VASCULAR PLANT SURVEY OF THE CANYONLANDS UNIT OF THE BIG THICKET NATIONAL PRESERVE, TYLER COUNTY, TEXAS

A Thesis

by

KELLY CAROLYN HAILE

Submitted to the Office of Graduate studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2012

Major Subject: Rangeland Ecology and Management

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Approved by:

Chair of Committee,	Stephan L. Hatch
Committee Members,	David M. Cairns
	Robert W. Knight
Department Head,	David D. Baltensperger

Major Subject: Rangeland Ecology and Management

ABSTRACT

Vascular Plant Survey of the

Canyonlands Unit of the Big Thicket National

Preserve, Tyler County, Texas. (August 2012)

Kelly Carolyn Haile, B.S., Texas A&M University

Chair of Committee: Dr. Stephan L. Hatch

The Big Thicket National Preserve is located in the southern part of the United States. It is within the Pineywoods vegetation region of southeastern Texas. This study area was the Canyonlands Unit, a unit located entirely within Tyler County, Texas. This unit is one of the most recently acquired units within the Big Thicket National Preserve. It was acquired in 1993 and is composed of 1,476 acres.

The purpose of this study was to make a complete list of all the vascular plant species within the Canyonlands Unit. The numbers of plant species within this unit were compared to three other units within the preserve that are relatively close to the Canyonlands Unit. The plant species within these units were compared on number of species that are native versus introduced, longevity, season of growth, plant type (woody versus herbaceous), plant group (monocots, dicots, gymnosperms, ferns) and upland versus wetland plants based on region six wetland indictor values. The wetland plant species were compared among themselves as the number of obligate species versus facultative wetland plant numbers. This study also shows the number of invasive and weedy species within the Canyonlands Unit.

Along with determining the number of plant species and comparing those with the number of species in the other units, a Cluster Analysis and Indicator Species Analysis was conducted on the woody vegetation within the Canyonlands Unit in order to determine woody plant communities. These analyses were conducted by using the statistical software, PC-ORD.

ACKNOWLEDGEMENTS

There are so many people that have helped me throughout this project. I would first like to thank my committee members, Dr. Stephan Hatch, Dr. David Cairns, and Dr. Robert Knight. Their help and guidance is what helped my complete this project. Dr. Hatch has been a real mentor throughout this project and my whole college career. I have learned so much from his classes and working with him the past four years. I would also like the thank Dr. Knight for all of his help throughout my college career as well, Dr. Knight has always been there when I had a question or needed something. I appreciate all that my committee members did to help me finish this project and look forward to working with them in the future.

I would also like to say how grateful I am to have Dale Kruse at the herbarium, and thank him for all of his help throughout my project, he was always there if I didn't understand something or to point out other related topics that I should look into throughout this project. Dale could always give me his expert opinion about something and I always appreciated the help. Also, I want to thank him for all of his help identifying ferns and sedges, he saved me a lot of time and aggravation. Dale also helped me figure out PC-ORD and helped me understand what I was working with.

There are many people that I would like to thank that helped with the field work of this project. I would like to thank Mindy Gallardo for helping start this project and make some of the first collections. I would like to thank the student workers, Steven Goertz and Erin Wied for having an interest in the Big Thicket and agreeing to help on the collection trips.

I would also like to thank my family and friends that put time into this project and help me complete the work that needed to get done. I want to give a big thanks to my dad and sister Katherine for the time that they put in collecting plants and conducting transect for the Indicator Species Analysis and Cluster Analysis on the hot summer days at the Big Thicket. It is a tough

job but they both volunteered to go back whenever I was going. They made the trips enjoyable and fun. I would also like to thank George Umphres for his help in the field and the encouragement for completing this project.

And last but not least, I would like to thank my parents for all of their help and encouragement throughout my entire college career and life. They have always been there for me no matter the situation. I am so grateful to have a family who supports my decisions and helps me achieve my goals that I set for myself.

Thanks everyone who has had a hand in this project, I appreciate all of the help and support that has been shown to me during this time. I am excited about completing this degree and seeing what is in store for me next. I look forward to the new opportunities and leaning experiences that are to come.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

The Big Thicket National Preserve is located in the Pineywoods vegetation area of southeastern Texas. The Preserve was established in 1974, and was America's first National Preserve with approximately 86,000 acres (Peacock 1994). In 1981 the preserve was designated a UNESCO Biosphere Reserve by the United Nations and in 2001 the American Bird Conservancy designated the preserve as a Globally Important Bird Area. Today the preserve consists of just over 100,000 acres that make up a total of 15 units that spread over parts of seven different counties in Texas (Watson 2006).

The Big Thicket National Preserve is composed of many different landscape types from dry upland areas to lowland cypress swamps. This vast arrangement of landscapes makes the area unique and home to a wide array of wildlife species. This Preserve is also open to the public for recreation activities such as hiking, camping, birding, fishing, canoeing, hunting (with permit) and other nature related recreational activities (Peacock 1994). This area is a great place to enjoy the outdoors and see a unique part of Texas.

This project focuses on the Canyonlands Unit of the Big Thicket National Preserve. The Big Thicket National Preserve acquired the Canyonlands Unit in 1993. It consists of approximately 1,476 acres and is located on the eastern boundary of Tyler County along 3.5 miles of the Neches River paralleling the east side of the unit. This unit is thought to be the most diverse unit of all of the units within the Big Thicket relative to size. This assumption was made due to the diverse habitat, topography and elevation changes within the unit. Within these few 1,476 acres, there are a variety of landscape changes which include, upland habitat, wetland and riparian areas, cypress swamps and Pineywoods. A floristic study was conducted on this unit to

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This thesis follows the style and format of the Journal of the Botanical Research Institute of Texas.

determine the number of vascular plant species. The research for this floristic study started in November 2008. Not only did this study look at the total number of species but a comparison was made of the plants origin (native versus introduced), longevity (annual versus perennial), season of growth (warm season versus cool season), plant type (woody versus herbaceous), plant group (monocots, dicots, gymnosperms, ferns), wetland versus upland plants, and facultative wetland plants versus obligate wetland plants. The number of invasive and weedy species within the Canyonlands Unit is also given. Along with conducting a floristic study on this unit, an Indicator Species Analysis and Cluster Analysis of all the woody vegetation was done to determine the woody communities within the unit.

This unit is not the only unit to have a floristic study conducted. Floristic studies have been conducted and reported on several of the units in the Big Thicket. The units with floristic studies include Hickory Creek Unit (MacRoberts et al. 2002), Turkey Creek Unit (Brown et al. 2005), The Big Sandy Creek Unit (Brown et al. 2006), Lance Rosier Unit (Brown et al. 2006), Beech Creek Unit (Brown et al. 2008b), Loblolly Unit (Brown et al. 2008a). The results for each of these units are located in table 1.

TABLE 1. Previous floristic study findings.

Unit name	Acres	Species	Families	Introduced species
Hickory Creek Unit	769	400	79	17
Turkey Creek Unit	7800	749	124	50
The Big Sandy Creek Unit	14,300	693	126	45
Lance Rosier Unit	25,024	694	113	71
Beech Creek Unit	4,856	328	103	29
Loblolly Unit	550	305	89	34

The species data from the Beech Creek Unit, Turkey Creek Unit and Hickory Creek Unit will be used to compare to the species data that was collected from the Canyonlands Unit. These

three units were chosen because of their relative location to the Canyonlands Unit (Appendix D). The plant specimens that are collected in the Canyonlands Unit of the Big Thicket will be deposited in at the S.M. Tracy Herbarium at Texas A&M University, College Station, Texas.

The S.M. Tracy Herbarium, the 3rd largest herbarium in Texas, currently houses approximately 250,000 vascular plant specimens, 2,000 fruit and seed specimens, and 5,500 non-vascular plant specimens. This Herbarium serves as the National Park Service repository for the following National Parks and Preserves: the Natchez Trace Parkway (Mississippi, Tennessee and Alabama); Hubbell Trading Post (Arizona); Palo Alto Battlefield, Padre Island National Seashore, and the Big Thicket National Preserve (Texas). The Tracy Herbarium acquires new specimens through the annual collection endeavors of the faculty, staff, and students associated with research and educational pursuits. It also has an on-going specimen exchange program with about 35 herbaria throughout the world. The majority of the specimens housed in the herbarium are geographically from the United States, Canada, Mexico, Central and South America. With an emphasis on education, extension and research, the herbarium activities have been based on taxonomic research related to vascular plants in Texas, the southern United States, and northern Mexico. Recent projects have broadened this focus to include plants of wetland habitats, bioinformatics, and invasive species. The herbarium has also received grant support from the Texas Higher Education Coordination Board- Advanced Research Program and National Park Service to establish an on-line searchable database of the specimens housed at the herbarium, along with various other on-line education related tools to aid in plant identification and research.

Research Objectives

The primary objective of the project was to conduct a floristic study of the Canyonlands Unit of the Big Thicket National Preserve. The information collected shows a current checklist

of all the plants observed and/or collected within this unit. This study becomes the baseline for management of invasive species and threatened and endangered species studies in that unit. This study compares the number of wetland plant species to the upland plant species within the unit. Within the wetlands, a comparison was made of obligate plants versus facultative wet plants. It also compared the number of wetland versus upland species of this unit to the Beech Creek Unit, Turkey Creek Unit and Hickory Creek Unit. This project also looks at the number of woody plants species versus the number of herbaceous plant species and compares the findings to the other three units. A comparison was also made of number of introduced versus native plant species, annual versus perennial plant species, plant group (monocot, dicot, fern and gymnosperms) and warm versus cool plant species. These entities will be compared across Beech Creek Unit, Hickory Creek Unit, and Turkey Creek Unit.

The plants that were collected throughout the unit were compared based on season of growth. This may suggest what season is most productive, be it cool or warm season. The Hickory Creek Unit, Beech Creek Unit, and the Turkey Creek Unit were selected to compare with the Canyonlands Unit because of their relative location and that they already had a completed floristic study conducted. Calculations were made of the number of species within each of these units and a comparison was made of number of plant species/acre based on the total number of species with the total number of acres within the unit. This simple calculation helps determine roughly the unit with the most plant species/acre.

Along with collecting and identifying plant species for the Canyonlands Unit, an Indicator Species Analysis and a Cluster Analysis was conducted on this unit using PC-ORD. These analyses were conducted in order to determine the different woody plant communities. This was only conducted on the woody plant species within the unit.

CHAPTER II

PHYSICAL DESCRIPTION

Location

The Canyonlands Unit is located within the Pineywoods vegetation area of southeastern Texas (Hatch et al. 1990), within Tyler County (Fig. 1). The unit parallels 3.5 miles of the Neches River on the eastern boundary and Hwy 92 on the western boundary, just north of Spurger, Texas.

FIG. 1. Tyler County, Texas. Location of the Canyonlands Unit of the Big Thicket National Preserve.

North of the unit is B.A. Steinhagen Lake that feeds into the Neches River.

Since October 2008, a total of 11 trips were made to the unit in order to make a collection of all the vascular plants in the area (Appendix A) based on climate conditions for the period of the study. A total of 126 different sites were visited during these collection trips. Several sites were visited multiple times throughout the study in order to collect the plants during the different growing seasons (Appendix A). Each site visited was given a different site location number. In addition to the 126 different collection sites, a total of 25 different sites were observed when conducting the Indicator Species Analysis and Cluster Analysis transects.

Topography

The Canyonlands Unit is composed of various types of landscapes and elevations ranging from 60 feet to 200 feet above sea level, with various types of habitat within the 1,476 acres (Fig. 2). There are four distinctive community types within this unit making it unique. These include upland plateau, hill, floodplain and riparian areas. This unit has the unique canyons that create distinctive habitat unlike any of the other units within the preserve. With the wide range of elevation and topography change, this unit was expected to be home to many unique plant species. Pictures of the various landscapes and habitat types can be found in Appendix B**.**

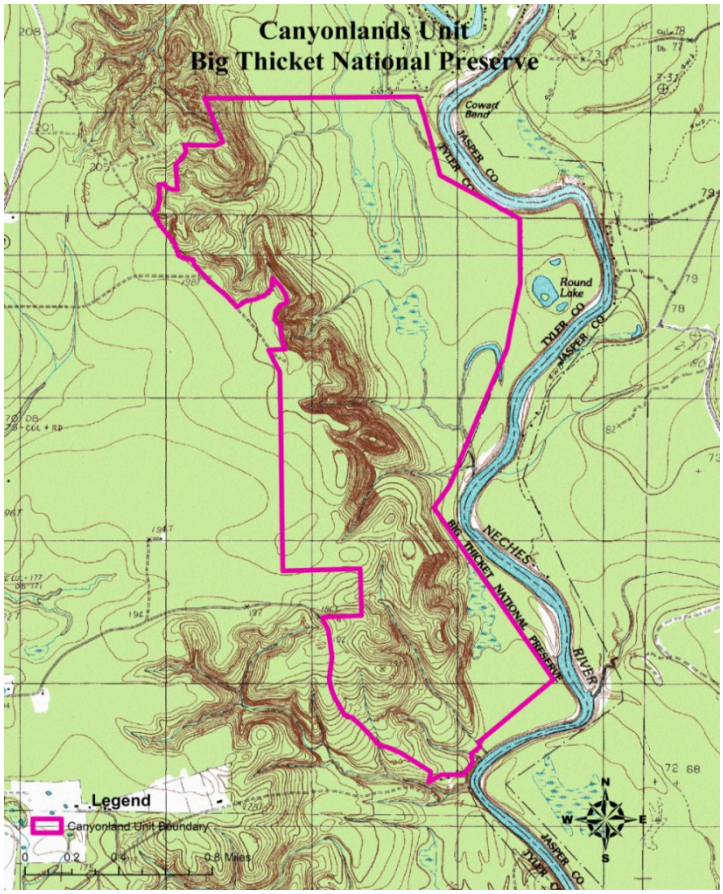

Fig. 2. Canyonlands Unit boundary map, with contour lines and elevation.

Climate

The Canyonlands Unit located in East Texas and has an annual average temperature of 66 – 68° F and receives on average 50” to 54” of rain on an annual basis (Spatial Climate Analysis Services 2000). This portion of Texas is the westernmost area of the eastern United States to receive this large amount of annual rain (MacRoberts 2008). However, as in many areas of Texas, the past two years (2010 & 2011) had below normal rainfall. In 2010 a total of 36.72” were received in Tyler County. In 2011 a total of 31.18” of rain were received (Fig. 3). These were the lowest recorded rainfall for Tyler County. In 1988 a total of 34.11 inches was recorded, before 1988 the least amount of annual rainfall occurred in 1956 with 35.7 inches recorded. In 2008 and in 2009, Tyler County received the average annual rainfall for this region of Texas (Fig. 3). Even with these records it is indicated that 2011 was the driest year on record according to Texas Water Development Boards records that date back to 1940.

Throughout this project we tried to conduct collecting trips during the growing season of each year. The dates of the collecting trips were adjusted based on when the area received rain. With the reduced rainfall there were many changes that took place in this unit during those dry years.

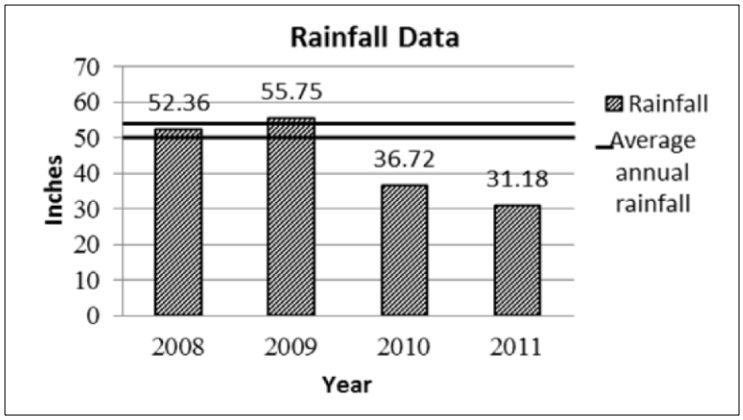

FIG. 3. Tyler County Rainfall data 2008-2011. Bars indicate total rainfall for these years. Solid black horizontal lines indicate the average annual rainfall for this county.

Soils

There are a total of 20 different soil types located within this unit. There are a variety of soil types: sand, silt, clay, and loam. The clay soils are found in lower elevation areas with very little slope in and along the bog areas. The sand, silt, and loam soils are mostly found in upland sites and areas with a greater slope.

The Estes-Angelina complex (EtA) soil is the most abundant soil within this unit making up 36 % of the area within the unit, encompassing 530 acres of the unit. This soil is found at elevations ranging from 20-450 ft. with a 0-1% slope in areas that are frequently flooded. It is composed of clay up to 80". It is a poorly drained soil which makes the water holding capacity high and able to support facultative wetland and obligate wetland plants.

The Woodville fine sandy loam (WnD) soil is the second largest soil component within the unit. This unit contains 25% of WnD which is equaled to 375 acres of the unit. The WnD is found at elevations ranging from 150-450 ft. with 5-15% slopes. This soil has a top layer (0-7 in.) of very fine sandy loam, followed by a clay layer. The soil is primarily found along the steep canyons of the unit.

The other 18 soils are in smaller increments. A full soils report and soils map of the unit can be found in Appendix C. The report gives a description of the soils within the unit and their location. The map has all the soils labels and their locations within the unit. The soils are taken into consideration when deciding the plant communities for the Indicator Species Analysis and Cluster Analysis that was performed on the woody species of the unit.

CHAPTER III

METHODS

Plant Collecting

Collection of the vascular plants within the Canyonlands Unit is one of the major goals of this project. It was the plan to collect and identify over 90% of the current vascular plant flora occurring within the Canyonlands Unit. The species within this Unit were compared to the species in the Beech Creek Unit, Hickory Creek Unit, and the Turkey Creek Unit (Appendix D). The hypothesis of this project was that the Canyonlands Unit would have the most diverse flora due to the variety of habitat types, topography changes and landscape changes. Diversity of the flora will be based on the total number of plants species per acre.

Collection trips took place over a course of three years. Starting in 2008 and ending in 2011. The Canyonlands Unit was visited multiple times throughout the project in order to collect all the plants during the different growing seasons. A total of 126 collection sites were recorded throughout the project. Four collection trips occurred during the wet years with trips decreasing during the dry years. This is due to the lack of rain and lack of plant species flowering. Multiple trips will increase accuracy of gathering representative flora within the unit. A total of 11 visits were made to the Unit in order to complete the project. A time line of these visits and purpose of going are given in Appendix A.

There are several different habitats within the Canyonlands Unit. Habitat types were determined by using soil, elevation and topographic maps. These habitats determine the collection sites visited. If the soils, elevation and topography of two areas looked similar, both sites were not necessarily visited.

During a collection trip, a team of 2-4 people spread out over an area and collected all the fertile specimens with fruit and/or flowering parts. These collections were used to accurately

identify each specimen collected. Each specimen was given a collection number, date collected, and GPS location. Longevity and origin data was recorded from the *Checklist of the Vascular Plants of Texas*, USDA-NRCS-PLANTS Database, and *Illustrated Flora of North Central Texas*. Each site visited was given a site number (Appendix A), GPS location, soil type of the areas, and date site was visited. A site description was written for every area that a plant was collected. Multiple plants were collected in many of the sites. If the same site was visited on a different day, it received a new site description and number. A GPS location was recorded for all of the sites visited even if a collection was not made at that site (Appendix A). This is to show that the area was visited but no new species were observed at the site. Once the plant specimen was collected, assigned a collection number and other data recorded, this plant was placed in a plant press along with its collection number to dry before identification and verification. The plant press is a tool used to dry the plants before storing. It is composed of plywood, cardboard, newspaper, and straps. This tool is tightened with the straps and placed in front of a fan so that the plants have to opportunity to dry and press without wilting. Many plants were collected multiple times. These plants all received identifications but only one of each species was to be mounted for the National Park Service. The extra specimens will be mounted and housed in the S.M. Tracy Herbarium.

After a plant is collected, pressed, and dried it is then keyed out and identified. Multiple books were used to identify each of the species. These include, *Trees, Shrubs, & Woody Vines of East Texas* (Nixon 1985), *Illustrated Flora of North Central Texas* (Diggs et al. 1999), *Aquatic and Wetland Plants of Southeastern United States: Dicotyledons* (Godfrey and Wooten 1981), *Aquatic and Wetland Plants of Southeastern United States: Monocotyledons* (Godfrey and Wooten 1979), and *Goulds Grasses of Texas* (Hatch 2010). After an identification is assigned to

a plant it was then verified. These plants were primarily verified using the specimens from the S.M. Tracy Herbarium (TAES) or Botanical Research Institute of Texas (BRIT) online image gallery (http://www.brit.org/herbarium) and the University of Texas Herbarium (TEX-LL) online image gallery (http://www.biosci.utexas.edu/prc/types.html).

Once the plant was identified and verified, the label information and other compared information was recorded in a field notebook. *The Checklist of the Vascular Plants of Texas* (Hatch et al. 1990), *Goulds Grasses of Texas* (Hatch 2010) and the USDA-NRCS-PLANTS Database (USDA 2009-2012), (http://plants.usda.gov) were used to determine longevity, origin, and season of growth and authorities of each plant species. The wetland indicator status for Region 6 was also determined for all of the plants this information was also derived from the USDA-NRCS-PLANTS Database (USDA 2009-2012) and National List of Plant Species: That Occur in Wetlands: Texas (Reed 1988). If a wetland status was not given for region 6 the plant was given an NI for no indicator status.

Once the specimens were identified and labels prepared specimens were mounted on standard 11 ½ ” X 16 ½” herbarium paper along with label containing the following information: family name, scientific name and authority, physical location, latitude and longitude data, associated species, collector name(s), collection number, any special notes about the plant and date of collection. Each of these specimens is stored in the S.M. Tracy Herbarium as voucher specimens for the Canyonlands Unit of the Big Thicket National Preserve. The extra specimens will be used for reference and teaching purposes.

In order to compare the plant species within the Canyonlands Unit to the Beech Creek Unit, Hickory Creek Unit and the Turkey Creek Unit information was derived from floristic studies Brown et al. 2005, 2008 and Mac Roberts et al. 2002. These data compared includes:

number of acres within each unit, number of species within each unit, species origin, longevity, season of growth, wetland indicator status, plant group (monocot dicot, gymnosperm, fern) and plant type (herbaceous and woody). All of this information was determined from USDA-NRCS-PLANTS Database (USDA 2009-2012) and The *Checklist of the Vascular Plants of Texas* (Hatch et al. 1990). Each of these compared entities was compared on a percent bases, number of plants within that entity divided by total number of plants within the unit. The total number of plants per acre was determined by dividing total number of plant species by the number of acres within the unit.

Wetland indicator values were one of the main comparisons; these comparisons were made on wetland versus upland species. Then within the wetland species a comparison was made of the obligate wetland plants and the facultative wetland plants. If a plant has a facultative wet or obligate wet status it was considered a wetland plant. If the plant has a facultative, facultative upland, upland, or an no indicator status it was considered a upland plant.

Species Analysis

An Indicator Species Analysis (ISA) and Cluster Analysis were conducted on all the woody species within the Canyonlands Unit. These analyses were chosen to look at the woody species communities due to the time of year that the observations were taken and that the majority of the area is dominated by woody plant species. The data collection for this portion of the project was conducted in Fall of 2011. Indicator Species Analysis and Cluster Analysis were chosen in order to determine objectively the vegetation communities within this unit.

All of the woody species were identified to species with some exceptions: the *Quercus*, *Nyssa*, *Carya*, *Acer*, *Rubus*, *Sesbania*, and *Ilex* species were combined into groups based on genus due to them residing in similar areas. *Ilex opaca* was given its own group from the rest of the *Ilex* species because it is easily distinguished form the other *Ilex* species and it has a different growth habit from the other species.

The data for the indicator species analysis and cluster analysis were collected by using 25 randomly positioned 200 m long transects (Appendix D). Along each of these transects four 5 m X 5 m quadrats (Marks & Harcomb 1981) were established every 50 m (Appendix D). Within each of the quadrats the Diameter at Breast Height (DBH) was taken for each of the woody species present in the quadrat. If a woody species was less than 1.5 m tall it was given a DBH of ½ in. There were a total of 100 quadrats located throughout the Canyonlands Unit when the observations were complete.

Once the data were collected from the field, they were entered into an excel spread sheet. After determining the total DBH of each species, a frequency data table was produced to show the total number of each individuals of each species within the quadrats. It was decided that frequency data would be more useful for the ISA and the Cluster Analysis than the DBH data. This decision was made because frequency data are easier to interpret. The quadrats that

had fewer than 3 species present in them were removed from the data set (McCune & Grace 2002). Species with less than two occurrences never yield an indicator value stronger than expected by chance (McCune & Grace 2002).

It was determined with PC-ORD by using the Indicator Species Analysis to use 7 different groupings for the Cluster Analysis. This was done by looking at the observed sum of Indicator Value maximum across all species, average p value for all species and the number of significant indicators. The p-value measures consistency by calculating the probability of observing the results from your sample of data or a sample with results more extreme, assuming the null hypothesis is true**.** The smaller the p-value, the greater the inconsistency (Churchill et al. 2000). These values will peak at the most logical place to make clusters (Appendix F).

Indicator Species Analysis:

Indicator Species Analysis is a tool that allows you to assess the degree that a species is indicative of a group. This is based on constancy, and distribution of abundance. This tool is used when wanting to contrast performance of individual species in two or more groups of sample units (McCune & Grace 2002). It can provide a quantitative, objective criterion for picking the most ecologically meaningful point to cut the dendrogram for a cluster analysis (McCune & Grace 2002). The ISA was used to determine the optimum level of grouping for the quadrats when using the Cluster Analysis. ISA produces indicator values ranging from 0-100, 0 meaning no indication and 100 meaning a perfect indication. ISA also gives p values that also aids in determine the optimum number of groups.

Cluster analysis:

Cluster Analysis allows you to assign sample units to groups on the basis of similarity (Peck 2010). The Cluster Analysis for this project was performed by using PC-ORD statistical software. Cluster analysis on PC-ORD uses a hierarchical agglomerative polythetic process.

Wards linkage and Euclidian distance methods were used to conduct the cluster analysis. The Wards linkage method searches for the minimum variance to group and join plots together (McCune & Grace 2002). It is recommended to use the Euclidian distance and Wards linkage methods together when conducting a cluster analysis (McCune & Grace 2002). ISA was used to determine the ideal number of clusters to use for the cluster analysis. This was done by using the Indicator value and the p value that the ISA produced.

The final result for a Cluster analysis is a dendrogram (Appendix F). This dendrogram shows a breakdown of the clusters and the quadrats that are associated in each of the given groups.

