tops, and maintained (mowed) recreation space around the lake. The number of unique plant assemblages within a study site greatly influences the likely diversity. In the case of SCP the majority of reported diversity is characteristic of either the cove forest or ridge top forest habitats. These two habitats covered the majority of the 809 ha wilderness area in the park.

In some study sites large changes in elevation may increase the number of plant communities and overcome habitat uniformity due to a small area. The elevational range in SCP only covers a little over 200 meters, which is a relatively narrow range in elevation for a study site within the Southern Appalachians. The Ridge and Valley is a lowland province and

characterized by ridges or knobs of moderate elevation change (Fenneman 1938). The narrow elevational range of the SCP and the limited number of distinct habitats probably limits the total plant diversity within SCP. Habitats within SCP are mainly dry ridge forest and moist cove forest. Few instances of exposed rocks were found in the interior of the park that could be considered a micro-habitat for vascular plants. These areas were checked thoroughly when encountered and did yield the collection of *Cheilanthes lanosa* (Michaux) D.C. Eaton and *Pellaea atropurpurea* (Linnaeus) Link.

The park is located near the border of Tennessee. The border between Sullivan County, TN and the state of Virginia is less than 1.2 km away from SCP at the closest point. The park is near the northern limit for sites in Tennessee. I was interested to see if floras produced in the southern portion of Tennessee along the shared border with Georgia would yield greater diversity. The flora of Red Clay State Historical Area (Houck 1990) provides an example of a site from southern Tennessee that displayed a high level of plant diversity. Although this flora covered the smallest area of the studies included it exceeded the expected diversity by the largest amount. Red Clay State Historical Area is located in Polk County, TN and sits on the border between Tennessee and Georgia. The reported diversity of this site, which is now a state park, was the closest to an outlier within the data set.

Steele Creek Park is surrounded by an urban setting and is contained within the city limits. The management as a city park permits a considerable amount of human use. The chances for human interaction significantly affecting diversity are not restricted to major disturbances. Commercially exploited species and long-lived, late maturing plants such as orchids or *Trillium* can be damaged by casual collecting.

The disturbance records for Steele Creek Park indicate that it was extensively logged within the last 60 years. Large portions of the park were cut for timber in the 1940s. This is consistent with the current forest age within the park. In some remote areas of the park, *Panax quinquefolius* was found in several populations, which suggests that some sections of forest, most likely the more difficult terrain, were avoided during logging. Two fires of unknown scale occurred in the park and were possibly associated with the effects of logging. More recently a tornado also disturbed areas of the park. A powerline crosses the ridges above Trinkle Hollow and is maintained by cutting on a five-year interval. It was most recently cut in 2012 (Jeremy

Stout pers. comm. 2014). Some plants were collected within this artificial corridor of high sunlight, and one favors rapid plant dispersal.

Collecting at times can become tedious, but frequent collecting trips to the same location within the study site may produce new species each time. Sometimes plants are missed while searching. Collecting adequate material for identification requires the botanist to be present during the window of that individual plant's fertility. The duration of fertility varies interspecifically and infra-specifically. I was injured while collected on May 2, 2013, and sustained a bite or sting that resulted in an allergic reaction that prevented me from collecting during the majority of that month. This can be seen in the species discovery curve in Figure 16. May is a critical time for botanical work because the spring ephemerals are blooming. Missed collecting trips can cause incompleteness in the floristic diversity surveyed.

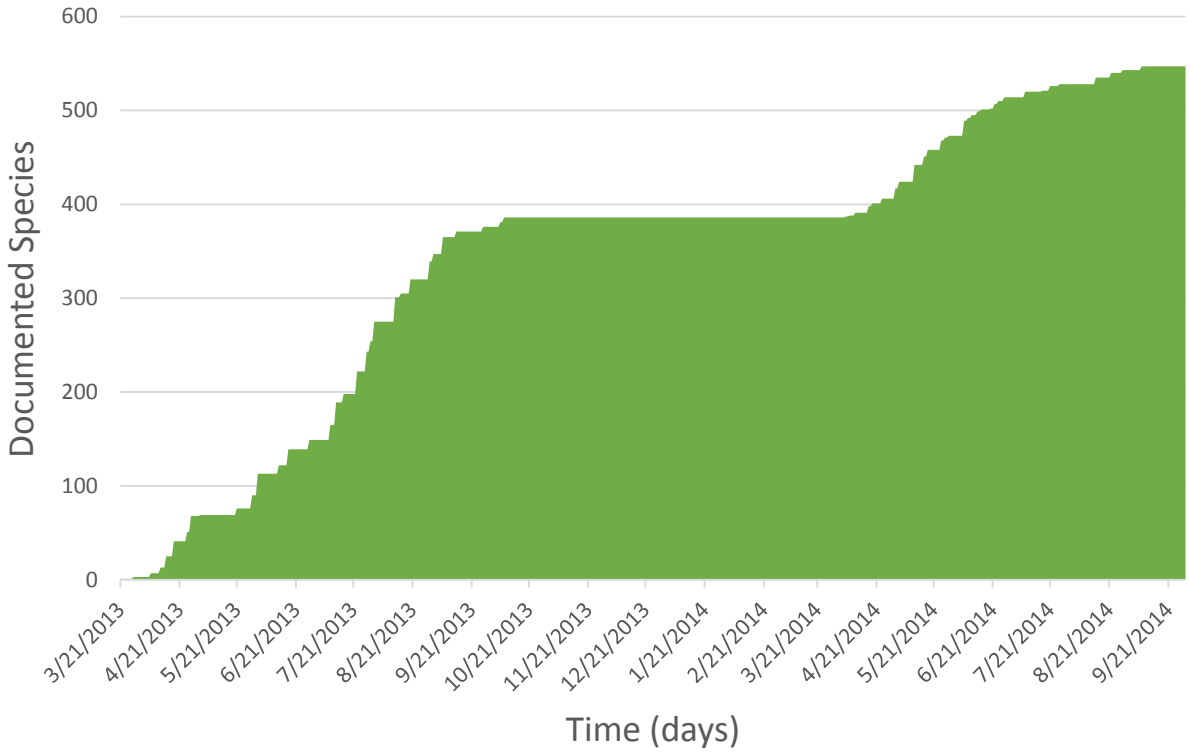


Figure 16. The Species Discovery Curve for the Current Study with All Dates (March 21, 2013 to September 30, 2014) Included so that the Rate of Time is Uniform

Collecting trips were reviewed, and the number of documented species at each date was used to create Figure 16. This shows the species discovery curve for the current study, which is a measurement of inventorying progress (Bebber 2007). It is important to note that for this study it should not be used as a prediction of available diversity. It is, however, an accurate representation of the learning curve involved with a thorough botanical inventory in combination with the rate of collections representing new species. This species discovery curve is not predictive because the current study was the first botanical inventory I conducted as a botanist. During the course of the current study I became more aware of vascular plant taxa that may exist in the park and developed an eye for distinguishing previously undocumented taxa. This added to the rate of collecting new species, while other influences conversely diminished the rate of new species. With collections being made each week the number of taxa that could be newly documented diminished over time. It became more difficult to find new taxa as the study progressed. The discovery rate of new species was also influenced by the season the collecting trips were made in, as this strongly determines the number and composition of vascular plants available for collection.

Covering time and space is critical in witnessing plants so that they may be collected. Active searching is only the means of locating a possible plant for collection. Observations in the field must be made to determine if a plant is different from previously documented plants in diagnostically significant ways. In some cases a study can under-collect taxa that may be difficult to determine to the level of species. Many amateur botanists avoid difficult groups such as Asteraceae, Cyperaceae, and Poaceae. It was my intent early in the current study to put considerable effort into these sometimes neglected families. Field collections of difficult genera, such as *Carex* and *Solidago*, yielded many species being repeated in the total collection. However, it was often beneficial to collect several specimens of plants appearing even slightly different so as to document possible diversity as well as ensure good material for mounting.

The accuracy and completeness of species determinations directly affects the quantity and quality of floristic inventory data. The species richness reported from a floristic study will depend in part upon the attention given to species determinations. This is particularly true for plant groups that are more challenging to identify, such as the grasses, sedges, and asters. The difficulty of making species determinations may bias collectors towards avoiding collections in

such difficult-to-identify families. Collections and determinations in this study have given deliberate attention to collecting and identifying species in these often under-collected families. This is reflected in the high numbers of species collections from SCP for the Asteraceae, Poaceae, and Cyperaceae.

Particular species-level determinations may be challenging regardless of the plant family involved. A *Boechera* specimen collected in the current study can be used as an example of how difficult some determinations can be. The presence of auriculated leaf bases and specific pedicel lengths produced a determination of *Arabis perstellata* while using Gleason and Cronquist (1991). This would have been an interesting find, and so Weakley (draft 2008) was consulted as a secondary opinion. The dichotomous keys in these manuals used different characteristics and resulted in different species determinations. It was not until inspecting the Flora of North America (FNA 2010) that it was discovered that *Arabis canadensis* on rare occasions can have auriculated leaf bases. This was accepted as the final species determination due to fruit morpho-metrics but changed in synonymy when the collection was converted to Flora of Virginia (Weakley 2012). Variable plant specimens make the precision of species determinations difficult at times and influence the accuracy of the floristic inventory.

Taxonomic groupings have changed drastically over the time in which the set of reference floras for the current study were conducted. Taxonomic treatments often fall into the categories of lumping or splitting. Some identification manuals recognize more diversity by splitting additional taxa out of a group that would be lumped together by other treatments. Table 12 gives a list of manuals used by the set of Floras.

Final species determinations, formal species names and species concepts used in this study are those of The Flora of Virginia (Weakley et al 2012). The Manual of the Vascular Flora of the Carolinas (Radford et al. 1968) was the most commonly used manual within the set of floras compared to the current study. This identification manual was used briefly during the beginning of my study to learn the regional flora, but it was not used for determinations of specimens collected.

Table 12. Manuals Used for Determinations in the Set of Floristic Surveys Compared to the Current Study

		1954	1956	1956	1972	1976	1977	1978	1984	1985	1987	1987	1990	1991	1997	2004	2007	2010	2011	2012	2014	TOTAL
		Roller, J.E.	Pearman, J.R.	Grindstaff, A.B.	Hut, A.C.	Thomas, R. D.	Malter, J.L.	Howe, R.T.	Bentley, B.N.	Mann, L.K. *et al.*	Begley, B.C.	Murrell, Z.E., B.E. Wofford	Houck, D.F.	Hamilton, A.R.	Bullington, B.C.	Fleming, C.A., B.E. Wofford	Beck, J.T., G.S. Van Horn	Huskins, S.D., J. Shaw	Evans, J.R.	Blyvels, E., J. Shaw	Klahs, P.C.	
1930	Muenscher							1														1
1933	Small							1		1								1	1			4
1949	Bailey																1					1
1949	Sargent							1														1
1950	Fernald	1	1	1		1	1	1		1		1	1				1					10
1950	Hitchcock									1			1									2
1952	Gleason				1		1	1	1	1		1			1							7
1952	Shanks	1																				1
1954	Shaver							1														1
1956	Cobb							1														1
1963	Gleason and Cronquist							1					1					1	1			4
1968	Radford				1	1	1	1	1	1	1	1	1	1		1	1	1	1	1		15
1970	Mahler																1					1
1971	Hitchcock																1					1
1977	Smith																		1			1
1978	Strausbaugh and Core															1						1
1979	Godfrey and Wooten												1				1					2
1980	Cronquist									1		1	1				1	1	1	1		7
1981	Godfrey and Wooten																1					1
1989	Wofford														1	1		1	1	1		5
1990	Isely																1					1
1991	Gleason and Cronquist														1	1	1			1	1	5
1993	Flora of North America																1		1		1	3
1993	Wofford and Kral														1							1
1994	Swanson																		1			1
1997	Flora of North America																1					1
2002	Flora of North America																1	1		1	1	4
2002	Wofford and Chester															1		1	1	1		4
2003	Flora of North America																1	1		1		3
2004	Flora of North America																1					1
2005	Flora of North America																1					1
2005	Jones															1		1	1	1		4
2007	Flora of North America																				1	1
2008	Weakley																	1	1	1	1	4
	TOTAL	2	1	1	2	2	3	9	2	6	1	4	6	1	4	6	16	10	11	9	5	

Canopy Gap Vegetation Patterns

The investigation of vegetative patterns in canopy gaps was a secondary effort of the current study. Patterns in vegetation among canopy gaps was observed and documented using the Carolina Vegetation Survey methodology. Considerable time was spent exploring the park for canopy gaps that could provide locations for study sites. The 2014 collecting season leading up to the month of June was aimed at accomplishing the primary goal of collecting vascular plants, but all gaps created by fallen trees found during this time were considered as possible study sites for gap analysis. Trips made to the park during the month of June 2014 were almost completely dedicated to the installation of the 20 study plots. Additional time was later spent analyzing the data recorded.

Species Associated with Canopy Gaps

The most noticeable pattern of affinity for canopy gaps was the occurrence of *Phytolacca americana* (pokeweed) within the canopy gap study. Pokeweed was absent from closed canopy plots but found in half of the canopy gap locations studied and provided an example of a species habitat correlated with the canopy versus gap difference in microhabitat. Pokeweed is a fast-growing tall perennial herb. In addition to its rapid growth in sunny sites, this species' distribution is facilitated by bird dispersal of its abundant fleshy fruits, a favored bird food. Pokeweed is thus an unusually effective colonizer of small forest gap microhabitats. A photograph documenting the aggressive colonizing ability of *Phytolacca americana* is presented in Figure 17. This picture was taken in a canopy gap considered as a possible study site but not used in the current study.

Figure 17. *Phytollaca americana* Growing in Soil on the Trunk of a Fallen Tree

Other species included in the set of supposed highly shade intolerant plants were only recorded once or twice during the entire study. Groups of species were only found in canopy gap plots (Figure 14 and Appendix C). These species may be considered as having an affinity for sunlight if the only documented occurrences were within a canopy gap plot. Whether or not the installation of additional study plots would further demonstrate this pattern is uncertain. The small number of plots installed is a limitation of the current canopy gap study and prevents further conclusions.

Species Associated with Full Canopy

Fewer species were strongly associated with full canopy than with canopy gaps. The most noticeably shade tolerant plants documented by the current study were *Conopholis americana, Botrypus virginianus,* and *Parthenocissus quinquefolia.* The ratio of occurrences in gap study plots to occurrences in intact canopy plots for these species trended towards intact canopy. *Conopholis americana* was found twice in study plots, and both cases were under full canopy. *Conopholis americana* is an obligate root parasite on *Quercus,* contains no chlorophyll, and does not need sun.

Some plants were only found once during the study plot portion of the current study, with their single occurrence in a full canopy plot. Additional plots encountering these species could strengthen their observed affinity for shade or possibly show that their rare occurrence in plots was more influential than their habitat preferences.

Limitations of Study Plots

Other limitations of the canopy gap study are characteristic in general of research using study plots. An original purpose of the Carolina Vascular Survey Plot Protocol was to document diversity in wetland areas with less stratification of vascular plants throughout a canopy or shrub layer (Peet et al. 1998). The possible underreporting of woody vines may have significant effects on the reported diversity. Nevertheless, the data collected from these plots documents a wide range of species and hints at their spatial patterns.

