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The Role of Fire in the Ecotone Between Upland Pine and Bottomland Hardwoods

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THE ROLE OF FIRE IN THE ECOTONE BETWEEN UPLAND PINE AND BOTTOMLAND HARDWOODS

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ABSTRACT

Southeastern coastal plain landscapes are recognized for sharp transitions between upland pine and bottomland hardwoods. The ecotone is characterized by distinct elevational and compositional changes and thought to be, in part, maintained by fire. The goal of this study was to investigate the role of fire in this ecotone by examining differences between burned and unburned ecotones as well as changes from pre- to post-burn conditions on the coastal plain of South Carolina.

Two locations were selected for this study, the Francis Marion National Forest (FMNF) and a nearby private plantation. Vegetation and environmental variables were collected in the summers of 2005 and 2006. Vegetative species presence absence data coupled with environmental variables were used in nonmetric multidimensional scaling (NMS) and revealed compositional differences between locations. These differences are hypothesized to be in part due to the period of prolonged fire absence at the FMNF in the mid 20th century, which may have successfully shifted the vegetative community composition and structure.

Analyses indicated that the ecotone was unpredictable, with some variables being more similar to pine, others more similar to hardwoods, while still others are unique from both adjacent ecosystems. Contrary to prior hypothesis,

unique species were not found in the ecotone. Instead NMS ordination indicated the existence of unique plant assemblages and vegetative structure found in the ecotone community type. The dissimilarity of the ecotone to the surrounding communities are likely influenced by several factors including: long-term land history events, recent management practices (including plowed fire lines), and uneven fire behavior occurring within the ecotone.

Short-term burn response was confounded by the time of measurement. When comparing pre- and post-burn years, many significant reductions in cover occurred for both burned and unburned sites, across all the community types at both locations. Most notably, functional group cover (graminoids, forbs, vines, woody) had significant reductions across all treatments. The findings of this study suggest that historical events have persistent effects on current and future vegetation composition and structure.

DEDICATION

I would like to dedicate this to my friends and family who have seen me through this long journey, especially my betrothed, Steven Wangen, and my parents, Dan and Beth Grasser. I could not have done this without their love and support.

ACKNOWLEDGMENTS

I would like to thank the Doris Duke Charitable Foundation for funding the Lowcountry Forest Conservation Partnership, of which this project was a part. Thanks also to Dr. Geoff Wang, my advisor, for spending his time and effort guiding me through this process, to my committee members: Dr. James Rieck for aid in statistics, and Dr. William Conner for suggestions and editorial support. Thanks and appreciation goes to Dr. Joan Walker for her support and guidance. A special thanks to Steven Wangen for assistance in the field as well as conceptual and logistical support and to Dr. Patrick McMillan for lending his plant identification skills. I would also like to thank various land managers for there assistance at both locations including: Bert Shiftlet, Kevin Parker, and Bill Twomey. Thanks are also in order to Tonya Harrington and Ryan Bollinger for working long, uncomfortable days in the field.

TABLE OF CONTENTS

Table of Contents (Continued)

LIST OF TABLES

List of Tables (Continued)

LIST OF FIGURES

INTRODUCTION

The use of fire in upland pine communities and the effect fire has on pine communities in the southeastern United States has been well documented. However, not only does fire in pine communities affect the composition and structure of the pine communities themselves, but also affects surrounding ecosystems and the ecotones that exist in between. Despite the numerous studies investigating aspects of fire in the upland pine community, the ecotone existing between upland pine and bottomland hardwood communities has not been extensively investigated. This study aims to examine two major aspects of fire in the upland pine-bottomland hardwood ecotone: differences between burned and unburned ecotones, and short-term differences of pre- and post-burned ecotones.