CHAPTER IV

RESULTS AND DISCUSSION

Canyonlands Vascular Flora

The Canyonlands Unit of the Big Thicket National preserve vascular plant collections totaled, 383 different taxa, 376 different species in 235 separate genera and 99 different families. The scientific name of each taxon and common name are listed alphabetically by division and family in the checklist below. Within the division the taxa are listed alphabetically, first by family, then generus, then specific epithet, and subspecies or varieties. The authority is listed after the specific epithet for each species. Following the name of each species is the origin, longevity, and season of growth for that plant (Table 2). Scientific names, origin, longevity were from the USDA-NRCS-PLANTS Database (http://plants.usda.gov) and *The Checklist of Vascular Plants of Texas* (Hatch et al. 1990). The full species list with scientific name, authority and all compared entities for each plant species can be found in Appendix E.

TABLE 2. Definition of codes used to indicate origin, longevity, and season of growth of the plants collected in the Canyonlands Unit.

Origin
N= Native **I**= Introduced
Longevity
A= Annual **P**=Perennial
Season of Growth
W=Warm-season growth **C**= Cool-season growth
Synonym
Syn=Synonym

All of the plant species were collected over the three year period by multiple collectors. Appendix A gives a list of collectors and people that had a hand in the collecting the plants for this project. A site description list for all the plants collected can be found in Appendix A.

Checklist of the Vascular Plants of the Canyonlands Unit of the Big Thicket National Preserve

Pteridophyta

ASPLENIACEAE			
Asplenium platyneuron (L.) B.S.P	N	P	W
BLECHNACEAE			
Woodwardia areolata (L.) T. Moore	N	P	W
DRYOPTERIDACEAE			
Athyrium filix-femina (L.) Roth	N	P	W
Onoclea sensibilis L.	N	P	W
Polystichum acrostichoides (Michx.) Schott	N	P	W
LYGODIACEAE			
Lygodium japonicum (Thunb.) Sw.	I	P	W
OSMUNDACEAE			
Osmunda cinnamomea L.	N	P	W
Osmunda regalis L.	N	P	W
POLYPODICAEAE			
Pleopeltis polypodioides (L.) Andrews & Windham	N	P	W
PTERIDACEAE			
Pteris multifida Poir.	I	P	W
THELYPTERIDACEAE			
Thelypteris kunthii (Desv.) Morton	N	P	W

Pinophyta

PINACEAE			
Pinus echinata Mill.	N	P	W
Pinus taeda L.	N	P	W

TAXODIACEAE			
Taxodium distichum (L.) Rich.	N	P	W
CUPRESSACEAE			
Juniperus virginiana L.	N	P	W

Magnoliophyta: Liliopsida

AGAVACEAE			
Yucca louisianensis Trel.	N	P	C
ALISMATACEAE			
Sagittaria platyphylla (Engelm.) J.G. Smith	N	P	W
ARACEAE			
Arisaema dracontium(L.) Schott	N	P	C
Arisaema triphyllum (L.) Schott	N	P	C
ARECACEAE			
Sabal minor (Jacq.) Pers.	N	P	W
BROMELIACEAE			
Tillandsia usneoides (L.) L.	N	P	W
BURMANNIACEAE			
Apteria aphylla (Nutt.) Barnh ex Small	N	P	W
COMMELINACEAE			
Commelina erecta L. var. *angustifolia* (Michx.) Fernald	N	P	W
Commelina erecta L. var. *erecta*	N	P	W
Tradescantia hirsutiflora Bush	N	P	C
CYPERACEAE			
Carex basiantha Steud.	N	P	C
Carex caroliniana Schwein.	N	P	C
Carex debilis Michx.	N	P	C
Carex frankii Kunth	N	P	W
Carex glaucescens Elliott	N	P	W
Carex leptalea Wahl.	N	P	C

CYPERACEAE (continued)			
Carex louisianica Bailey	N	P	C
Carex lupilina Willd.	N	P	W
Carex scabrata Schwein.	N	P	W
Carex tribuloides Wahlenb.	N	P	C
Cyperus cyperinus (Retz.) Sur	I	P	C
Cyperus esculentus L.	N	P	W
Cyperus haspan L.	N	P	W
Cyperus plukenetii Fernald	N	P	W
Cyperus retrorsus Chapm.	N	P	W
Cyperus virens Michx.	N	P	W
Rhynchospora caduca Elliott	N	P	W
Rhynchospora globularis (Chapm.) Small	N	P	W
Rhynchospora glomerata (L.) Vahl	N	P	W
Rhynchospora harveyi W. Boott	N	P	W
Scirpus cyperinus (L.) Kunth	N	P	W
Scleria oligantha Michx.	N	P	C
Scleria triglomerata Michx.	N	P	C
IRIDACEAE			
Sisyrinchium campestre E.P. Bicknell	N	P	C
Sisyrinchium langloisii Greene	N	P	C
JUNCACEAE			
Juncus coriaceus Mack.	N	P	C
Juncus diffusissimus Buckley	N	P	C
Juncus effusus L.	N	P	W
Juncus elliottii Chapm.	N	P	W
Juncus polycephalus Michx.	N	P	W
Luzula echinata (Small) F.J. Herm.	N	P	C
LILIACEAE			
Allium canadense L.	N	P	C
Hypoxis hirsuta (L.) Coville	N	P	C
Nothoscordum bivalve (L.) Britton	N	P	C

LILIACEAE (continued)			
Trillium gracile J.D. Freeman	N	P	C
POACEAE			
Agrostis elliottiana Schult.	N	A	C
Andropogon gerardii Vitman	N	P	W
Andropogon glomeratus (Walter) Britton	N	P	W
Andropogon gyrans Ashe	N	P	W
Andropogon ternarius Michx.	N	P	W
Andropogon virginicus L.	N	P	W
Aristida lanosa Muhl. ex Elliott	N	P	W
Aristida longespica Poir. var. *longespica*	N	A	W
Aristida oligantha Michx.	N	A	W
Aristida purpurascens Poir. var. *purpurascens*	N	P	W
Arundinaria gigantea (Walter) Muhl.	N	P	C
Axonopus fissifolius (Raddi) Kuhlm.	N	P	W
Brachyelytrum erectum (J. von Schreber) P. Beauv.	N	P	C
Briza minor L.	I	A	C
Chasmanthium latifolium (Michx.) Yates	N	P	W
Chasmanthium laxum (L.) Yates	N	P	W
Cynodon dactylon (L.) Pers.	I	P	W
Dichanthelium aciculare (Desv. ex Poir.) Gould & C. Clark	N	P	C
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark	N	P	C
Dichanthelium boscii (Poir.) Gould & C.A. Clark	N	P	C
Dichanthelium clandestinum (L.) Gould	N	P	C
Dichanthelium commutatum (Schult.) Gould	N	P	C
Dichanthelium dichotomum (L.) Gould var. *dichotomum*	N	P	C

POACEAE (continued)

Dichanthelium dicotomum var. *lacidium*	N	P	C
Dichanthelium laxiflorum (Lam.) Gould	N	P	C
Dichanthelium nodatum (A. Hitchc. & Chase) Gould	N	P	C
Dichanthelium oligosanthes (Schult.) Gould var. *oligosanthes*	N	P	C
Dichanthelium portoricense (Desv. ex Ham.) B.F. Hansen & Wunderlin	N	P	C
Dichanthelium ravenelii (Scribn. & Merr.) Gould	N	P	C
Dichanthelium sphaerocarpon (Elliott) Gould	N	P	C
Digitaria patens (Swallen) Henr.	N	P	W
Echinochloa walteri (Pursh) A. Heller	N	A	W
Eragrostis capillaris (L.) Nees	N	A	W
Eragrostis refracta (Muhl.) Scribn.	N	P	W
Eragrostis secundiflora J. Presl	N	P	W
Eragrostis spectabilis (Pursh) Steud.	N	P	W
Gymnopogon ambiguus (Michx.) B.S.P.	N	P	W
Leersia lenticularis Michx.	N	P	W
Leersia oryzoides (L.) Sw.	N	P	W
Leersia virginica Willd.	N	P	W
Lolium perenne L.	I	A	C
Melica mutica Walter	N	P	W
Mnesithea cylindrical (Michx.) Koning & Sosef	N	P	W
Oplismenus hirtellus (L.) P. Beauv.	I	P	W
Panicum anceps Michx.	N	P	W
Panicum brachyanthum Steud.	N	P	W
Panicum gymnocarpon Elliott	N	P	W
Panicum hemitomon Schult.	N	P	W
Panicum hians Elliott	N	P	W
Panicum rigidulum Bosc ex Nees	N	P	W
Panicum verrucosum Muhl.	N	A	W

POACEAE (continued)			
Paspalum floridanum Michx.	N	P	W
Paspalum fluitans (Elliott) Kunth	N	A	W
Paspalum notatum Fluggé	I	P	W
Paspalum plicatulum Michx.	N	P	W
Paspalum setaceum Michx.	N	P	W
Paspalum setaceum Michx. var. *muhlenbergii* (Nash) D. Banks	N	P	W
Paspalum setaceum Michx. var. *setaceum* (Nash) D. Banks	N	P	W
Paspalum setaceum Michx. var. *stramineum* (Nash) D. Banks	N	P	W
Paspalum urvillei Steud.	I	P	W
Piptochaetium avenaceum (L.) Parodi	N	P	C
Poa annua L.	I	A	C
Poa autumnalis Muhl. ex Elliott	N	P	C
Saccharum baldwinii Spreng.	N	P	W
Schizachyrium scoparium (Michx.) Nash	N	P	W
Sorghastrum elliottii (C. Mohr) Nash	N	P	W
Sphenopholis filiformis (Chapm.) Scribn.	N	P	C
Sphenopholis longiflora (Vasey) A. Hitchc.	N	P	C
Sporobolus compositus (Poir.) Merr. var. *clandestinus* (Biehler) Wipff & S.D. Jones	N	P	W
Sporobolus indicus (L.) R. Br.	I	P	W
Tridens flavus (L.) A. Hitchc. var. *chapmanii* (Small) Shinners	N	P	W
Tridens flavus (L.) A. Hitchc. var. *flavus*	N	P	W
Vulpia octoflora (Walter) Rydb.	N	A	C
PONTEDERIACEAE			
Eichhornia crassipes (Mart.) Solms	I	P	W

SMILACACEAE			
Smilax bona-nox L.	N	P	C
Smilax glauca Walter	N	P	C
Smilax laurifolia L.	N	P	C
Smilax pumila Walter	N	P	C
Smilax rotundifolia L.	N	P	C
Smilax smallii Morong	N	P	C
Smilax walteri Pursh	N	P	C
TYPHACEAE			
Typha domingensis Pers.	N	P	W
Typha latifolia L.	N	P	W
XYRIDACEAE			
Xyris jupicai Rich.	N	P	W

Magnoliophyta: Magnoliopsida

ACANTHACEAE			
Justicia ovata (Walt.) Lindau.	N	P	W
Ruellia caroliniensis (Gmel.) Steud.	N	P	W
ACERACEAE			
*Acer rubru*m L.	N	P	C
Acer saccharum Marsh.	N	P	C
ANACARDIACEAE			
Rhus copallina L.	N	P	W
Toxicodendron radicans (L.) O. Ktze.	N	P	C
ANNONACEAE			
Asimina parviflora (Michx.) Dunal	N	P	C
Asimina triloba (L.) Dunal	N	P	C
APIACEAE			
Chaerophyllum tainturieri Hook.	N	A	C
Hydrocotyle verticillata Thumb.	N	P	W

APOCYNACEAE			
Amsonia glaberrima Woods.	N	P	W
Trachelospermum difforme (Walt.) A. Gray	N	P	W
AQUIFOLIACEAE			
Ilex coriacea (Pursh.) Chapm.	N	P	C
Ilex decidua Walt.	N	P	C
Ilex opaca Soland.	N	P	C
Ilex vomitoria Soland.	N	P	C
ARALIACEAE			
Aralia spinosa L.	N	P	W
ASCLEPIADACEAE			
Asclepias perennis Walt.	N	P	W
Asclepias tuberosa L.	N	P	W
Cynanchum laeve (Michx.) Pers.	N	P	W
ASTERACEAE			
Ambrosia psilostachya DC.	N	P	W
Amphiachyris dracunculoides (DC.) Nutt.	N	A	C
Baccharis halimifolia L.	N	P	W
Berlandiera betonicifolia (Hook.) Small	N	P	C
Berlandiera pumila (Michx.) Nutt.	N	P	C
Chrysopsis pilosa Nutt.	N	A	W
Cirsium horridulum Michx.	N	P	C
Conyza canadensis (L.) Cronquist	N	A	W
Coreopsis grandiflora Sweet	N	P	C
Coreopsis linifolia Nutt.	N	P	C
Croptilon divaricatum (Nutt.) Raf.	N	A	W
Elephantopus carolinianus Raeusch.	N	P	W
Elephantopus nudatus A. Gray	N	P	W
Erechtites hieraciifolia (L.) Raf. ex DC.	N	P	W
*Erigeron strigosu*s Muhl. ex. Willd.	N	A	C
Eupatorium capillifolium (Lam.) Small	N	P	W

ASTERACEAE (continued)			
Eupatorium coelestinum L.	N	P	W
Eupatorium perfoliatum L.	N	P	W
Eupatorium rugosum Houtt.	N	P	W
Gaillardia aestivalis (Walter) H. Rock	N	P	W
Gamochaeta falcata (Lam.) Cabrera	N	A	W
Helenium amarum (Raf.) H. Rock	N	A	W
Helenium elegans DC.	N	A	W
Helianthus angustifolius L.	N	P	W
Helianthus pauciflorus Nutt.	N	P	W
Heterotheca subaxillaris (Lam.) Britt. & Rusby	N	A	W
Hymenopappus artemisiifolius DC.	N	P	W
Krigia occidentalis Nutt.	N	A	C
Liatris elegans (Walt.) Michx.	N	P	W
Mikania scandens (L.) Willd.	N	P	W
Parthenium hysterophorus L.	N	A	W
Pityopsis graminifolia (Michx.) Nutt.	N	P	W
Pluchea camphorata (L.) DC.	N	P	W
Pluchea foetida (L.) DC.	N	P	W
Pyrrhopappus carolinianus (Walt.) DC.	N	A	W
Rudbeckia hirta L.	N	P	W
Verbesina virginica L.	N	P	W
Vernonia missurica Raf.	N	P	W
Vernonia texana (Gray) Small	N	P	W
BERBERIDACEAE			
Podophyllum peltatum L.	N	P	C
BETULACEAE			
Alnus serrulata (Dryand ex Ait.) Willd.	N	P	C
Carpinus caroliniana Walt.	N	P	C
Ostrya virginiana (Mill) K. Koch	N	P	C
BIGNONIACEAE			
Bignonia capreolata L.	N	P	C

BIGNONIACEAE (continued)			
Campsis radicans (L.) Seem ex Bureau	N	P	W
BORAGINACEAE			
Cynoglossum virginianum L.	N	P	C
Heliotropium indicum L.	N	P	W
Myosotis macrosperma Engelm.	N	A	C
BRASSICACEAE			
Cardamine bulbosa (Schreb. ex Muhl.) Britton	N	P	W
BUDDLEJACEAE			
Polypremum procumbens L.	N	A	W
CAMPANULACEAE			
Lobelia appendiculata A. DC.	N	A	C
Lobelia cardinalis L.	N	P	W
Lobelia puberula Michx.	N	A	W
Triodanis perfoliata (L.) Nieuw.	N	A	C
Wahlenbergia marginata (Thunb.) A. DC.	N	A	C
CAPRIFOLIACEAE			
Lonicera japonica Thunb.	N	P	C
Lonicera sempervirens L.	N	P	C
Sambucus canadensis L.	N	P	W
Sambucus nigra L. ssp. *canadensis* (L.) R. Bolli	N	P	W
Symphoricarpos orbiculata Moench	N	P	W
Viburnum dentatum L.	N	P	W
Viburnum prunifolium L.	N	P	W
Viburnum rufidulum Raf.	N	P	C
CARYOPHYLLACEAE			
Cerastium glomeratum Thuillier	I	A	C
CLUSIACEAE			
Hypericum galioides Lam.	N	P	W
Hypericum hypericoides (L.) Crantz	N	P	W
Hypericum sphaerocarpum Michx.	N	P	W

CONVOLVULACEAE			
Ipomoea cordatotriloba Dennst.	N	P	W
*Ipomoea pandura*ta (L.) Mey.	N	P	W
CORNACEAE			
Cornus florida L.	N	P	C
Nyssa aquatica L.	N	P	C
Nyssa sylvatica Marsh.	N	P	C
CYRILLACEAE			
Cyrilla racemiflora L.	N	P	W
DROSERACEAE			
Drosera capillaris Poir.	N	A	C
ERICACEAE			
Lyonia mariana (L.) D. Don	N	P	W
Rhododendron canescens (Michx.) Sweet	N	P	C
Vaccinium arboreum Marsh.	N	P	C
Vaccinium elliottii Chapm.	N	P	C
EUPHORBIACEAE			
Chamaesyce cordifolia (Elliott) Small	N	A	W
Cnidoscolus texanus (Müll. Arg.) Small	N	P	W
Croton capitatus Michx.	N	A	W
Croton michauxii G.L. Webster	N	A	W
Sapium sebifera (L.) Small	I	P	W
Syn= *Triadica sebifera* (L.) Small			
Sebastiana fruticosa (Bartr.) Fern.	N	P	W
Stillingia sylvatica L.	N	P	C
Tragia smallii Shinners	N	P	W
FABACEAE			
Albizia julibrissin Durazz.	I	P	W
Baptisia australis (L.) R. Br.	N	P	C
Baptisia nuttalliana Small	N	P	C
Cercis canadensis L.	N	P	C

FABACEAE (continued)			
Chamaecrista fasciculata (Michx.) Greene	N	A	W
Crotalaria purshii DC.	N	P	W
Dalea purpurea Vent.	N	P	W
Dioclea multiflora (T. & G.) Mohr	N	P	W
*Erythrin*a *herbacea* L.	N	P	C
Lespedeza hirta (L.) Hornem.	N	P	W
Mimosa hystricina (Small ex Britton & Rose) B.L.Turner	N	P	W
Mimosa nuttallii (DC. ex Britton & Rose) B.L. Turner	N	P	W
Rhynchosia latifolia Nutt. ex Torr. & A. Gray	N	P	W
Sesbania drummondii (Rydb.) Cory.	N	P	W
Sesbania herbacea (Mill.) McVaugh	N	A	W
Strophostyles umbellata (Muhl. ex Willd.) Britton	N	A	W
Stylosanthes biflora (L.) B.S.P.	N	P	W
Tephrosia virginiana (L.) Pers.	N	P	C
FAGACEAE			
Castanea pumila (L.) Mill.	N	P	C
Fagus grandifolia Ehrh.	N	P	C
Quercus alba L.	N	P	C
Quercus laurifolia Michx.	N	P	C
Quercus lyrata Walter	N	P	C
Quercus macrocarpa Michx.	N	P	C
Quercus margarettae (Ashe) Small	N	P	C
Quercus marilandica Münchh.	N	P	C
Quercus michauxii Nutt.	N	P	C
Quercus nigra L.	N	P	C
Quercus phellos L.	N	P	C
Quercus stellata Wangenh.	N	P	C

GENTIANACEAE			
Sabatia campestris Nutt.	N	P	W
GROSSULARIACEAE			
Itea virginica L.	N	P	W
HALORAGACEAE			
Myriophyllum aquaticum (Vell.) Verdc.	I	P	W
Proserpinaca palustris L.	N	P	W
HAMAMALIDACEAE			
Hamamelis virginiana L.	N	P	C
Hamamelis vernalis Sarg.	N	P	C
Liquidambar styraciflua L.	N	P	C
HIPPOCASTINACEAE			
Aesculus pavia L.	N	P	C
JUGLANDACEAE			
Carya alba (L.) Nutt.	N	P	C
Syn= *Carya tomentosa*			
Carya aquatica (Michx. f.) Nutt.	N	P	C
Carya cordiformis (Wang.) K. Koch	N	P	C
Carya laciniosa (Michx. f.) G. Don	N	P	C
Carya texana Buckley	N	P	C
LAMIACEAE			
Monarda punctata L.	N	A	W
Salvia lyrata L.	N	P	C
Scutellaria cardiophylla Engelm. & A. Gray	N	P	W
Scutellaria drummondii Benth.	N	P	C
Scutellaria ovata Hill	N	P	W
LAURACEAE			
Persea borbonia (L.) Spreng.	N	P	W
Sassafras albidum (Nutt.) Nees	N	P	C
LENTIBULARIACEAE			
Utricularia radiata Small	N	A	C

LINACEAE			
Linum medium (Planch.) Britton	N	P	C
LOGANIACEAE			
Gelsemium sempervirens (L.) W.T. Aiton	N	P	C
MAGNOLIACEAE			
Magnolia grandiflora L.	N	P	C
Magnolia virginiana L.	N	P	C
MONOTROPACEAE			
Monotropa uniflora L.	N	P	C
MORACEAE			
Morus rubra L.	N	P	C
MYRICACEAE			
Myrica cerifera L	N	P	C
OLEACEAE			
Chionanthus virginicus L.	N	P	C
Fraxinus americana L.	N	P	C
Fraxinus caroliniana Mill	N	P	C
Fraxinus pennsylvanica Marsh.	N	P	C
Ligustrum sinense Lour.	I	P	W
ONAGRACEAE			
Ludwigia decurrens Walter	N	P	W
OROBANCHACEAE			
Epifagus virginiana (L.) W. Bartram	N	P	W
OXALIDACEAE			
Oxalis stricta L.	N	P	C
Oxalis corniculata L	N	A	C
PASSIFLORACEAE			
Passiflora incarnata L	N	P	W
PHYTOLACCACEAE			
Phytolacca americana L.	N	A	W

PLANTAGINACEAE			
Plantago aristata Michx.	N	A	C
Plantago rhodosperma Decne.	N	A	C
PLATANACEAE			
Platanus occidentalis L.	N	P	C
POLYGALACEAE			
Polygala incarnata L.	N	A	W
Polygala polygama Walter	N	P	C
Polygala sanguinea L.	N	A	W
POLYGONACEAE			
Brunnichia ovata (Walter) Shinners	N	P	C
Polygonum hydropiperoides Michx.	N	P	W
Polygonum virginianum L.	N	A	W
Rumex hastatulus Baldw.	N	A	C
PRIMULACEAE			
Anagallis arvensis L.	I	A	C
Samolus valerandi L.	N	P	W
RANUNCULACEAE			
Clematis crispa L.	N	P	C
Clematis pitcheri Torr. & A. Gray	N	P	W
Clematis reticulata Walter	N	P	W
Ranunculus hispidus Michx.	N	P	C
Ranunculus pusillus Poir.	N	A	C
RHAMNACEAE			
Berchemia scandens (Hill) K. Koch	N	P	C
Ceanothus americanus L.	N	P	C
Rhamnus caroliniana Walter	N	P	C
ROSACEAE			
Crataegus marshallii Eggl.	N	P	C
Crataegus spathulata Michx.	N	P	C
Duchesnea indica (Andrews) Focke	I	P	C
Geum canadense Jacq.	N	P	C

ROACEAE (continued)			
Prunus angustifolia Marsh.	N	P	C
Prunus umbellata Elliott	N	P	C
Rubus aboriginum Rydb.	N	P	C
Rubus trivialis L.H. Bailey	N	P	C
RUBIACEAE			
Cephalanthus occidentalis L.	N	P	W
Diodia virginiana L.	N	P	W
Galium obtusum Bigelow	N	P	C
Galium tinctorium (L.) Scop.	I	P	W
Houstonia micrantha (Shinners) Terrell	N	A	C
Houstonia pusilla Schoepf	N	A	C
Mitchella repens L.	N	P	C
RUTACEAE			
Zanthoxylum clava-herculis L.	N	P	C
SALICACEAE			
Populus deltoides Bartram ex Marsh.	N	P	C
SALVINIACEAE			
Salvinia minima Baker	I	P	W
SAPOTACEAE			
Bumelia lanuginosa (Michx.) Pers.	N	P	W
Syn= *Sideroxylon lanuginosum* Michx.			
SAURURACEAE			
Saururus cernuus L.	N	P	W
SCROPHULARIACEAE			
*Mecardoni*a *procumbens* (Mill.) Small	N	P	W
Scoparia dulcis L.	I	A	W
SOLANACEAE			
Solanum carolinense L.	N	P	W
STYRACACEAE			
Halesia diptera Ellis	N	P	C

SYMPLOCACEAE			
Symplocos tinctoria (L.) L'Her.	N	P	C
ULMACEAE			
Celtis tenuifolia Nutt.	N	P	C
Planera aquatica J.F. Gmel.	N	P	C
Ulmus alata Michx.	N	P	C
Ulmus americana L.	N	P	C
URTICACEAE			
Pilea pumila (L.) A. Gray	N	A	W
VERBENACEAE			
Glandularia bipinnatifida (Nutt.) Nutt.	N	P	W
Glandularia canadensis (L.) Nutt.	N	P	W
Callicarpa americana L.	N	P	W
Verbena rigida Spreng.	I	P	W
VIOLACEAE			
Viola missouriensis Greene	N	P	C
Viola primulifolia L.	N	P	C
VITACEAE			
Parthenocissus quinquefolia (L.) Planch.	N	P	W
Vitis aestivalis Michx.	N	P	C
Vitis cinerea (Engelm.) Engelm. ex Millard	N	P	C
Vitis monticola Buckley	N	P	C
Vitis rotundifolia Michx.	N	P	C
Vitis vulpina L.	N	P	C

Summary of the Vascular Plant Flora within the Canyonlands Unit

Many of eastern plant species reach their furthest western point at the Big Thicket (MacRoberts 2007). Some of these species occur in the Canyonlands Unit. These species include, *Fagus grandiflora, Hypericum galoides, Cyrilla racemiflora,* and *Rhododendron canescens.* The number of families within each phylum was summarized (Table 3).

TABLE 3. Summarization of families within each phylum collected in the Canyonlands Unit.

Phylum	Class	Families
Pteridophyta	Filicopsida	8
Pinophyta	Pinopsida	3
Magnoliophyta	Liliopsida	16
Magnolyophyta	Magnoliopsida	72
	Total	**99**

A total of 383 different taxa from 376 different species were collected within the Canyonlands Unit boundary of the Big Thicket National Preserve. A summarization was made of total number of genera and species that was collected during this project (Table 4).

TABLE 4. Summarization of number of genera and species collected in the Canyonlands Unit.