A problem with most study plots is that they are installed once and not subsequently monitored. This limits the documentable vascular plant species to only the ones available for determination during the window of plot installment. The season of installment greatly influences the composition of species that are found fertile and identifiable. All the plots installed during the current study were begun and completed within four-hour intervals in the month of June 2014. This month was chosen deliberately to ensure that vascular plants recorded would be sampled at a time when the canopy was near its fullest extent of summer leaves.

The current study of herbaceous vegetation patterns within canopy gaps provides data for meta-comparisons of vascular plant assemblages at a regional level and is a step towards research with permanent study plots by recording an initial state for future studies.

Management Recommendations

Steele Creek Park largely represents two distinct communities; the dry ridge hardwood forest and the moist cove hardwood forest. Although these communities are not considered rare, they are abundant in the park and continue to disappear from other urban landscapes. Relatively high diversity was documented as occurring within these habitats of the park, including several rare species characteristic of these forest types. The land within the park has not been intensively

manipulated since the logging that occurred over half a century ago. An exception to this is the management of trails and the power line corridor, but large tracts of intact forest remain in the interior of the park.

In order to permit the natural forests of Steele Creek Park to develop into old growth and to further their recovery from intensive clear-cutting, human disturbance should be kept to a minimum. The remote areas of the park in some cases are used illegally by individuals in ways that could damage vascular plant populations. This includes the use of All Terrain Vehicles (ATVs) within Slagle Hollow from access points through adjacent private property. The park has an official restriction on motorized vehicles in the wilderness area, but this still occurs in the secluded regions too distant to actively monitor. The forest should be allowed to reach maturity at a natural pace. Rare species, especially those in close proximity to hiking trails, should be monitored as resources permit and the locations of commercially exploited species not publicized.

Conclusion

Steele Creek Park is a location of substantial vascular plant diversity. The steeply undulating terrain characteristic of the Ridge and Valley Province has limited human disturbance in the remote interior of the Beaver Creek Knobs. The persistence of *Panax quinquefolius* in the form of several scattered populations is evidence of this. The park is an important natural resource for the city of Bristol, TN. It is comparable in species richness to many parks in the surrounding region that have been floristically surveyed and is favorably comparable to the regression line of species richness per area.

The documentation of 547 species representing 323 genera and 101 families within Steele Creek Park provides an updated species checklist for the park. The reporting of 216 new county records for Sullivan County is a substantial contribution to the maintained record of species distributions within the State of Tennessee. The herbarium specimens produced by the current collection may be used for future botanical studies at the ETSU Herbarium and educational programs at the SCP Herbarium.

REFERENCES

Bailey, LH. 1949. Manual of cultivated plants. MacMillan Company, New York, New York.

Barden, LS. 1979. Tree Replacement in Small Canopy Gaps of a Tsuga canadensis Forest in the Southern Appalachians, Tennessee. Oecologia 44(1): 141-142.

Barden, LS. 1983. Size, Age, and Growth Rate of Trees in Canopy Gaps of a Cove Hardwood Forest in the Southern Appalachians. Castanea 48(1): 19-23.

Bates, V. 1985. The Vascular Plants of Tennessee: A Taxonomic and Geographic Guide to the Floristic Literature. Journal of the Tennessee Academy of Science 60(3): 66-67.

Bebber, DP, FHC Marriott, KJ Gaston, SA Harris, RW Scotland. 2007. Predicting unknown species numbers using discovery curves. Proceedings of the Royal Society: Biological Sciences, Vol. 274, No. 1618 (Jul. 7, 2007), pp. 1651-1658.

Beck, JT and GS Van Horn. 2007. A Vascular Flora of Prentice Cooper State Forest and Wildlife Management Area, Tennessee. Castanea 72(1):15-44.

Begley, BC. 1987. Vascular Flora of Warriors Path State Park, Sullivan County, Tennessee. M.S. Thesis - East Tennessee State University, Johnson City, Tennessee.

Bentley, BN. 1984. The Vegetation types and vascular flora of the Laurel Run Hawkins County, Tennessee. M.S. Thesis - East Tennessee State University, Johnson City, Tennessee.

Blyveis, E and J Shaw. 2012. The Vascular Flora and Phytogeographical Analysis of the Tennessee River Gorge, Hamilton and Marion Counties, Tennessee. Southeastern Naturalist 11(4):599-636.

Braun, EL. 1950. Deciduous forests of eastern North America. Macmillan Publishing Company, New York, New York.

Brown, DM. 1941. Vegetation of Roan Mountain: A phytosociological and successional study. Ecological Monographs 11:61-97.

Buchanan, B. 1981. The History of Stacy J. Grayson Park at Steele Creek. http://www.friendsofsteelecreek.org/wp-content/uploads/2010/04/buchanan-steele-creek-history.pdf [accessed 01 October 2014].

Cobb, B. 1956. A field guide to the ferns. Houghton Mifflin Co., Boston. 281 pp.

Cronquist, AJ. 1980. Vascular flora of the southeastern United States. Volume 1. Asteraceae. The University of North Carolina Press, Chapel Hill, North Carolina.

Davis, RV. 1979. Vascular flora of Natural Tunnel State Park, Scott County, Virginia. M.S. Thesis - East Tennessee State University, Johnson City, Tennessee.

Denslow, MW, MW Palmer, ZE Murrell. 2010. A Bibliography of North Carolina Local Floras. Castanea 75(4):475-483.

Domangue, BE, CK McMullen. 2013. Floristic Survey of the Vascular Plants of Shenandoah County, Virginia. Castanea 78(4): 312-322.

Fenneman, NM. 1938. Physiography of Eastern United States. McGraw-Hill Book Company, Inc., New York and London.

Fernald, ML. 1950. Gray's manual of botany. 8th ed. American Book Company, New York, New York.

Fleming, CA, BE Wofford. 2004. The Vascular Flora of Fall Creek Falls State Park, Van Buren and Bledsoe Counties, Tennessee. Castanea 69(3):164-184.

Flickr, Klahs.Botany Account. Created 2014. https://www.flickr.com/photos/126123152@N06/.

Flora of North America Editorial Committee. 1993. Pteridophytes and Gymnosperms. Oxford University Press Volume 2. Oxford University Press, Inc., New York, New York.

Flora of North America Editorial Committee. 1997. Flora of North America, north of Mexico. Volume 3. Magnoliophyta: Magnoliidae and Hamamelidae. Oxford University Press, Inc., New York, New York.

Flora of North America Editorial Committee. 2002. Magnoliaphyta: Commelinidae (in part): Cyperaceae. Oxford University Press Volume 23. Oxford University Press, Inc., New York, New York.

Flora of North America Editorial Committee. 2003a. Flora of North America, north of Mexico. Volume 23. Magnoliophyta: Commelinidae (in part): Cyperaceae. Oxford University Press, Inc., New York, New York.

Flora of North America Editorial Committee. 2003b. Flora of North America, north of Mexico. Volume 26. Magnoliophyta: Liliidae: Liliales and Orchidales. Oxford University Press, Inc., New York, New York.

Flora of North America Editorial Committee. 2004. Flora of North America, north of Mexico. Volume 4. Magnoliophyta: Caryophyllidae, part 1. Oxford University Press, Inc., New York, New York.

Flora of North America Editorial Committee. 2005. Flora of North America, north of Mexico. Volume 5. Magnoliophyta: Caryophyllidae, part 2. Oxford University Press, Inc., New York, New York.

Flora of North America Editorial Committee. 2007. Magnoliaphyta: Commelinidae (in part): Poaceae, part 1. Oxford University Press Volume 24.

Flora of North America Editorial Committee. 2010. Magnoliaphyta: Salicaceae to Brassicaceae. Oxford University Press Volume 7.

Hilton F. 2014. Bays Mountain Park Naturalist. Personal communication.

Friends of Steele Creek Park Website. Accessed March 2013 from http://www.friendsofsteelecreek.org/.

Fridley, JD, RK Peet, TR Wentworth, PS White. 2005. Connecting Fine- and Broad-Scale Species-Area Relationships of Southeastern U.S. Flora. Ecology 86(5): 1172-1177.

Gleason, HA. 1952. The new Britton and Brown illustrated flora of the northeastern United States and adjacent Canada. The New York Botanical Gardens, New York. 3 volumes. 1724 pp.

Gleason, HA, A Cronquist. 1963. Manual of vascular plants of northeastern United States and adjacent Canada. Van Nostrand Reinhold Co., New York. 810 pp.

Gleason, HA, A Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. The New York Botanical Garden Press, Bronx, New York.

Godfrey, RK, JW Wooton. 1979. Aquatic and wetland plants of southeastern United States: monocotyledons. The University of Georgia Press, Athens, Georgia.

Godfrey, RK, JW Wooton. 1981. Aquatic and wetland plants of southeastern United States: dicotyledons. The University of Georgia Press, Athens, Georgia.

Hess, A. 1997. A Survey of the Flora and Plant Communities of Steele Creek Park.

Himes, JM, JS Rentch. 2013. Canopy Gap Dynamics in a Second-Growth Appalachian Hardwood Forest in West Virginia. Castanea 78(3): 171-184.

Hitchcock, AS. 1971. Manual of Grasses of the United States, 2nd ed., A. Chase (rev.). Volumes I and II. Dover Publications, Inc., New York, New York.

Howard, LH. 1972. A Survey of the Flowering Plants and Ferns at Slagle Creek Area. M.S. Thesis - East Tennessee State University.

Howe, RT. 1978. A Survey of the vascular flora of Turkeypen Cove, Green County, Tennessee. M.S. Thesis - East Tennessee State University.

Huskins, SD, J Shaw. 2010. The Vascular Flora of the North Chickamauga Creek Gorge State Natural Area, Tennessee. Castanea 75(1):101-125.

Hut, AC. 1972. The flora and Vegetation of Panther Creek State Park. M.S. Thesis - East Tennessee State University.

Isely, A. 1990. Vascular flora of the southeastern United States. Volume III. Part 2. Leguminosae (Fabaceae). The University of North Carolina Press, Chapel Hill, North Carolina.

Jackson, J. 1971. A Natural History and Limnological Study. 263 pp.

Jennings, MD, D Faber-Langendoen, OL Loucks, RK Peet, D Roberts. 2009. Standards for Associations and Alliances of the U.S. National Vegetation Classification. Ecological Monographs 70(2): 173-199.

Jones, LJ. 2005. Plant life of Kentucky. The University Press of Kentucky, Lexington, Kentucky.

Luther, ET. 1977. Our Restless Earth: The Geologic Regions of Tennessee. Univ. of Tennessee Press, Knoxville, TN.

Mahler, WF. 1970. Manual of the legumes of Tennessee. J. Tennessee Acad. Sci. 45:65-96.

Marty Silver. 2014. Warrior's Path State Park Naturalist. Personal Communication.

Muenscher, WC. 1930. Keys to woody plants, 6th ed. rev. Comstock Publishing Associates. 108 pp.

Murrell, ZE, BE Wofford. 1987. Floristics and Phytogeography of Big Frog Mountain, Polk County, Tennessee. Castanea 52(4):262-290.

NatureServe. 2008. NatureServe Plant Community Descriptions. NatureServe, Arlington, Virginia. Accessed May 2014 from http://www.natureserve.org.

Nandi, A, CM Liutkus, MJ Whitelaw. 2009. Geotechnical Characterization of Sevier and Rome Shale, East Tennessee. American Rock Mechanics Association.

National Oceanic and Atmospheric Administration (NOAA). Accessed 2014. Officials of the National Oceanic and Atmospheric Administration, United States Department of Commerce. Climatological data from 1954 - 2010. National Climatic Data Center (NCDC), Asheville, North Carolina.

National Resources Conservation Service. 2014. Statewide STATSGO generalized Soils Coverage.

Palmer, MW, GL Wade, and P Neal. 1995. Standards for the Writing of Floras. BioScience 45(5): 339-345.

Pearman, JR. 1956. A survey of the vascular plants of the Sinking Creek Area of Carter County, Tennessee. M.S. Thesis - East Tennessee State University, Johnson City, Tennessee.

Peet, RK, TR Wentworth, and P.S. White. 1998. A Flexible Multipurpose Method for Recording Vegetation Composition and Structure. Castanea 63(3):262-274.

Peet, RK, MT. Lee, MF Boyle, TR Wentworth, MP Schafale, AS Weakley. 2011. Vegetation-plot database of the Carolina Vegetation Survey. Long Database Report.

Poindexter, DB. 2006. Vascular Flora of Mount Jefferson State Natural Area and Environs, Ashe County, North Carolina. M.S. Thesis - Appalachian State University, Boone, North Carolina.

Poindexter, DB, ZE. Murrell. 2008. Vascular Flora of Mount Jefferson State Natural Area and Environs, Ashe County, North Carolina. Castanea 73(4): 283-327.

Prather, LA, O. Alvarez-Fuentes, MH Mayfield, CJ Ferguson. 2004. Implications of the Decline in Plant Collecting for Systematic and Floristic Research. Systematic Botany 29(1):216-220.

Qian, H, JD Fridley, and MW Palmer. 2007. The latitudinal gradient of species-area relationships for vascular plants of North America. . The American Naturalist 170.5(2007):690-701.

Radford, AE, HE Ahles, CR Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill, North Carolina.

Richards, JD, JL Hart. 2011. Canopy Gap Dynamics and development patterns in secondary Quercus stands on the Cumberland Plateau, Alabama, USA. Forest Ecology and Management 262(2011):2229-2239.

Rocha, LA, A Aleixo, G Allen, F Almeda, CC Baldwin, MVL Barclay, JM Bates, AM Bauer, F Benzoni, CM Berns, et al. 2014. Specimen collection: An essential tool. Letters to Science. 344(6186): 814-815.

Rowell, B. 1970. A Natural History Inventory, Steele Creek Park. 302 pp.

Rowell, B. 1972. A Natural History Inventory Slagle Hollow Environmental Demonstration Area. 171 pp.

Sargent, CS. 1949. Manual of the trees of North America, 2nd ed. Dover Publications, Inc., New York. 2 volumes. 910 pp.

Sauer, JD. 1952. A Geography of Pokeweed. Annals of the Missouri Botanical Garden. 39(2):113-125.

Shanks, RE, FH Norris. 1950. Microclimatic Variation in a Small Valley in Eastern Tennessee. Ecology 31(4): 532-539.

Shanks, RE. 1952. Checklist of the Woody Plants of Tennessee. University of Tennessee, Knoxville.

Shaver, JM. 1954. Ferns of the eastern central states with special reference to Tennessee. Dover Publications, Inc., New York. 502 pp.

Shure, DJ, DL Phillips, PE Bostick. 2006. Gap Size and Succession in Cutover Southern Appalachian Forests: An 18 Year Study of Vegetation Dynamics. Plant Ecology 185(2): 299-318

Skeen, JN. 1973. An Extension of the Concept of Importance Value in Analyzing Forest Communities. Ecology 54(3): 655-656

Small, JK. 1933. Manual of the southeastern flora. By the author, New York. 1554 pp.

Smith, JP. 1977. Vascular Plant Families. Mad River Press, Eureka, California.

Strausbaugh, PD, EL Core. 1978. Flora of West Virginia, 2nd ed. Seneca Books, Inc., Grantsville, West Virginia.

Swanson, RE. 1994. A field guide to the trees and shrubs of the southern Appalachians. Johns Hopkins University Press, Baltimore, Maryland.