Burned/unburned comparison studies have been used extensively to investigate differences in composition and structure for communities that were historically fire-maintained in the southeast (Glitzenstein et al. 2003, Haywood & Grelen 2000, Kush & Meldahl 2000, Streng et al. 1993, Waldrop et al. 1992). In this study, I investigated both compositional and structural differences in ecotonal communities that exist between upland pine and bottomland hardwood stands on the coastal plain of South Carolina. Two types of sites were of particular interest, the first having a recent and prolonged history of prescribed fire and the second a prolonged period of fire elimination. The objectives for the first part of the study were to quantify (1) differences in composition between burned and unburned pine-hardwood ecotone and (2) differences in structure between burned and unburned pine-hardwood ecotone.

Based on an understanding of fire effects on vegetation, I proposed several research hypotheses for the burned versus unburned comparison. (1) Unique species occur in burned ecotones. (2) Vegetative composition and species richness are similar across treatment combinations. (3) Composition and structure of the burned ecotone are more similar to that of burned pine rather than burned hardwood. (4) Composition and structure of the unburned ecotone are more similar to those of the unburned hardwood. (5) Shrub cover is higher in burned plots than in unburned plots. (6) Burning does not affect stand basal area, and stand basal area is higher in burned hardwood than burned pine, with ecotone basal area more similar to pine.

Studies that compare pre- and post-burn conditions offer insight into fire effects and provide short-term responses (Streng et al. 1993). Although long-term studies provide a timeframe more appropriate to the lifespan of the community, more attainable short-term studies are able to expand in areas that may be overlooked in longer studies.

In the second part of the study, I attempt to quantify how a single fire event affects the structure and composition of the upland pine – bottomland hardwood ecotone, providing a clearer picture of this ecological event. The fire severity measurements taken after each prescribed burn provide evidence on the type of fire that occurred.

Based on short-term vegetation response to fire, I hypothesize several outcomes to the prescribed burns. (1) A decrease in functional group cover <1m in height (graminoids, forbs, vines, woody), shrub cover, and sapling basal area. (2) A decrease in organic matter depth on burned (B) sites and an increase on unburned (U) sites. (3) No significant mortality in overstory trees due to one prescribed fire. (4) The expected increase in species richness often associated with burning is not evident after a single burning event.

This study was a small part of a larger project, Lowcountry Forest Conservation Partnership (LFCP), funded by the Doris Duke Charitable Foundation. The overall goal of the LFCP was to enhance conservation in the rapidly developing Coastal Plain of South Carolina. LFCP recognizes the importance of private land holdings and seeks to minimize fragmentation and encourage the use of fire for habitat maintenance and restoration. In addition to supporting projects focused on forest issues, this organization also supports research and education for other ecological issues including urban sprawl and river hydrology restoration.

LITERATURE REVIEW

Upland Pine-Bottomland Hardwood Ecotone

Ecotones are complex and adaptive systems (Malanson et al. 2001). These unique transition areas incorporate ecological components from the surrounding systems, often harboring rare species by providing unique niches and acting as buffers from disturbances such as floods and fires (Oosterhoorn & Kappelle 2000, Kirkman et al. 1998). Often ecotones are forgotten, neglected or excluded from protection when the surrounding land areas are managed or harvested (Kirkman et al. 1998).

Upland-wetland ecotones are very prevalent in temperate ecosystems. These ecotones are characterized by changes in soil properties and depth to water table, both of which are strongly correlated to local hydrology and topography (Boughton et al. 2006, Carter et al. 1994). Ecotones are transitional areas marked by a gradient of physical properties, including water availability, nutrient availability, soil properties, elevation, and slope. These properties are also dynamic in the ecotone, constantly in a state of flux between the conditions found in the two bordering vegetation types. In turn, these conditions create dynamics in plant distribution and competition.