Phylum	Class	Number of genera	Number of species
Pteridophyta	Filicopsida	10	11
Pinophyta	Pinopsida	3	4
Magnoliophyta	Liliopsida	54	123
Magnolyophyta	Magnoliopsida	168	238
	Total	**235**	**376**

Weedy and Invasive Species

The species list above was also compared to both the Interactive Encyclopedia of North American Weeds for "weedy" species at http://www.thundersnow.com/pdfdocs/weedlistv4sci.pdf, and with the national invasive species list at www.invasive.org. This is a partnership with the Bugwood Network, USDA Forest Service, USDA Animal and Plant Health Inspection Service and the University of Georgia for invasive plants. "The ecological perspective considers any plant a weed if it is a pioneer species that thrives in a degraded habitat with a history of disturbance through human agency. Such weeds may be native or introduced (Hilty 2006)." This explains that just because the weedy species is on the weedy list does not make the plant a harmful or problem plant.

An invasive plant species is described by www.invasive.org as any plant "species (including seeds, spores, or other propagules) whose introduction causes or is likely to cause economic harm, environmental harm, or harm to human health. The term "invasive"; is used for the most aggressive species. These species grow and reproduce rapidly, causing major disturbance to the areas in which they are present (Invasive Species 2009)." The main difference between weedy and invasive species is that weedy species are not considered a threat to the environment they reside in. The invasive species however, have the potential to reproduce rapidly and invade the area of concern.

A total of 67 weedy species were present in the Canyonlands Unit (Table 5). A total of 32 of the plants species found in the Canyonlands Unit are listed on the invasive species list (Table 6). There is some overlap between the weed and invasive species within the Unit.

TABLE 5. Recognized weedy species collected in the Canyonlands Unit.

Family	Scientific name
Anacardiaceae	*Toxicodendron radicans*
Asclepiadaceae	*Cynanchum laeve*
Asteraceae	*Ageratina altissima*
Asteraceae	*Ambrosia psilostachya*
Asteraceae	*Amphiachyris dracunculoides*
Asteraceae	*Cirsium horridulum*
Asteraceae	*Conyza canadensis*
Asteraceae	*Erigeron strigosus*
Asteraceae	*Eupatorium capillifolium*
Asteraceae	*Eupatorium perfoliatum*
Asteraceae	*Helenium amarum*
Asteraceae	*Parthenium hysterophorus*
Asteraceae	*Pyrrhopappus carolinianus*
Asteraceae	*Rudbeckia hirta*
Bignoniaceae	*Campsis radicans*
Boraginaceae	*Cynoglossum virginianum*
Campanulaceae	*Triodanis perfoliata*
Caprifoliaceae	*Lonicera japonica*
Caprifoliaceae	*Symphoricarpos orbiculata*
Convolvulaceae	*Ipomoea cordatotriloba*
Convolvulaceae	*Ipomoea pandurata*
Cornaceae	*Cornus florida*
Cyperaceae	*Carex frankii*
Cyperaceae	*Carex lupilina*
Cyperaceae	*Cyperus esculentus*
Cyperaceae	*Cyperus retrorsus*
Cyperaceae	*Cyperus virens*
Cyperaceae	*Rhynchospora globularis*
Cyperaceae	*Scirpus cyperinus*
Euphorbiaceae	*Croton capitatus*
Euphorbiaceae	*Croton michauxii*
Euphorbiaceae	*Triadica sebifera*
Fabaceae	*Albizia julibrissin*
Fabaceae	*Sesbania herbacea*
Lamiaceae	*Monarda punctata*
Lamiaceae	*Salvia lyrata*
Liliaceae	*Allium canadense*
Oleaceae	*Ligustrum sinense*
Onagaceae	*Ludwigia decurrens*
Oxalidaceae	*Oxalis stricta*
Passifloraceae	*Passiflora incarnata*
Phytolaccaceae	*Phytolacca americana*
Plantaginaceae	*Plantago aristata*
Poaceae	*Andropogon virginicus*
Poaceae	*Aristida oligantha*

TABLE 5. continued

Family	Scientific name
Poaceae	*Cynodon dactylon*
Poaceae	*Eragrostis spectabilis*
Poaceae	*Leersia oryzoides*
Poaceae	*Lolium perenne*
Poaceae	*Paspalum notatum*
Poaceae	*Paspalum urvillei*
Poaceae	*Poa annua*
Poaceae	*Schizachyrium scoparium*
Poaceae	*Sporobolus indicus*
Poaceae	*Tridens flavus*
Poaceae	*Vulpia octoflora*
Polygonaceae	*Brunnichia ovata*
Pontederiaceae	*Eichhornia crassipes*
Primulaceae	*Anagallis arvensis*
Rosaceae	*Duchesnea indica*
Rubiaceae	*Diodia virginiana*
Saururaceae	*Saururus cernuus*
Scrophulariaceae	*Scoparia dulcis*
Solanaceae	*Solanum carolinense*
Typhaceae	*Typha latifolia*
Vitaceae	*Parthenocissus quinquefolia*

TABLE 6. Recognized invasive species collected in the Canyonlands Unit.

Family	Scientific name
Anacardiaceae	*Toxicodendron radicans*
Apiaceae	*Hydrocotyle verticillata*
Asteraceae	*Erechtites hieraciifolia*
Asteraceae	*Conyza canadensis*
Caprifoliaceae	*Lonicera japonica*
Caprifoliaceae	*Lonicera sempervirens*
Convolvulaceae	*Ipomoea cordatotriloba*
Cyperaceae	*Cyperus esculentus*
Cyperaceae	*Cyperus haspan*
Cyperaceae	*Rhynchospora caduca*
Euphorbiaceae	*Sapium sebifera*
Fabaceae	*Sesbania herbacea*
Haloragaceae	*Myriophyllum aquaticum*
Liliaceae	*Allium canadense*
Lygodiaceae	*Lygodium japonicum*
Oxalidaceae	*Oxalis stricta*
Phytolaccaceae	*Phytolacca americana*
Poaceae	*Andropogon virginicus*
Poaceae	*Axonopus fissifolius*
Poaceae	*Briza minor*
Poaceae	*Cynodon dactylon*
Poaceae	*Lolium perenne*
Poaceae	*Oplismenus hirtellus*
Poaceae	*Paspalum notatum*
Poaceae	*Paspalum urvillei*
Poaceae	*Poa annua*
Poaceae	*Sporobolus indicus*
Pontederiaceae	*Eichhornia crassipes*
Rosaceae	*Duchesnea indica*
Rubiaceae	*Diodia virginiana*
Salviniaceae	*Salvinia minima*
Solanaceae	*Solanum carolinense*

Comparison of Units

The Beech Creek Unit (4856 acres), Hickory Creek Unit (668 acres), and the Turkey Creek Unit (7800 acres) were all compared to the Canyonlands Unit based on number of species, plant type (woody vs. herbaceous), plant group (monocot, dicot, gymnosperms and ferns), longevity, season of growth, origin, wetland indicator status, and facultative wetland versus

obligate wetland. These units were chosen due to them being relatively close to the Canyonlands Unit. Floristic studies of these three units were previously completed.

It was thought that the Canyonlands Unit would be the most diverse unit in the Big Thicket National Preserve based on size, due to the vast array of topography, landscape changes and the different habitat types within the unit. With the total number of acres and the number of species collected from this unit, it showed that the Canyonlands Unit is the second most diverse unit of the three units that it was compared to (Table 7). The comparison was made at the species level and did not look at the subspecies or varieties.

TABLE 7. Comparison of number of acres, number of species and number of plant species/acre across the Canyonlands, Beech Creek, Hickory Creek, and Turkey Creek Units.

Unit name	Acres	Species	Plant
Canyonlands Unit	1476	376	0.25
Beech Creek Unit	4856	328	0.07
Hickory Creek Unit	769	400	0.52
Turkey Creek Unit	7800	746	0.10

Table 7 shows Hickory Creek Unit to have the most plant species diversity per acre, and the Canyonlands Unit to have the second most. Even though the Turkey Creek Unit had 746 different species, these species were spread over 7800 acres making it the least diverse group because of the large area of land it covers.

The number of introduced versus native species were also compared in these four units. A percentage of each native and introduced species in each group was calculated (Fig.4**).** When comparing introduced species to native species it was found that across all four units the majority of the plants were considered native to this region. Over 90% of all the species found in

these units are native. The Hickory Creek Unit showed to have the highest percentage native species with 96%, followed by Canyonlands Unit with 94%.

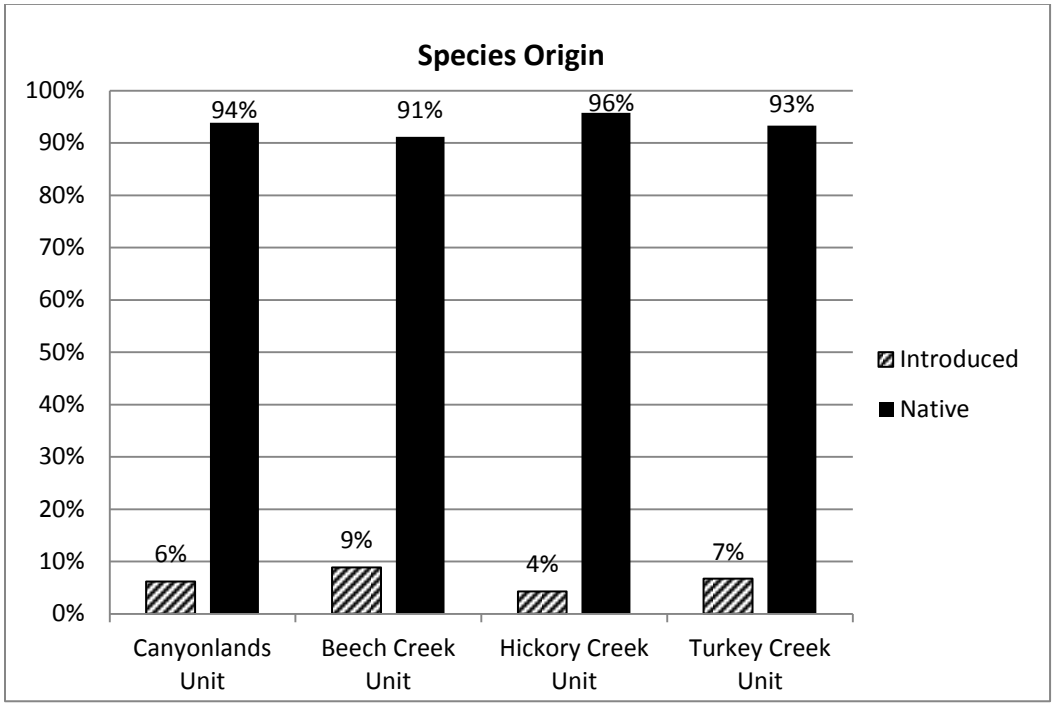

FIG. 4. Comparison of species origin. Denotes the percentage of introduced versus native plant species across the four compared units.

A comparison of species longevity was made across these four units. Longevity (annual or perennial) was recorded for each species. This information was recorded from *The Checklist of the Vascular Plants of Texas* and the USDA-NRCS-PLANTS Database. This comparison was conducted in order to see if there was a higher percentage of annuals or perennials in each of the four different units (Fig. 5). These results can suggest rangeland health and/or successional stage of an area. The higher number of annuals would suggest early stages of succession or that there has been some type of disturbance in the area. These results are given in a percentage. The percentage was figured by taking the number of both native and introduced species and dividing it by the total number of plants within the unit. These results showed that there were a higher

percentage of perennials across all units, 91% or more. The Canyonlands Unit had the highest percentage of perennials of the four units compared. This could indicate that there is less disturbance within this unit and that it has had more time to develop perennials plants. Disturbance could be related to humans, feral hobs, flooding, or hurricanes. During the time spent in this unit there was little to no hurricane disturbance observed. However it is possible for this unit to experience hurricane effects.

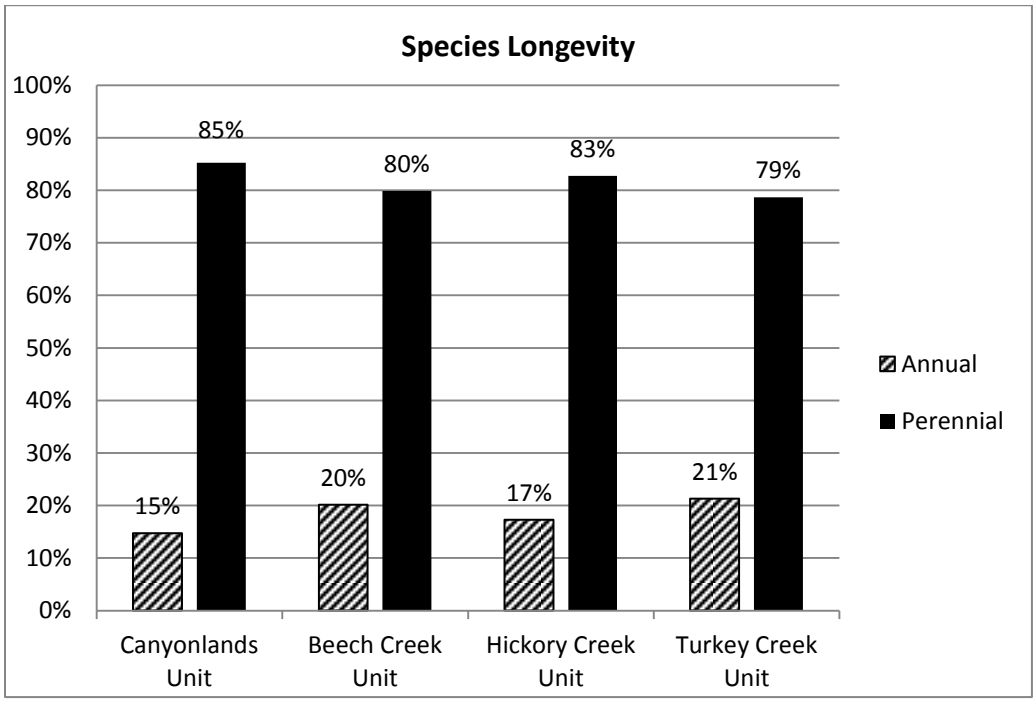

FIG. 5. Comparison of species longevity. Denotes the percentage of annual plant species versus percentage of perennial plant species across the four compared units.

A comparison was made of herbaceous versus woody plant species; this was given the title of plant type. This comparison was made in order to see if the units were dominated by a higher percentage of woody or herbaceous plant species (Fig. 6). This assessment compares the number of species of each type not the number of individual plants of each type. In order to

compare the plant type across all units, a percentage was figured for each of the units. The number of both the herbaceous and woody plant species within each of the units was divided by the total number of species for each unit. Higher number of woody species and plants, along with duff, pine needles and high density of plants per area could limit the number of herbaceous plants. If light cannot penetrate to the understory this may limit the growth of herbaceous plants. With this information it cannot be determined if that is actually the case, however it suggest an idea of the type of vegetation that is present at this site. Across all the units, there was a higher percentage of herbaceous plant species. The highest percentage of woody species was seen in the Canyonlands and Beech Creek units.

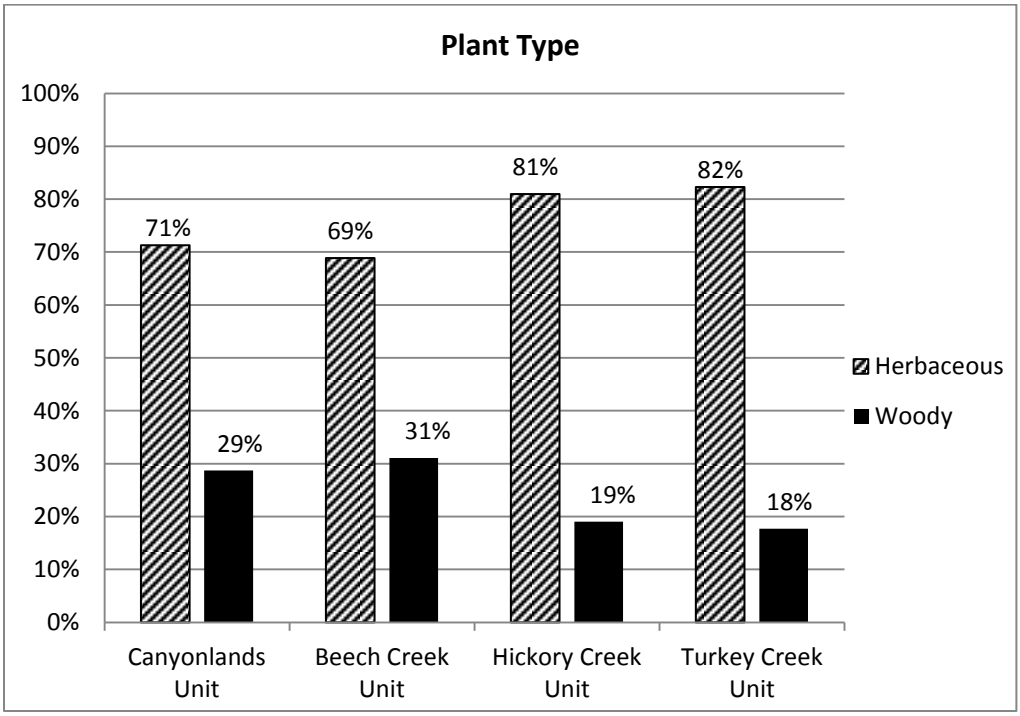

FIG. 6. Comparison of plant type. Denotes the percentage of woody versus herbaceous plant species across the four compared units (species, not number of plants).

A comparison was made across all units on monocots, dicots, gymnosperms and ferns. The comparison was made based on a percentage of each one of these groups based on the total number of the plant species within the Unit (Fig. 7). The dicots have the highest percentage of species across all units. This comparison was done just to give an idea of how the plant groups are distributed across the units.

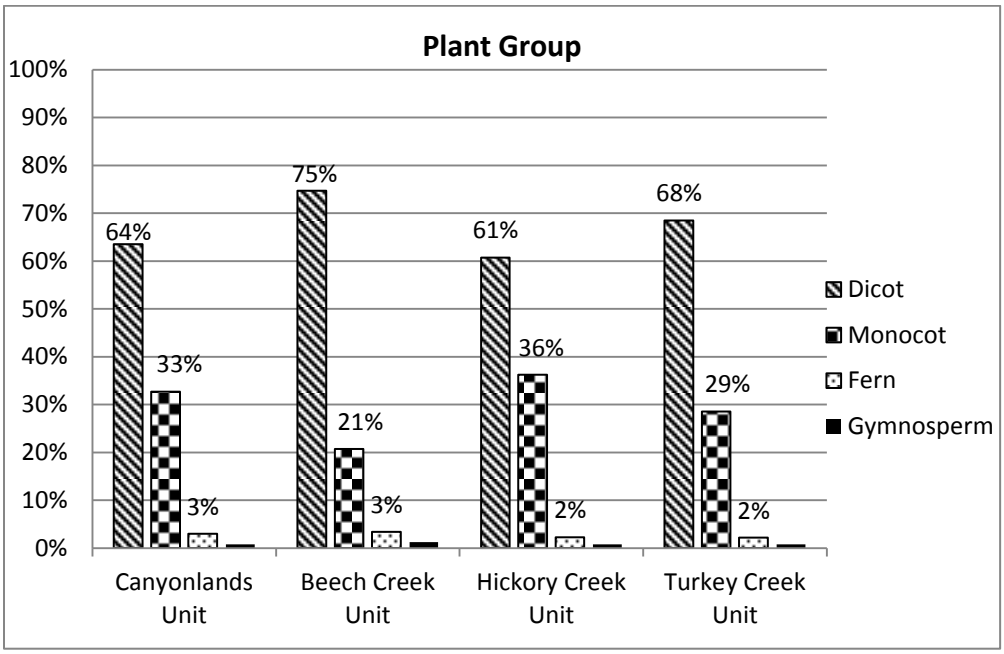

FIG. 7. Comparison of plant groups. Compares the percentage of monocots, dicots, ferns and gymnosperms across the four units (based on species numbers not plant numbers).

The season of growth was evaluated to possibly see what season is more productive and/or which season would have the most plants reproducing. The season of growth (warm versus cool) was recorded for each of the species, this information was obtained from *The Checklist of the Vascular Plants of Texas*, *Illustrated Flora of North Central Texas* and *Gould's Grasses of Texas*. This information indicated the time of year that the species is growing, flowering and reproducing. A comparison was made across the four units comparing the most

productive season of growth for each of the units (Fig. 8). These were compared on a percentage bases. This indicates that across all units there is a slight higher percentage of warm season species than cool season species. The Canyonlands Unit has the highest percentage of cool season species than the other units.

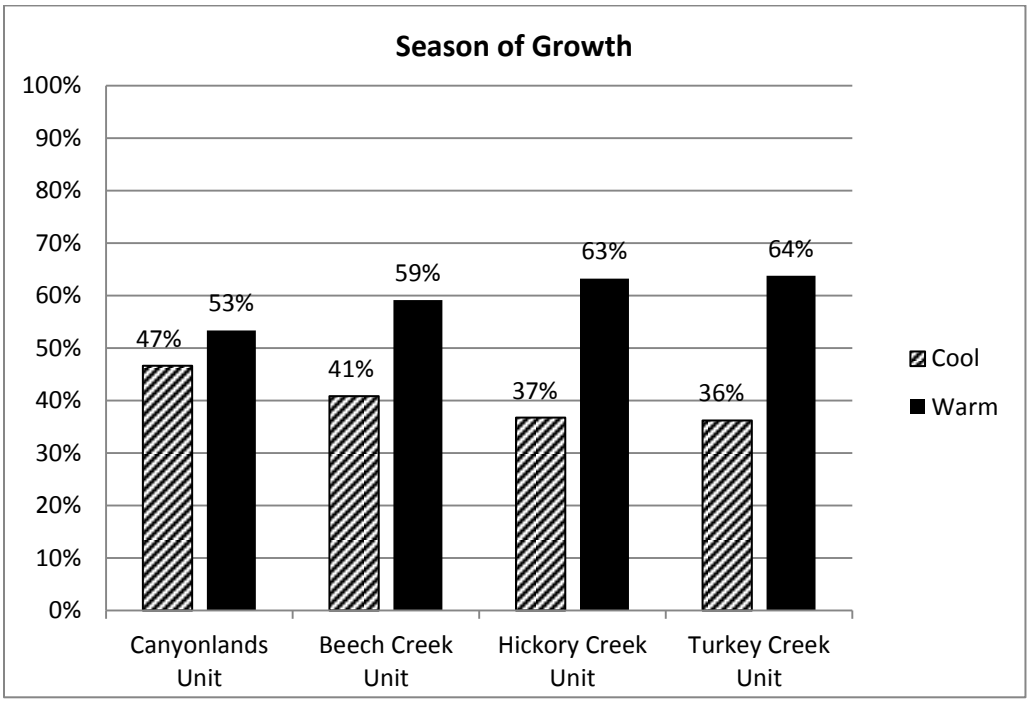

FIG. 8. Comparison of Season of growth. Denotes the percentage of warm season versus cool season plant species across the four compared unit.

A comparison of the wetland versus upland plant species across all four units was conducted. A wetland plant is a plant that is capable of surviving in water or near water along with anaerobic soils conditions for extended periods of time. An upland plant is a plant that is occurs almost always in areas that does not have constant water. Table 8 shows the indicator status for wetland and upland plants with a description. A complete plant list for the Canyonlands Unit with their designated indicator status can be found in Appendix E. *The*

National List of Plant Species that Occur in Wetlands (Reed 1988) and USDA-NRCS-PLANTS Database were used to indicate the wetland indicator status. There are 13 different regions that this list recognizes. The Big Thicket is encompassed in region six. Region six is composed on Texas and Oklahoma. When comparing these species the first comparison was made of all upland plants (FAC, FACU, UPL and NI) versus all wetland plants (OBL and FACW) see Fig. 9. Within the wetland plants the comparison was taken one step further with a comparison of obligate wetland species versus facultative wetlands species (Fig. 10).

TABLE 8. Description and codes of the different wetland indicators (USDA-NRCS-PLANTS Database 2012).

Indicator code	Wetland type	Description
OBL	Obligate Wetland	Occurs almost always (estimated probability 99%) under natural conditions in wetland.
FACW	Facultative Wetland	Usually occurs in wetlands (estimated probability 67%-99%), but occasional found in non-wetlands.
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands (estimated 34%-66%.
FACU	Facultative Upland	Usually occurs in non-wetlands (estimating probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).
UPL	Obligate Upland	Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural condition in non-wetlands in the region six. If a species does not occur in wetlands in any region, it is not on the National List.
NI	No Indicator	Insufficient information was available to determine an indicator status.

Across all four units there were a higher percentage of upland plant species than wetland plant species (Fig. 9). The Canyonlands Unit had the highest percentage of upland plants species. The percentage of upland plants was higher across all units. However, these two entities were very

similar based on percentage. The highest percentage of upland plants was in the Canyonlands Unit. The percentage in Figure 9 does not add up to 100% because the NI species were not figured into this calculation. The NI plants are plants that are not given an indicator status for Region 6 by the *National List of Plant Species that occur in Wetlands: Texas.* A comparison of the obligate wetland species and the facultative wetland species was conducted (Fig. 10). The Canyonlands Unit had the lowest percentage of wetland plant species than the other three units. This could be related to the drought conditions that were reported the past two years and the obligate plants species were not flowering or growing as they would under normal rainfall conditions.

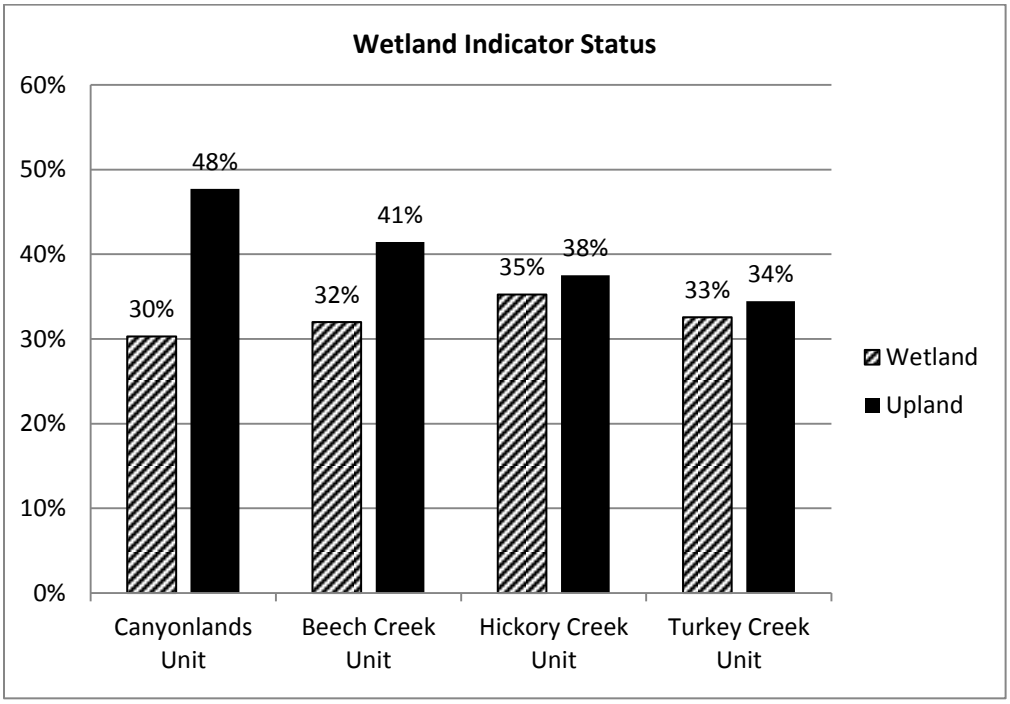

FIG. 9. Comparison of Wetland indicator status. Denotes the percentage of upland versus wetland plant species across the four compared units.