Tennessee Department of Agriculture, Forestry Division. 2012. City of Bristol, TN Tree Canopy Report.

Tennessee Exotic Pest Plant Council (TN-EPPC). 2009. 2nd ed. Invasive plants of Tennessee. Accessed October 2014 from http://www.tneppc.org/invasive_plants.

Tennessee GIS Clearinghouse (TNGIS). 2014. Data Collections accessed April 2014 from http://www.tngis.org/data-collections.htm.

Tennessee Natural Heritage Program. 2014. Tennessee rare plant list. Tennessee Division of Natural Heritage, Tennessee Department of Environmental and Conservation, Nashville, Tennessee.

The City of Bristol, Tennessee. 2012. Steele Creek Park Trail Map. Department of Parks and Recreation.

The Trust for Public Land. 2010. 150 Largest City Parks. Accessed September 2014 from https://www.tpl.org/150-largest-parks-2010.

United States Forest Service. 2014. Personal communication with various internal departments.

University of Tennessee Herbarium (TENN). 2014. Database of Tennessee vascular plants (http://tenn.bio.utk.edu/vascular/vascular.html). The University of Tennessee, Knoxville, Tennessee.

United States Department of Agriculture, Soil Conservation Service. 1987. Soil Survey of Sullivan County Tennessee.

Wade, GL, RL Thompson. 1991. The Species-Area Curve and Regional Floras. Trans. Ky. Acad. Sci. 52(1-2):21-26.

Wagner, D. 1991. The "1-in-20 rule" for plant collectors. Plant Science Bulletin 37 (2):11.

Weakley, AS. (in preparation, draft 2008). Flora of the Carolinas, Virginia, and Georgia, and Surrounding areas. University of North Carolina, Chapel Hill, North Carolina.

Weakley, AS, JC Ludwig, JF Townsend. 2012. Flora of Virginia. Botanical Research Institute of Texas Press. Fort Worth, Texas.

Wofford, BE. 1989. Guide to the vascular flora of the Blue Ridge. University of Georgia Press, Athens, Georgia.

Wofford, BE, R Kral. 1993. Checklist of the vascular plants of Tennessee. Sida Bot. misc. no 10.

Wofford, BE, EW Chester. 2002. Trees, shrubs, and woody vines of Tennessee. University of Tennessee Press, Knoxville, Tennessee.

APPENDIX A

Species Checklist of Vascular Plants Documented in Steele Creek Park, Sullivan County, Tennessee

All nomenclature pertaining to families, genera, and species in this list follows Flora of Virginia (Weakley et al. 2012).

A common name is given in parentheses "( )" after the scientific binomial nomenclature.

The following symbols are used in brackets "[ ]" to indicate the listed notations:

$ = Sullivan County Record
* = Introduced or Exotic Species
@ = Planted individual was collected
% = Rare, Threatened, or Endangered Species
# = Previously reported by Louise Howard in 1972

SCPP standing for "Steele Creek Park Project" precedes the collection numbers of voucher specimens.

DIVISION LYCOPODOPHYTA

LYCOPODIACEAE

Dendrolycopodium obscurum (Linnaeus) A. Haines
(Common Tree Clubmoss) [$] SCPP 1030
Diphasiastrum digitatum (Dillenius ex A. Braun) Holub
(Common Running-cedar) [#] SCPP 399, 696
Huperzia lucidula (Michaux) Trevisan
(Shining Clubmoss) SCPP 171

DIVISION EQUISETOPHYTA

EQUISETACEAE

Equisetum arvense Linnaeus
(Field Horsetail) SCPP 900
Equisetum hyemale Linnaeus ssp. *affine* (Engelmann) Calder & R.L. Taylor
(Tall Scouring Rush) SCPP 1054

DIVISION PTERIDOPHYTA

ASPLENIACEAE

Asplenium platyneuron (Linnaeus) Britton, Sterns, & Poggenburg
(Ebony Spleenwort) [#] SCPP 183, 185, 188, 210, 319, 889, 969
Asplenium rhizophyllum Linnaeus
(Walking Fern) [#] SCPP 518

DENNSTAEDTIACEAE

Dennstaedtia punctilobula (Michaux) T. Moore
(Hay-scented Fern) SCPP 1072
Pteridium aquilinum (Linnaeus) Kuhn
(Bracken Fern) [#] SCPP 502, 506

DIPLAZIOPSIDACEAE

Homalosorus pycnocarpos (Sprengel) Pichi
(Glade Fern) [#] SCPP 534

DRYOPTERIDACEAE

Dryopteris intermedia (Muhlenberg ex Willdenow) A. Gray
(Evergreen Wood Fern) SCPP
Dryopteris marginalis (Linnaeus) A. Gray
(Marginal Wood Fern) [#] SCPP 999, 1034
Polystichum acrostichoides (Michaux) Schott
(Christmas Fern) [#] SCPP 164, 187, 207

ONOCLEACEAE

Onoclea sensibilis Linnaeus var. *sensibilis*
(Sensitive Fern) [#] SCPP 849, 923

OPHIOGLOSSACEAE

Botrypus virginianus (Linnaeus) Holub
(Rattlesnake Fern) [#] SCPP 95, 141
Sceptridium dissectum (Sprengel) Lyon
(Cut-leaf Grape Fern) [#] SCPP 511, 716

PTERIDACEAE

Adiantum pedatum Linnaeus
(Northern Maidenhair Fern) [#] SCPP 140
Cheilanthes lanosa (Michaux) D.C. Eaton
(Hairy Lip Fern) [#] SCPP 1037
Pellaea atropurpurea (Linnaeus) Link
(Purple Cliff-break) [#] SCPP 1036

THELYPTERIDACEAE

Phegopteris hexagonoptera (Michaux) Fee
(Broad Beech Fern) SCPP 335, 1050

WOODSIACEAE

Athyrium asplenioides (Michaux) A.A. Eaton
(Southern Lady Fern) SCPP 1028, 1058
Cystopteris protrusa (Weatherby) Blasdell
(Lowland Brittle Fern) [#] SCPP 865
Woodsia obtusa (Sprengel) Torrey ssp. *obtusa*
(Blunt-lobed Cliff Fern) SCPP 499

DIVISION PINOPHYTA

CUPRESSACEAE

Juniperus virginiana Linnaeus var. *virginiana*
(Eastern Redcedar) [#] SCPP 324
Taxodium distichum (Linnaeus) L.C. Richard
(Baldcypress) [@] SCPP 823

PINACEAE

Pinus echinata P. Miller
(Short-leaf Pine) [#] SCPP 150
Pinus pungens Lambert
(Table-mountain Pine) SCPP 650
Pinus strobus Linnaeus
(Eastern White Pine) [#] SCPP 78, 100
Pinus virginiana P. Miller
(Virginia Pine) [#] SCPP 151, 390, 897
Tsuga canadensis (Linnaeus) Carriere
(Eastern Hemlock) [$] SCPP 205, 600

DIVISION MAGNOLIOPHYTA
(LILIOPSIDA)

ALISMATACEAE

Sagittaria australis (J.G. Smith) Small
(Long-beaked Arrowhead) [$] SCPP 646, 702
Sagittaria latifolia Willdenow
(Broad-leaved Arrowhead) [$] SCPP 316

AMARYLLIDACEAE

Allium canadense Linnaeus var. *canadense*
(Meadow Onion) [#] SCPP 912
Allium tricoccum Aiton
(Wild Leek) [@ %] SCPP 942, 1044
Allium vineale Linnaeus
(Field Garlic) [*] SCPP 694
Narcissus pseudonarcissus Linnaeus
(Common Daffodil) [$ * @] SCPP 776

ARACEAE

Arisaema triphyllum (Linnaeus) Schott
(Small Jack-in-the-pulpit) [#] SCPP 294, 820
Spirodela polyrhiza (Linnaeus) Schleiden
(Greater Duckweed) [$] SCPP 700

COLCHICACEAE

Uvularia grandiflora J.E. Smith
(Large-flowered Bellwort) [#] SCPP 20
Uvularia perfoliata Linnaeus
(Perfoliate Bellwort) [#] SCPP 77

COMMELINACEAE

Commelina communis Linnaeus
(Erect Dayflower) SCPP 612, 652

CYPERACEAE

Carex appalachica J. Webber & P.W. Ball
(Appalachian Sedge) SCPP 1105
Carex atlantica Bailey
(Atlantic Sedge) [$] SCPP 815
Carex blanda Dewey
(Eastern Woodland Sedge) SCPP 166, 817
Carex cephalophora Muhlenberg ex Willdenow
(Oval-leaved Sedge) SCPP 127, 172, 874
Carex communis Bailey
(Fibrous-rooted Sedge) SCPP 798
Carex complanata Torrey & Hooker
(Hirsute Sedge) SCPP 125, 254
Carex digitalis Willdenow var. *digitalis*
(Slender Woodland Sedge) SCPP 116, 876
Carex frankii Kunth
(Frank's Sedge) SCPP 278, 314
Carex gracillima Schweinitz
(Graceful Sedge) SCPP 178, 821
Carex granularis Muhlenberg ex Willdenow
(Limestone Meadow Sedge) SCPP 937
Carex laevivaginata (Küthenthal) Mackenzie
(Smooth-sheathed Sedge) SCPP 855
Carex laxiflora Lamarck
(Broad Loose-flowered Sedge) SCPP 132, 783, 795, 979
Carex nigromarginata Schweinitz

(Black-edged Sedge) [$] SCPP 784, 786
Carex pensylvanica Lamarck
(Pennsylvania Sedge) [$] SCPP 14, 16, 17, 39, 867
Carex plantaginea Lamarck
(Plantain-leaved Sedge) SCPP 807
Carex platyphylla Carey
(Broad-leaved Sedge) SCPP 136, 208
Carex prasina Wahlenberg
(Drooping Sedge) SCPP 173, 854, 918
Carex purpurifera Mackenzie
(Limestone Purple Sedge) [$] SCPP 830
Carex rosea Schkuhr ex Willdenow
(Rosy Sedge) SCPP 126, 167
Carex shortiana Dewey
(Short's Sedge) SCPP 903
Carex striatula Michaux
(Lined Sedge) SCPP 822
Carex torta F. Boott
(Twisted Sedge) [$] SCPP 762, 852
Carex umbellata Schkuhr ex Willdenow
(Parasol Sedge) [$] SCPP 984
Carex virescens Muhlenberg ex Willdenow
(Ribbed Sedge) SCPP 123, 177, 389, 873, 888
Carex vulpinoidea Michaux
(Fox Sedge) [#] SCPP 858, 1021
Cyperus flavescens Linnaeus
(Yellow Flatsedge) SCPP 575
Cyperus strigosus Linnaeus
(Straw-colored Flatsedge) [#] SCPP 359, 590
Eleocharis obtusa (Willdenow) J.A. Schultes
(Blunt Spikerush) [#] SCPP 315, 974
Kyllinga gracillima Miquel
(Pasture Spikesedge) SCPP 578
Scirpus atrovirens Willdenow
(Dark Green Bulrush) SCPP 1053
Scirpus polyphyllus Vahl
(Leafy Bulrush) [$] SCPP 222
Scleria triglomerata Michaux
(Tall Nutrush) [$] SCPP 405, 988

DIOSCOREACEAE

Dioscorea polystachya Turczaninow
(Chinese Yam) [*] SCPP 621
Dioscorea villosa Linnaeus
(Wild Yam) [$ #] SCPP 106

IRIDACEAE

Iris cristata Aiton
(Dwarf Crested Iris) [#] SCPP 75
Iris psuedoacorus Linnaeus
(Yellow Iris) [*] SCPP 818
Sisyrinchium angustifolium P. Miller
(Narrow Leaved Blue-eyed-grass) [#] SCPP 88, 96, 339

JUNCACEAE

Juncus coriaceus Mackenzie
(Leathery Rush) [$] SCPP 853
Juncus effusus Linnaeus
(Common Rush) SCPP 341, 1022
Juncus tenuis Willdenow
(Path Rush) [#] SCPP 129, 451
Luzula acuminata Rafinesque
(Woodrush) SCPP 775, 804, 1025
Luzula echinata (Small) F.J. Hermann
(Spreading Woodrush) [$] SCPP 115, 890
Luzula multiflora (Ehrhart) Lejeune var. *multiflora*
(Common Woodrush) [$] SCPP 24

LILIACEAE

Clintonia umbellulata (Michaux) Morong
(Speckled Wood Lily) [#] SCPP 864
Lilium michauxii Poiret
(Carolina Lily) [$ * #] SCPP 494
Prosartes lanuginosa (Michaux) D. Don
(Yellow Fairy-bells) [#] SCPP 56, 468

ORCHIDACEAE

Aplectrum hyemale (Muhlenberg ex Willdenow) Torrey
(Adam-and-Eve) [#] SCPP 899
Corallorhiza odontorhiza (Willdenow) Poiret
(Autumn Coralroot) [$] SCPP 651
Corallorhiza wisteriana Conrad
(Spring Coralroot) [#] SCPP
Cypripedium acaule Aiton
(Pink Lady's-slipper) [% #] SCPP
Cypripedium parviflorum Salisbury var. *pubescens*
(Large Yellow Lady's-slipper) [#] SCPP 519
Galearis spectabilis (Linnaeus) Rafinesque ex de Candolle

(Showy Orchid) [#] SCPP 805
Goodyera pubescens (Willdenow) R. Brown
(Downy Rattlesnake-plantain) [$ #] SCPP 307, 1059
Isotria verticillata (Muhlenberg ex Willdenow) Rafinesque
(Large Whorled Pogonia) SCPP 1027, 1047
Platanthera ciliaris (Linnaeus) Lindley
(Yellow Fringed Orchid) SCPP 496
Platanthera lacera (Michaux) G. Don
(Green Fringed Orchid) SCPP 1007
Tipularia discolor (Pursh) Nuttall
(Cranefly Orchid) SCPP 1046, 1074

POACEAE

Agrostis perennans (Walter) Tuckerman
(Autumn Bentgrass) SCPP 532, 533, 632, 1067
Andropogon gerardii Vitman
(Big Bluestem) [@] SCPP 362
Andropogon virginicus Linnaeus
(Broomstraw) SCPP 624, 671, 688, 692
Anthoxanthum odoratum Linnaeus
(Sweet Vernal Grass) [$ *] SCPP 953
Arthraxon hispidus (Thunberg) Makino var. *hispidus*
(Joint-head Grass) [*] SCPP 686, 689
Arundinaria gigantea (Walter) Walter
(River Cane) [$] SCPP 338
Brachyelytrum erectum (Schreber ex Sprengel) Palisot de Beauvois
(Common Shorthusk) [$] SCPP 131, 133, 241, 520, 1056
Bromus commutatus Schrader
(Meadow Brome Grass) [*] SCPP 947
Bromus inermis Leysser
(Awnless Brome Grass) [$ *] SCPP 965
Bromus japonicus Thunberg ex Murrey
(Japanese Brome Grass) [$ *] SCPP 964
Bromus pubescens Muhlenberg ex Willdenow
(Common Eastern Brome Grass) SCPP 135, 179, 203, 219, 1032
Cinna arundinacea Linnaeus
(Common Wood Reedgrass) [$] SCPP 267, 666
Coleataenia anceps (Michaux) Soreng
(Beaked Panic Grass) [#] SCPP 289, 352
Dactylis glomerata Linnaeus
(Orchard Grass) [*] SCPP 894
Danthonia spicata (Linnaeus) Palisot de Beauvois ex Roemer & J.A. Schultes
(Poverty Oatgrass) SCPP 117, 128, 940, 983
Diarrhena americana Palisot de Beauvois
(American Beakgrain) [$] SCPP 505