In the southeastern United States, a very distinct and dynamic ecotone occurs between upland pine and bottomland ecosystems. In addition to the gradient of physical properties, these ecotones are also heavily influenced by the presence of frequent fire. The natural fire frequency in this ecotone is typically very high, every 1 to 3 years (Frost 1995, Gilliam & Platt 1999, Kirkman et al. 1998, Van Lear et al. 2005). The interaction of fire and the gradient of physical properties create unique habitats which are able to support a distinct vegetative community (Boughton et al. 2006). Unfortunately, human influences have had a dramatic effect on the fire regime in these areas through fire suppression (Drewa et al. 2002, Gilliam & Platt 1999, Kirkman et al. 1998) and the construction of physical barriers for agriculture, road construction, and fire containment (Kirkman et al. 1998, Frost et al. 1986).

Historical Role of Fire

Fire has been an important sculptor of the landscape, and it has been used as a management tool for thousands of years (Van Lear et al. 2005, Whelan 1995). Before humans, natural fires ignited by lightning helped to shape many of the ecosystems across the globe (Gartner & Thompson 1972). Prehistoric peoples used fire to clear dense vegetation to ease travel, manage wildlife, regenerate edible vegetation, provide firebreaks around settlements (both for visibility and fuel reduction), and reduce biting insect populations (Van Lear et al. 2005, Whelan 1995). Current land managers use fire for similar reasons, including wildlife management, vegetation management and maintenance, and fuel load reduction (Whelan 1995).

In the early twentieth century, there was a push to eliminate fire from the landscape in the United States. People portrayed fire as being both destructive and damaging (Gartner & Thompson 1972), largely unaware of the beneficial and maintenance aspects of burning. The U.S. Forest Service and other state forestry agencies preached and practiced fire exclusion (Van Lear et al. 2005). This led to increased fuel loading across the United States on both private and public lands.

The 1988 wildfire in Yellowstone National Park painted a very destructive and negative picture of fire. Since this event, the public has come to understand that the reason this fire was so catastrophic was due to excessive fuel loading compounded by fire suppression during the previous decades (Romme & Despain 1989). Prior to this event, land managers had already begun to shift their opinions on the role of fire, realizing the importance for maintenance, biodiversity, and fuel suppression.

Fire as an Ecological Factor Shaping Ecotones

The suppression of fire on the landscape has taken its toll and altered many fire adapted ecosystems and adjacent ecotones. It is plausible that frequent prehistoric ignition of fires by both humans and lightning resulted in genetically adapted characteristics in species present in ecosystems subject to frequent fire (Heuberger & Putz 2003). The suppression of fire could have a potentially very negative effect with respect to the presence and abundance of these species, and in extreme cases, could cause species to become threatened or endangered (Leach & Givnish 1996).

Fire aids in the maintenance of the vegetational composition of the ecotone, prohibiting encroachment from species not adapted to fire, while enhancing specific environments for species coexistence, and providing crucial habitat for niche species (Kirkman 1995, Frost et al. 1986). Fire suppression has affected ecotones by causing geographic shifts in position, drastically changing dynamics, and resulting in a loss of species diversity (Kirkman et al. 1998). In order to restore ecosystems and ecotones adapted to fire to their natural or presettlement condition, land managers should be aware of the detrimental impacts they can have, and alter their view of this ecotone from a low-priority transitional area to an extension of the highly regarded pine ecosystem, with unique plant assemblages.

COMPARISONS OF BURN TREATMENTS AND COMMUNITY TYPES

Materials and Methods

Study Sites

This study was conducted on the Francis Marion National Forest (FMNF) located in Berkeley County, South Carolina and on a private plantation in Jasper County, South Carolina (Figure 1). These two locations were chosen based on their similarity in recent fire history. However, there are some differences in the past management history between the two locations.

Before becoming a National Forest in 1936, the FMNF went through some very interesting land changes. Prior to the Civil War, much of the now forested land was in agricultural use as rice fields. The fields were then converted into forest, but demand for timber during World War I resulted in many southern forests being cleared. Many of the forested stands that exist at the FMNF today are third or fourth generation forests since the National Forest was established (USFS 1977). Management records indicate a significant period of fire exclusion during the mid 20th century. There are several abandoned fire plow lines existing in or near many of the pine-hardwood ecotones. The current management plan includes several harvesting techniques along with biennial, dormant season burning on all pine sites that pose low risk of fire escape.