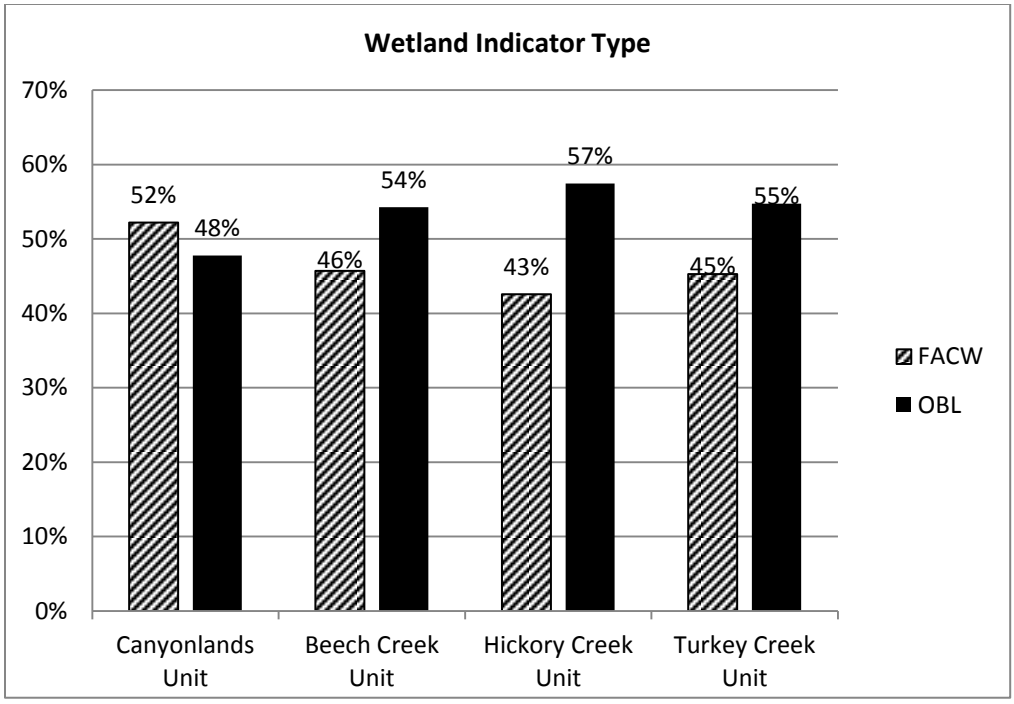

FIG. 10. Comparison of wetland indicator types. Denotes the percentage of FACW and OBL plant species across the four compared units.

Species Analysis

A total of 37 woody species (trees and shrubs) were observed and identified throughout this portion of the study, these species were present in at least 1 sample quadrat (Table 9). Of these 37 species 27 of them occurred in more than three quadrats (Table 9). The information that was derived from the Indicator Species Analysis suggests using 7 groups for the Cluster Analysis, the final result of a Cluster Analysis is a dendrogram (Appendix F). The average p value, indicator value and number of significant indicator graphs were all used to determine the seven groups for the Cluster Analysis (Appendix F). The Relative Abundance table produced from PC-ORD is used to describe the 7 different groups, the percentage of perfect indication (average abundance of a given species in a given group of plots over the average abundance of that Species in all Plots expressed as a percent value) see Appendix F. Indicator values were given in PC-ORD when conducting the Indicator Species Analysis (Appendix F).

Each of the community groups were assigned community names based on the positions of the group (upland, slope, floodplain or flatland), the community type the group is within (forest, savanna, or shrub thicket), and combined this with the important trees of the area in some cases (pine, oak, hardwood), (Harcombe and Marks 1980).

TABLE 9. Woody species within the Canyonlands Unit of the Big Thicket National Preserve that were observed during the Indicator Species Analysis and Cluster Analysis. The plant codes are the official NRCS-USDA format. *indicates plants species that occur in fewer than three quadrats and were removed from the data set.

Code	Species name or genera name	Code	Species name or genera name
ACER	*Acer*	MAGR4	*Magnolia grandiflora*
ARSP2	*Aralia spinosa*	MYCE	*Myrica cerifera*
ASPA18	*Asimina parviflora*	NYSSA	*Nyssa*
BAHA	*Baccharis halimifolia*	OSVI	*Ostrya virginiana*
BENI*	*Betula nigra*	PEBO	*Persea borbonia*
BULA*	*Sideroxylon lanuginosum*	PITA	*Pinus taeda*
	Syn= *Bumelia lanuginosa*	PLAQ	*Planera aquatica*
CAAM2	*Callicarpa americana*	PLOC	*Platanus occidentalis*
CARYA	*Carya*	QUERC	*Quercus*
COFL2	*Cornus florida*	RHCO*	*Rhus copallinum*
CYRA*	*Cyrilla racemiflora*	RHOD*	*Rhododendron canescens*
FAGR	*Fagus grandifolia*	RUBUS	*Rubus*
FRCA13	*Frangula caroliniana*	SASE5	*Sapium sebiferum*
GLAQ*	*Gleditsia aquatica*		Syn= *Triadica sebifera*
HAVI4	*Hamamelis virginiana*	SAAL5	*Sassafras albidium*
ILEX	*Ilex*	SEFR*	*Sebastalia fruticosa*
ILOP	*Ilex opaca*	SESBA*	*Sesbania*
JUVI*	*Juniperus virginiana*	TADI2	*Taxodium distichum*
LISI*	*Ligustrum sinense*	ULAM	*Ulmus alata*
LIST2	*Liquidambar styraciflua*		

Group I (Mid to Lower Slope Pine Oak Forest) had a total of 37 quadrats, there are four species that represent this group. The most abundant species in group one was *Ulmus alata* with 75% followed by *Cornus florida* with 49%, *Ostrya virginiana* with 43%, and *Ilex opaca* with 24%. These percentages are the average abundance of a given species in a given group of quadrats over the average abundance of that species in all quadrats. *Ostrya virginiana* had the highest indicator value for this group. The quadrats within this group were predominantly located on either Silsbee fine sandy loam (SiC) soil or Woodville fine sandy loam (WnB). Both of these soils are found are areas with up to 5% slope. These soils types have a fine or very fine sandy loam top layer with a clay soil as the following layers. The areas where many of these

quadrats are located are along the main canyon that stretches from the north end of the Canyonlands Unit all the way to the south end of the unit.

Group II (Flatland Shrub Thicket) had a total of 6 quadrats. There were three species that represented this group. The most abundant species within group two was *Rubus* with 98% this was followed by *Baccharis halimifolia* with 83% and *Triadica sebifera* with 72%. *Rubus* had an indicator value of 98 which is almost a perfect indication. *Baccharis halimifolia* and *Triadica sebifera* also had high indicator values. Many of these quadrats were found on areas that have been cleared in the past. All but one of these quadrats was found on the very edge of these cleared areas after dropping off the slope of the canyon. Alazan very fine sandy loam (AaB) soil is where 67% of these quadrats are located. This soil occurs in areas that have 0-4% slope. The top layer of this soil is a very fine sandy loam with the second layer being a sandy clay loam.

Group III (Wetland Oak Thicket) has a total of 4 quadrats. There were numerous plants that were abundant in this group. These species included *Aralia spinosa* with 93%, *Acer* with 51%, *Asimina parviflora* 32 %, *Hamamelis virginiana* 48%, *Liquidambar styraciflua* 41%, *Nyssa* 42%, *Planera aquatica* 47 %, *Platanus occidentalis* 85%, and *Quercus* 59%. This group had several abundant plant species. *Quercus,* and *Aralia spinosa* had the two highest indicator values for this group. These quadrats occurred in bottomland areas that had potential to be inundated by water. Many of these species are FAC, FACW or OBL wetland indicator species.

Group IV (Swamp Cypress Forest) had a total of 28 quadrats. There were 4 species that were most abundant in this group. These included *Taxodium distichum* with 76 %, *Fagus grandifolia* 70%, *Magnolia grandiflora* 66% and *Persea borbonia* 40%. *Taxodium distichum, Magnolia grandiflora* and *Nyssa* had the highest indicator values for this group, ranging from 10-16. These quadrats occurred mostly in either bottomland areas that were inundated with water or areas that were along small streams or creeks. The quadrats that occurred in the bottomland

areas that were inundated with water was just over 50% of the total quadrats within this group. These quadrats were in one of two soil types, Cypress mucky clay (CyA) or Estes-Angelina complex (EtA) both of these soils are clay dominated soils throughout all layers and are prone to flooding or intermitant stream beds. In the quadrats that do not show to occur within these soil types can be seen in a close relation to a creek or stream, these areas may be a micro habitat with clay type soils that do not occur on the soils map that is presented.

Group V (Upland Slope Yaupon Pine Forest) consisted of 19 different quadrats. There were three dominant species within this group. These included *Myrica cerifera* with 69%, *Frangula caroliniana* 58% and *Carya* 47%. *Ilex* and *Pinus taeda* had the two highest indicator values for this group. They were 22 and 17 respectively. Many of these quadrats occurred on upland areas. There were several soils that these quadrats were associated with, however all of the soils were a type of sandy loam soil with very little clay present until at least the third layer of soil. There are a few quadrats that occurred in some of the bottomland areas but it is assumed that there is a rise in the topography at that quadrat that caused a change in soil type.

Group VI (Upland Pine Forest) consisted of 5 quadrats. There were four dominant species within this group. These include *Callicarpa americana* with 61% followed by *Ilex* 58%, *Sassafras albidium* 55% and *Pinus taeda* 36%. *Ilex* and *Pinus taeda* also had the highest indicator scores for Group VI. These quadrats were located on strictly upland sites with two types of Silsbee fine sandy loam soils. These soil types range from 3-12 % slope and is easily drained due to the amount of sand. These two Silsbee fine sandy loam soils do not have clay particles until at least 15 in deep. The quadrats within this group are located on the west margin of the Canyonlands Unit.

Group VII (Floodplain Hardwood Forest) consisted of only one quadrat. This quadrat was located in the center of a wetland area and completely inundated by water. The dominant

plant in the quadrat was *Planera aquatica* these plant were young and just starting to grow. There was such an abundance of this species at this quadrat that it did not match the rest of the grouping so became a group of its own.

Seven different groups were identified using the ISA and Cluster Analysis. These groups are created by combining vegetation that grows together in similar areas. After looking at these groups a conclusion can be drawn that the different vegetation communities relate to the different soil types and soil moisture located within the unit (Appendix F). In this study, soil moisture was not tested but one can assume that the clay soils will have high moisture content because of its high water holding capacity. The sandy and sandy loam soils are not going to retain the moisture as well because water is able to move through soils with large soil particles quickly.

CHAPTER V

CONCLUSIONS

The Canyonlands Unit of the Big Thicket National Preserve was visited multiple times in order to collect all the vascular plant species over a three year period. The trips resulted in over 700 collections made with 383 different taxa and 376 different species. There were a total of 99 families collected, and 235 different genera (Appendix E). The species collected in the Canyonlands Unit were compared to the species collected in the Beech Creek Unit, Hickory Creek Unit and Turkey Creek Unit. These units were compared on number of species, native versus introduced species, cool season versus warm season species, annual versus perennial species, upland versus wetland species, obligate wetland versus facultative wetland species, woody versus herbaceous, and monocot, dicot, ferns, and gymnosperms. The full list containing each species with its designated entity can be found in Appendix E. A list of site descriptions where the plants were collected can be found in Appendix A.

It was thought at the start of this project that the Canyonlands Unit would be the most diverse unit in the preserve based on unit size and having a completed floristic study. After the collections were made and identified, the results indicated that this unit was not the most diverse unit. Due to the last two dry years it is probable that many plants were not flowering during time of collections.

Along with collecting the vascular plants species within the unit an Indicator Species Analysis and Cluster Analysis was performed on all the woody (trees and shrubs) species. These analyses were conducted in order to identify the communities within the unit. These analyses identified seven different groups. Group I (Mid to Lower Slope Pine Oak Forest) was identified as areas with slopes that occur along the main canyons of the unit. Group II (Flatland Shrub Thicket) was identified as areas that were previously cleared and had young pine growth. Group

III (Wetland Oak Thicket) this group was identified as wet area community type with many of the quadrats occurring in the frequently wet areas of the unit this group is designated as riparian areas. Group IV (Swamp Cypress Forest) many of these quadrats occurred primarily in the wetland and bog areas that are frequently flooded. The species within this group are facultative or obligate taxa capable of tolerating anaerobic soils and standing water. Group V (Upland Slope Pine Forest), this group of quadrats were primarily associated with sandy loam soil, many of these quadrats occur on the upland areas and on the canyon edges. Group VI (Upland Yaupon Pine Forest) is primarily upland community with many of the quadrats occurring on uplands sites. Group VII (Floodplain Hardwood Forest) only contained one quadrat and was found in a moist area. This area contained standing water from a previous rain and flooding of the river or creeks.

Future collecting trips during years that have the average rainfall will likely discover plants that were not found during this study. This information will make for a more complete list of the vascular plants within this area.

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APPENDIX A

COLLECTION INFORMATION

Site Description and Label Data

Site	Date	Site Description
1	October 31, 2008	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30.72621° W 94.14021°
2	October 31, 2008	Canyonlands Unit of the Big Thicket. S end of unit in creek bed. Sandy soil with shade. N 30.72002 ° W 94.13995 °
3	October 31, 2008	Canyonlands Unit of the Big Thicket. Southern end of the unit on an upland site. Sandy soil. Partial shade. N 30.72062 ° W 94.13994 °
4	November 1, 2008	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. On the edge of the Canyonlands Unit and the Corridor Unit, in Beaver pond, shady, swampy area, with loam soil. Shady bottomland habitat. N 30.71616 ° W 94.13794 °
5	November 1, 2008	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. On the edge of the Canyonlands Unit and the Corridor Unit, in Beaver pond, shady, swampy area, with loam soil. Shady bottomland habitat N 30.71678 ° W 94.13723 °
6	November 1, 2008	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. On the edge of the Canyonlands Unit and the Corridor Unit, shady, swampy area, with loam soil. N 30.71736 ° W 94.13806 °
7	November 1, 2008	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. N 30.7602 ° W 94.14537 °
8	November 1, 2008	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. On the edge of the Canyonlands Unit and the Corridor Unit, in beaver pond, shady, swampy area, with loam soil. Shady bottomland habitat.

Site	Date	Site Description
9	March 19, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Hwy 92 to County Road 4415 about 4 mi then left onto dirt road. SE portion of the unit towards the Neches River upland area along dirt loop road above canyon area of the unit., partial shade. Soil sandy. N 30.72618 º W 94.14139 º
10	March 19, 2009	Southern end of the Canyonlands Unit. Upland are along old logging path. Sandy soil, shady area. N 30.72900 º W 94.14339 º
11	March 19, 2009	Southern end of the Canyonlands Unit. Plant along road within the unit. Upland sunny area with sandy soil. N 30.72988 º W 94.14515 º
12	March 19, 2009	Southern end of Canyonlands Unit. Plant on and along an old logging road. Upland shady area with sandy soil. N 30.72991 º W 94.14539 º
13	March 19, 2009	Southern end of Canyonlands Unit. Plant on and along an old logging road. Upland shady area with sandy soil. N 30.72981 º W 94.14432 º
14	March 19, 2009	Upland area of the Canyonlands Unit. Southern end of unit, upland site, partially shady. Sandy soil N 30.7273 º W 94.1422 º
15	March 19, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30.72606 º W 94.14036 º
16	March 19, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30.72615 º W 94.14055 º
17	March 19, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Hwy 92 to County Road 4415 about 4 mi then left onto dirt road. SE portion of the unit towards the Neches River in large canyon below the loop road of the southern portion of the unit. N 30º43.627” W 94º08.531”

Site	Date	Site Description
18	March 19, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit. Growing along creek SE of the camp area. 300 yards E of the Neches River. Shaded bottomland area with sandy soil. N 30°43.010” W 94°08.218”
19	March 19, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Hwy 92 to County Road 4415 about 4 mi then left onto dirt road. SE portion of the unit along the loop road of the southern portion of the unit. Shady area. Soil sandy. N 30.72986 ° W 94.14534 °
20	March 19, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30.72055 ° W 94.13991 °
21	March 19, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30.71598 ° W 94.13983 °
22	March 19, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. Wetland habitat N 30.71725 ° W 94.13675 °
23	March 19, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. Wetland habitat. N 30.71866 ° W 94.13324 °
24	March 19, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. SE of camp area 300yds W of the Neches River. Habitat very dense shady moist area. Soil sandy. On the margin of a wetland area. N 30.71823 ° W 94.13651 °
25	March 19, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. SE portion of the unit along the loop road of the southern portion of the unit. Shady area. Soil sandy. N 30.73015 ° W 94.15005 °

Site	Date	Site Description
26	March 19, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Hwy 92 to County Road 4415 about 4 mi then left onto dirt road. SE portion of the unit towards the Neches River upland area along dirt loop road above canyon area of the unit. N 30.72642 º W 94.14218 º
27	March 19, 2009	Southern end of the Canyonlands Unit. Shady area. N 30.73032 º W 94.15063 º
28	March 19, 2009	Southern end of the Canyonlands Unit. Shady area. N 30.72616 º W 94.14512 º
29	March 19, 2009	Southern end of the Canyonlands Unit. Shady area. N 30.72630 º W 94.14350 º
30	March 19, 2009	Southern end of the Canyonlands Unit. Shady area. N 30.72616 º W 94.14242 º
32	March 20, 2009	Southern end of the Canyonlands Unit. Bottomland area with small creek. Shaded by larger trees and understory shrubs. Sandy soil. N 30.72028 º W 94.14034 º
33	March 20, 2009	Southern end of the Canyonlands Unit. Bottomland area . N 30.71793 º W 94.13838 º
34	March 20, 2009	Southern end of the Canyonlands Unit. Bottomland area with small creek. N 30.71842 º W 94.13258 º
35	March 20, 2009	Southern end of the Canyonlands Unit. Bottomland area with small creek. Next to the Neches River. N 30.72724 º W 94.13656 º
36	March 20, 2009	Southern end of the Canyonlands Unit. Bottomland area with small creek. Next to the Neches River. N 30.71773 º W 94.13348 º
37	March 20, 2009	Southern end of the Canyonlands Unit. Bottomland area with small creek. N 30.71732 º W 94.13439 º

Site	Date	Site Description
38	March 20, 2009	Southern end of the Canyonlands Unit. Bottomland area with seep. Hydrophytic soils N 30.71598 ^{o} W 94.13983 ^{o}
39	March 18, 2009	Big Thicket National Preserve. N end of the Canyonlands Unit in draw at the head of the canyon. Shady moist area with sandy soil. Small stream running through area. N 30°44.825 W 94°09.068
40	May 14, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30° 43.231 W 94°08.401
41	May 14, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Partly shaded area, upland habitat. Soil dry sandy. N 30°43.274 W 94°00.866
42	May 14, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Partly shaded area, upland habitat. Soil dry sandy. N 30°43.564 W 94°08.628
43	May 14, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Partly shaded area, upland habitat. Soil dry sandy. N 30°43.295 W 94°08.655
44	May 14, 2009	Southern end of the Canyonlands Unit. In creek bottom just S of the camp area. N 30°43.069 W 94°08.286
45	May 14, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp are growing along creek. Bottomland shady area with moist sandy soil. N 30°43.126 W 94°08.328
46	May 15, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just S of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30° 42.467 W 94°08.215

Site	Date	Site Description
47	May 15, 2009	Big Thicket National Preserve. N end of the unit in draw at the head of the canyon. Shady moist area with sandy soil. Small stream running through area, bottom of gully, deep soil. N 30°43.884 W 94°08.272
48	May 15, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just S of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30° 42.975 W 94°08.292
49	May 15, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just S of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30° 43.082 W 94°08.302
50	May 15, 2009	Big Thicket National Preserve. N end of the Canyonlands Unit. E of where cars are parked above main canyon in clearing. Upland partly sunny area. Soils sandy loam, with some moisture. N 30° 44.875 W 94° 08.973
51	May 15, 2009	Upland area of the Canyonlands Unit. On the margin of a canyon before dropping off. Shady area with sandy soils. N 30° 43.892 W 94° 08.750
52	May 15, 2009	Big Thicket National Preserve. N end of the Canyonlands Unit in draw at the head of the canyon. Shady moist area with sandy soil. Small stream running through area N 30°44.806 W 94°09.127
53	15 May 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just S of camp area growing along creek. Bog area along hillside on the W side of the unit, with moist sandy soil. N 30° 42.975 W 94°08.292
54	May 15, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30° 43.335 W 94°08.773
55	May 15, 2009	Big Thicket National Preserve N end of the unit. Young forest clear cut. Partially shady. Sandy soil surface and clay subsoil. N 30°43.285 W 94°08.655

Site	Date	Site Description
56	May 15, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Partly shaded area, upland habitat. Soil dry sandy. N 30°43.389 W 94°08.842
57	May 15, 2009	Northern end of the Canyonlands Unit. In Wooded area in bottom land portion of the unit. Shady area with sandy soil. N 30°43.863 W 94°08.775
58	May 16, 2009	Big Thicket National Preserve. N end of the Canyonlands Unit W of the northern Canyons. Shady upland habitat. N 30°44.745 W 94°09.125
59	May 16, 2009	Big Thicket National Preserve. N end of the unit in draw at the head of the canyon. Shady moist area with sandy soil. Small stream running through area. N 30°44.832 W 94°09.061
60	May 16, 2009	Big Thicket National Preserve. N end of the Canyonlands Unit cypress swamp. Shady wet area with loam soil. N 30°44.884 W 94°08.878
61	May 16, 2009	Big Thicket National Preserve. N end of the unit in draw at the head of the canyon. Shady moist area with sandy soil. Small stream running through area N 30°43.163 W 94°08.822
62	May 17, 2009	Big Thicket National Preserve. N end of the Canyonlands Unit cypress swamp. Shady wet area with loam soil N 30°46.097 W 94°08.865
63	July 18, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Sunny area, upland habitat. Soil dry sandy. N 30°43.046 W 94°08.691
64	July 18, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Off of County Road 4415, plant at the head of large canyon. Sunny area, upland habitat. Soil dry and sandy. N 30°43.568 W 94°08.540

Site	Date	Site Description
65	July 18, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Off of County Road 4415, plant at the head of large canyon. Sunny area, upland habitat. Soil dry and sandy. N 30°43.566 W 94°08.472
66	July 18, 2009	Big Thicket National Preserve. N end of the unit in draw almost at the bottom of the canyon. Shady moist area with sandy soil. Small stream running through area N 30°43.546 W 94°08.412
67	July 18, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Sunny area, upland habitat. Soil dry sandy. N 30°43.794 W 94°08.839
68	July 18, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit, County Road 4415 along the dirt road of the second entrance of the unit headed towards creek and camp area. Sunny area, upland habitat. Soil dry sandy. N 30°43.393 W 94°08.861
69	July 18, 2009	Canyonlands Unit of the Big Thicket National Preserve, Located on the outskirts of the canyon just off of County Road 4416. Sandy soil with small spring running through the site. Area shaded by the surrounding trees. N 30°43.567 W 94°08.379
70	July 18, 2009	Off County Road 4416, taking first entrance to the Canyonlands Unit. Red and yellow marking on tree. Growing at the end of this road after the first road on the right. Sandy soil. N30°43.565 W94°08.590
71	July 18, 2009	Big Thicket National Preserve, Canyonlands Unit. Along edge of road of the furthest point along dirt road directly S of the creek. Sandy soil. N30°43.214 W94°08.458
72	July 19, 2009	North end of Canyonlands Unit of the Big Thicket National Preserve. Site N of oil pad at the head of a major canyon. Area shaded on upland site. N30°44.797 W94°09.064

Site	Date	Site Description
73	July 19, 2009	North end of Canyonlands Unit of the Big Thicket National Preserve. Plants collected NE of oil pad in very dense shaded area provided mostly by hardwoods. Sandy Soil. N30°44.874 W94°08.878
74	July 19, 2009	N end of the Canyonlands Unit of the Big Thicket National Preserve. Growing in moist area, open area. Soil sandy. N30°44.873 W94°08.833
75	July 19, 2009	North end of the Canyonlands Unit of the Big Thicket National Preserve, at the parking place of the main canyon just north of the oil pad. Sandy soil. N30°44.736 W94°09.119
76	July 19, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. E of camp area below house that is located at the very edge of the unit. Habitat very dense shady moist area. Soil sandy. N 30°43.085 W 94°08.286
77	July 19, 2009	Canyonlands Unit of the Big Thicket National Preserve. Northern end of unit, in wet moist canyon bottom very shady area. Moist sandy soil. N 30°44.883 W 94°08.951
78	July 19, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp are growing along creek. Bottomland shady area with moist sandy soil. N 30°43.199 W 94°08.375
79	July 19, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30°43.028 W 94°08.188
80	July 19, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Hwy 92 to County Road 4415 about 4 mi then left onto dirt road. SE portion of the unit towards the Neches River. N 30°43.391 W 94°08.854
81	October 2, 2009	Big Thicket National Preserve. N end of the unit in draw at the head of the canyon. Shady moist area with sandy soil. Small stream running through area. N 30°44.830 W 94°09.065

Site	Date	Site Description
82	October 2, 2009	Northern end of the Canyonlands Unit of the Big Thicket National Preserve. Plant in bottomland area, along creek in bottom of canyon. Shaded area with moist sandy soil. N 30°44.873 W 94°09.039
83	October 2, 2009	Northern end of the Canyonlands Unit of the Big Thicket National Preserve. Plant in bottomland area, along creek in bottom of canyon. Shaded area with moist sandy soil. N 30°44.897 W 94°08.851
84	October 2, 2009	Big Thicket National Preserve. N end of the Canyonlands Unit. Bottomland shady habitat. Located at the head of a canyon on the margins of small spring running through the site. Abundant ground cover and large trees and shrubs shading the site. Soil sand. N 30°44.871 W 94°09.098
85	October 2, 2009	North end of the Canyonlands Unit of the Big Thicket National Preserve. About 7 mi N of Spurger on right side of road at the top of canyon before dropping off. Shady upland site. Sandy soil. N30°44.785 W94°09.127
86	October 2, 2009	North end of the Canyonlands Unit of the Big Thicket National Preserve. At the rim of canyon before entering bottom of the canyon. Moist shady upland area. N30°44.828 W94°09.118
87	October 2, 2009	North end of the Canyonlands Unit of the Big Thicket National Preserve. Down clearing to the E just off of dirt road leading to canyon, on upland partly sunny site. N30°44.735 W94°09.074
88	October 3, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Seepy area below camp area along the creek near house on the margin of the unit
89	October 3, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Partly shaded area, upland habitat. Soil dry sandy. N 30°43.274 W 94°00.866
90	October 3, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30°43.558 W 94°08.408