Dichanthelium acuminatum (Swartz) Gould & Clark var. *lindheimeri* (Nash) Gould & Clark
(Lindheimer's Panic Grass) [$] SCPP 871, 872, 939
Dichanthelium boscii (Poitet) Gould & Clark
(Bosc's Panic Grass) SCPP 929
Dichanthelium commutatum (Schultes) Gould
(Panic Grass) [$] SCPP 118, 875, 878
Dichanthelium depauperatum (Muhlenberg) Gould
(Starved Panic Grass) [$] SCPP 938
Dichanthelium latifolium (Linnaeus) Harvill
(Broad-leaf Panic Grass) SCPP 240, 452, 528, 1110
Dichanthelium linearifolium (Scribner) Gould
(Slim-leaf Panic Grass) [$] SCPP 124
Dichanthelium sphaerocarpon (Elliott) Gould
(Round-fruited Panic Grass) [$] SCPP 503
Digitaria sanguinalis (Linnaeus) Scopoli
(Northern Crabgrass) [$ *] SCPP 617
Eleusine indica (Linnaeus) Gaertner
(Yard Grass) [*] SCPP 690
Elymus hystrix Linnaeus
(Bottlebrush Grass) [#] SCPP 543
Elymus riparius Wiegand
(Riverbank Wild Rye) SCPP 1092
Elymus virginicus Linnaeus
(Virginia Wild Rye) SCPP 261, 369, 370, 371
Eragrostis spectabilis (Pursh) Steudel
(Purple Lovegrass) SCPP 1095
Festuca subverticillata (Persoon) Alexeev
(Nodding Fescue) SCPP 134, 356, 972
Leersia virginica Willdenow
(White Grass) SCPP 536, 677
Microstegium vimineum (Trinius) A. Camus
(Japanese Stiltgrass) [*] SCPP 707
Muhlenbergia screberi J.F. Gmelin
(Nimblewill) SCPP 558
Muhlenbergia tenuiflora (Willdenow) Britton, Sterns, & Poggenburg
(Slender Muhly) [$] SCPP 415, 529
Panicum capillare Linnaeus
(Witch Grass) SCPP 976
Panicum virgatum Linnaeus
(Switchgrass) [$] SCPP 348, 701
Paspalum dilatatum Poiret
(Dallis Grass) [*] SCPP 375
Pennisetum glaucum (Linnaeus) R. Brown
(Pearl Millet) [*] SCPP 507, 523
Phleum pratense Linnaeus
(Timothy Grass) [*] SCPP 372

Poa cuspidata Nuttall
(Short-leaved Bluegrass) SCPP 37, 752
Poa pratensis Linnaeus ssp. *pratensis*
(Kentucky Bluegrass) [$ *] SCPP 816
Poa sylvestris A. Gray
(Woodland Bluegrass) SCPP 846
Schedonorus arundinaceus (Screber) Dumortier
(Tall Fescue) [*] SCPP 698
Setaria parviflora (Poiret) Kerguelen
(Knotroot Foxtail) SCPP 355, 564, 596
Sorghum halepense (Linnaeus) Persoon
(Johnson Grass) [*] SCPP 697
Sphenopholis nitida (Biehler) Scribner
(Wedgegrass) SCPP 120, 856, 893
Sphenopholis obtusata (Michaux) Scribner
(Prairie Wedgegrass) [$] SCPP 121, 130
Sporobolus indicus (Linnaeus) R. Brown
(Smut Grass) [*] SCPP 601
Tridens flavus (Linnaeus) A.S. Hitchcock
(Tall Redtop) SCPP 354, 710

RUSCACEAE

Convallaria majalis Linnaeus
(European Lily-of-the-valley) [$ *] SCPP 801
Maianthemum racemosum (Linnaeus) Link ssp. *racemosum*
(Eastern Solomon's-plume) [#] SCPP 310, 877
Polygonatum biflorum (Walter) Elliott
(Solomon's-seal) [$] SCPP 870

SMILACACEAE

Smilax bona-nox Linnaeus
(Fringed Greenbrier) [$ #] SCPP 154, 331, 512
Smilax glauca Walter
(White-leaf Greenbrier) [$] SCPP 500
Smilax hispida Rafinesque
(Bristly Greenbrier) [$ #] SCPP 320, 322, 681
Smilax rotundifolia Linnaeus
(Common Greenbrier) [$ #] SCPP 326, 810

TRILLIACEAE

Trillium erectum Linnaeus
(Red Trillium) [#] SCPP 34
Trillium flexipes Rafinesque
(Drooping Trillium) SCPP 806

XANTHORRHOEACEAE

Hemerocallis fulva (Linnaeus) Linnaeus
(Orange Day-lily) [@] SCPP 379

DIVISION MAGNOLIOPHYTA (MAGNOLIOPSIDA)

ACANTHACEAE

Ruellia caroliniensis (J.F. Gmelin) Steudel
(Carolina Wild-petunia) SCPP 909

ACERACEAE (see SAPINDACEAE)

ADOXACEAE

Sambucus canadensis Linnaeus
(Common Elderberry) [#] SCPP 958, 1023
Viburnum acerifolium Linnaeus
(Maple-leaf Viburnum) [#] SCPP 92, 110

ALTINGIACEAE

Liquidambar styraciflua Linnaeus
(Sweetgum) [$] SCPP 619

ANACARDIACEAE

Rhus copallinum Linnaeus
(Winged Sumac) [#] SCPP 272, 683
Rhus glabra Linnaeus
(Smooth Sumac) [#] SCPP 1094
Rhus typhina Linnaeus
(Staghorn Sumac) [$] SCPP 1057
Toxicodendron radicans (Linnaeus) Kuntze
(Poison Ivy) [$ #] SCPP 387, 456

ANNONACEAE

Asimina triloba (Linnaeus) Dunal
(Pawpaw) [#] SCPP

APIACEAE

Angelica venenosa (Greenway) Fernald
(Hairy Angelica) [$] SCPP 330
Chaerophyllum tainturieri Hooker
(Southern Wild Chervil) [$] SCPP 840
Cicuta maculata Linnaeus var. *maculata*
(Water-hemlock) [$ #] SCPP 312
Cryptotaenia canadensis (Linnaeus) A.P. de Candolle
(Honewort) [#] SCPP 165, 236, 407.6
Daucus carota Linnaeus
(Queen Anne's Lace) [#] SCPP 246
Ligusticum canadense (Linnaeus) Britton
(American Lovage) [$] SCPP 971
Osmorhiza claytonii (Michaux) C.B. Clarke
(Sweet Cicely) [#] SCPP 797
Osmorhiza longistylis (Torrey) A.P. de Candolle
(Aniseroot) [#] SCPP 792
Sanicula canadensis Linnaeus
(Black Snakeroot) [#] SCPP 424, 471.5
Sanicula odorata (Rafinesque) K.M. Pryer & L.R. Phillippe
(Clustered Snakeroot) [#] SCPP 409, 850, 880
Thaspium barbinode (Michaux) Nuttall
(Hairy-jointed Meadow Parsnip) [#] SCPP 309, 901, 956
Zizia aurea (Linnaeus) W.D.J. Koch
(Golden-alexanders) SCPP 23, 881

APOCYNACEAE

Asclepias incartnata Linnaeus var. *incarnata*
(Swamp Milkweed) SCPP 868
Asclepias quadrifolia Jacquin
(Four-leaf Milkweed) [#] SCPP 139, 891, 898, 1014
Asclepias syriaca Linnaeus
(Common Milkweed) [$ #] SCPP 394, 1040
Asclepias tuberosa Linnaeus var. *tuberosa*
(Common Butterflyweed) [$ #] SCPP 201, 255, 986
Asclepias variegata Linnaeus
(White Milkweed) [$ #] SCPP 981
Vinca minor Linnaeus
(Periwinkle) [*] SCPP 777

AQUIFOLIACEAE

Ilex crenata Thunberg
(Japanese Holly) [*] SCPP 967
Ilex opaca Aiton var. *opaca*
(American Holly) SCPP 663

ARALIACEAE

Hedera helix Linnaeus
(English Ivy) [$ * @] SCPP 582
Panax quinquefolius Linnaeus
(American Ginseng) [$ % #] SCPP 991, 1019, 1039

ARISTOLOCHIACEAE

Asarum canadense Linnaeus
(Common Wild Ginger) [#] SCPP 69
Hexastylis arifolia (Michaux) Small var. *ruthii* (Ashe) Blomquist
(Appalachian Little Brown Jug) [#] SCPP 29
Hexastylis heterophylla (Ashe) Small
(Variable-leaf Heartleaf) SCPP 60
Isotrema macrophyllum (Lamarck) C.F. Reed
(Dutchman's Pipe) [#] SCPP 483.5, 978

ASTERACEAE

Achillea millefolium Linnaeus
(Common Yarrow) [#] SCPP 251, 290
Ageratina altissima King & H.E. Robinson
(White Snakeroot) SCPP 639
Ambrosia artemisiifolia Linnaeus
(Common Ragweed) [$ #] SCPP 537
Ambrosia trifida Linnaeus
(Giant Ragweed) [$ #] SCPP 475, 538
Antennaria plantaginifolia (Linnaeus) Richardson
(Plantain-leaved Pussytoes) [#] SCPP 40, 751
Arctium minus Bernhardi
(Common Burdock) [$ *] SCPP 449
Arnoglossum atriplicifolium (Linnaeus) H.E. Robinson
(Pale Indian-plantain) [$] SCPP 928
Bidens aristosa (Michaux) Britton
(Tickseed Sunflower) [$] SCPP 572
Bidens bipinnata Linnaeus
(Spanish Needles) [$] SCPP 628, 1075
Cichorium intybus Linnaeus

(Chicory) [*] SCPP 247, 622
Cirsium discolor (Muhlenberg ex Willdenow) Sprengel
(Field Thistle) [$] SCPP 623, 1089
Cirsium vulgare (Savi) Tenore
(Bull Thistle) [$ *] SCPP 406
Conoclinium coelestinum (Linnaeus) A.P. de Candolle
(Mistflower) [$] SCPP 667
Coreopsis major Walter
(Woodland Coreopsis) [$ #] SCPP 200, 1080
Coreopsis tinctoria Nuttall var. *tinctoria*
(Plains Coreopsis) [@] SCPP
Elephantopus carolinianus Raeuschel
(Elephant's-foot) SCPP 576, 1085
Erechtites hieraciifolius (Linnaeus) Rafinesque ex de Candolle
(American Burnweed) [$] SCPP 1048
Erigeron annuus (Linnaeus) Persoon
(Annual Fleabane) [#] SCPP 180, 287, 358, 589, 604, 655
Erigeron philadelphicus Linnaeus var. *philadelphicus*
(Philadelphia Fleabane) [#] SCPP 97, 896
Erigeron pulchellus Michaux var. *pulchellus*
(Robin's Plantain) [$ #] SCPP 63, 109, 930
Erigeron strigosus Muhlenberg ex Willdenow var. *strigosus*
(Daisy Fleabane) SCPP 212, 949
Eupatorium sessilifolium Linnaeus var. *sessilifolium*
(Upland Boneset) SCPP 301, 498, 545
Eurybia divaricata (Linnaeus) Nesom
(White Wood Aster) [$] SCPP 1099
Eurybia macrophylla (Linnaeus) Cassini
(Large-leaved Aster) [$] SCPP 1103
Eurybia surculosa (Michaux) Nesom
(Creeping Aster) SCPP 497, 665
Eutrochium purpureum (Linnaeus) E.E. Lamont var. *purpureum*
(Purple Joe-pye-weed) [$ #] SCPP 300, 388, 439, 1073
Gamochaeta purpurea (Linnaeus) Cabrera
(Purple Cudweed) [$] SCPP 951
Helenium autumnale Linnaeus
(Common Sneezeweed) SCPP 586
Helianthus hirsutus Rafinesque
(Hairy Sunflower) SCPP 217
Helianthus microcephalus Torrey & Gray
(Small-headed Sunflower) SCPP 428, 440, 597
Hieracium caespitosum Dumortier
(Meadow Hawkweed) [* #] SCPP 913, 941
Hieracium gronovii Linnaeus
(Hairy Hawkweed) SCPP 581, 1082
Hieracium venosum Linnaeus

(Rattlesnake Weed) [#] SCPP 90.5, 517, 835
Hypochaeris radicata Linnaeus
(Spotted Cat's-ear) [$ *] SCPP 954
Lactuca biennis (Moench) Fernald
(Tall Blue Lettuce) [$] SCPP 620
Lactuca canadensis Linnaeus
(Wild Lettuce) [$ #] SCPP 360, 473, 610, 670, 992
Lactuca foridana (Linnaeus) Gaertner
(Woodland Lettuce) [$] SCPP 547, 548
Lapsana communis Linnaeus
(Common Nipplewort) [$ *] SCPP 960
Leucanthemum vulgare Lamarck
(Oxeye Daisy) [* #] SCPP 253, 605, 915
Liatris spicata (Linnaeus) Willdenow
(Dense Blazing Star) [$] SCPP 376
Matricaria discoidea A.P. de Candolle
(Rayless Chamomile) [$ *] SCPP 859
Nabalus altissimus (Linnaeus) Hooker
(Tall Rattlesnake-root) SCPP 401
Nabalus trifoliolatus Cassini
(Gall-of-the-earth) [$] SCPP 661
Packera anonyma (Wood) W.A. Weber & Á. Löve
(Small's Ragwort) SCPP 102, 755, 826
Packera aurea (Linnaeus) Á. & D. Löve
(Golden Ragwort) [#] SCPP 48
Packera obovata (Muhlenberg ex Willdenow) W.A. Weber & Á. Löve
(Round-leaved Ragwort) [#] SCPP 832
Rudbeckia hirta Linnaeus
(Black-eyed Susan) [$ #] SCPP 268, 599, 985
Rudbeckia laciniata Linnaeus var. *laciniata*
(Cut-leaf Coneflower) SCPP 606, 1070
Rudbeckia triloba Linnaeus var. *triloba*
(Three-lobed Coneflower) SCPP 1084
Seriocarpus asteroides (Linnaeus) Britton, Sterns, & Poggenburg
(Toothed White-top Aster) [#] SCPP 1010
Solidago arguta Aiton var. *caroliniana* A. Gray
(Atlantic Goldenrod) [$] SCPP 645
Solidago canadensis Linnaeus
(Canada Goldenrod) [$] SCPP 501, 627, 1091, 1096
Solidago curtisii Torrey & A. Gray
(Curtis' Goldenrod) [$] SCPP 630, 648, 660, 1106
Solidago erecta Pursh
(Erect Goldenrod) SCPP 1102
Solidago flaccidifolia Small
(Appalachian Goldenrod) [$] SCPP 630.5, 635, 636, 649, 711
Solidago nemoralis Aiton var. *nemoralis*