The private plantation has a more steady history, having been under the same management plan since the late 19th century. This plan is based on frequent prescribed fires (1-5 year rotation) and includes several different harvesting techniques such as clear cutting, row thinning, and selective thinning. Prescribed burning takes place from January until March as the weather permits and there are no fire plow lines.

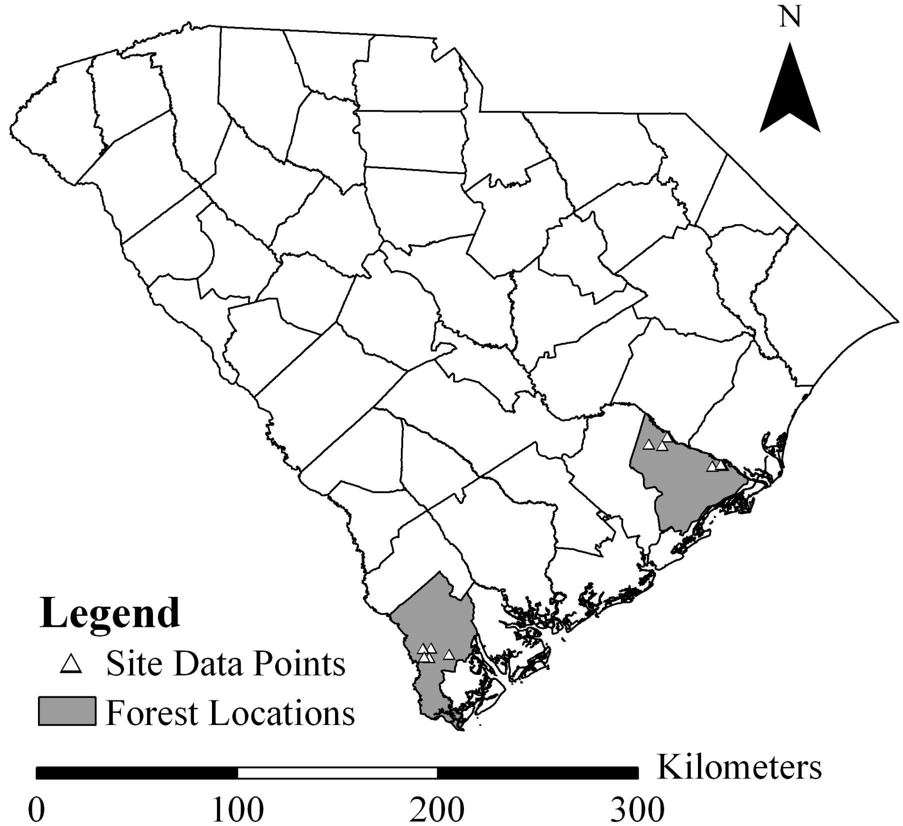

Figure 1. Location of sites on the coastal plain of South Carolina.

Study Design

This study was originally designed as a split-plot design, with burn as the whole plot factor and blocked on location. Before the study began, the two locations were assumed analogous. However, preliminary investigations into species composition made the inherent differences between the two locations apparent. After this discovery, location was not treated as a blocking factor; instead the locations were analyzed separately.

A total of six burned (B) sites, defined as having both historical and recent prescribed burns applied frequently (every 2-3 years), were selected, three at each location. Five unburned (U) sites, characterized as having an absence of fire for at least the last ten years, were selected, three at the FMNF and two at the private plantation.

Each of these sites contained five transects, extending across three community types: pine, ecotone, and hardwood. Within the ecotone, 10x10m plots were established at a 3m spacing along the transect while the upland pine and bottomland hardwood sample plots were established 15m away from the nearest ecotone plot, upslope or downslope respectively (Kirkman et al. 1998). Plots were considered to be in the ecotone if the basal area estimate was between 70% pine and 70% hardwoods (USDA Forest Service 1988). A 10 factor basal area prism was used to delineate the boundary, sweeps were made every 10 meters, starting in the upland pine and traversing through the ecotone, into the bottomland hardwoods. A detailed layout of each 10x10m sampling plot is illustrated in Figure 2.