Site	Date	Site Description
91	October 3, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30°43.565 W 94°08.480
92	October 3, 2009	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing along creek. Bottomland shady area with moist sandy soil. N 30°43.212 W 94°08.401
93	October 3, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. SE portion of the unit below camp area, towards the Neches River, where creek widens out above river. Shady area. Soil sandy. N 30°42.969 W 94°08.271
94	October 3, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. SE portion of the unit towards the Neches River. Shady area. Soil sandy N 30°43.030 W 94°08.186
95	October 4, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Hwy 92 to County Road 4415 about 4 mi then left onto dirt road. SE portion of the unit towards the Neches River. Shady area. Soil sandy. N 30°43.752 W 94°08.811
96	October 4, 2009	Northern end of the Canyonlands Unit of the Big Thicket National Preserve. Plant in bottomland area, along creek in bottom of canyon. Shaded area with moist sandy soil.
97	October 4, 2009	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Hwy 92 to County Road 4415 about 4 mi then left onto dirt road. SE portion of the unit towards the Neches River. N 30°43.222 W 94°08.382
98	March 27, 2010	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Sunny area, upland habitat. Soil dry sandy. N 30°43.264 W 94°08.686

Site	Date	Site Description
99	March 27, 2010	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing in seasonal creek bed. Bottomland shady area with moist sandy soil. N 30°43.141 W 94°08.329
100	March 27, 2010	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Hwy 92 to County Road 4415 about 4 mi then left onto dirt road. SE portion of the unit towards the Neches River upland area along dirt loop road above canyon area. of the unit. Partial shade. Soil sandy, abundant leaf material making the ground warm and moist. N 30°43.563 W 94°08.440
101	March 27, 2010	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Sunny area, upland habitat. Soil dry sandy. N 30°43.564 W 94°08.577
102	March 27, 2010	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing in seasonal creek bed. Bottomland shady area with moist sandy soil. N 30°43.209 W 94°08.407
103	March 27, 2010	Canyonlands Unit of The Big Thicket National Preserve on the margins of the Corridor Unit. Plants in damp swampy area shaded with loblolly pine and various other tree species. N30°43.127 W94°08.338
104	March 27, 2010	Canyonlands Unit of the Big Thicket National Preserve. Off of County Road 4415 in the Canyonlands Unit on the direct margins of the road. Upland dry site. Sunny area with some trees.
105	March 28, 2010	Hwy 92 N of Spurger about 7 mi located down dirt road on the Northern end of the Canyonlands Unit of the Big Thicket National Preserve. Plants growing on upland sire at top of canyon with large magnolia and beech trees. N30°44.841 W94°09.094
106	March 28, 2010	Canyonlands Unit of The Big Thicket National Preserve located on the northern end of the unit, in bottom of canyon along small creek, ferns in area brown. N30°44.873 W94°09.001

Site	Date	Site Description
107	May 20, 2010	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Sunny area, upland habitat. Soil dry sandy. N 30°43.445 W 94°08.869
108	May 20, 2010	Big Thicket National Preserve. Southern end of the Canyonlands Unit E of camp area towards the Neches River, along the Corridor Unit of the Big Thicket. Shady low lying area. Bottomland with moist sandy soil. N 30°43.003 W 94°08.236
109	May 20, 2010	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp area growing in seasonal creek bed. Bottomland shady area with moist sandy soil. N 30°43.200 W 94°08.383
110	May 20, 2010	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415 after second entrance into Canyonlands Unit along 4415. Sunny area, upland habitat. Soil dry sandy. N 30°43.218 W 94°08.543
111	May 20, 2010	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. At the very west margin of the unit along County Road 4415. Sunny area, upland habitat. Soil dry sandy.
112	May 20, 2010	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Hwy 92 to County Road 4415 about 4 mi then left onto dirt road. SE portion of the unit towards the Neches River in large canyon below the loop road of the southern portion of the unit. N 30°43.566 W 94°08.512
113	May 21, 2010	Canyonlands Unit of the Big Thicket National Preserve. Northern end of unit, in wet moist canyon bottom very shady area. Moist sandyloam soil. N 30°44.886 W 94°09.044
114	May 21, 2010	Big Thicket National Preserve. N end of the unit in draw at the head of the canyon. Shady moist area with sandy loam soil. Small stream running through area. N 30°44.860 W 94°09.126

Site	Date	Site Description
115	June 27, 2011	Big Thicket National Preserve. N end of the unit along the W margin. Upland sunny habitat with partial shade. Area a mature pine forest. N 30°45.218 W 94°09.295
116	June 27, 2011	Big Thicket National Preserve. N end of the unit along the W margin. Upland sunny habitat with adequate amount of shade. Area a mature pine forest. Plant perennial. Soil sandy loam. N 30°45.561 W 94°09.450
117	June 27, 2011	Big Thicket National Preserve. N end of the Canyonlands Unit along the N margin. Upland sunny habitat with partial shade. Area a mature pine forest. Plant perennial. Soil sandy loam. N 30°45.484 W 94°09.444
118	June 27, 2011	Big Thicket National Preserve. N end of the Canyonlands Unit along the W margin. Upland sunny habitat with partial shade. Area a mature pine forest. Plant perennial. Soil sandy loam.
119	June 27, 2011	Big Thicket National Preserve. N end of the Canyonlands Unit along the W margin. Upland sunny habitat with partial shade. About 0.75 mi SW of the northern boundary. Area a mature pine forest. N 30°45.163 W 94°08.965
120	June 27, 2011	Big Thicket National Preserve. N end of the Canyonlands Unit. Bottomland shady habitat. Located on the margins of small spring running through the site. Abundant ground cover and large trees and shrubs shading the site. Soil sand. N 30°44.871 W 94°09.108
121	June 27, 2011	Big Thicket National Preserve. N end of the unit along the W margin. Upland sunny habitat with partial shade. Area a mature pine forest. N 30°45.328 W 94°09.350
122	June 27, 2011	Northern end of the Canyonlands Unit of the Big Thicket National Preserve, about 1/2 mi S of the northern boundary. Plant growing in young growth of pine and sapium. Area mostly sunny. Soil sandy. N30°45.350 W94°09.166
123	June 28, 2011	Southern end of the Canyonlands Unit of the Big Thicket National Preserve. Along creek just south of camp area. N30°43.237 W94°08.404

Site	Date	Site Description
124	June 28, 2011	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp are growing along creek. Bottomland shady area with moist sandy soil. N 30°43.535 W 94°08.571
125	June 28, 2011	Big Thicket National Preserve. Southern end of the Canyonlands Unit just east of camp are growing along creek towards the Neches River. Bottomland shady area with moist sandy soil. N 30°42.981 W 94°08.268
126	June 28, 2011	Big Thicket National Preserve. Southern end of the Canyonlands, N of the camp area on the W margin of the unit on small trail. Shady upland area with sandy soil. N 30°43.810 W 94°09.008

Collectors/Assistants
Mindy Gallardo
Steven Goertz
Katherine Haile
Kelly Haile
Robert Haile
Stephan Hatch
Dale Kruse
George Umphres
Erin Wied

Collection Trip Information

Year	Date	Activities
Year 1		
	October 31-November 1, 2008	Defined unit boundaries, plant communities, collection sites and started initial field collections. The primary goal of this trip was to determine unit boundaries, collect seasonally dominant species within the entire Canyonlands Unit. Collectors: Mindy Gallardo, Stephan Hatch & Dale Kruse
	March 18-19, 2009	This trip was designed to collect the early spring flowering plant species. The objective of this collecting trip as with all the others to collect any flowering plant species that was not previously collected. Collectors: Kelly Haile, Mindy Gallardo & Steven Goertz
	May 14-17, 2009	The purpose of this trip was to collect all the late spring flowering plants. Any plant that was flowering that was not previously collected was collected and pressed. Collectors: Kelly Haile, Stephan Hatch & Steven Goertz
	July 18-19, 2009	The mid-summer trip was conducted in order to collect all the warm season plants that were flowering in the summer. During this collection trip the wetland areas were observed to see the effects of the summer months. 2009 was a fairly wet year so the wetland areas were in good condition with standing water. Collectors: Kelly Haile, Stephan Hatch & Steven Goertz.
Year 2		
	October 2-4, 2009	This trip took place to collect late summer, early fall plants that were not previously collected during the Oct. 2008 trip. Duplicate trips of the areas increased the number of plant species collected. T Collectors: Kelly Haile, Stephan Hatch & Steven Goertz.
	March 27-28, 2010	This early spring trip was conducted to collect plant species that were flowering in early spring. The goal was to collect and look for plant species that were not previously collected in March 2009. This duplicate spring trip allowed us to collect and observe plants that we missed were that were not flowering during the previous early spring collection trip. Collectors: Kelly Haile, Robert Haile & Stephan Hatch

Year	Date	Activities
Year 2	May 20-21, 2010	This late spring collection trip was conducted in order to make a second trip to collect plants that flower in the late spring that we missed or did not collect during the first late spring collection trip made in 2009. The duplicate trip for each of the season increased the number of plant species to allow for us to making a complete plant list of the area. A summer trip was not conducted during year 2 due to the drought conditions. Collectors: Kelly Haile, Robert Haile, Stephan Hatch & Erin Wied
Year 3		
	Jun 27-28, 2011	This was the first collection trip during year 3 due to the lack of rain. This trip was made to observe the effects of the lack of rain and to make early summer plant collections. This gave us the opportunity to collect plants that we missed with the later spring and mid-summer collection trip previously conducted. This trip was also made to observe areas that we had not currently been to, to be sure that the same vegetation was in these areas and that we did not miss any plants. Collectors: Kelly Haile, Katherine Haile & Stephan Hatch
	Aug 10, 2011	This trip was conducted for primarily mapping reason, to visit some of the areas that we had not visited and did not show a location point on the map. When visiting these sites, a location point was taken and the vegetation was observed to be sure that there was no new plant species that was not previously collected. Observers: Kelly Haile & George Umphres
	September 9-10, 2011	This trip was designed to conduct transects for the Indicator Species Analysis and Cluster Analysis that was conducted on the Canyonlands Unit. 17 transect were conducted during this trip. Along with conducting transects plant species were observed and if a new on was found it was collected, pressed and added to the species list. Observers: Kelly Haile & George Umphres
	November 14-15, 2011	This trip was conducted in order to complete the goal of 25 transects for the Indicator Species Analysis and Cluster Analysis for the Canyonlands Unit. Observers: Kelly Haile & Robert Haile

APPENDIX B

PLANT AND HABITAT PICTURES

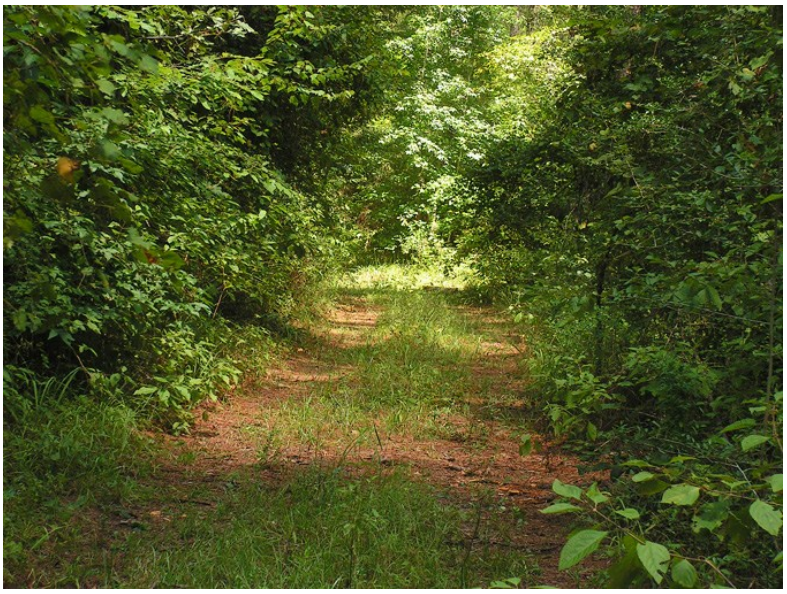
Beaver Pond, Spring 2009, pond contained standing water. This pond is one of the major wetland areas within the Canyonlands Unit. (Photo by Stephan L. Hatch)

Beaver Pond, Spring 2011. 2011 was the driest year on record, during this time the Beaver Pond had very little standing water, and many wetland plants were no longer in the water. (Photo by Stephan L. Hatch)

Northern end of the unit. Upland area on one of the roads within the Canyonlands Unit. (Photo by Kelly Haile)

Northern end of the Canyonlands Unit in one of the major canyons looking up. These areas are dominated by large hardwoods. (Photo by Robert Haile)

Southern end of the Canyonlands Unit, adjacent to the beaver pond. Large cypress knees, with small creek running through the area. (Photo by Robert Haile)



Road on the southern end of the Unit. Located on an upland site. (Photo by Kelly Haile)

Northern end of the Unit, looking down into one of the major canyons. (Photo by Stephan L. Hatch)

Northern end of the Unit, looking down into one of the major canyons. (Photo by Stephan L. Hatch)

Northern end of the Unit. Small stream running through one of the major canyon within the unit. (Photo by Stephan L. Hatch)

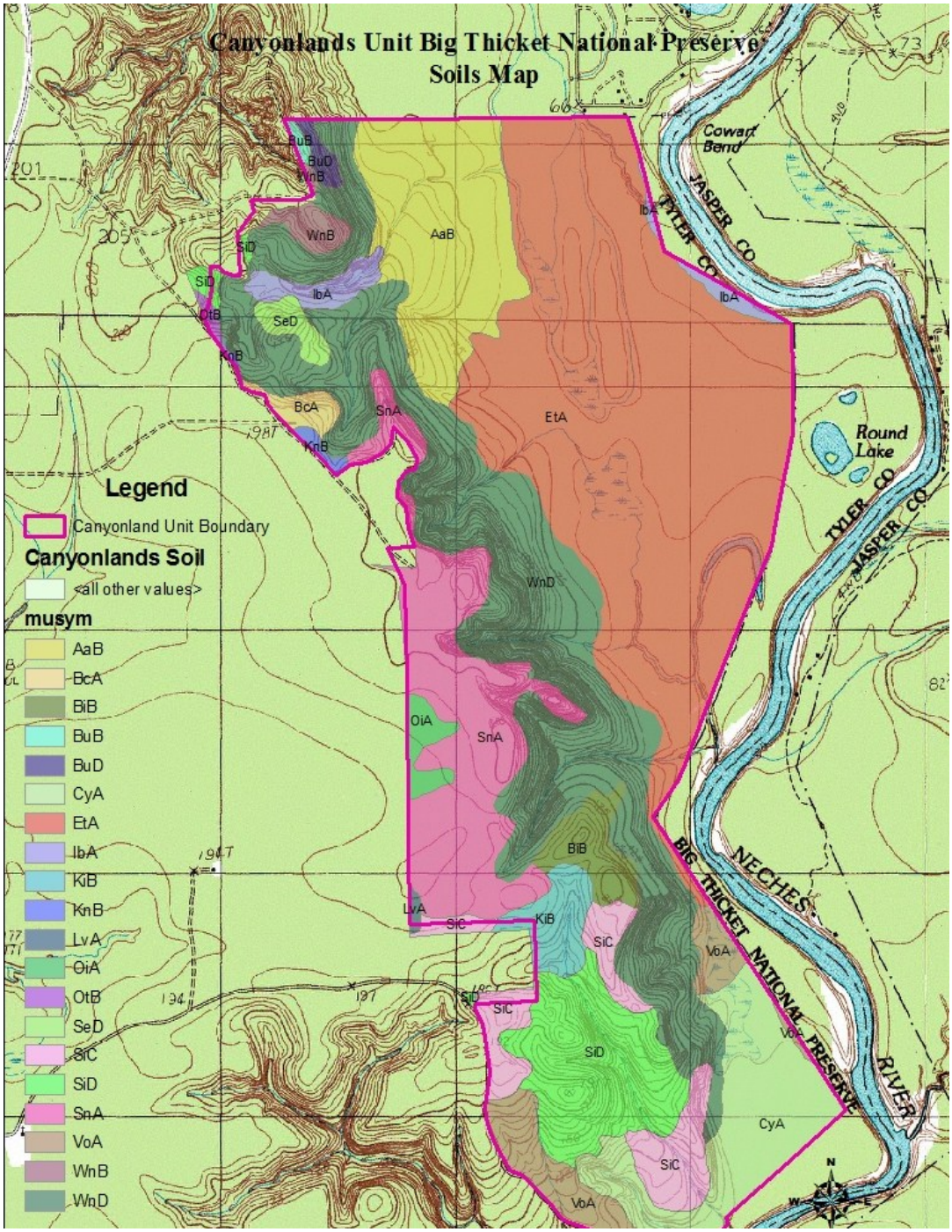
Rhododendron canescens **(Michx.) Sweet. (Photo by Robert Haile)**

***Cornus florida* L. (Photo by Kelly Haile)**

***Podophyllum peltatum* L. (Photo by Robert Haile)**

APPENDIX C

SOILS DESCRIPTION AND SOILS MAP



Soils Map of the Canyonlands Unit. The different colors/codes are the different soil types within the unit. A description of each soil type can be found in the soil descriptions below.

Soils Description

The soil descriptions for the Canyonlands Unit of the Big Thicket National Preserve were obtained from the USDA-NRCS web soil survey (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm).

AaB—Alazan very fine sandy loam, 0 to 4 percent slopes

Map Unit Setting

- *Elevation:* 150 to 450 feet
- *Mean annual precipitation:* 40 to 56 inches
- *Mean annual air temperature:* 64 to 70° F
- *Frost-free period:* 220 to 260 days

Properties and qualities

- *Slope:* 0 to 4 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* About 18 to 30 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Available water capacity:* Moderate (about 8.8 inches)
- *Land capability (nonirrigated):* 2w

Typical profile

- *0 to 18 inches:* Very fine sandy loam
- *18 to 80 inches:* Sandy clay loam

BcA—Belrose-Caneyhead complex, 0 to 1 percent slopes

Map Unit Setting

- *Elevation:* 20 to 330 feet
- *Mean annual precipitation:* 42 to 60 inches
- *Mean annual air temperature:* 64 to 70° F
- *Frost-free period:* 230 to 270 days

Properties and qualities

- *Slope:* 1 to 3 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* High to very high (2.41 to 19.98 in/hr)
- *Depth to water table:* About 28 to 36 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 1.0 mmhos/cm)

Typical profile

- *0 to 6 inches:* Loamy very fine sand
- *6 to 16 inches:* Loamy very fine sand
- *16 to 27 inches:* Loamy very fine sand
- *27 to 42 inches:* Loamy very fine sand
- *42 to 80 inches:* Very fine sandy loam

BiB—Belrose loamy very fine sand, 1 to 3 percent slopes

Map Unit Setting

- *Elevation:* 30 to 130 feet
- *Mean annual precipitation:* 48 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 240 to 270 days

Properties and qualities

- *Slope:* 1 to 3 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* High to very high (2.41 to 19.98 in/hr)
- *Depth to water table:* About 28 to 36 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 1.0 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 4.0
- *Available water capacity:* Moderate (about 7.1 inches)

Typical profile

- *0 to 5 inches:* Loamy very fine sand
- *5 to 20 inches:* Loamy very fine sand
- *20 to 44 inches:* Loamy very fine sand
- *44 to 63 inches:* Loamy very fine sand
- *63 to 80 inches:* Very fine sandy loam

BuB—Burkeville clay, 3 to 5 percent slopes

Map Unit Setting

- *Elevation:* 150 to 450 feet
- *Mean annual precipitation:* 40 to 58 inches
- *Mean annual air temperature:* 64 to 70° F
- *Frost-free period:* 230 to 270 days

Properties and qualities

- *Slope:* 3 to 5 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum content:* 10 percent
- *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Available water capacity:* Moderate (about 6.6 inches)

Typical profile

- *0 to 14 inches:* Clay
- *14 to 80 inches:* Clay

<u>BuD—Burkeville clay, 5 to 15 percent slopes</u>

Map Unit Setting

- *Elevation:* 300 to 650 feet
- *Mean annual precipitation:* 40 to 55 inches
- *Mean annual air temperature:* 63 to 70° F
- *Frost-free period:* 230 to 270 days

Properties and qualities

- *Slope:* 5 to 15 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum content:* 10 percent
- *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Available water capacity:* Moderate (about 6.6 inches)

Typical profile

- *0 to 9 inches:* Clay
- *9 to 79 inches:* Clay

<u>CyA—Cypress mucky clay, 0 to 1 percent slopes, frequently flooded</u>

Map Unit Setting

- *Elevation:* 10 to 100 feet
- *Mean annual precipitation:* 50 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 246 to 255 days

Properties and qualities

- *Slope:* 0 to 1 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Very poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* About 0 inches
- *Frequency of flooding:* Frequent
- *Frequency of ponding:* Frequent
- *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 2.0
- *Available water capacity:* High (about 9.8 inches)

Typical profile

- *0 to 12 inches:* Mucky clay
- *12 to 17 inches:* Clay
- *17 to 80 inches:* Clay

<u>EtA—Estes-Angelina complex, 0 to 1 percent slopes, frequently flooded</u>

Map Unit Setting

- *Elevation:* 20 to 450 feet
- *Mean annual precipitation:* 40 to 65 inches
- *Mean annual air temperature:* 64 to 70° F
- *Frost-free period:* 220 to 260 days

Properties and qualities

- *Slope:* 0 to 1 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Somewhat poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* About 0 to 18 inches
- *Frequency of flooding:* Frequent
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 5.0
- *Available water capacity:* Moderate (about 9.0 inches)

Typical profile

- *0 to 5 inches:* Clay
- *5 to 10 inches:* Clay
- *10 to 43 inches:* Clay
- *43 to 80 inches:* Clay

<u>IbA—Iulus-Bleakwood complex, 0 to 1 percent slopes, frequently flooded</u>

Map Unit Setting

- *Elevation:* 20 to 300 feet
- *Mean annual precipitation:* 40 to 58 inches
- *Mean annual air temperature:* 64 to 70° F
- *Frost-free period:* 235 to 260 days

Properties and qualities

- *Slope:* 0 to 1 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* About 18 to 48 inches
- *Frequency of flooding:* Frequent
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 1.0 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 2.0
- *Available water capacity:* Moderate (about 9.0 inches)

Typical profile

- *0 to 3 inches:* Fine sandy loam
- *3 to 23 inches:* Loam
- *23 to 52 inches:* Fine sandy loam
- *52 to 80 inches:* Fine sandy loam

<u>KiB—Kirbyville fine sandy loam, 0 to 2 percent slopes</u>

Map Unit Setting

- *Elevation:* 80 to 150 feet
- *Mean annual precipitation:* 48 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 240 to 270 days

Properties and qualities

- *Slope:* 0 to 2 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately low (0.01 to 0.14 in/hr)
- *Depth to water table:* About 18 to 30 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 0.5 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 2.0
- *Available water capacity:* High (about 10.7 inches)

Typical profile
- *0 to 6 inches:* Very fine sandy loam
- *6 to 13 inches:* Loam
- *13 to 19 inches:* Loam
- *19 to 56 inches:* Loam
- *56 to 80 inches:* Clay loam

KnB—Kountze very fine sandy loam, 0 to 2 percent slopes
Map Unit Setting
- *Elevation:* 80 to 150 feet
- *Mean annual precipitation:* 48 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 240 to 270 days

Properties and qualities
- *Slope:* 0 to 2 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.14 to 1.42 in/hr)
- *Depth to water table:* About 18 to 24 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.2 to 0.6 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 3.0
- *Available water capacity:* High (about 10.2 inches)

Typical profile
- *0 to 6 inches:* Very fine sandy loam
- *6 to 17 inches:* Very fine sandy loam
- *17 to 25 inches:* Very fine sandy loam
- *25 to 54 inches:* Very fine sandy loam
- *54 to 80 inches:* Loam

LvA—Lelavale silt loam, 0 to 1 percent, ponded
Map Unit Setting
- *Elevation:* 80 to 150 feet
- *Mean annual precipitation:* 48 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 245 to 270 days

Properties and qualities
- *Slope:* 0 to 1 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Very poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately high (0.00 to 0.20 in/hr)
- *Depth to water table:* About 0 inches

- *Frequency of flooding:* None
- *Frequency of ponding:* Frequent
- *Maximum salinity:* Nonsaline to very slightly saline (0.0 to 4.0 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 8.0
- *Available water capacity:* High (about 11.4 inches)

Typical profile
- *0 to 4 inches:* Loam
- *4 to 12 inches:* Silt loam
- *12 to 16 inches:* Loam
- *16 to 41 inches:* Clay loam
- *41 to 49 inches:* Clay
- *49 to 80 inches:* Clay loam

OiA—Olive-Dallardsville complex, 0 to 1 percent slopes
Map Unit Setting
- *Elevation:* 80 to 150 feet
- *Mean annual precipitation:* 48 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 140 to 270 days

Properties and qualities
- *Slope:* 0 to 1 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Very poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.01 in/hr)
- *Depth to water table:* About 0 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* Frequent
- *Maximum salinity:* Nonsaline (0.0 to 0.1 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 1.0
- *Available water capacity:* Low (about 4.4 inches)

Typical profile
- *0 to 14 inches:* Fine sandy loam
- *14 to 22 inches:* Fine sandy loam
- *22 to 65 inches:* Loam
- *65 to 80 inches:* Loam

OtB—Otanya very fine sandy loam, 1 to 3 percent slopes
Map Unit Setting
- *Elevation:* 80 to 150 feet
- *Mean annual precipitation:* 48 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 240 to 260 days

Properties and qualities

- *Slope:* 1 to 3 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.14 to 1.42 in/hr)
- *Depth to water table:* About 54 to 60 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 0.6 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 3.0
- *Available water capacity:* High (about 10.1 inches)

Typical profile

- *0 to 6 inches:* Very fine sandy loam
- *6 to 12 inches:* Very fine sandy loam
- *12 to 19 inches:* Very fine sandy loam
- *19 to 60 inches:* Sandy clay loam
- *60 to 80 inches:* Sandy clay loam