(Gray Goldenrod) SCPP 1107
Solidago odora Aiton
(Sweet Goldenrod) [$] SCPP 633, 654
Solidago rugosa P. Miller
(Wrinkle-leaf Goldenrod) [$] SCPP 281, 530, 614, 634
Sonchus arvensis Linnaeus var. *glabrescens* (Günther) Grabowski & Wimmer
(Field Sow Thistle) [$] SCPP 607
Sonchus asper (Linnaeus) Hill
(Spiny-leaf Sow Thistle) SCPP 214, 556
Symphyotrichum novae-angliae (Linnaeus) Nesom
(New England Aster) SCPP 363, 367, 560
Symphyotrichum patens (Aiton) Nesom var. *patens*
(Late Purple Aster) SCPP 559, 657
Symphyotrichum pilosum (Willdenow) Nesom var. *pringlei* (A. Gray) Nesom
(Pringle's Aster) SCPP 396, 602, 641, 656
Symphyotrichum undulatum (Linnaeus) Nesom
(Wavy-leaved Aster) SCPP 541, 658, 659, 1093
Taraxacum officinale G.H. Weber ex Wiggers
(Common Dandelion) [$ * #] SCPP 555, 565
Tussilago farfara Linnaeus
(Coltsfoot) [*] SCPP 764
Verbesina alternifolia (Linnaeus) Britton ex Kearnery
(Wingstem) SCPP 585
Vernonia gigantea (Walter) Trelease
(Tall Ironweed) SCPP 353
Vernonia noveboracensis (Linnaeus) Michaux
(New York Ironweed) [$] SCPP 626

BALSAMINACEAE

Impatiens capensis Meerburg
(Orange Jewelweed) [#] SCPP 238, 471
Impatiens pallida Nuttall
(Yellow Jewelweed) [#] SCPP 305, 647

BERBERIDACEAE

Berberis bealei Fortune
(Chinese Mahonia) [$ *] SCPP 0
Berberis thunbergii A.P. de Candolle
(Japanese Barberry) [$ *] SCPP 704
Podophyllum peltatum Linnaeus
(Mayapple) [#] SCPP 803, 831

BETULACEAE

Alnus serrulata (Aiton) Willdenow
(Smooth Alder) [$] SCPP 476
Betula lenta Linnaeus
(Birch) [#] SCPP 45
Carpinus caroliniana Walter
(American Hornbeam) [$ #] SCPP 33, 435

BIGNONIACEAE

Bignonia capreolata Linnaeus
(Cross-vine) [#] SCPP 861
Campsis radicans (Linnaeus) Seeman ex Bureau
(Trumpet-creeper) [#] SCPP 1088

BORAGINACEAE

Cynoglossum virginianum Linnaeus var. *virginianum*
(Wild Comfrey) [#] SCPP 851
Hackelia virginiana (Linnaeus) I.M. Johnston
(Virginia Stickseed) [$] SCPP 296
Hydrophyllum macrophyllum Nuttall
(Large-leaf Waterleaf) [$ #] SCPP 905
Myosotis macrosperma Engelmann
(Large-seed Forget-me-not) SCPP 85, 834, 845
Phacelia bipinnatifida Michaux
(Forest Phacelia) SCPP 58, 910

BRASSICACEAE

Alliaria petiolata (Bieberstein) Cavara & Grande
(Garlic Mustard) [*] SCPP 757
Barbarea verna (P. Miller) Ascherson
(Early Winter Cress) [$ *] SCPP 769, 794
Barbarea vulgaris R. Brown
(Common Winter Cress) [* #] SCPP 793, 811
Boechera canadensis (Linnaeus) Al-Shehbaz
(Canada Rock Cress) SCPP 416, 931, 982, 1015
Boechera laevigata (Muhlenberg ex Willdenow) Al-Shehbaz
(Smooth Rock Cress) [#] SCPP 32, 68, 206, 484, 844, 887, 1016
Capsella bursa-pastoris (Linnaeus) Medikus
(Common Shepherd's Purse) [$ *] SCPP 587
Cardamine angustata O.E. Schulz
(Slender Toothwort) [#] SCPP 5, 67, 756
Cardamine concatenata (Michaux) O. Schwarz

(Cut-leaf Toothwort) [#] SCPP 779
Cardamine diphylla (Michaux) A. Wood
(Two-leaf Toothwort) [#] SCPP 64, 73, 750, 771
Cardamine hirsuta Linnaeus
(Hairy Bittercress) [$ *] SCPP 18, 765
Cardamine pensylvanica Muhlenberg ex Willdenow
(Pennsylvania Bittercress) [#] SCPP 74
Cardamine rotundifolia Michaux
(American Bittercress) [$ %] SCPP 847
Hesperis matronalis Linnaeus
(Dame's Rocket) [$ *] SCPP 104
Lepidium campestre (Linnaeus) R. Brown
(Field Peppercress) [$ * #] SCPP 828, 843
Lepidium virginicum Linnaeus
(Virginia Peppercress) [$ #] SCPP 245, 404, 524, 906, 922

CAMPANULACEAE

Campanula americana Linnaeus
(Tall Bellflower) [#] SCPP 228
Campanula divaricata Michaux
(Appalachian Bellflower) SCPP 510, 1066
Lobelia cardinalis Linnaeus
(Cardinal Flower) SCPP 550, 552, 1069
Lobelia inflata Linnaeus
(Indian Tobacco) [$ #] SCPP 357, 458, 472, 579, 1063
Lobelia siphilitica Linnaeus var. *siphilitica*
(Great Blue Lobelia) SCPP 577
Triodanis perfoliata (Linnaeus) Nieuwland
(Small Venus' Looking-glass) [$ #] SCPP 952

CAPRIFOLIACEAE

Lonicera dioica Linnaeus
(Red Honeysuckle) [% #] SCPP
Lonicera japonica Thunberg
(Japanese Honeysuckle) SCPP 105, 318, 345, 493, 706
Lonicera maackii (Ruprecht) Maximowicz
(Amur Honeysuckle) [#] SCPP 833.5
Valerianella radiata (Linnaeus) Dufresne
(Beaked Corn-salad) SCPP 791, 902

CARYOPHYLLACEAE

Arenaria serpyllifolia Linnaeus
(Large Thyme-leaved Sandwort) [$] SCPP 825

Cerastium fontanum Baumgartner var. *vulgare* (Hartman) Greuter & Burdet
(Common Mouse-ear Chickweed) [#] SCPP
Paronychia canadensis (Linnaeus) Wood
(Smooth Forked Nailwort) [* #] SCPP 1006
Silene virginica Linnaeus
(Fire Pink) [#] SCPP 83, 248, 569, 789
Stellaria pubera Michaux
(Star Chickweed) [#] SCPP 25, 758, 896.5

CELESTRACEAE

Euonymus americanus Linnaeus
(American Strawberry-bush) [#] SCPP 93, 427, 675, 678, 687

CONVOLVULACEAE

Calystegia sepium (Linnaeus) R. Brown
(Hedge Bindweed) [$] SCPP 431
Cuscuta gronovii Willdenow ex J.A. Schultes
(Common Dodder) [$ #] SCPP 1109
Cuscuta pentagona Engelmann
(Five-angled Dodder) [$] SCPP 373
Ipomoea lacunosa Linnaeus
(Small White Morning Glory) [$] SCPP 544, 570
Ipomoea pandurata (Linnaeus) G.F.W. Meyer
(Man-of-the-earth) [$] SCPP 397, 1031
Ipomoea purpurea (Linnaeus) Roth
(Common Morning Glory) [$ * #] SCPP 571, 1087

CORNACEAE

Cornus alternifolia Linnaeus
(Alternate-leaf Dogwood) SCPP
Cornus amomum P. Miller
(Silky Dogwood) SCPP 481
Cornus florida Linnaeus
(Flowering Dogwood) [$ #] SCPP 197, 553, 773

CRASSULACEAE

Sedum ternatum Michaux
(Woodland Stonecrop) [#] SCPP 836

DIAPENSIACEAE

Galax urceolata (Poiret) Brummitt
(Galax) [#] SCPP

ERICACEAE

Chimaphila maculata (Linnaeus) Pursh
(Spotted Wintergreen) [#] SCPP 176
Epigea repens Linnaeus
(Trailing Arbutus) [$] SCPP 19
Gaultheria procumbens Linnaeus
(Wintergreen) [$ #] SCPP 321, 682
Kalmia latifolia Linnaeus
(Mountain Laurel) [#] SCPP 233, 917
Monotropa uniflora Linnaeus
(Indian Pipe) [#] SCPP 170
Oxydendrum arboreum (Linnaeus) A.P. de Candolle
(Sourwood) [$ #] SCPP 421, 489, 693
Rhododendron arborescens (Pursh) Torrey
(Sweet Azalea) [$] SCPP 802
Rhododendron calendulaceum (Michaux) Torey
(Flame Azalea) [#] SCPP 904
Rhododendron canescens (Michaux) Sweet
(Pink Azalea) SCPP
Rhododendron maximum Linnaeus
(Great Rhododendron) [$ #] SCPP 295, 1008
Vaccinium pallidum Aiton
(Hillside Blueberry) [$ #] SCPP 71, 153, 194
Vaccinium stamineum Linnaeus
(Deerberry) [#] SCPP 94, 813, 838

EUPHORBIACEAE

Acalypha rhomboidea Rafinesque
(Common Three-seeded Mercury) [$] SCPP 1038
Acalypha virginica Linnaeus
(Vigininia Three-seeded Mercury) [$] SCPP 653, 669, 1045, 1060, 1097
Euphorbia corollata Linnaeus
(Flowering Spurge) [$ #] SCPP 379.5, 392.5, 402, 444
Euphorbia nutans Lagasca & Segura
(Nodding Spurge) [$] SCPP 433

FABACEAE

Albizia julibrissin Durazzini
(Mimosa) [*] SCPP 274, 508.5
Amphicarpaea bracteata (Linnaeus) Fernald
(Hog-peanut) SCPP 546, 551, 640, 1083
Apios americana Medikus
(Groundnut) [$] SCPP 1061
Cercis canadensis Linnaeus var. *canadensis*
(Eastern Redbud) [#] SCPP 31, 285
Chamaecrista fasciculata (Michaux) Greene
(Common Partridge-pea) [$] SCPP 361, 1081
Chamaecrista nictitans (Linnaeus) Moench var. *nictitans*
(Sensitive Partridge-pea) [$] SCPP 429
Clitoria mariana Linnaeus var. *mariana*
(Butterfly Pea) [$] SCPP 1012
Desmodium canescens (Linnaeus) A.P. de Candolle
(Hoary Tick-trefoil) SCPP 1079
Hylodesmum glutinosum (Muhlenberg ex Willdenow) H. Ohashi & R.R. Mill
(Pointed-leaf Tick-trefoil) SCPP 229, 457
Hylodesmum nudiflorum (Linnaeus) H. Ohashi & R.R. Mill
(Naked-Flowered Tick-trefoil) [$ #] SCPP 213, 293, 1064
Kummerowia stipulacea (Maximowicz) Makino
(Korean-clover) [$ *] SCPP 568
Lathyrus latifolius Linnaeus
(Everlasting Pea) [*] SCPP 1062
Lespedeza cuneata (Dumont-Cours.) G. Don
(Chinese Lespedeza) [$ *] SCPP 611
Lespedeza hirta (Linnaeus) Hornemann var. *hirta*
(Hairy Lespedeza) [$ #] SCPP 328, 495
Medicago lupulina Linnaeus
(Black Medick) [*] SCPP 252, 283, 961
Melilotus albus Medikus
(White Sweet-clover) [$ * #] SCPP 934
Pueraria montana (Loureiro) Merritt var. *lobata* (Willdenow) van Der Maesen & S. Almeida
(Kudzu) [$ *] SCPP 708
Robinia psuedoacacia Linnaeus
(Black Locust) [#] SCPP 277, 925
Securigera varia (Linnaeus) Lassen
(Crown Vetch) [*] SCPP 998
Tephrosia virginiana (Linnaeus) Persoon
(Virginia Goat's-rue) [$ #] SCPP 1009
Trifolium campestre Schreber
(Low Hop Clover) [* #] SCPP 946
Trifolium pratense Linnaeus
(Red Clover) [* #] SCPP 235, 609, 907

Trifolium repens Linnaeus
(White Clover) [$ * #] SCPP 629, 908
Vicia caroliniana Walter
(Wood Vetch) [#] SCPP 13, 15
Vicia sativa Linnaeus var. *nigra* (Linnaeus) Ehrhart
(Narrow-leaf Vetch) [$ *] SCPP 857
Vicia villosa Roth
(Winter Vetch) [*] SCPP 927

FAGACEAE

Castanea dentata (Marshall) Borkhausen
(American Chestnut) [% #] SCPP 662, 680
Fagus grandifolia Ehrhart
(American Beech) [#] SCPP 50, 61, 426
Quercus alba Linnaeus
(White Oak) [$ #] SCPP 168, 705, 1024
Quercus coccinea Muenchhausen
(Scarlet Oak) SCPP
Quercus falcata Michaux
(Southern Red Oak) [$ #] SCPP 664
Quercus marilandica Muenchhausen var. *marilandica*
(Blackjack Oak) [$] SCPP 715
Quercus montana Willdenow
(Chestnut Oak) SCPP 157, 158, 308, 453, 454, 885
Quercus palustris Muenchhausen
(Pin Oak) [$] SCPP 513
Quercus rubra Linnaeus
(Red Oak) SCPP 36, 461, 1017
Quercus velutina Lamarck
(Black Oak) [$ #] SCPP 156

GENTIANACEAE

Obolaria virginica Linnaeus
(Pennywort) [#] SCPP 768
Sabatia angularis (Linnaeus) Pursh
(Rose-pink) SCPP 1111

GERANIACEAE

Geranium carolinianum Linnaeus
(Carolina Geranium) [$ #] SCPP 841, 975
Geranium maculatum Linnaeus
(Wild Geranium) [#] SCPP 28, 59

HAMAMELIDACEAE

Hamamelis virginiana Linnaeus var. *virginiana*
(Witch Hazel) [#] SCPP 44, 327

HIPPOCASTANACEAE (see SAPINDACEAE)

HYDRANGEACEAE

Hydrangea arborescens Linnaeus
(Wild Hydrangea) [#] SCPP 190, 391, 993.5

HYPERICACEAE

Hypericum gentianoides (Linnaeus) Britton, Sterns, & Poggenburg
(Pineweed) [$] SCPP 567
Hypericum hypericoides (Linnaeus) Crantz
(St. Andrew's Cross) [$ #] SCPP 785
Hypericum punctatum Lamarck
(Spotted St. John's-wort) SCPP 181, 202, 220, 259, 450, 594
Hypericum stragulum P. Adams & Robson
(Low St. Andrew's Cross) SCPP 273

JUGLANDACEAE

Carya glabra (P. Miller) Sweet
(Pignut Hickory) [#] SCPP 437
Carya ovata (P. Miller) K. Koch
(Shagbark Hickory) [$ #] SCPP 161, 438, 1018
Carya pallida (Ashe) Engler & Graebner
(Pale Hickory) [$ #] SCPP 487, 800
Carya tomentosa (Lamarck ex Poiret) Nuttall
(Mockernut Hickory) [$ #] SCPP 160, 198, 447, 460, 467
Juglans cinerea Linnaeus
(White Walnut) [$ % #] SCPP 588, 1004
Juglans nigra Linnaeus
(Black Walnut) [#] SCPP 488

LAMIACEAE

Clinopodium vulgare Linnaeus
(Wild Basil) [#] SCPP 275
Collinsonia canadensis Linnaeus
(Canada Horse-balm) [#] SCPP 608, 685, 1101

Glechoma hederacea Linnaeus
(Ground-ivy) [* #] SCPP 98, 772
Lycopus americanus Muhlenberg ex W. Barton
(American Bugleweed) SCPP 432
Mentha spicata Linnaeus
(Spearmint) [$ *] SCPP 478
Monarda clinopodia Linnaeus
(Basil Beebalm) [#] SCPP 174, 230, 340, 966, 970
Monarda fistulosa Linnaeus
(Wild Bergamot) SCPP 291, 403
Prunella vulgaris Linnaeus
(Heal-all) [$ *] SCPP 249, 297, 474
Pycnanthemum montanum Michaux
(Mountain-mint) SCPP 1068
Pycnanthemum pycnanthemoides (Leavenworth) Fernald var. *pycnanthemoides*
(Southern Mountain-mint.) [$] SCPP 193
Salvia lyrata Linnaeus
(Nettle-leaf Sage) [$ #] SCPP 87, 521
Scutellaria elliptica Muhlenberg ex Sprengel var. *hirsuta* (Short & Peter) Fernald
(Hairy Skullcap) [#] SCPP 175, 860, 968, 997
Scutellaria lateriflora Linnaeus
(Blue Skullcap) SCPP 1090
Scutellaria serrata Andrzedowski
(Showy Skullcap) [#] SCPP 189, 933
Stachys cordata Riddell
(Heart-leaf Hedge-nettle) [#] SCPP 996, 1029

LAURACEAE

Lindera benzoin (Linnaeus) Blume
(Spicebush) [#] SCPP 6, 306, 408
Sassafras albidum (Nuttall) Nees
(Sassafras) [$ #] SCPP 38, 41, 159

MAGNOLIACEAE

Liriodendron tulipifera Linnaeus
(Tulip-tree) [$ #] SCPP 812
Magnolia acuminata Linnaeus
(Cucumber-tree) [#] SCPP 192, 425, 465
Magnolia tripetala (Linnaeus) Linnaeus
(Umbrella-tree) [$] SCPP 490
Magnolia virginiana Linnaeus
(Sweetbay Magnolia) [@] SCPP 926

MALVACEAE

Tilia americana Linnaeus var. *heterophylla* (Verntenat) Loudon
(White Basswood) [#] SCPP 407, 462, 483, 1005

MONTIACEAE

Claytonia virginica Linnaeus
(Virginia Spring Beauty) [#] SCPP 4

MORACEAE

Morus alba Linnaeus
(White Mulberry) [$ * @] SCPP 1013
Morus rubra Linnaeus
(Red Mulberry) [#] SCPP

NYSSACEAE

Nyssa sylvatica Marshall
(Black Gum) [#] SCPP 420, 464, 973

OLEACEAE

Fraxinus americana Linnaeus
(White Ash) [#] SCPP 412, 466, 527, 584, 895
Ligustrum sinense Loureiro
(Chinese Privet) [$ *] SCPP 112, 234, 284, 592

ONAGRACEAE

Circaea canadensis (Linnaeus) Hill ssp. *canadensis*
(Enchanter's Nightshade) [#] SCPP 224, 226, 990
Oenothera biennis Linnaeus
(Common Evening-primrose) SCPP 395.5, 616, 1076

OROBANCHACEAE

Aureolaria laevigata (Rafinesque) Rafinesque)
(Entire-leaf Yellow False Foxglove) SCPP 642, 1065
Aureolaria virginica (Linnaeus) Pennell
(Downy Yellow False Foxglove) [$ #] SCPP 216, 1035
Conopholis americana (Linnaeus) Wallroth
(Bearcorn) [#] SCPP 43
Epifagus virginiana (Linnaeus) W. Barton
(Beechdrops) [#] SCPP 673

Orobanche uniflora Linnaeus
(Cancer-root) [#] SCPP
Pedicularis canadensis Linnaeus
(Lousewort) [* #] SCPP 65, 516

OXALIDACEAE

Oxalis grandis Small
(Great Yellow Wood-sorrel) [#] SCPP 103, 262, 317
Oxalis stricta Linnaeus
(Common Yellow Wood-sorrel) [$] SCPP 349, 827, 842
Oxalis violacea Linnaeus
(Violet Wood-sorrel) [#] SCPP 790

PAPAVERACEAE

Sanguinaria canadensis Linnaeus
(Bloodroot) [#] SCPP 7

PASSIFLORACEAE

Passiflora lutea Linnaeus
(Yellow Passionflower) SCPP 508

PAULOWNIACEAE

Paulownia tomentosa (Thunberg) Siebold & Zuccarini ex Steudel
(Princess Tree) [*] SCPP 113

PENTHORACEAE

Penthorum sedoides Linnaeus
(Ditch Stonecrop) SCPP 1071

PHRYMACEAE

Mimulus alatus Aiton
(Winged Monkeyflower) SCPP 311, 549, 713, 1049
Phryma leptostachya Linnaeus var. *leptostachya*
(American Lopseed) [$] SCPP 459, 1055

PHYTOLACCACEAE

Phytolacca americana Linnaeus
(Pokeweed) [$ #] SCPP 148, 215, 980

PLANTAGINACEAE

Chelone glabra Linnaeus
(White Turtlehead) SCPP 1108
Penstemon laevigatus Aiton
(Eastern Smooth Beard-tongue) [#] SCPP 101, 142, 919
Penstemon pallidus Small
(Easter Pale Beard-tongue) [$] SCPP 869, 886
Plantago lanceolata Linnaeus
(English Plantain) [$ * #] SCPP 350, 243
Plantago rugelii Decaisne
(American Plantain) [$ #] SCPP 244, 304, 839
Plantago virginica Linnaeus
(Virginia Plantain) SCPP 950
Veronica arvensis Linnaeus
(Corn Speedwell) [$ * #] SCPP 824
Veronica officinalis Linnaeus
(Common Speedwell) [* #] SCPP 829
Veronicastrum virginicum (Linnaeus) Farwell
(Culver's-root) [$] SCPP 712

PLATANACEAE

Platanus occidentalis Linnaeus
(American Sycamore) [#] SCPP 574

POLYGONACEAE

Persicaria longiseta (de Bruijn) Kitagawa
(Long-bristled Smartweed) [$] SCPP 347
Persicaria maculosa S.F. Gray
(Lady's Thumb) [$ *] SCPP 535
Persicaria virginianum (Linnaeus) Gaertner
(Virginia Knotweed) SCPP 539
Rumex conglomeratus Murrey
(Clustered Dock) [$ *] SCPP 1043
Rumex crispus Linnaeus var. *crispus*
(Curly Dock) [* #] SCPP 263
Rumex obtusifolius Linnaeus
(Broad-leaf Dock) [$ *] SCPP 1086

PRIMULACEAE

Anagallis arvensis Linnaeus ssp. *arvensis*
(Scarlet Pimpernel) [* #] SCPP 525, 591
Lysimachia ciliata Linnaeus

(Fringed Loosestrife) [$] SCPP 200.5
Lysimachia nummularia Linnaeus
(Moneywort) [*] SCPP 1052
Lysimachia quadrifolia Linnaeus
(Whorled Loosestrife) [#] SCPP 138, 932, 963

RANUNCULACEAE

Actaea racemosa Linnaeus
(Common Black Cohosh) [#] SCPP 191
Anemone acutiloba (A.P. de Candolle) G. Lawson
(Sharp-lobed Liverwort) [#] SCPP 79
Anemone americana (A.P. de Candolle) H. Hara
(Round-lobed Liverwort) [#] SCPP 1
Anemone quinquefolia Linnaeus
(Wood Anemone) [#] SCPP 62, 759, 782
Anemone virginiana Linnaeus var. *virginiana*
(Tall Anemone) [$ #] SCPP 264, 279
Aquilegia vulgaris Linnaeus
(Purple Columbine) [*] SCPP 911
Clematis terniflora A.P. de Candolle
(Japanese Clematis) [*] SCPP 482, 509, 618
Clematis virginiana Linnaeus
(Virgin's-bower) [$ #] SCPP 615
Delphinium tricorne Michaux
(Dwarf Larkspur) [#] SCPP 79.5
Ranunculus abortivus Linnaeus
(Kidneyleaf Buttercup) [#] SCPP 54, 767
Ranunculus bulbosus Linnaeus
(Bulbous Buttercup) [$ * #] SCPP 781, 924
Ranunculus hispidus Michaux
(Bristly Buttercup) [#] SCPP 787, 788
Ranunculus recurvatus Poiret var. *recurvatus*
(Hooked Buttercup) [#] SCPP 81, 227
Ranunculus repens Linnaeus
(Creeping Buttercup) [$ *] SCPP 76
Thalictrum dioicum Linnaeus
(Early Meadow-rue) [#] SCPP 57, 70
Thalictrum pubescens Pursh
(Common Tall Meadow-rue) [$] SCPP 987
Thalictrum thalictroides (Linnaeus) Eames & Boivin
(Rue-anemone) [#] SCPP 22, 761

RHAMNACEAE

Ceanothus americanus Linnaeus
(New Jersey Tea) [#] SCPP 182
Frangula caroliniana (Walter) A. Gray
(Carolina Buckthorn) SCPP 441, 598

ROSACEAE

Agrimonia gryposepala Wallroth
(Tall Hairy Agrimony) SCPP 298, 411, 703
Agrimonia parviflora Aiton
(Small-flowered Agrimony) [$] SCPP 691
Agrimonia pubescens Wallroth
(Downy Agrimony) [#] SCPP 302
Amelanchier arborea (Michaux) Fernald
(Downy Serviceberry) [#] SCPP 11, 12, 422, 760, 914
Aruncus dioicus (Walter) Fernald
(Goat's-beard) [#] SCPP 108
Crataegus macrosperma Ashe
(Big-fruited Hawthorn) [$ #] SCPP 196
Crataegus punctata Jacquin
(Dotted Hawthorn) [$] SCPP 1033
Fragaria virginiana P. Miller
(Wild Strawberry) [#] SCPP 49
Geum canadense Jacquin
(White Avens) [$ #] SCPP 162, 239, 256
Geum fragarioides (Michaux) Smedmark
(Northern Barren Strawberry) [$] SCPP 808
Geum vernum (Rafinesque) Torrey & A. Gray
(Spring Avens) SCPP 819
Gillenia stipulata (Muhlenberg ex Willdenow) Nuttall
(American Ipecac) [$] SCPP 111
Gillenia trifoliata (Linnaeus) Moench
(Bowman's-root) [#] SCPP 892
Malus pumila P. Miller
(Common Apple) [$ * @ #] SCPP 374
Potentilla indica (Andrews) T. Wolf
(Indian-strawberry) [$ *] SCPP 47, 91, 378, 477, 593
Potentilla recta Linnaeus
(Sulphur Cinquefoil) [* #] SCPP 920
Potentilla simplex Michaux
(Common Cinquefoil) SCPP 42
Prunus americana Marshall
(American Wild Plum) [$ #] SCPP 84

Prunus mahaleb Linnaeus
(Rock Cherry) [*] SCPP 970.5
Prunus pensylvanica Linnaeus
(Fire Cherry) SCPP 383
Prunus serotina Ehrhart var. *serotina*
(Wild Black Cherry) [$ #] SCPP 155, 948
Pyrus communis Linnaeus
(Common Pear) [* @] SCPP 46, 753
Rosa carolina Linnaeus
(Carolina Rose) [#] SCPP 152, 184, 921
Rosa multiflora Thunberg ex Murrey
(Multiflora Rose) [*] SCPP 418, 833
Rosa palustris Marshall
(Swamp Rose) [#] SCPP 1011
Rubus allegheniensis Porter
(Allegheny Blackberry) [$ #] SCPP 221, 292, 417, 455
Rubus occidentalis Linnaeus
(Black Raspberry) SCPP 957
Rubus phoenicolasius Maximowicz
(Wineberry) [$ *] SCPP 257, 280
Rubus trivialis Michaux
(Southern Dewberry) [$ #] SCPP 89

RUBIACEAE

Cephalanthus occidentalis Linnaeus
(Buttonbush) SCPP 480
Diodia teres Walter
(Common Buttonweed) [$] SCPP 573
Diodia virginiana Linnaeus
(Virginia Buttonweed) [$] SCPP 377, 592, 1078
Galium aparine Linnaeus
(Cleavers) [$ #] SCPP 796
Galium circaezans Michaux
(Forest Bedstraw) SCPP 334, 381, 799, 935, 945
Galium latifolium Michaux
(Purple Bedstraw) [$] SCPP 1026
Galium sherardia E.H.L. Krause
(Field Madder) [*] SCPP 906.5
Galium tinctorium (Linnaeus) Scopoli
(Three-lobed Bedstraw) SCPP 959
Galium triflorum Michaux
(Sweet-scented Bedstraw) [#] SCPP 169, 231, 944
Houstonia canadensis Willdenow ex Roemer & J.A. Schultes
(Canada Bluets) [$] SCPP 837, 1100
Houstonia purpurea Linnaeus var. *purpurea*

(Summer Bluets) [#] SCPP 99, 282, 887.5, 943
Mitchella repens Linnaeus
(Partridge-berry) [$ #] SCPP 337

SALICACEAE

Salix nigra Marshall
(Black Willow) [$ #] SCPP 916

SANTALACEAE

Phoradendron leucarpum (Rafinesque) Reveal & M.C. Johnston ssp. *leucarpum*
(American Mistletoe) SCPP 754

SAPINDACEAE

Acer negundo Linnaeus var. *negundo*
(Eastern Boxelder) [$ #] SCPP 595, 763
Acer pensylvanicum Linnaeus
(Striped Maple) SCPP 863
Acer rubrum Linnaeus
(Red Maple) [#] SCPP 2, 3, 10, 325, 491, 580
Acer saccharum Marshall
(Sugar Maple) [#] SCPP 674
Aesculus flava Solander
(Yellow Buckeye) [#] SCPP 407.5, 486, 814

SAXIFRAGACEAE

Astilbe biternata (Ventenat) Britton
(Appalachian False Goat's-beard) [#] SCPP 995
Heuchera americana Linnaeus
(American Alumroot) [#] SCPP 30, 107
Mitella diphylla Linnaeus
(Two-leaved Miterwort) [#] SCPP 72
Tiarella cordifolia Linnaeus
(Heart-leaved Foamflower) [$ #] SCPP 80

SCROPHULARIACEAE

Verbascum blattaria Linnaeus
(Moth Mullein) [$ *] SCPP 250, 989
Verbascum thaspus Linnaeus
(Great Mullein) [$ *] SCPP 336

SIMAROUBACEAE

Ailanthus altissima (P. Miller) Swingle
(Tree-of-heaven) [$ *] SCPP 504

SOLANACEAE

Solanum carolinense Linnaeus var. *carolinense*
(Horse-nettle) [#] SCPP 143, 955
Solanum ptychanthum Dunal
(Eastern Black Nightshade) SCPP 485

ULMACEAE

Ulmus rubra Muhlenberg
(Slippery Elm) [$ #] SCPP 410, 866

URTICACEAE

Boehmeria cylindrica (Linnaeus) Swartz
(False Nettle) SCPP 313
Laportea canadensis (Linnaeus) Weddell
(Wood Nettle) [$ #] SCPP 237
Pilea pumila (Linnaeus) A. Gray
(Clearweed) [$] SCPP 668

VERBENACEAE

Verbena hastata Linnaeus
(Common Vervain) SCPP 1041
Verbena urticifolia Linnaeus
(White Vervain) [$ #] SCPP 271, 303, 434, 1042

VIOLACEAE

Viola bicolor Pursh
(Wild Pansy) [#] SCPP 770
Viola canadensis Linnaeus var. *canadensis*
(Tall White Violet) [#] SCPP 469, 470, 809, 862
Viola cucullata Aiton
(Marsh Blue Violet) SCPP 82
Viola hastata Michaux
(Halberd-leaved Yellow Violet) [#] SCPP 962
Viola palmata Linnaeus
(Wood Violet) [$] SCPP 86, 848
Viola pubescens Aiton

(Downy Yellow Violet) [#] SCPP 21, 51
Viola rostrata Pursh
(Long-spurred Violet) [#] SCPP 26, 52
Viola sororia Willdenow
(Confederate Violet) [#] SCPP 9, 27
Viola striata Aiton
(Striped Violet) [#] SCPP 766

VITACEAE

Parthenocissus quinquefolia (Linnaeus) Planchon
(Virginia-creeper) [$ #] SCPP 260, 382, 644
Vitis aestivalis Michaux var. *aestivalis*
(Summer Grape) SCPP 332, 436, 879, 993
Vitis cinerea (Engelmann in A. Gray) Engelmann ex Millardet var. *baileyana* (Munson) Comeaux
(Possum Grape) [#] SCPP 323
Vitis vulpina Linnaeus
(Frost Grape) SCPP 393

APPENDIX B

Species Reported in Steele Creek Park, Sullivan County, TN by Louise Howard (1972) but Not Found in the Current Study

This table contains species that were reported by Louise Howard in her 1972 study of Slagle Hollow Area but were not recovered in the current study. The species checklist is organized by family, with columns containing the species (nomenclature as she reported), whether a voucher specimen was found at the ETSU Herbarium, the current status of that voucher specimens determination, the new nomenclature if applicable, the botanist who annotated the sheet, and the date on which they were annotated.