<u>Oz—Ozias-Pophers complex, 0 to 1 percent slopes, frequently flooded</u>

Map Unit Setting

- *Elevation:* 100 to 250 feet
- *Mean annual precipitation:* 40 to 52 inches
- *Mean annual air temperature:* 64 to 68° F
- *Frost-free period:* 235 to 260 days

Properties and qualities

- *Slope:* 0 to 1 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Somewhat poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* About 0 to 18 inches
- *Frequency of flooding:* Frequent
- *Frequency of ponding:* None
- *Gypsum, maximum content:* 10 percent
- *Maximum salinity:* Nonsaline to moderately saline (2.0 to 16.0 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 14.0
- *Available water capacity:* Moderate (about 8.4 inches)

Typical profile

- *0 to 6 inches:* Clay
- *6 to 18 inches:* Silty clay
- *18 to 80 inches:* Silty clay

<u>SeD—Sawlit-Sawtown complex, 1 to 3 percent slopes</u>

Map Unit Setting

- *Elevation:* 150 to 450 feet
- *Mean annual precipitation:* 40 to 56 inches
- *Mean annual air temperature:* 64 to 68° F
- *Frost-free period:* 220 to 260 days

Properties and qualities

- *Slope:* 1 to 3 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* About 24 to 42 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Gypsum, maximum content:* 5 percent
- *Sodium adsorption ratio, maximum:* 4.0
- *Available water capacity:* High (about 9.2 inches)

Typical profile

- *0 to 12 inches:* Fine sandy loam
- *12 to 25 inches:* Loam
- *25 to 43 inches:* Sandy clay loam
- *43 to 80 inches:* Clay

<u>SiC—Silsbee fine sandy loam, 3 to 5 percent slopes</u>

Map Unit Setting

- *Elevation:* 80 to 150 feet
- *Mean annual precipitation:* 48 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 240 to 270 days

Properties and qualities

- *Slope:* 3 to 5 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 2.0
- *Available water capacity:* High (about 12.0 inches)

Typical profile
- *0 to 5 inches:* Fine sandy loam
- *5 to 15 inches:* Fine sandy loam
- *15 to 49 inches:* Sandy clay loam
- *49 to 58 inches:* Sandy clay loam
- *58 to 80 inches:* Sandy clay loam

SiD—Silsbee fine sandy loam, 5 to 12 percent slopes

Map Unit Setting
- *Elevation:* 80 to 150 feet
- *Mean annual precipitation:* 48 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 240 to 270 days

Properties and qualities
- *Slope:* 5 to 12 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 2.0
- *Available water capacity:* High (about 12.0 inches)

Typical profile
- *0 to 5 inches:* Fine sandy loam
- *5 to 15 inches:* Fine sandy loam
- *15 to 49 inches:* Sandy clay loam
- *49 to 58 inches:* Sandy clay loam
- *58 to 80 inches:* Sandy clay loam

SnA—Sorter-Dallardsville complex, 0 to 1 percent slopes

Map Unit Setting
- *Elevation:* 80 to 150 feet
- *Mean annual precipitation:* 48 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 240 to 270 days

Properties and qualities
- *Slope:* 0 to 1 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.01 to 1.42 in/hr)

- *Depth to water table:* About 0 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* Frequent
- *Maximum salinity:* Nonsaline (0.3 to 1.0 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 13.0
- *Available water capacity:* High (about 10.1 inches)

Typical profile
- *0 to 3 inches:* Very fine sandy loam
- *3 to 24 inches:* Very fine sandy loam
- *24 to 78 inches:* Very fine sandy loam
- *78 to 80 inches:* Very fine sandy loam

StM—Stringtown-Bonwier complex, 5 to 15 percent slopes
Map Unit Setting
- *Elevation:* 200 to 600 feet
- *Mean annual precipitation:* 40 to 58 inches
- *Mean annual air temperature:* 64 to 70° F
- *Frost-free period:* 240 to 265 days

Properties and qualities
- *Slope:* 5 to 15 percent
- *Depth to restrictive feature:* 40 to 60 inches to dense material
- *Drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.57 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water capacity:* High (about 9.9 inches)

Typical profile
- *0 to 10 inches:* Fine sandy loam
- *10 to 58 inches:* Sandy clay loam
- *58 to 72 inches:* Variable

VoA—Votaw fine sand, 0 to 1 percent slopes
Map Unit Setting
- *Elevation:* 20 to 450 feet
- *Mean annual precipitation:* 42 to 60 inches
- *Mean annual air temperature:* 64 to 70° F
- *Frost-free period:* 220 to 270 days

Properties and qualities
- *Slope:* 0 to 1 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Moderately well drained

- *Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
- *Depth to water table:* About 24 to 30 inches
- *Frequency of flooding:* Rare
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 0.5 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 8.0
- *Available water capacity:* Low (about 4.2 inches)

Typical profile
- *0 to 4 inches:* Fine sand
- *4 to 29 inches:* Fine sand
- *29 to 63 inches:* Fine sand
- *63 to 80 inches:* Fine sand

WbA—Waller-Dallardsville complex, 0 to 1 percent slopes
Map Unit Setting
- *Elevation:* 80 to 150 feet
- *Mean annual precipitation:* 48 to 56 inches
- *Mean annual air temperature:* 67 to 69° F
- *Frost-free period:* 245 to 285 days

Properties and qualities
- *Slope:* 0 to 1 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low (0.01 to 0.14 in/hr)
- *Depth to water table:* About 6 to 18 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Maximum salinity:* Nonsaline (0.0 to 0.3 mmhos/cm)
- *Sodium adsorption ratio, maximum:* 2.0
- *Available water capacity:* High (about 10.8 inches)

Typical profile
- *0 to 4 inches:* Silt loam
- *4 to 15 inches:* Silt loam
- *15 to 26 inches:* Silt loam
- *26 to 37 inches:* Loam
- *37 to 80 inches:* Clay loam

WnB—Woodville very fine sandy loam, 1 to 5 percent slopes
Map Unit Setting
- *Elevation:* 150 to 450 feet
- *Mean annual precipitation:* 40 to 58 inches
- *Mean annual air temperature:* 64 to 70° F
- *Frost-free period:* 230 to 270 days

Properties and qualities

- *Slope:* 1 to 5 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Somewhat poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum content:* 2 percent
- *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Available water capacity:* High (about 9.1 inches)

Typical profile

- *0 to 8 inches:* Very fine sandy loam
- *8 to 22 inches:* Clay
- *22 to 80 inches:* Clay

<u>WnD—Woodville fine sandy loam, 5 to 15 percent slopes</u>

Map Unit Setting

- *Elevation:* 150 to 450 feet
- *Mean annual precipitation:* 40 to 58 inches
- *Mean annual air temperature:* 64 to 70° F
- *Frost-free period:* 230 to 270 days

Properties and qualities

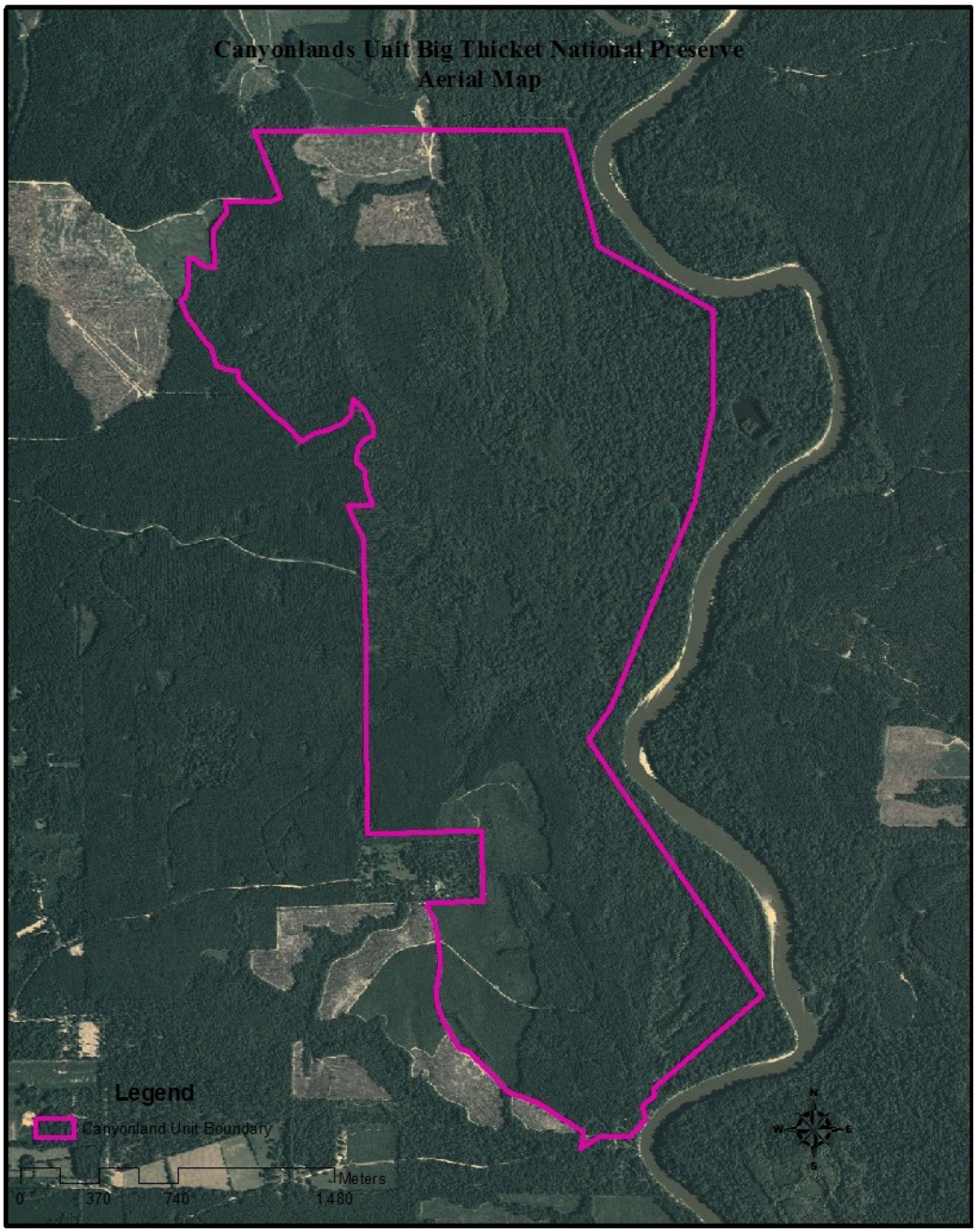
- *Slope:* 5 to 15 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Somewhat poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Calcium carbonate, maximum content:* 2 percent
- *Maximum salinity:* Nonsaline (0.0 to 2.0 mmhos/cm)
- *Available water capacity:* High (about 9.0 inches)

Typical profile

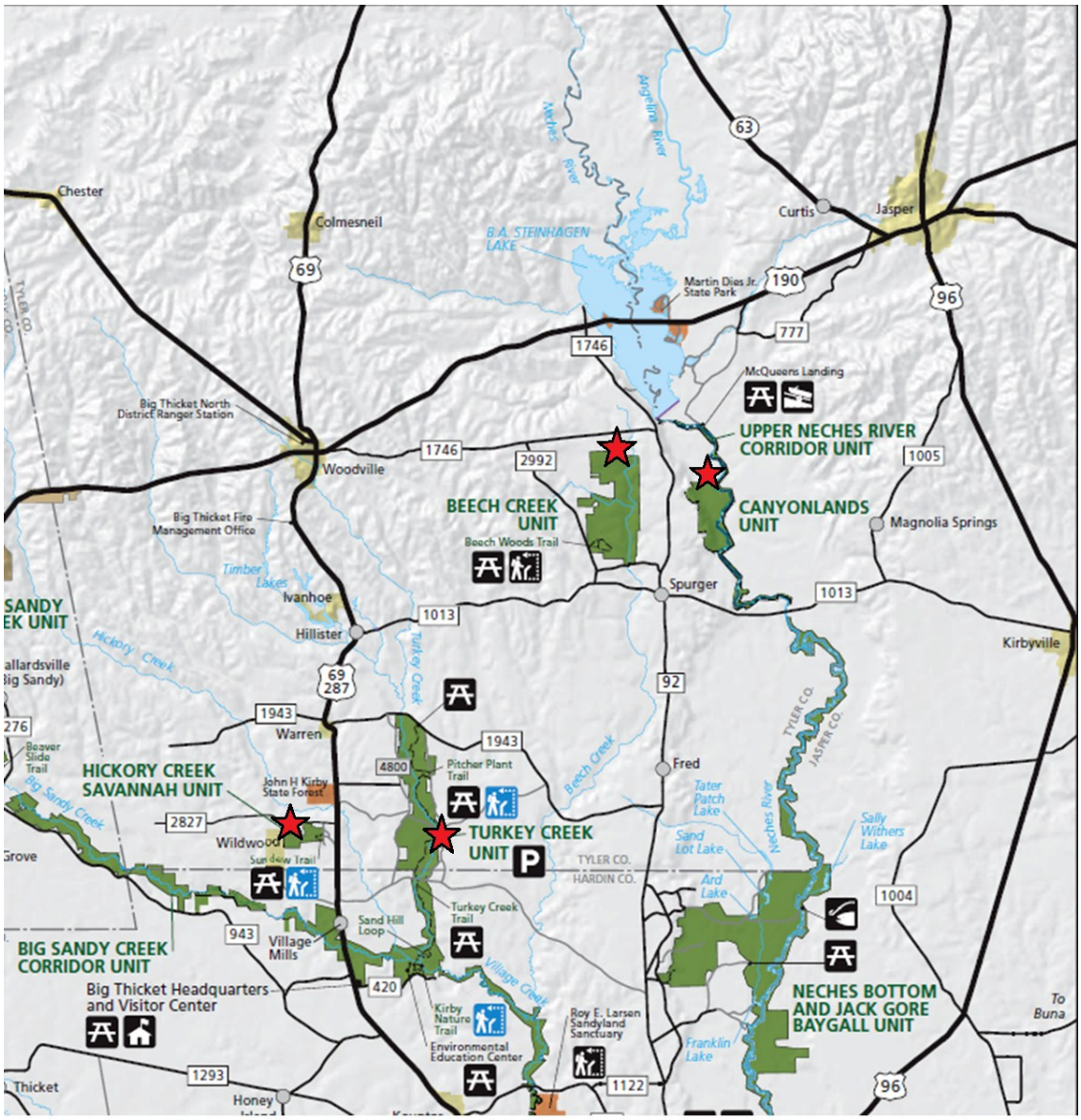
- *0 to 7 inches:* Very fine sandy loam
- *7 to 51 inches:* Clay
- *51 to 79 inches:* Clay

APPENDIX D

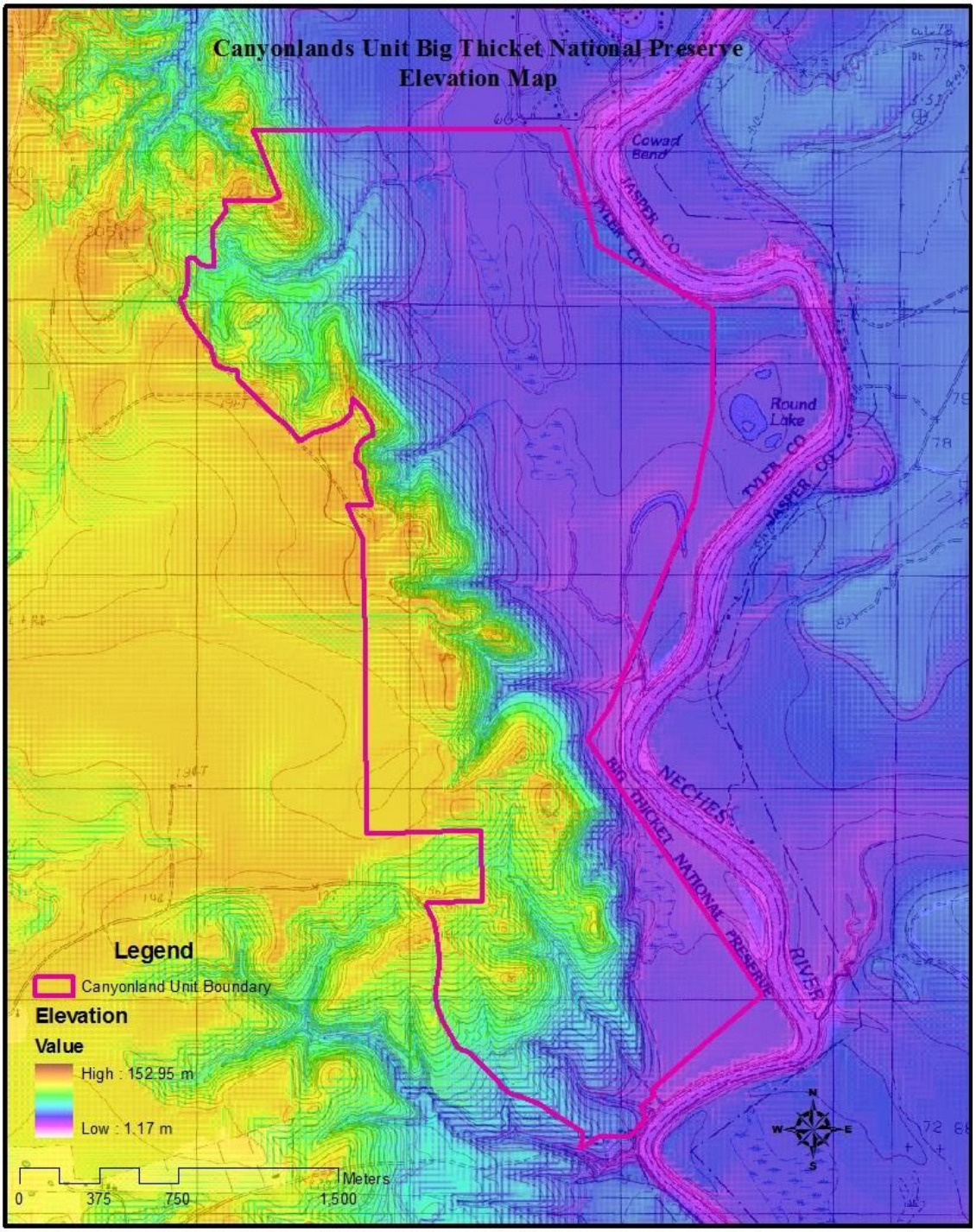
MAPS



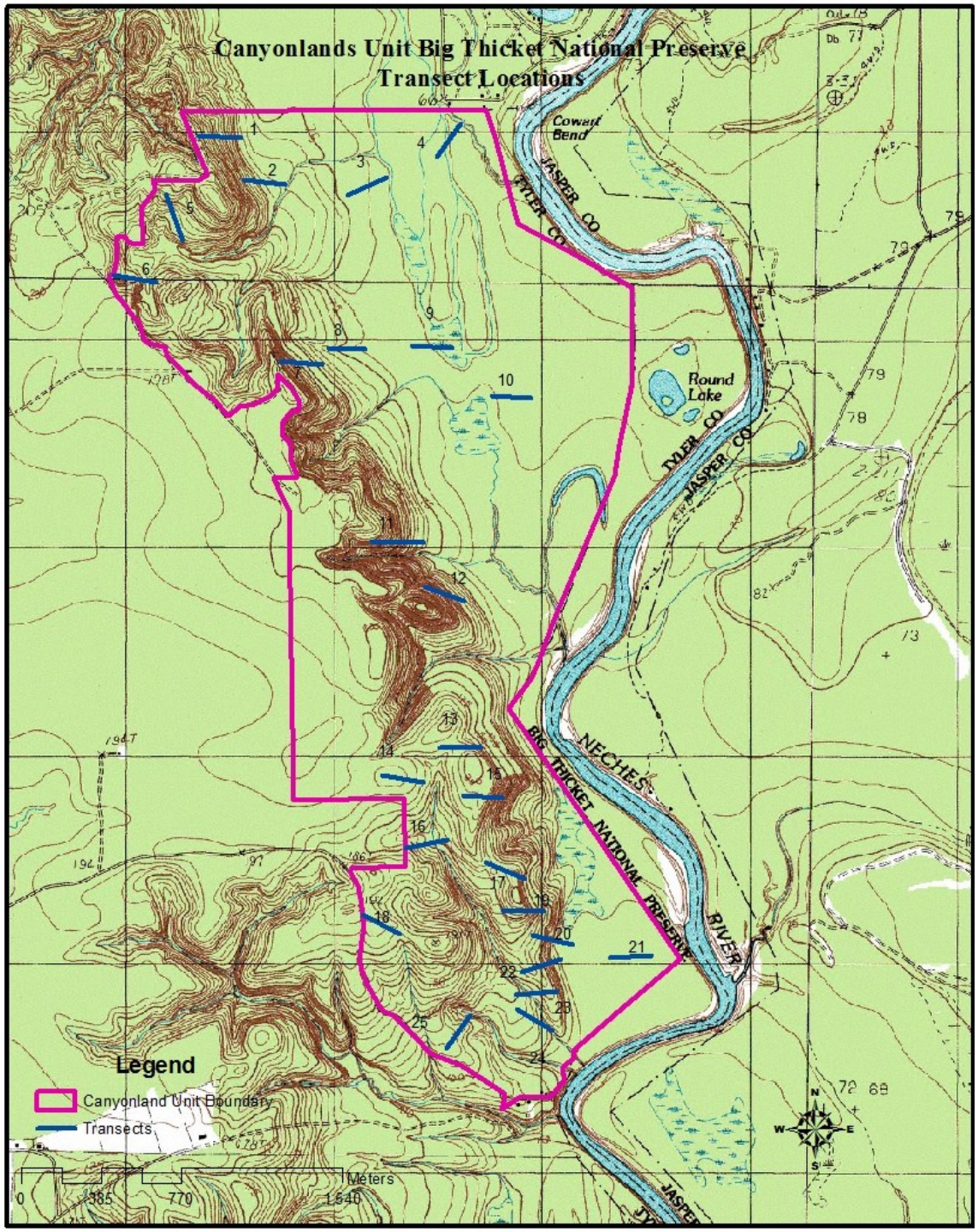
Aerial map of the Boundary of the Canyonlands Unit of the Big Thicket National Preserve.



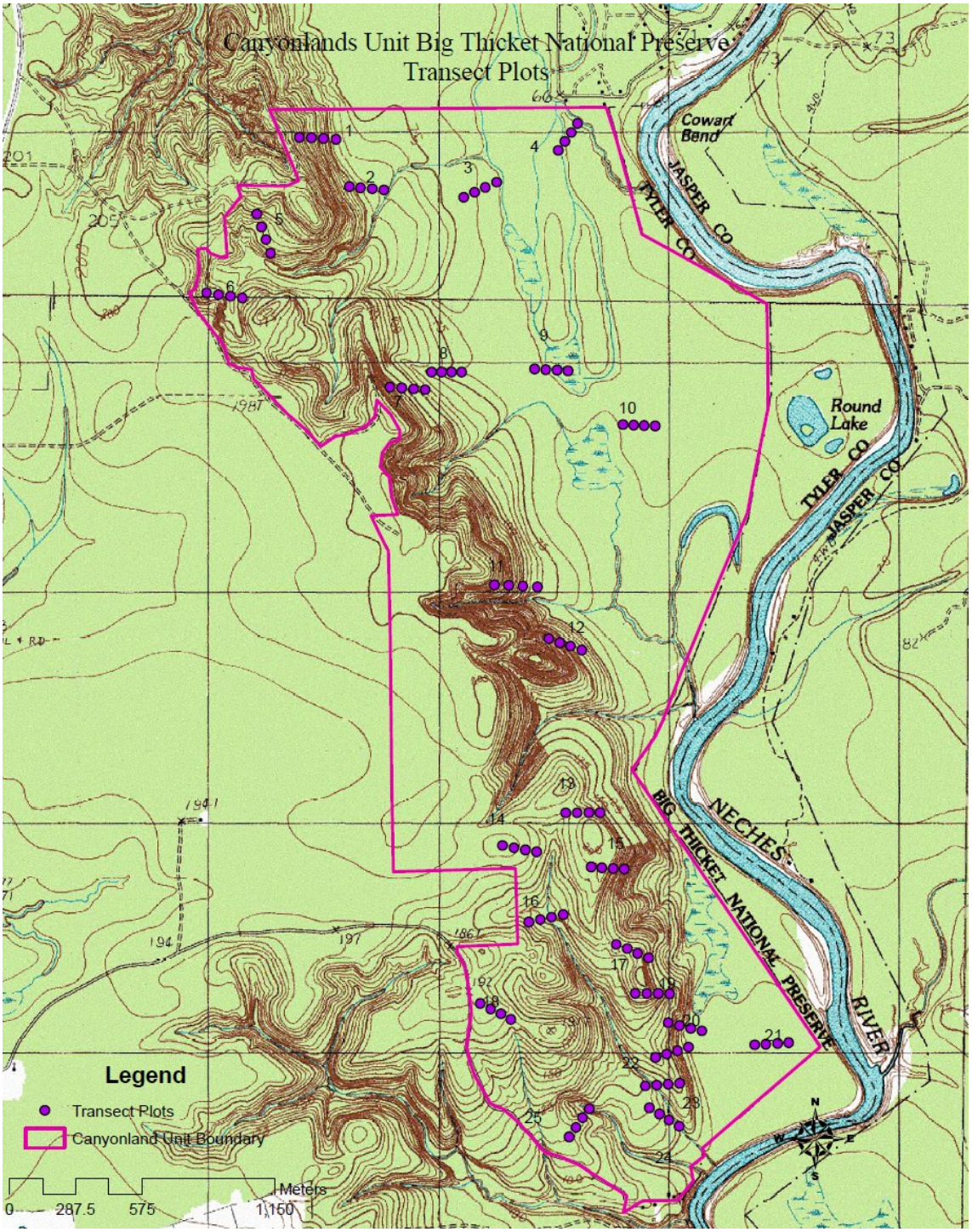
Big Thicket National Preserve map indicating the location of the Canyonlands Unit, Beech Creek Unit, Hickory Creek Unit and Turkey Creek Unit each location is denoted by a red star.



Elevation map of the Canyonlands Unit, this map shows the elevation range of the Canyonlands Unit.



Location of the 25 transects conducted within the Canyonlands Unit in order to perform the Indicator Species Analysis and Cluster Analysis on the woody species of the unit.



Location of the 100 quadrats observed along the 25 transects, used for the Indicator Species Analysis and the Cluster Analysis.

APPENDIX E

SPECIES LIST

Legend to the species list

A	B	C	D	E	F	G	H	I

A=Family name

B= Species name and authority (-ies)

C= Site description (Appendix A)

D=Origin (**N**=Native **I=** Introduced)

E=Longevity (**A=**Annual **P=**Perennial)

F= Season of Growth (**C**=Cool season **W**=Warm season)

G= Plant Type (**H**=Herbaceous **W**=Woody)

H= Plant Group (**F**=Fern **G**=Gymnosperm **M**=Monocot **D**= Dicot)

I=Wetland Indicator Status (**OBL**=Obligate wetland **FACW**=Facultative wetland **FAC**=Facultative **FACU**=Facultative upland **UPL**=Upland)

A	B	C	D	E	F	G	H	I
Acanthaceae	*Justicia ovata* (Walt.) Lindau.	76	N	P	W	H	D	OBL
Acanthaceae	*Ruellia caroliniensis* (Gmel.) Steud.	43	N	P	W	H	D	NI
Aceraceae	*Acer rubrum* L.	70	N	P	C	W	D	FACW
Aceraceae	*Acer saccharum* Marsh.	115	N	P	C	W	D	UPL
Agavaceae	*Yucca louisianensis* Trel.	47	N	P	C	H	M	NI
Alismataceae	*Sagittaria platyphylla* (Engelm.) J.G. Smith	79	N	P	W	H	M	OBL
Anacardiaceae	*Rhus copallina* L.	112	N	P	W	W	D	UPL
Anacardiaceae	*Toxicodendron radicans* (L.) O. Ktze.	112	N	P	C	W	D	FAC
Annonaceae	*Asimina parviflora* (Michx.) Dunal	68	N	P	C	W	D	FAC-
Annonaceae	*Asimina triloba* (L.) Dunal	45	N	P	C	W	D	FAC
Apiaceae	*Chaerophyllum tainturieri* Hook.	23	N	A	C	H	D	FAC
Apiaceae	*Hydrocotyle verticillata* Thumb.	49	N	P	W	H	D	OBL
Apocynaceae	*Amsonia glaberrima* Woods.	108	N	P	W	H	D	FACW+
Apocynaceae	*Trachelospermum difforme* (Walt.) A. Gray	62	N	P	W	H	D	FACW
Aquifoliaceae	*Ilex coriacea* (Pursh.) Chapm.	112	N	P	C	W	D	FACW
Aquifoliaceae	*Ilex decidua* Walt.	97	N	P	C	W	D	FACW-
Aquifoliaceae	*Ilex opaca* Soland.	90	N	P	C	W	D	FACU
Aquifoliaceae	*Ilex vomitoria* Soland.	1	N	P	C	W	D	FAC-
Araceae	*Arisaema dracontium* (L.) Schott	99	N	P	C	H	M	FACW
Araceae	*Arisaema triphyllum* (L.) Schott	15	N	P	C	H	M	FACW
Araliaceae	*Aralia spinosa* L.	47	N	P	W	W	D	FAC
Arecaceae	*Sabal minor* (Jacq.) Pers.	47	N	P	W	H	M	FACW
Asclepiadaceae	*Asclepias perennis* Walt.	108	N	P	W	H	D	OBL
Asclepiadaceae	*Asclepias tuberosa* L.	43	N	P	W	H	D	NI
Asclepiadaceae	*Cynanchum laeve* (Michx.) Pers.	43	N	P	W	H	D	FAC
Aspleniaceae	*Asplenium platyneuron* (L.) B.S.P	49	N	P	W	H	F	FACU-
Asteraceae	*Ambrosia psilostachya* DC.	64	N	P	W	H	D	FAC-

A	B	C	D	E	F	G	H	I
Asteraceae	*Amphiachyris dracunculoides* (DC.) Nutt.	70	N	A	C	H	D	NI
Asteraceae	*Baccharis halimifolia* L.	122	N	P	W	W	D	FACW-
Asteraceae	*Berlandiera betonicifolia* (Hook.) Small	64	N	P	C	H	D	NI
Asteraceae	*Berlandiera pumila* (Michx.) Nutt.	43	N	P	C	H	D	NI
Asteraceae	*Chrysopsis pilosa* Nutt.	63	N	A	W	H	D	NI
Asteraceae	*Cirsium horridulum* Michx.	39	N	P	C	H	D	FAC
Asteraceae	*Conyza canadensis*	87	N	A	W	H	D	UPL
Asteraceae	*Coreopsis grandiflora* Sweet	41	N	P	C	H	D	NI
Asteraceae	*Coreopsis linifolia* Nutt.	80	N	P	C	H	D	FACW
Asteraceae	*Croptilon divaricatum* (Nutt.) Raf.	17	N	A	W	H	D	NI
Asteraceae	*Elephantopus carolinianus* Raeusch.	65	N	P	W	H	D	FAC
Asteraceae	*Elephantopus nudatus* A. Gray	92	N	P	W	H	D	NI
Asteraceae	*Erechtites hieraciifolia* (L.) Raf. ex DC.	1	N	P	W	H	D	FACU
Asteraceae	*Erigeron strigosus* Muhl. ex Willd.	115	N	A	C	H	D	FAC-
Asteraceae	*Eupatorium capillifolium* (Lam.) Small	83	N	P	W	H	D	FACU
Asteraceae	*Eupatorium coelestinum* L.	80	N	P	W	H	D	NI
Asteraceae	*Eupatorium perfoliatum* L.	60	N	P	W	H	D	FACW+
Asteraceae	*Eupatorum rugosum* Houtt.	91	N	P	W	H	D	UPL
Asteraceae	*Gamochaeta falcata* (Lam.) Cabrera	107	N	A	W	H	D	NI
Asteraceae	*Helenium amarum* (Raf.) H. Rock	43	N	A	W	H	D	FACU
Asteraceae	*Helenium elegans* DC.	60	N	A	W	H	D	NI
Asteraceae	*Helianthus angustifolius* L.	51	N	P	W	H	D	FAC
Asteraceae	*Helianthus pauciflorus Nutt.*	115	N	P	W	H	D	NI
Asteraceae	*Heterotheca subaxillaris* (Lam.) Britt. & Rusby	40	N	A	W	H	D	UPL
Asteraceae	*Hymenopappus artemisiifolius* DC.	43	N	P	W	H	D	NI
Asteraceae	*Krigia occidentalis* Nutt.	98	N	A	C	H	D	FACU
Asteraceae	*Liatris elegans* (Walt.) Michx.	80	N	P	W	H	D	NI

A	B	C	D	E	F	G	H	I
Asteraceae	*Mikania scandens* (L.) Willd.	84	N	P	W	H	D	FACW
Asteraceae	*Parthenium hysterophorus* L.	80	N	A	W	H	D	NI
Asteraceae	*Pityopsis graminifolia* (Michx.) Nutt.	17	N	P	W	H	D	FACU
Asteraceae	*Pluchea camphorata* (L.) DC.	81	N	P	W	H	D	FACW-
Asteraceae	*Pluchea foetida* (L.) DC.	1	N	P	W	H	D	FACW-
Asteraceae	*Pyrrhopappus carolinianus* (Walt.) DC.	43	N	A	W	H	D	NI
Asteraceae	*Rudbeckia hirta* L.	107	N	P	W	H	D	FACU
Asteraceae	*Verbesina virginica* L.	110	N	P	W	H	D	FACU
Asteraceae	*Veronia missurica* Raf.	81	N	P	W	H	D	FACW
Asteraceae	*Veronia texana* (Gray) Small	61	N	P	W	H	D	UPL
Asteraceae	*Gaillardia aestivalis* (Walter) H. Rock	11	N	P	W	H	D	NI
Berberidaceae	*Podophyllum peltatum* L.	26	N	P	C	H	D	FACU-
Betulaceae	*Alnus serrulata* (Dryand ex Ait.) Willd.	1	N	P	C	W	D	OBL
Betulaceae	*Carpinus caroliniana* Walt.	108	N	P	C	W	D	FAC
Betulaceae	*Ostrya virginiana* (Mill) K. Koch	100	N	P	C	W	D	FACU+
Bignoniaceae	*Bignonia capreolata* L.	76	N	P	C	W	D	FAC
Bignoniaceae	*Campsis radicans* (L.) Seem ex Bureau	4	N	P	W	W	D	FAC
Blechnaceae	*Woodwardia areolata* (L.) T. Moore	45	N	P	W	H	F	FACW
Boraginaceae	*Cynoglossum virginianum*L.	84	N	P	C	H	D	NI
Boraginaceae	*Heliotropium indicum* L.	94	N	P	W	H	D	FACW
Boraginaceae	*Myosotis macrosperma* Engelm.	23	N	A	C	H	D	FAC
Brassicaceae	*Cardamine bulbosa* (Schreb. ex Muhl.) Britton	106	N	P	W	H	D	OBL
Bromeliaceae	*Tillandsia usneoides* (L.) L.	64	N	P	W	H	M	NI
Buddlejaceae	*Polypremum procumbens* L.	65	N	A	W	H	D	UPL
Burmanniaceae	*Apteria aphylla* (Nutt.) Barnh ex Small	1	N	P	W	H	M	FACW
Campanulaceae	*Lobelia appendiculata* A. DC.	81	N	A	C	H	D	FAC-
Campanulaceae	*Lobelia cardinalis* L.	83	N	P	W	H	D	FACW+

A	B	C	D	E	F	G	H	I
Campanulaceae	*Lobelia puberula* Michx.	89	N	A	W	H	D	FACW
Campanulaceae	*Triodanis perfoliata* (L.) Nieuw.	47	N	A	C	H	D	FAC
Campanulaceae	*Wahlenbergia marginata* (Thunb.) A. DC.	47	N	A	C	H	D	NI
Caprifoliaceae	*Lonicera japonica* Thunb.	51	N	P	C	H	D	FAC
Caprifoliaceae	*Lonicera sempervirens* L.	20	N	P	C	H	D	FAC-
Caprifoliaceae	*Sambucus canadensis* L.	84	N	P	W	W	D	FAC+
Caprifoliaceae	*Sambucus nigra* L.	60	N	P	W	W	D	FAC-
Caprifoliaceae	*Symphoricarpos orbiculata* Moench	80	N	P	W	W	D	FACU
Caprifoliaceae	*Viburnum dentatum* L.	64	N	P	W	W	D	FAC
Caprifoliaceae	*Viburnum prunifolium* L.	115	N	P	W	W	D	FACU
Caprifoliaceae	*Viburnum rufidulum* Raf.	42	N	P	C	W	D	FACU
Caryophyllaceae	*Cerastium glomeratum* Thuillier	99	I	A	C	H	D	FAC
Clusiaceae	*Hypericum galioides* Lam.	40	N	P	W	W	D	OBL
Clusiaceae	*Hypericum hypericoides* (L.) Crantz	114	N	P	W	W	D	FACU
Clusiaceae	*Hypericum sphaerocarpum* Michx.	89	N	P	W	W	D	FACU
Commelinaceae	*Commelina erecta* L.	40	N	P	W	W	M	FACW
Commelinaceae	*Tradescantia hirsutiflora* Bush	34	N	P	C	H	M	NI
Convolvulaceae	*Ipomoea cordatotriloba* Dennst.	61	N	P	W	H	D	FAC
Convolvulaceae	*Ipomoea pandurata* (L.) Mey.	63	N	P	W	H	D	FACU
Cornaceae	*Cornus florida* L.	43	N	P	C	W	D	FACU
Cornaceae	*Nyssa aquatica* L.	73	N	P	C	W	D	OBL
Cornaceae	*Nyssa sylvatica* Marsh.	62	N	P	C	W	D	OBL
Cupressaceae	*Juniperus virginiana* L.	73	N	P	W	W	G	FACU-
Cyperaceae	*Carex basiantha* Steud.	102	N	P	W	H	M	NI
Cyperaceae	*Carex caroliniana* Schwein.	107	N	P	C	H	M	OBL
Cyperaceae	*Carex debilis* Michx.	77	N	P	C	H	M	OBL
Cyperaceae	*Carex frankii* Kunth	113	N	P	W	H	M	OBL

A	B	C	D	E	F	G	H	I
Cyperaceae	*Carex glaucescens* Elliott	6	N	P	W	H	M	OBL
Cyperaceae	*Carex leptalea* Wahl.	44	N	P	C	H	M	OBL
Cyperaceae	*Carex louisianica* Bailey	96	N	P	C	H	M	OBL
Cyperaceae	*Carex lupilina* Willd.	50	N	P	W	H	M	OBL
Cyperaceae	*Carex scabrata* Schwein.	88	N	P	W	H	M	NI
Cyperaceae	*Carex tribuloides* Wahlenb.	108	N	P	C	H	M	OBL
Cyperaceae	*Cyperus cyperinus* (Retz.) Sur	44	I	P	C	H	M	NI
Cyperaceae	*Cyperus esculentus* L.	79	N	P	W	H	M	FACW
Cyperaceae	*Cyperus haspan* L.	78	N	P	W	H	M	OBL
Cyperaceae	*Cyperus plukenetii* Fernald	41	N	P	W	H	M	NI
Cyperaceae	*Cyperus retrorsus* Chapm.	80	N	P	W	H	M	FAC
Cyperaceae	*Cyperus virens* Michx.	78	N	P	W	H	M	FACW
Cyperaceae	*Rhynchospora caduca* Elliott	1	N	P	W	H	M	OBL
Cyperaceae	*Rhynchospora globularis* (Chapm.) Small	56	N	P	W	H	M	FACW
Cyperaceae	*Rhynchospora glomerata* (L.) Vahl	69	N	P	W	H	M	OBL
Cyperaceae	*Rhynchospora harveyi* W. Boott	107	N	P	W	H	M	FAC+
Cyperaceae	*Scirpus cyperinus* (L.) Kunth	78	N	P	W	H	M	OBL
Cyperaceae	*Scleria oligantha* Michx.	52	N	P	C	H	M	FAC
Cyperaceae	*Scleria triglomerata* Michx.	69	N	P	C	H	M	FAC
Cyrillaceae	*Cyrilla racemiflora* L.	92	N	P	W	W	D	FACW+
Droseraceae	*Drosera capillaris* Poir.	19	N	A	C	H	D	OBL
Dryopteridaceae	*Athyrium filix-femina* (L.) Roth	59	N	P	W	H	F	FAC+
Dryopteridaceae	*Onoclea sensibilis* L.	79	N	P	W	H	F	FACW
Drypteridaceae	*Polystichum acrostichoides* (Michx.) Schott	41	N	P	W	H	F	FACU
Ericaceae	*Lyonia mariana* (L.) D. Don	15	N	P	W	W	D	FAC
Ericaceae	*Rhododendron canescens* (Michx.) Sweet	15	N	P	C	W	D	FACW
Ericaceae	*Vaccinium arboreum* Marsh.	57	N	P	C	W	D	FACU

A	B	C	D	E	F	G	H	I
Ericaceae	*Vaccinium elliottii* Chapm.	100	N	P	C	W	D	FACW-
Euphorbiaceae	*Chamaesyce cordifolia* (Elliott) Small	64	N	A	W	H	D	NI
Euphorbiaceae	*Cnidoscolus texanus* (Müll. Arg.) Small	126	N	P	W	H	D	NI
Euphorbiaceae	*Croton capitatus* Michx.	68	N	A	W	H	D	NI
Euphorbiaceae	*Croton michauxii* G.L. Webster	112	N	A	W	H	D	NI
Euphorbiaceae	*Sapium sebifera* (L.) Small Syn= *Triadica sebifera* (L.) Small	122	I	P	W	W	D	FACU+
Euphorbiaceae	*Sebastiana fruticosa* (Bartr.) Fern.	69	N	P	W	W	D	FAC
Euphorbiaceae	*Stillingia sylvatica* L.	80	N	P	C	H	D	NI
Euphorbiaceae	*Tragia smallii* Shinners	112	N	P	W	H	D	NI
Fabaceae	*Albizia julibrissin* Durazz.	54	I	P	W	W	D	NI
Fabaceae	*Baptisia australis* (L.) R. Br.	40	N	P	C	H	D	NI
Fabaceae	*Baptisia nuttalliana* Small	124	N	P	C	H	D	NI
Fabaceae	*Cercis canadensis* L.	112	N	P	C	W	D	UPL
Fabaceae	*Chamaecrista fasciculata* (Michx.) Greene	70	N	A	W	H	D	FACU
Fabaceae	*Crotalaria purshii* DC.	56	N	P	W	H	D	NI
Fabaceae	*Dalea purpurea* Vent.	115	N	P	W	H	D	NI
Fabaceae	*Dioclea multiflora* (T. & G.) Mohr	52	N	P	W	H	D	FACU
Fabaceae	*Erythrina herbacea* L.	47	N	P	C	W	D	NI
Fabaceae	*Lespedeza hirta* (L.) Hornem.	124	N	P	W	H	D	NI
Fabaceae	*Mimosa hystricina* (Small ex Britton & Rose) B.L. Turner	107	N	P	W	H	D	NI
Fabaceae	*Mimosa nuttallii* (DC. ex Britton & Rose) B.L. Turner	43	N	P	W	H	D	NI
Fabaceae	*Rhynchosia latifolia* Nutt. ex Torr. & A. Gray	43	N	P	W	H	D	NI
Fabaceae	*Sesbania drummondii* (Rydb.) Cory.	110	N	A	W	H	D	FACW-
Fabaceae	*Sesbania herbacea* (Mill.) McVaugh	110	N	A	W	H	D	FACW-
Fabaceae	*Sesbania macrocarpa* Muhl. ex Raf.	110	N	A	W	H	D	FACW-
Fabaceae	*Strophostyles umbellata* (Muhl. ex Willd.) Britton	67	N	A	W	H	D	FACU

A	B	C	D	E	F	G	H	I
Fabaceae	*Stylosanthes biflora* (L.) B.S.P.	107	N	P	W	H	D	NI
Fabaceae	*Tephrosia virginiana* (L.) Pers.	61	N	P	C	H	D	NI
Fagaceae	*Castanea pumila* (L.) Mill.	71	N	P	C	W	D	NI
Fagaceae	*Fagus grandifolia* Ehrh.	84	N	P	C	W	D	FACU
Fagaceae	*Quercus alba* L.	47	N	P	C	W	D	FACU+
Fagaceae	*Quercus laurifolia* Michx.	70	N	P	C	W	D	FACW
Fagaceae	*Quercus lyrata* Walter	69	N	P	C	W	D	OBL
Fagaceae	*Quercus macrocarpa* Michx.	64	N	P	C	W	D	FAC-
Fagaceae	*Quercus margarettae* (Ashe) Small	51	N	P	C	W	D	NI
Fagaceae	*Quercus marilandica* Münchh.	67	N	P	C	W	D	NI
Fagaceae	*Quercus michauxii* Nutt.	113	N	P	C	W	D	FACW
Fagaceae	*Quercus nigra* L.	77	N	P	C	W	D	FAC+
Fagaceae	*Quercus phellos* L.	109	N	P	C	W	D	FACW
Fagaceae	*Quercus stellata* Wangenh.	126	N	P	C	W	D	FACU
Gentianaceae	*Sabatia campestris* Nutt.	117	N	P	W	H	D	FACU
Grossulariaceae	*Itea virginica* L.	76	N	P	W	W	D	OBL
Haloragaceae	*Myriophyllum aquaticum* (Vell.) Verdc.	22	I	P	W	H	D	OBL
Haloragaceae	*Proserpinaca palustris* L.	24	N	P	W	H	D	OBL
Hamamalidaceae	*Hamamelis vernalis* Sarg.	64	N	P	C	W	D	FAC-
Hamamalidaceae	*Hamamelis virginiana* L.	3	N	P	C	W	D	FAC-
Hamamalidaceae	*Liquidambar styraciflua* L.	1	N	P	C	W	D	FAC
Hippocastinaceae	*Aesculus pavia* L.	43	N	P	C	W	D	FAC-
Iridaceae	*Sisyrinchium campestre* E.P. Bicknell	19	N	P	C	H	M	NI
Iridaceae	*Sisyrinchium langloisii* Greene	40	N	P	C	H	M	NI
Juglandaceae	*Carya alba* (L.) Nutt.	63	N	P	C	W	D	FAC
Juglandaceae	*Carya aquatica* (Michx. f.) Nutt.	118	N	P	C	W	D	OBL
Juglandaceae	*Carya cordiformis* (Wang.) K. Koch	54	N	P	C	W	D	FAC

A	B	C	D	E	F	G	H	I
Juglandaceae	*Carya laciniosa* (Michx. f.) G. Don	43	N	P	C	W	D	FAC
Juglandaceae	*Carya texana* Buckley	90	N	P	C	W	D	NI
Juglandaceae	*Carya tomentosa* (Lam.) Nutt.	63	N	P	C	W	D	NI
Juncaceae	*Juncus coriaceus* Mack.	69	N	P	C	H	M	OBL
Juncaceae	*Juncus diffusissimus* Buckley	50	N	P	C	H	M	FACW
Juncaceae	*Juncus effusus* L.	77	N	P	W	H	M	OBL
Juncaceae	*Juncus elliottii* Chapm.	114	N	P	W	H	M	OBL
Juncaceae	*Juncus polycephalus* Michx.	50	N	P	W	H	M	OBL
Juncaceae	*Luzula echinata* (Small) F.J. Herm.	52	N	P	C	H	M	FAC
Lamiaceae	*Monarda punctata* L.	68	N	A	W	H	D	UPL
Lamiaceae	*Salvia lyrata* L.	19	N	P	C	H	D	FAC
Lamiaceae	*Scutellaria cardiophylla* Engelm. & A. Gray	43	N	P	W	H	D	FAC
Lamiaceae	*Scutellaria drummondii* Benth.	19	N	P	C	H	D	NI
Lamiaceae	*Scutellaria ovata* Hill	110	N	P	W	H	D	FACU
Lauraceae	*Persea borbonia* (L.) Spreng.	100	N	P	W	W	D	FACW
Lauraceae	*Sassafras albidum* (Nutt.) Nees	54	N	P	C	W	D	FACU
Lentibulariaceae	*Utricularia radiata* Small	24	N	A	C	H	D	OBL
Liliaceae	*Allium canadense* L.	41	N	P	C	H	M	FACU-
Liliaceae	*Hypoxis hirsuta* (L.) Coville	126	N	P	C	H	M	FACW
Liliaceae	*Nothoscordum bivalve* (L.) Britton	26	N	P	C	H	M	FACU
Liliaceae	*Trillium gracile* J.D. Freeman	39	N	P	C	H	M	FAC
Linaceae	*Linum medium* (Planch.) Britton	56	N	P	C	H	D	FAC
Loganiaceae	*Gelsemium sempervirens* (L.) W.T. Aiton	100	N	P	C	W	D	FAC
Lygodiaceae	*Lygodium japonicum* (Thunb.) Sw.	4	I	P	W	H	F	FACW
Magnoliaceae	*Magnolia grandiflora* L.	52	N	P	C	W	D	FAC-
Magnoliaceae	*Magnolia virginiana* L.	60	N	P	C	W	D	OBL
Monotropaceae	*Monotropa uniflora* L.	9	N	P	C	H	D	UPL

A	B	C	D	E	F	G	H	I
Moraceae	*Morus rubra* L.	52	N	P	C	W	D	FACU
Myricaceae	*Myrica cerifera* L	15	N	P	C	W	D	FAC
Oleaceae	*Chionanthus virginicus* L.	19	N	P	C	W	D	FAC
Oleaceae	*Fraxinus americana* L.	84	N	P	C	W	D	FACU
Oleaceae	*Fraxinus caroliniana* Mill.	52	N	P	C	W	D	OBL
Oleaceae	*Fraxinus pennsylvanica* Marsh.	41	N	P	C	W	D	FACW-
Oleaceae	*Ligustrum sinense* Lour.	95	I	P	W	W	D	UPL
Onagaceae	*Ludwigia decurrens* Walter	92	N	P	W	H	D	OBL
Orobanchaceae	*Epifagus virginiana* (L.) W. Bartram	7	N	P	W	H	D	NI
Osmundaceae	*Osmunda cinnamomea* L.	15	N	P	W	H	F	FACW
Osmundaceae	*Osmunda regalis* L.	45	N	P	W	H	F	OBL
Oxalidaceae	*Oxalis stricta* L.	36	N	P	C	H	D	FACU
Oxsalidaceae	*Oxalis corniculata* L.	40	N	A	C	H	D	FACU
Passifloraceae	*Passiflora incarnata* L.	122	N	P	W	H	D	FACU
Phytolaccaceae	*Phytolacca americana* L.	59	N	A	W	H	D	FAC-
Pinaceae	*Pinus echinata* Mill.	7	N	P	W	W	G	NI
Pinaceae	*Pinus taeda* L.	26	N	P	W	W	G	FAC-
Plantaginaceae	*Plantago aristata* Michx.	40	N	A	C	H	D	NI
Plantaginaceae	*Plantago rhodosperma* Decne.	43	N	A	C	H	D	FACU
Platanaceae	*Platanus occidentalis* L.	4	N	P	C	W	D	FAC+
Poaceae	*Agrostis elliottiana* Schult.	95	N	A	C	H	M	NI
Poaceae	*Andropogon gerardii* Vitman	95	N	P	W	H	M	FACU
Poaceae	*Andropogon glomeratus* (Walter) Britton	94	N	P	W	H	M	FACW+
Poaceae	*Andropogon gyrans* Ashe	83	N	P	W	H	M	NI
Poaceae	*Andropogon ternarius* Michx.	89	N	P	W	H	M	FACU
Poaceae	*Andropogon virginicus* L.	83	N	P	W	H	M	FACU+
Poaceae	*Aristida lanosa* Muhl. ex Elliott	89	N	P	W	H	M	NI