Voucher specimens for sixteen of the reported species in this list were not found in the ETSU Herbarium. It is not known if specimens existed for these species that were lost or now reside in other herbaria. In her thesis she stated that duplicate specimens were sent to UT Herbarium in Knoxville. Upon contacting the Herbarium staff there and reviewing their accession records no specimens collected by Louise Howard were found.

In two instances the species reported in Louise Howard's thesis were not found in the ETSU Herbarium, but a different species in the same genus that was not reported was found while searching. These include *Lindernia anagallidea* and *Asclepias incarnata var. pulchra*. A voucher specimen for *Lindernia anagallidea* was not found, but a specimen collected by Louise Howard in 1972 in Slagle Hallow area of the unreported *Lindernia pyxidaria* was found in the Scrophulariaceae section of the ETSU Herbarium. *Asclepias incarnata var. pulchra* was not found, but rather a specimen collected by Louise Howard from Slagle Hollow Area of *Asclepias exaltata*. The *Asclepias exaltata* determination was confirmed by John C. Warden in January of 1977.

The remaining specimens were found, although eight had been previously annotated and improper determinations corrected. In all cases, except one, these were annotated by John C. Warden, the curator of the ETSU Herbarium from 1966 to 1997. The exception to this is a correction of *Hexastylis virginica* to *Hexastylis heterophylla* by James E. Padgett in 2003.

Family	Species	Specimen Found at ETSU Herbarium	Status of Determination	New Nomenclature	Annoted By	Date Annoted
Acanthaceae	*Ruellia humilis*	yes	incorrect	Ruellia purshiana Fern.	John C. Warden	1976
Apocynaceae	*Apocynum cannabinum*	no				
Aquifoliaceae	*Ilex montana*	yes	incorrect	Ilex ambigua (Michx.) Torr.	John C. Warden	1977
Aristolochiaceae	*Hexastylis virginica*	yes	incorrect	Hexastylis heterophylla (Ashe) Small	James E. Padgett	2003
Asclepiadaceae	*Asclepias incarnata var. pulchra*	maybe		Asclepias exaltata L.		
Berberidaceae	*Caulophyllum thalictroides*	yes				
Betulaceae	*Corylus americana*	yes				
Betulaceae	*Ostrya virginiana*	yes				
Caprifoliaceae	*Sambucus ebulus*	yes	incorrect	Sambucus canadensis L.	John C. Warden	1977
Caprifoliaceae	*Viburnum prunifolium*	yes				
Caprifoliaceae	*Lonicera dioica*	yes				
Caryophyllaceae	*Cerastium viscosum*	yes	correct		John C. Warden	1977
Caryophyllaceae	*Saponaria officinalis*	yes				
Caryophyllaceae	*Dianthus armeria*	yes				
Compositae	*Antennaria solitaria*	yes				
Compositae	*Coreopsis grandiflora*	yes				
Compositae	*Eupatorium fistulosum*	yes				
Compositae	*Eupatorium perfoliatum*	yes				
Compositae	*Galinsoga ciliata*	yes				
Compositae	*Helianthus divaricatus*	yes				
Compositae	*Krigia occidentalis*	yes				
Compositae	*Verbesina virginica*	yes				
Compositae	*Cirsium nuttallii*	no				
Cruciferae	*Cardamine bulbosa*	yes				
Cruciferae	*Dentaria incisifolia*	yes				
Ebenaceae	*Disospyros virginiana*	yes				
Ericaceae	*Vaccinium tenellum*	yes	incorrect	Gaylussacia baccata (Wang.) K. Koch	John C. Warden	1980
Ericaceae	*Vaccinium melanocarpum*	yes				
Ericaceae	*Vaccinium neglectum*	yes				
Fabaceae	*Robinia viscosa*	yes				
Fabaceae	*Desmodium paniculatum*	no				
Fabaceae	*Lathyrus venosus*	no				
Fabaceae	*Melilotus officinalis*	no				
Fagaceae	*Castanea pumila*	no				
Fagaceae	*Quercus borealis var. maxima*	no				
Fagaceae	*Quercus prinus*	no				
Fagaceae	*Quercus stellata*	no				
Geraniaceae	*Geranium dissectum*	yes				
Geraniaceae	*Geranium rotundifolium*	yes				
Hippocastanaceae	*Aesculus pavia*	yes				

Family	Species	Specimen Found at ETSU Herbarium	Status of Determination	New Nomenclature	Annoted By	Date Annoted
Hypericaceae	*Hypericum perforatum*	yes	incorrect	Hypericum punctatum Lam.	John C. Warden	1976
Juglandaceae	*Carya cordiformis*	no				
Liliaceae	*Aletris farinosa*	yes				
Liliaceae	*Polygonatum canaliculatum*	yes				
Linaceae	*Linum virginianum*	no				
Loganiaceae	*Spigelia marilandica*	yes				
Lythraceae	*Rotala ramosior var. interior*	yes				
Menispermaceae	*Menispermum canadense*	yes				
Oxalidaceae	*Oxalis repens*	yes	incorrect			
Oxalidaceae	*Oxalis europaea*	yes				
Polygalaceae	*Polygala senega*	yes				
Polygonaceae	*Polygonella polygama*	yes				
Polygonaceae	*Rumex acetosella*	yes				
Polygonaceae	*Polygonum sagittatum*	no				
Portulacaceae	*Claytonia caroliniana*	yes	correct			
Primulaceae	*Steironema ciliatum*	yes				
Pteridaceae	*Thelypteris noveboracensis*	yes	correct			
Pteridaceae	*Dryopteris goldiana*	yes	correct			
Ranunculaceae	*Ranunculus allegheniensis*	yes	correct		John C. Warden	
Ranunculaceae	*Anemone lancifolia*	yes		included in *Anemone quinquefolia*		
Ranunculaceae	*Ranunculus septentrionalis*	yes				
Ranunculaceae	*Thalictrum clavatum*	no				
Rosaceae	*Agrimonia striata*	yes				
Rosaceae	*Geum virginianum*	yes				
Rosaceae	*Potentilla canadensis*	yes		likely *Potentilla simplex*		
Rosaceae	*Rubus strigosus*	yes				
Rubiaceae	*Galium pilosum*	yes				
Rubiaceae	*Houstonia longifolia*	yes				
Salicaceae	*Populus balsamifera*	no				
Salicaceae	*Salix sericea*	no				
Saxifragaceae	*Heuchera pubescens*	yes				
Scrophulariaceae	*Veronica serphyllifolia var. humifusa*	yes				
Scrophulariaceae	*Lindernia anagallidea*	maybe		Lindernia pyxidaria L.		
Ulmaceae	*Ulmus americana*	yes				
Umbelliferae	*Sanicula trifoliata*	yes				
Umbelliferae	*Zizia trifoliata*	yes				
Violaceae	*Viola eriocarpa*	yes	incorrect	Viola pensylvanica		
Violaceae	*Viola triloba*	yes				
Vitaceae	*Vitis palmata*	yes				
Vitaceae	*Vitis riparia*	yes				
Vitaceae	*Vitis rupestris*	yes	propably incorrect			

APPENDIX C

Site Descriptions of Carolina Vascular Survey Study Plots Installed in Canopy Gaps and Fully Canopy Locations within Steele Creek Park, Sullivan County, Tennessee

A description of each study site including the rational for using that canopy gap, the finding of an area for the comparable intact canopy plot, and additional notes are provided here. The data are also given and will also be available on the Carolina Vascular Survey database.

STUDY SITE 1.

Slagle Creek lies in the deep valley on the western half of Steele Creek Park. It has two tributary branches, both contained by the ridges of the park, which converge to form a perennial stream. The riparian zone of Slagle Creek includes an area of level land averaging 40 m wide covered in muddy loam soil bordered by abruptly steep slopes. The creek winds within this flat strip in a recessed bed, and in places the banks are about a meter high. A stand of *Arundinaria gigantea* (Walt.) Muhl. was found growing in this portion of the park. *Arundinaria gigantea* is a member of the tribe Bambuseae within the family Poaceae that is native to North America (FNA 2013). I had been working intensely on grasses, so this plant immediately captivated my attention. The surrounding area became significant in telling this plant's story. The stand covered an area of approximately 120 square meters. Historically populations growing in dense clusters known as canebrakes could cover large areas. Human disturbance and domesticated grazing have significantly reduced canebrake ecosystems. They are characterized as "critically endangered" ecosystems by the National Biological Service (Zaczek 2003).

The population of *Arundinaria gigantea* was between Slagle Hollow Trail and Slagle Creek but remained on the muddy loam shelf. A large *Platanus occidentalis* L. growing on the edge of Slagle Creek's bank had fallen and landed on the western edge of the *Arundinaria gigantea* population. A *Quercus* tree on the opposite bank had also fallen. Both trees had root balls attached on the creek bank and were now lying parallel with their crowns pointing northeast. The gap created in the canopy by these two trees was continuous and deemed a viable study site for canopy gaps within the park.

The area within the gap designated for the 10 m x 10 m plot was a gravel bar contained by a bend in the river to the south. The northwest and northeast corners of the plot were on the northern stream bank and covered approximately eight square meters of the flat loamy land above the creek bed. The northeast corner of the plot included the root ball of the fallen *Quercus* tree, and the southeast corner was just west of the *Platanus occidentalis* root ball. The area contained in the study plot received abundant direct sunlight. The dominant plant by percent cover was *Packera aurea* (L.) A. & D. Love, which covered 40% of the area within the plot. *Sisyrinchium angustifolium* Mill., *Iris cristata* Sol., and *Stachys cordata* Riddell were others species present worth noting. The comparable full canopy plot was chosen by searching Slagle Hollow for the nearest location that met the requirements. Approximately 50 m upstream Slagle Creek bent to create a similar area of gravel bar and loam bank. The canopy was completely full here and the area within the plot was well shaded.

The canopy gap plot had 35 species occurring within it. Thirty species were documented in the full canopy plot. Within this study site 18 species were found only in the canopy gap plot. Conversely 13 species were found only in the full canopy plot. Seventeen species were documented in both plots, with 48 total species recorded in this study site.

The purposes of installing plots in this location were to represent a canopy gap occurring in a riparian zone and to document the species currently occupying the gap within range of the *Arundinaria gigantea*. This canopy gap could create a new habitat for the *Arundinaria* or allow an invasive exotic plant to become established in that area of the park. Future monitoring of this area could result in recording the succession or revival of a canebreak plant community.

STUDY SITE 2.

This study site was one of the last sites added and was sought because a large section of the park was not represented by a canopy gap study site. The intent was to locate a canopy gap occurring on the ridges north of Slagle Hollow. The knobs that extend in this section of the park were explored and several possible canopy gaps were considered. A very interesting location was found in this region of the park along the ridge to the west of the Logging Road Trail. Almost a dozen trees had been blown down, and a continuous canopy gap was created on a steep portion

of the ridge. This site was considered extremely interesting but also not accessible. The amount of woody debris, the slope of the hill, and the amount of woody succession occurring made it too difficult to install a study plot. The primary gap fillers were *Ceanothus americanus* L. and *Acer rubrum* L. during the current study. Although the area was explored for inventory purposes and the dominant woody successors were noted, no additional work was done in this area.

An alternative site was chosen farther south on the same ridge that had a single fallen *Quercus* in a more manageable location. The area was still relatively steep and characteristic of the mixed-Oak forest growing on the majority of the ridges within the park. The canopy gap study plot was installed in an area of direct sunlight containing a large amount of woody debris.

Thirty-six species were recognized growing within this plot with a dominant presence of *Smilax*. Twenty-seven species were recorded in a comparable location with full canopy. Within this study site 12 species were unique to the gap plot, 24 species were observed in both, and only three species were unique to the full canopy plot. The species *Aesculus flava* Sol., *Cornus alternifolia* L., and *Goodyera pubescens* (Willd.) R.Br. were found only in the full canopy plot. Thirty-nine species in total were documented as occurring in plots installed in this study site.

STUDY SITE 3.

This study site may serve as the most valuable plot that I sampled during the current study. The *Carya ovata* (P. Miller) K. Koch that fell to create the canopy gap here is known to have fallen during the storm on June 23, 2014. I had been visiting the location frequently because I knew of Study Site 4 and was monitoring the growth of some *Cypripedium* species in the adjacent valley. The tree was still standing on June 20, 2014 when I passed it hiking to the *Cypripedium*. On June 24, 2014, the day after an intense storm swept through eastern Tennessee, I returned to the location to find the tree fallen. This is a confirmed date of when the tree fell and the study plot was installed within a week of the tree being down.

Thirty-one species were documented in the canopy gap plot, and 33 species were found in full canopy plot. Within this study site 11 species were unique to the gap plot, 20 species were observed in both, and 13 species were unique to the full canopy plot. Forty-four species in total were documented as occurring in plots installed in this study site. It is expected that all of these

species are shade tolerant and that shade intolerant plants will begin to colonize and outcompete within the canopy gap.

The purpose of installing plots in this location was to document a canopy as close to its time of origin as possible. Future monitoring of this location will have an accurate record of the initial composition from which interesting comparisons could be made.

STUDY SITE 4.