A	B	C	D	E	F	G	H	I
Poaceae	*Aristida longespica* Poir	17	N	A	W	H	M	FACU
Poaceae	*Aristida oligantha* Michx.	89	N	A	W	H	M	UPL
Poaceae	*Aristida purpurascens* Poir.	9	N	P	W	H	M	FAC
Poaceae	*Arundinaria gigantea* (Walter) Muhl.	39	N	P	C	H	M	FACW
Poaceae	*Axonopus fissifolius* (Raddi) Kuhlm.	40	N	P	W	H	M	FAC
Poaceae	*Brachyelytrum erectum* (J. von Schreber) P. Beauv.	50	N	P	C	H	M	NI
Poaceae	*Briza minor* L.	43	I	A	C	H	M	FAC+
Poaceae	*Chasmanthium latifolium* (Michx.) Yates	5	N	P	W	H	M	FAC
Poaceae	*Chasmanthium laxum* (L.) Yates	1	N	P	W	H	M	FAC
Poaceae	*Cynodon dactylon* (L.) Pers.	9	I	P	W	H	M	FACU
Poaceae	*Dichanthelium aciculare* (Desv. ex Poir.) Gould & C. Clark	126	N	P	C	H	M	FACU
Poaceae	*Dichanthelium acuminatum* (Sw.) Gould & C. Clark	40	N	P	C	H	M	FAC
Poaceae	*Dichanthelium boscii* (Poir.) Gould & C. Clark	41	N	P	C	H	M	NI
Poaceae	*Dichanthelium clandestinum* (L.) Gould	47	N	P	C	H	M	FAC+
Poaceae	*Dichanthelium commutatum* (Schult.) Gould	52	N	P	C	H	M	FAC
Poaceae	*Dichanthelium dichotomum* (L.) Gould	50	N	P	C	H	M	FAC
Poaceae	*Dichanthelium laxiflorum* (Lam.) Gould	1	N	P	C	H	M	FAC-
Poaceae	*Dichanthelium nodatum* (Hitchc. & Chase) Gould	80	N	P	C	H	M	NI
Poaceae	*Dichanthelium oligosanthes* (Schult.) Gould	47	N	P	C	H	M	FACU
Poaceae	*Dichanthelium portoricense* (Desv. ex Ham.) B.F. Hansen & Wunderlin	57	N	P	C	H	M	NI
Poaceae	*Dichanthelium ravenelii* (Scribn. & Merr.) Gould	61	N	P	C	H	M	FAC
Poaceae	*Dichanthelium sphaerocarpon* (Elliott) Gould	56	N	P	C	H	M	FACU
Poaceae	*Digitaria patens* (Swallen) Henr.	89	N	P	W	H	M	NI
Poaceae	*Echinochloa walteri* (Pursh) A. Heller	94	N	A	W	H	M	OBL
Poaceae	*Eragrostis capillaris* (L.) Nees	80	N	A	W	H	M	NI
Poaceae	*Eragrostis refracta* (Muhl.) Scribn.	17	N	P	W	H	M	FACW

A	B	C	D	E	F	G	H	I
Poaceae	*Eragrostis secundiflora* J. Presl	80	N	P	W	H	M	FACU-
Poaceae	*Eragrostis spectabilis* (Pursh) Steud.	9	N	P	W	H	M	FACU-
Poaceae	*Gymnopogon ambiguus* (Michx.) B.S.P.	7	N	P	W	H	M	FACU
Poaceae	*Leersia lenticularis* Michx.	93	N	P	W	H	M	OBL
Poaceae	*Leersia oryzoides* (L.) Sw.	94	N	P	W	H	M	OBL
Poaceae	*Leersia virginica* Willd.	81	N	P	W	H	M	FACW
Poaceae	*Lolium perenne* L.	9	I	A	C	H	M	FACU
Poaceae	*Manisuris campestris* (Nutt.) A. Hitchc.	26	N	P	W	H	M	NI
Poaceae	*Melica mutica* Walter	100	N	P	W	H	M	NI
Poaceae	*Oplismenus hirtellus* (L.) P. Beauv.	81	I	P	W	H	M	FACU+
Poaceae	*Panicum anceps* Michx.	124	N	P	W	H	M	FAC+
Poaceae	*Panicum brachyanthum* Steud.	17	N	P	W	H	M	FACU+
Poaceae	*Panicum gymnocarpon* Elliott	8	N	P	W	H	M	NI
Poaceae	*Panicum hemitomon* Schult.	125	N	P	W	H	M	OBL
Poaceae	*Panicum hians* Elliott	125	N	P	W	H	M	FACW
Poaceae	*Panicum rigidulum* Bosc ex Nees	6	N	P	W	H	M	FACW
Poaceae	*Panicum verrucosum* Muhl.	6	N	A	W	H	M	FACW-
Poaceae	*Paspalum floridanum* Michx.	125	N	P	W	H	M	FACW-
Poaceae	*Paspalum fluitans* (Elliott) Kunth	8	N	A	W	H	M	OBL
Poaceae	*Paspalum notatum* Fluggé	5	I	P	W	H	M	FAC
Poaceae	*Paspalum plicatulum* Michx.	5	N	P	W	H	M	FAC
Poaceae	*Paspalum setaceum* Michx.	5	N	P	W	H	M	FAC
Poaceae	*Paspalum urvillei* Steud.	61	I	P	W	H	M	FAC
Poaceae	*Piptochaetium avenaceum* (L.) Parodi	41	N	P	C	H	M	UPL
Poaceae	*Poa annua* L.	21	I	A	C	H	M	FAC
Poaceae	*Poa autumnalis* Muhl. ex Elliott	39	N	P	C	H	M	FAC-
Poaceae	*Saccharum baldwinii* Spreng.	93	N	P	W	H	M	FACW

A	B	C	D	E	F	G	H	I
Poaceae	*Schizachyrium scoparium* (Michx.) Nash	9	N	P	W	H	M	FACU+
Poaceae	*Sorghastrum elliottii* (C. Mohr) Nash	89	N	P	W	H	M	NI
Poaceae	*Sphenopholis filiformis* (Chapm.) Scribn.	26	N	P	C	H	M	FACW
Poaceae	*Sphenopholis longiflora* (Vasey) A. Hitchc.	43	N	P	C	H	M	NI
Poaceae	*Sporobolus compositus* (Poir.) Merr.	17	N	P	W	H	M	UPL
Poaceae	*Sporobolus indicus* (L.) R. Br.	9	I	P	W	H	M	FACU+
Poaceae	*Tridens flavus* (L.) A. Hitchc.	5	N	P	W	H	M	UPL
Poaceae	*Vulpia octoflora* (Walter) Rydb.	43	N	A	C	H	M	UPL
Polygalaceae	*Polygala incarnata* L.	107	N	A	W	H	D	FAC-
Polygalaceae	*Polygala polygama* Walter	40	N	P	C	H	D	FACU
Polygalaceae	*Polygala sanguinea* L.	43	N	A	W	H	D	FACW
Polygonaceae	*Brunnichia ovata* (Walter) Shinners	82	N	P	C	H	D	FACW-
Polygonaceae	*Polygonum hydropiperoides* Michx.	78	N	P	W	H	D	OBL
Polygonaceae	*Polygonum virginianum* L.	81	N	A	W	H	D	FAC
Polygonaceae	*Rumex hastatulus* Baldw.	61	N	A	C	H	D	FAC-
Polypodicaeae	*Pleopeltis polypodioides* (L.) Andrews & Windham	1	N	P	W	H	F	NI
Pontederiaceae	*Eichhornia crassipes* (Mart.) Solms	94	I	P	W	H	M	OBL
Primulaceae	*Anagallis arvensis* L.	56	I	A	C	H	D	FACW-
Primulaceae	*Samolus valerandi* L.	50	N	P	W	H	D	OBL
Pteridaceae	*Pteris multifida* Poir.	78	I	P	W	H	F	NI
Ranunculaceae	*Clematis crispa* L.	62	N	P	C	H	D	FAC
Ranunculaceae	*Clematis pitcheri* Torr. & A. Gray	43	N	P	W	H	D	FACU
Ranunculaceae	*Clematis reticulata* Walter	111	N	P	W	H	D	NI
Ranunculaceae	*Ranunculus hispidus* Michx.	38	N	P	C	H	D	FAC
Ranunculaceae	*Ranunculus pusillus* Poir.	24	N	A	C	H	D	OBL
Rhamnaceae	*Berchemia scandens* (Hill) K. Koch	108	N	P	C	W	D	FAC+
Rhamnaceae	*Ceanothus americanus* L.	61	N	P	C	H	D	NI

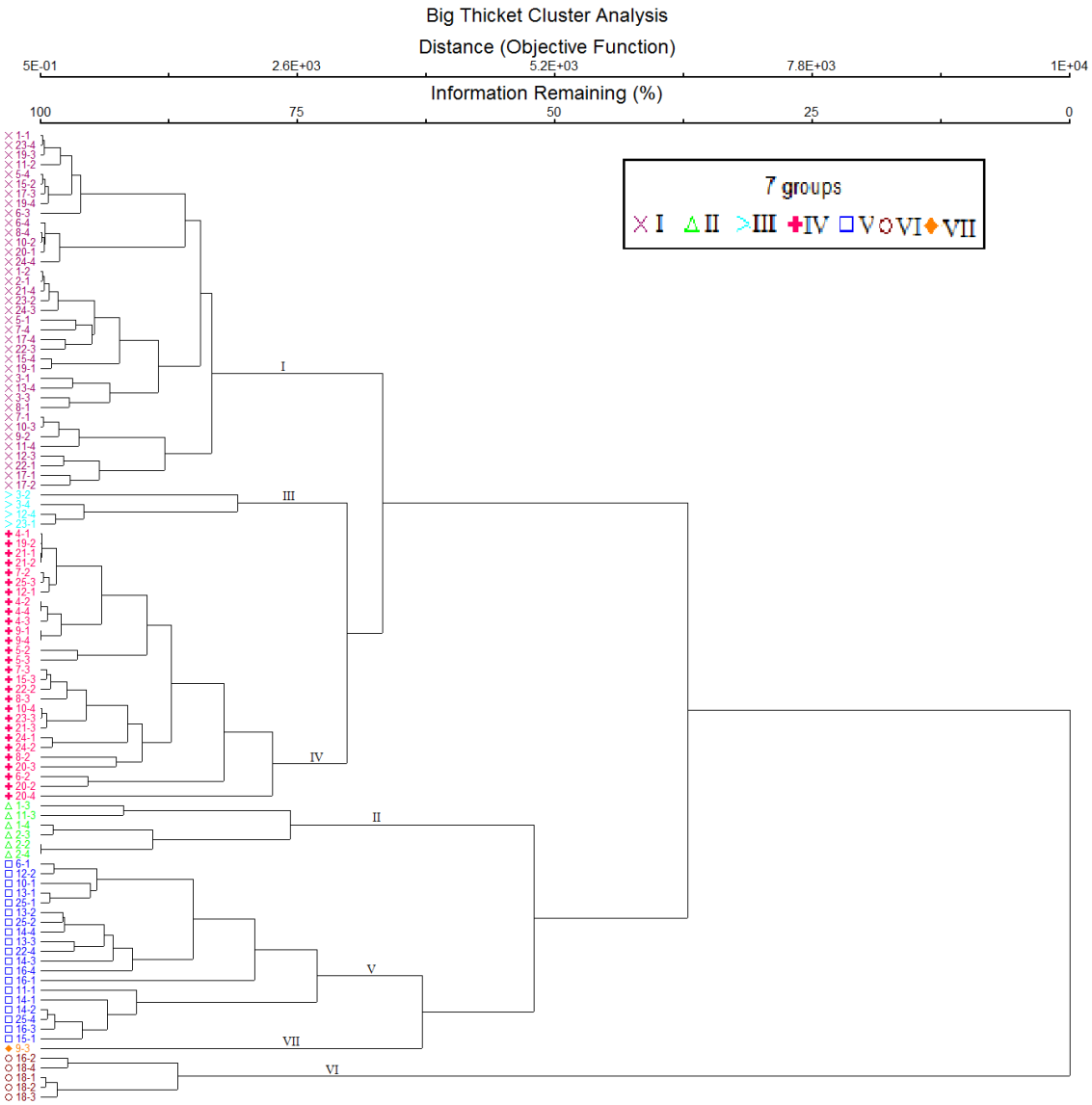
A	B	C	D	E	F	G	H	I
Rhamnaceae	*Rhamnus caroliniana* Walter	111	N	P	C	W	D	FACU-
Rosaceae	*Crataegus marshallii* Eggl.	116	N	P	C	W	D	FAC-
Rosaceae	*Crataegus spathulata* Michx.	47	N	P	C	W	D	FAC+
Rosaceae	*Duchesnea indica* (Andrews) Focke	84	I	P	C	H	D	FAC
Rosaceae	*Geum canadense* Jacq.	47	N	P	C	H	D	FAC
Rosaceae	*Prunus angustifolia* Marsh.	95	N	P	C	W	D	NI
Rosaceae	*Prunus umbellata* Elliott	124	N	P	C	W	D	NI
Rosaceae	*Rubus aboriginum* Rydb.	74	N	P	C	H	D	NI
Rosaceae	*Rubus trivialis* Michx.	19	N	P	C	H	D	FAC+
Rubiaceae	*Cephalanthus occidentalis* L.	119	N	P	W	W	D	OBL
Rubiaceae	*Diodia virginiana* L.	119	N	P	W	H	D	OBL
Rubiaceae	*Galium obtusum* Bigelow	48	N	P	C	H	D	OBL
Rubiaceae	*Galium tinctorium* (L.) Scop.	24	I	P	W	H	D	OBL
Rubiaceae	*Houstonia micrantha* (Shinners) Terrell	95	N	A	C	H	D	UPL
Rubiaceae	*Houstonia pusilla* Schoepf	19	N	A	C	H	D	UPL
Rubiaceae	*Mitchella repens* L.	86	N	P	C	H	D	FAC
Rutaceae	*Zanthoxylum clava-herculis* L.	80	N	P	C	W	D	FAC
Salicaceae	*Populus deltoides* Bartram ex Marsh.	117	N	P	C	W	D	FAC
Salviniaceae	*Salvinia minima* Baker	5	I	P	W	H	D	OBL
Sapotaceae	*Bumelia lanuginosa* (Michx.) Pers. Syn= *Sideroxylon lanuginosum* Michx.	99	N	P	W	W	D	FACU
Saururaceae	*Saururus cernuus* L.	45	N	P	W	H	D	OBL
Scrophulariaceae	*Mecardonia procumbens* (Mill.) Small	23	N	P	W	H	D	OBL
Scrophulariaceae	*Scoparia dulcis* L.	17	I	A	W	H	D	FACU
Smilacaceae	*Smilax bona-nox* L.	117	N	P	C	W	M	FAC
Smilacaceae	*Smilax glauca* Walter	41	N	P	C	W	M	UPL
Smilacaceae	*Smilax laurifolia* L.	92	N	P	C	W	M	OBL
Smilacaceae	*Smilax pumila* Walter	109	N	P	C	W	M	NI

A	B	C	D	E	F	G	H	I
Smilacaceae	*Smilax rotundifolia* L.	113	N	P	C	W	M	FAC
Smilacaceae	*Smilax smallii* Morong	41	N	P	C	W	M	FACU
Smilacaceae	*Smilax walteri* Pursh	113	N	P	C	W	M	OBL
Solanaceae	*Solanum carolinense* L.	111	N	P	W	H	D	UPL
Styracaceae	*Halesia diptera* Ellis	76	N	P	C	W	D	FAC+
Symplocaceae	*Symplocos tinctoria* (L.) L'Her.	19	N	P	C	W	D	FAC
Taxodiaceae	*Taxodium distichum* (L.) Rich.	5	N	P	W	W	G	OBL
Thelypteridaceae	*Thelypteris kunthii* (Desv.) Morton	49	N	P	W	H	F	FAC
Typhaceae	*Typha domingensis* Pers.	74	N	P	W	H	M	OBL
Typhaceae	*Typha latifolia* L.	106	N	P	W	H	M	OBL
Ulmaceae	*Celtis tenuifolia* Nutt.	2	N	P	C	W	D	NI
Ulmaceae	*Planera aquatica* J.F. Gmel.	110	N	P	C	W	D	OBL
Ulmaceae	*Ulmus alata* Michx.	124	N	P	C	W	D	FACU
Ulmaceae	*Ulmus americana* L.	1	N	P	C	W	D	FAC
Urticaceae	*Pilea pumila* (L.) A. Gray	125	N	A	W	H	D	FAC
Verbenaceae	*Glandularia bipinnatifida* (Nutt.) Nutt.	19	N	P	W	H	D	NI
Verbenaceae	*Glandularia canadensis* (L.) Nutt.	100	N	P	W	H	D	NI
Verbinaceae	*Callicarpa americana* L.	107	N	P	W	H	D	FACU
Verbinaceae	*Verbena rigida* Spreng.	62	I	P	W	H	D	NI
Violaceae	*Viola missouriensis* Greene	100	N	P	C	H	D	FACW
Violaceae	*Viola primulifolia* L.	99	N	P	C	H	D	FAC
Vitaceae	*Parthenocissus quinquefolia* (L.) Planch.	80	N	P	W	W	D	FAC
Vitaceae	*Vitis aestivalis* Michx.	116	N	P	C	W	D	FAC
Vitaceae	*Vitis cinerea* (Engelm.) Engelm. ex Millard	110	N	P	C	W	D	FACW
Vitaceae	*Vitis monticola* Buckley	47	N	P	C	W	D	NI
Vitaceae	*Vitis rotundifolia* Michx.	110	N	P	C	W	D	FAC
Vitaceae	*Vitis vulpina* L.	43	N	P	C	W	D	FAC

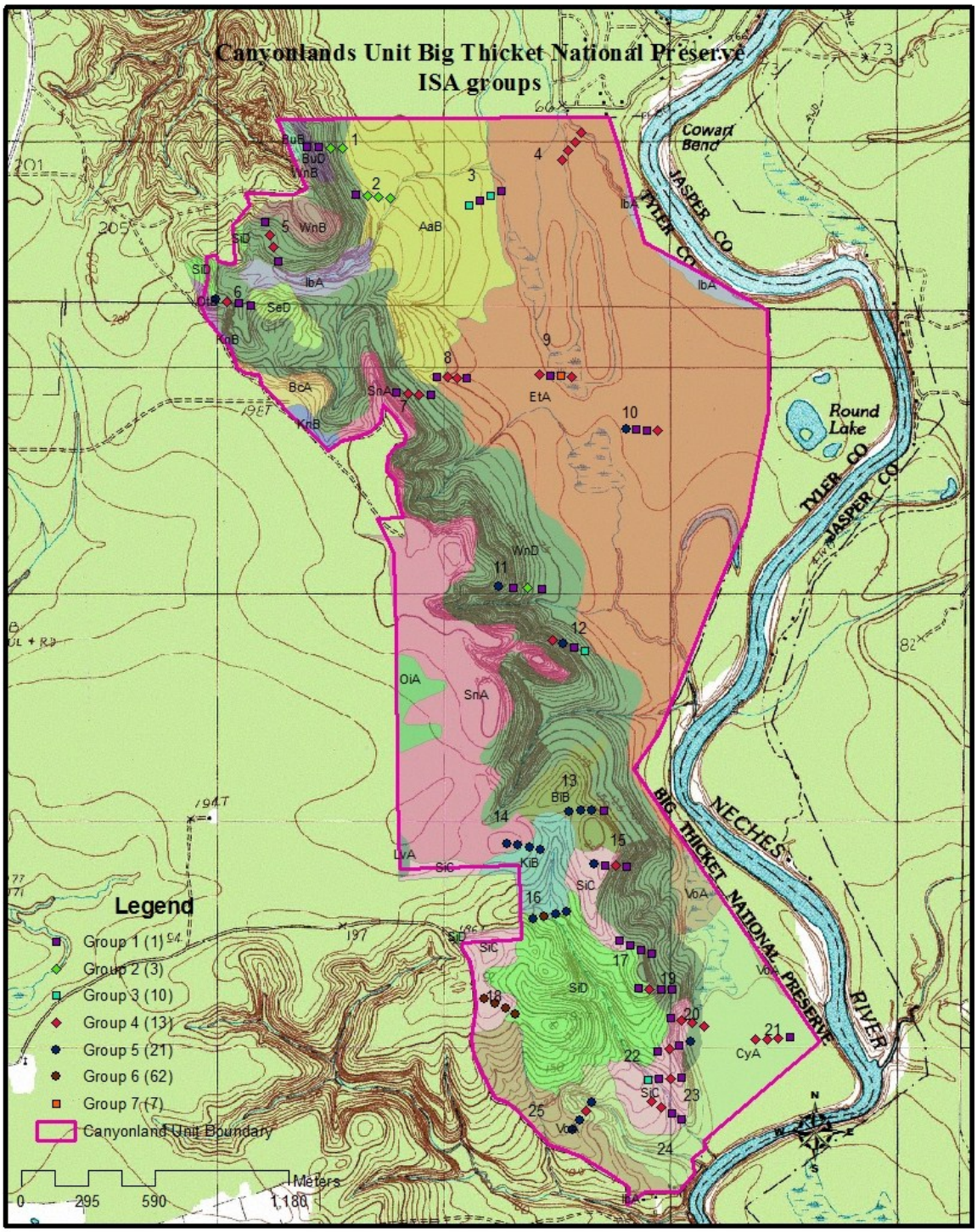
A	B	C	D	E	F	G	H	I
Xyridaceae	*Xyris jupicai* Rich.	78	N	P	W	H	M	OBL

APPENDIX F

SPECIES ANALYSIS



Cluster dendrogram. Hierarchical cluster analysis from ISA illustrates the seven vegetation groups within the Canyonlands Unit of the Big Thicket National Preserve. The groups are denoted by roman numerals.



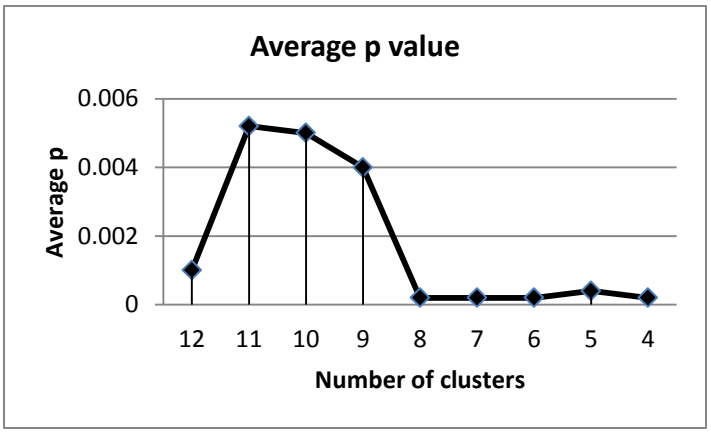
Above is the map of the Canyonlands Unit, showing the distribution of the different quadrats. Each quadrat is assigned to a group based on the color. The numbers on the map represent the transect numbers and the letters on the map represent the soil type, the description of each soil type can be found in Appendix C.

Below is the ISA table showing relative abundance, which is the distribution of a species average abundance across all groups.

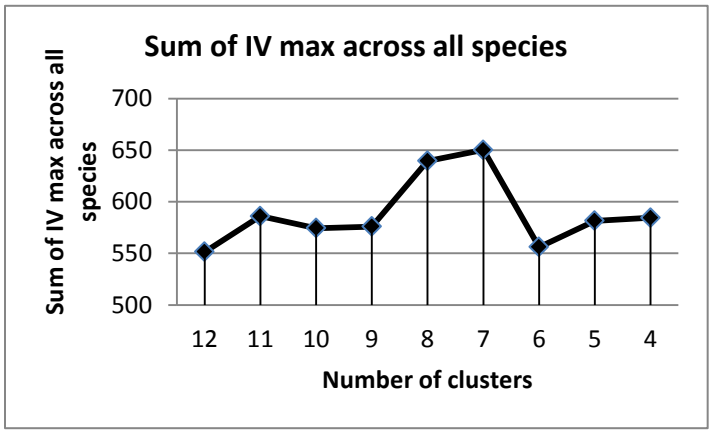
Group: Species	1	2	3	4	5	6
ACER	24	0	51	15	11	0
ARSP2	0	5	93	0	2	0
ASPA18	28	0	32	14	27	0
BAHA	1	83	13	0	3	0
CAAM2	14	0	25	0	0	61
CARYA	35	0	0	5	47	14
COFL2	49	0	45	6	0	0
FAGR	22	0	0	70	9	0
FRCA13	6	36	0	0	58	0
HAVI4	0	0	48	41	10	0
ILEX	8	9	1	1	22	58
ILOP	24	22	11	19	23	0
LIST2	10	5	41	8	21	15
MAGR4	13	16	0	66	5	0
MYCE	3	0	25	4	69	0
NYSSA	11	0	42	39	9	0
OSVI	43	31	9	11	6	0
PEBO	18	0	19	40	23	0
PITA	6	25	5	4	24	36
PLAQ	17	0	47	11	13	12
PLOC	9	0	85	6	0	0
QUERC	10	9	59	7	6	9
RUBUS	0	98	0	0	2	0
SASE5	0	72	11	17	0	0
SAAL5	30	0	0	0	15	55
TADI2	2	0	22	76	0	0
ULAL	75	0	0	25	0	0

Below is the Indicator value table. This table shows the percent of perfect indicator for each species in a group. The numbers range from 0 (no indication) - 100 (perfect indication). When the value is 100 it shows that the species is a perfect indicator for that group, always occurring in that group and never occurring in any other group. If the value is 0, this means that the species is not an indicator for the group.

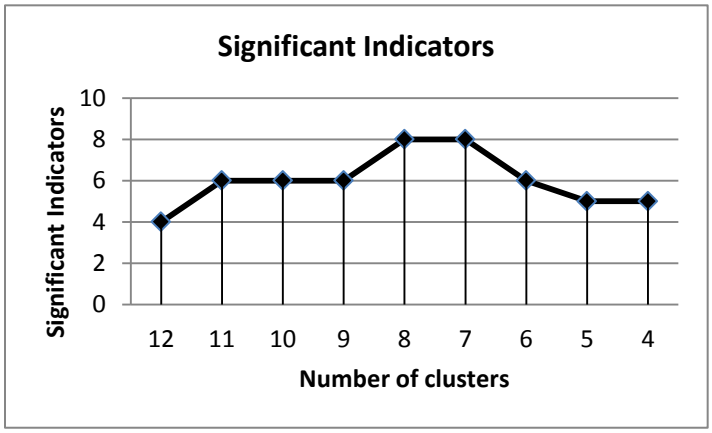
Group: **Species**	**1**	**2**	**3**	**4**	**5**	**6**
ACER	5	0	13	3	1	0
ARSP2	0	1	47	0	0	0
ASPA18	3	0	8	1	4	0
BAHA	0	42	3	0	0	0
CAAM2	1	0	6	0	0	12
CARYA	9	0	0	0	12	3
COFL2	11	0	11	0	0	0
FAGR	1	0	0	10	0	0
FRCA13	0	6	0	0	3	0
HAVI4	0	0	12	4	1	0
ILEX	8	6	1	0	22	58
ILOP	6	4	3	3	10	0
LIST2	4	1	20	4	8	9
MAGR4	1	3	0	7	0	0
MYCE	0	0	6	0	14	0
NYSSA	1	0	10	10	0	0
OSVI	19	15	2	2	1	0
PEBO	2	0	5	7	2	0
PITA	3	25	1	1	17	36
PLAQ	3	0	23	1	1	2
PLOC	0	0	21	0	0	0
QUERC	8	6	59	4	3	3
RUBUS	0	98	0	0	0	0
SASE5	0	60	3	2	0	0
SAAL5	3	0	0	0	1	11
TADI2	0	0	6	16	0	0
ULAL	6	0	0	1	0	0



Average p value, this shows that the lowest p value is .0002.



Observed sum of Indicator Value across all species. This shows that cluster 7 has the highest indicator value.



Significant Indicators, the number of species with $p \leq 0.05$ for each stem of clustering.

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