I discovered this canopy gap while exploring during the 2013 collecting season. It is one of the most interesting locations within the park. The cove has extremely steep slopes on both sides and a thin strip of level land between them. A small stream runs through this and into Slagle Creek. A large *Carya* and *Pinus strobus* L., both with a dbh of about a meter had fallen. They lay parallel with their crowns facing west. Three other mature trees had been involved in the disturbance. These smaller trees were all snapped off by the falling giants but contributed a large amount of woody debris to the area. The loss of five trees within the cove created a large gap in the canopy. The magnitude of this location largely contributed to my decision to install study plots in canopy gaps. The location was so impressive that I wanted to document it, and the installation of study plots was the most viable way to record the pertinent information.

Thirty-eight species were documented in the canopy gap plot, and 35 species were found in full canopy plot. Within this study site 15 species were unique to the gap plot, twenty-three species were observed in both, and 12 species were unique to the full canopy plot. This was the most diverse study site, with fifty species documented in total.

STUDY SITE 5.

This site was located on a steep slope just below the North Ridge Trail. A large *Quercus alba* L. growing on one slope had fallen and now spanned the cove like a bridge. Four additional trees had also fallen in this area to contribute to a single canopy gap. All trees were positioned with their crowns pointing west. The ridge above this disturbance was now receiving an increased amount of direct sunlight.

The canopy gap study plot was installed to the northeast of the fallen woody debris. The southern edge of the plot was parallel to the large *Quercus alba* that had fallen, but separated by 5 meters. The western edge of the plot included the root ball of one of the smaller trees that had fallen.

Thirty-five species were documented in the canopy gap plot, and 21 species were documented in the full canopy plot. Within this study site, 19 species were found only in the gap plot, five species were found only in the full canopy plot, and 16 were found in both. Forty species in total were documented for this study site.

STUDY SITE 6.

This location was found while hiking the Lake Ridge Trail. Three large *Quercus rubra* L. had fallen creating a single canopy gap. The crowns of the trees were all pointing south, and the ridge above them was now exposed to direct sunlight. The age of this gap based on the fallen woody debris and rate of gap filling was estimated to be within the last three years. In comparison to the majority of the other plots this site was a relatively recent disturbance.

Twenty-five species were documented in the canopy gap plot and 27 species were documented in the full canopy plot. This was one of the three study sites where more vascular plant diversity was found in the full canopy plot than the canopy gap. Within this study site 10 species were found only in the gap plot, 12 species were found only in the full canopy plot, and 15 were found in both. Thirty-seven species in total were documented for this study site.

STUDY SITE 7.

The location for this study site was found while searching for *Buckleya distichophylla* (Nutt.) Torr., a rare shrub that grows by parasitizing the roots of *Tsuga canadensis* (L.) Carr and various other species in healthy cove forests of the Southern Appalachians. *Buckleya distichophylla* was not found within Steele Creek Park, but the hemlock forest provided a remarkable canopy gap to install a plot in. The two stands of hemlock within SCP cover less than five hectares on the slope above the western shore of the lake and less than five hectares in the

valley surrounding Hemlock Trail. Both populations have been affected by *Adelges tsugae* (Hemlock woolly adelgid).

Four trees, a *Pinus strobus*, a *Quercus rubra*, and two *Carya*, had fallen to create a single gap within the Hemlock forest. The surrounding trees were almost entirely *Tsuga canadensis*. The crowns of the fallen trees were all facing south. The plot was installed running parallel to one of the *Carya* with the southeast corner encompassing the root ball of the fallen *Quercus rubra*.

The canopy gap plot was the most diverse plot installed during the current study with Forty-four species occurring in a 10 m x 10 m area. The comparable plot installed in full canopy of a hemlock forest had only 19 species, which tied for the least diverse plot. Within this study site 27 species were found exclusively in the gap plot, only two species were unique to the full canopy plot, and 17 species were found in both. The two species found only in the full canopy plot were *Nyssa sylvatica* and *Goodyera pubescens*. Forty-six species in total were documented for this study site.

STUDY SITE 8.

The fallen tree at this location was the original inspiration to explore the patterns of vegetation in canopy gaps. I discovered the canopy gap during the end of the 2013 collecting season. The leaves had fallen, allowing high visibility, and from a nearby ridge I was able to observe the entire tree laying on the slope below me.

Twenty-eight species were documented in the canopy gap plot, and 30 species were found in the full canopy plot. Within this study site, 11 species were found only in the canopy gap, 13 were found only under full canopy, and 17 were recorded in both. In total 41 species were documented within this study site.

STUDY SITE 9.

This study site contained the most woody debris within the installed canopy gap plot of the current study. A *Quercus* tree had fallen with its crown pointing south. The path of the falling

tree intercepted several large branches of nearby *Quercus* and *Carya* trees. These were all snapped off and brought down into a pile close to the East Ridge Trail. Sunlight was reaching the plants amongst this woody debris, and a noticeable difference in composition was observed under the canopy gap as compared to adjacent full canopy forest.

Twenty-six species were documented within the canopy gap plot, and 19 species were found in the full canopy plot. Within this study site 16 species were found only in the canopy gap plot, nine species were found only in the full canopy plot, and 10 were found in both. In total 35 species were observed as occurring within the plots of this study site.

STUDY SITE 10.

The purpose of this study site was to document the forest composition on the slopes and ridges of Trinkle Hollow because this is the only place in SCP where *Rhododendron maximum* L. is established as an understory component of the forest community. Three *Rhododendron* species, *R. maximum*, *R. arborescens* (Pursh) Torr., and *R. calendulaceum* (Michx.) Torr., were found in the plots installed here.

Twenty-six species were documented within the canopy gap plot, and 25 species were found in the full canopy plot. Within this study site 10 species were found only in the canopy gap plot, nine species were found only in the full canopy plot, and 16 were found in both. In total 35 species were observed as occurring within the plots of this study site.

Species	Site 1 Plot A	Site 1 Plot B	Site 2 Plot A	Site 2 Plot B	Site 3 Plot A	Site 3 Plot B	Site 4 Plot A	Site 4 Plot B	Site 5 Plot A	Site 5 Plot B	Site 6 Plot A	Site 6 Plot B	Site 7 Plot A	Site 7 Plot B	Site 8 Plot A	Site 8 Plot B	Site 9 Plot A	Site 9 Plot B	Site 10 Plot A	Site 10 Plot B	Total Occurrences In Plot A (Gaps)	Total Occurrences In Plot B (Canopy)	Total
Acer pensylvanicum										1											0	1	1
Acer rubrum			1	1			1	1	1	1	1	1	1	1	1	1			1	1	7	7	14
Acer saccharum		1			1	1	1	1	1			1	1	1		1	1	1			5	7	12
Actaea racemosa		1			1	1	1	1					1								3	3	6
Adiantum pedatum		1					1													1	1	2	3
Aesculus flava	1	1		1																	1	2	3
Amelanchier arborea								1	1	1	1	1			1	1	1		1	1	5	5	10
Anemone quenquefolia																			1		1	0	1
Angelica venenosa			1						1		1										3	0	3
Antennaria plantaginifolia												1									0	1	1
Arisaema triphyllum			1		1	1	1	1				1				1	1				4	4	8
Aruncus dioicus	1																				1	0	1
Asarum canadense		1			1	1	1	1					1								3	3	6
Asplenium platyneuron									1							1					1	1	2
Betula lenta			1	1	1	1	1	1		1	1	1	1	1	1	1			1	1	7	8	15
Boechera laevigata									1												1	0	1
Botrypus virginianus	1	1						1								1		1			1	4	5
Brachyelytrum erectum												1			1						1	1	2
Calystegia sepium			1	1							1										2	1	3
Cardamine diphylla		1																			0	1	1
Cardamine hirsuta	1																				1	0	1
Carex laxiflora					1										1			1			2	1	3
Carex lurida	1																				1	0	1
Carex rosea																	1				1	0	1
Carex virescens	1												1								2	0	2
Carpinus caroliniana	1		1	1		1						1	1	1							3	4	7
Carya glabra			1		1	1															2	1	3
Carya ovata					1								1	1							2	1	3
Castanea dentata													1								1	0	1
Cercis canadensis					1	1	1				1	1	1	1	1	1	1				6	4	10
Chimaphila maculata			1	1					1	1	1	1			1	1			1		5	4	9
Circaea canadensis	1						1														2	0	2
Cirsium vulgare													1								1	0	1
Clintonia umbellulata																			1	1	1	1	2
Conopholus americana						1														1	0	2	2
Coreopsis major												1									0	1	1
Cornus alternifolia				1	1	1															1	2	3
Cornus florida			1	1			1	1		1	1		1		1	1					5	4	9
Cuscuta pentagona	1	1																			1	1	2
Cynoglossum virginianium															1						1	0	1
Dioscorea villosa			1	1		1	1				1					1	1		1	1	5	4	9
Dryopteris marginalis													1						1		2	0	2
Erigeron annuus	1																1				2	0	2
Eupatorium perfoliatum															1						1	0	1
Fagus grandifolia		1																			0	1	1
Fraxinus americana			1	1		1	1	1	1		1	1	1	1			1	1		1	6	7	13

Species	Site 1 Plot A	Site 1 Plot B	Site 2 Plot A	Site 2 Plot B	Site 3 Plot A	Site 3 Plot B	Site 4 Plot A	Site 4 Plot B	Site 5 Plot A	Site 5 Plot B	Site 6 Plot A	Site 6 Plot B	Site 7 Plot A	Site 7 Plot B	Site 8 Plot A	Site 8 Plot B	Site 9 Plot A	Site 9 Plot B	Site 10 Plot A	Site 10 Plot B	Total Occurrences In Plot A (Gaps)	Total Occurrences In Plot B (Canopy)	Total
Galium aparine	1		1			1	1		1						1	1	1				6	2	8
Galium circaezans			1	1	1	1	1	1	1		1	1	1	1		1					6	6	12
Galium latifolium																			1		1	0	1
Gaultheria procumbens													1		1						2	0	2
Geranium maculatum	1	1						1													1	2	3
Goodyera pubescens				1				1						1	1				1	1	2	4	6
Hamamelis virginiana					1		1												1		3	0	3
Heuchera americana										1											0	1	1
Hexastylis arifolia								1					1							1	1	2	3
Hexastylis heterophylla																			1		1	0	1
Houstonia purpurea		1									1										1	1	2
Hypericum punctatum						1							1								1	1	2
Impatiens pallida	1																				1	0	1
Iris cristata	1																				1	0	1
Juglans nigra			1								1										2	0	2
Laportea canadensis					1														1		2	0	2
Ligustrum sinense											1										1	0	1
Lindera benzoin	1	1			1	1	1	1								1	1	1			4	5	9
Liriodendron tulipifera			1	1			1				1	1	1	1	1	1	1	1	1	1	7	6	13
Lobelia siphilitica						1															0	1	1
Lonicera japonicum	1								1			1	1		1		1	1			5	2	7
Luzula acuminata	1																		1	1	2	1	3
Magnolia acuminata			1	1		1	1	1	1	1									1		4	4	8
Maianthemum racemosum									1												1	0	1
Medicago lupilina															1						1	0	1
Monarda clinipodia					1	1	1														2	1	3
Morus rubra													1								1	0	1
Nyssa sylvatica		1	1	1			1		1	1	1	1		1	1	1		1	1	1	6	8	14
Oxalis grandis					1																1	0	1
Oxalis stricta	1												1								2	0	2
Oxalis violacea																	1				1	0	1
Packera aurea	1	1						1				1									1	3	4
Panax quinquefolia							1														1	0	1
Parthenocissus quinquefolia	1	1	1	1	1	1		1	1	1		1	1	1	1	1		1		1	6	10	16
Phacelia bipinnatifida	1	1	1				1	1											1		4	2	6
Phytolacca americana							1		1		1		1				1				5	0	5
Pinus strobus					1								1								2	0	2
Pinus virginiana															1	1					1	1	2
Platanus occidentalis	1	1																			1	1	2
Poa pratensis					1	1															1	1	2
Podophyllum peltatum																		1			0	1	1
Polygonatum biflorum		1	1	1			1	1			1		1	1		1	1				5	5	10
Polystichum acrostichoides	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1	1	1	9	8	17
Potentilla simplex													1								1	0	1
Prosartes lanuginosa			1		1		1	1	1	1		1					1	1	1	1	6	5	11
Prunus serotina			1	1			1		1	1	1		1		1					1	6	3	9

Species	Site 1 Plot A	Site 1 Plot B	Site 2 Plot A	Site 2 Plot B	Site 3 Plot A	Site 3 Plot B	Site 4 Plot A	Site 4 Plot B	Site 5 Plot A	Site 5 Plot B	Site 6 Plot A	Site 6 Plot B	Site 7 Plot A	Site 7 Plot B	Site 8 Plot A	Site 8 Plot B	Site 9 Plot A	Site 9 Plot B	Site 10 Plot A	Site 10 Plot B	Total Occurrences In Plot A (Gaps)	Total Occurrences In Plot B (Canopy)	Total
Quercus alba			1			1		1												1	1	3	4
Quercus marilandica	1		1						1				1		1			1			5	1	6
Quercus montana			1	1	1				1	1	1	1			1	1			1	1	6	5	11
Quercus rubra	1	1	1	1	1	1			1	1	1	1	1	1	1	1		1	1	1	8	9	17
Ranunculus hispidus	1	1															1				2	1	3
Rhododendron arborescens													1								1	0	1
Rhododendron calendulaceum																			1		1	0	1
Rhododendron maximum																			1	1	1	1	2
Rhus copallinum													1								1	0	1
Rhus glabra									1				1								2	0	2
Rosa carolina			1						1	1											2	1	3
Rubus argutus			1				1		1	1	1	1	1			1					5	3	8
Rubus flagellaris									1												1	0	1
Rubus occidentalis						1			1				1								2	1	3
Sanguinaria canadensis					1	1	1	1													2	2	4
Sassafras albidum			1	1					1	1	1	1	1		1	1				1	5	5	10
Scutellaria elliptica		1				1	1						1			1		1			2	4	6
Sedum ternatum					1			1													1	1	2
Sisyrinchium angustifolium	1																				1	0	1
Smilax hispida	1	1				1	1	1									1				3	3	6
Smilax rotundifolia			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9	9	18
Solidago curtissii	1	1			1	1	1	1	1				1				1	1		1	6	5	11
Stachys cordata	1																				1	0	1
Thalictrum thalictroides	1	1			1	1	1	1													3	3	6
Thaspium barbinode	1		1	1	1		1	1	1	1		1	1	1							6	5	11
Tilia americana	1	1			1			1									1	1			3	3	6
Toxicodendron radicans			1	1													1				2	1	3
Trillium erectum		1																			0	1	1
Tsuga canadensis													1	1							1	1	2
Ulmus rubra		1							1							1		1			1	3	4
Urtica dioica	1	1					1										1				3	1	4
Uvularia perfoliata		1	1	1		1	1	1							1						3	4	7
Vaccinium pallidum			1	1					1	1	1	1									3	3	6
Verbascum thapsus													1								1	0	1
Verbesina alternifolia																1					0	1	1
Viburnum acerfolium			1					1		1		1			1	1			1	1	3	5	8
Vinca minor													1	1		1	1				2	2	4
Viola canadensis					1	1															1	1	2
Viola rotundifolia								1													0	1	1
Vitis vulpina									1								1				2	0	2
Zizia aurea									1												1	0	1
Totals	34	30	36	27	31	33	37	34	35	21	25	27	44	19	28	30	26	19	26	25			

VITA

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