Soils

Soil types are variable among the locations and sites and between ecological community types. However, soil textures are similar within community types. At the FMNF, soils in the pine plots are comprised of combinations of fine sand and loam. Two of the B pine sites have Typic Quartzipsamments, characterized as being deep, excessively drained, and having formed in sandy marine sediments. Soil on the other B pine site at the FMNF is a Typic Paleaquult, characterized as being very deep and poorly drained, also formed from marine or fluviomarine deposits. The U pine sites have slightly less well drained soils and include Aquic Hapudults, Aquic Arenic Paleudults, and Aquic Paleudults. The Aquic Hapudults are characterized as being very deep, moderately well drained, and are also formed from marine sediments. Aquic Arenic Paleudults are more poorly drained than the Aquic Paleudults that were formed in clayey Coastal Plain sediments, while the Aquic Arenic Paleudults were formed in sandy and loamy marine sediments (Long 1980).

The private plantation has similar soil types in the pine sites, with four of the sites having Aeric Endoaqualfs, characterized as, very deep, somewhat poorly drained, and formed by marine deposits, fluviomarine deposits, and alluvium. Another soil type found on one of the B pine sites at the private plantation is Typic Endoaqualfs, which is characterized as very deep, poorly drained, and formed from loamy sediments on the Coastal Plain (Stuck 1980).

The soils found on hardwood plots at the FMNF are loamy or loamy with fine sand. Cumulic Humaquepts are found on two of the B hardwoods sites and are very deep, very poorly drained, and formed by marine or fluvial sediments. The third B hardwood site has Typic Paleaquults soils which are also very deep and poorly drained and formed by marine or fluvial sediments. Two of the U hardwood sites at the FMNF are Typic Albaqualfs. These soils are often very deep, poorly drained, and formed by fluviomarine deposists or alluvium. Fluvaquentic Dystrudepts is found on one of the U hardwood sites at the FMNF and is characterized as very deep, somewhat poorly drained, and formed by fluvial sediments (Long 1980).

Four of the hardwood sites at the private plantation are Typic Endoaqualfs which are very deep and very poorly drained soils, formed by clayey marine sediments. The remaining hardwood sites at the private plantation are Aeric Endoaqualfs and Typic Argiaquaolls. Similar to the Typic Endoaqualfs, Aeric Endoaqualfs are very deep, somewhat poorly drained, but formed by marine deposists, fluviomarine deposits, and alluvium. The Typic Argiaquolls are very poorly drained and formed by clayey marine sediments (Stuck 1980). The ecotones existing between the pine and hardwood soils have an unpredictable mixture of the two bordering soil types, often resulting in variable vegetation patterns and plant growth environments.

Data Collection

Vegetation

Presence/absence of ground layer species was accounted for at two scales: whole plot (10x10m) and in ten subplots (0.25x0.25m) located along the transect (Figure 2). Average species richness was obtained by using species found in the 0.25x0.25m subplots. Seedlings were also accounted for in the 0.25x0.25m subplots and defined as a single stemmed woody plant <0.5m tall. A 1x1m nested subplot was established in each plot corner, where cover estimates of functional groups (graminoids, forbs, vines, and woody species) < 1m in height were taken. Cover estimates for each species of the shrub layer were taken in the 25m^2 of the lower left corner of the whole plot. Shrubs were defined as vegetation >1m tall with a diameter at breast height (DBH, 1.37m) <2cm. DBH and species of all saplings (2cm<DBH<6cm) were recorded for the same 25m^2. Tree (DBH >6cm) species and DBH were recorded for all stems within the 100m^2 plot (Figure 2).

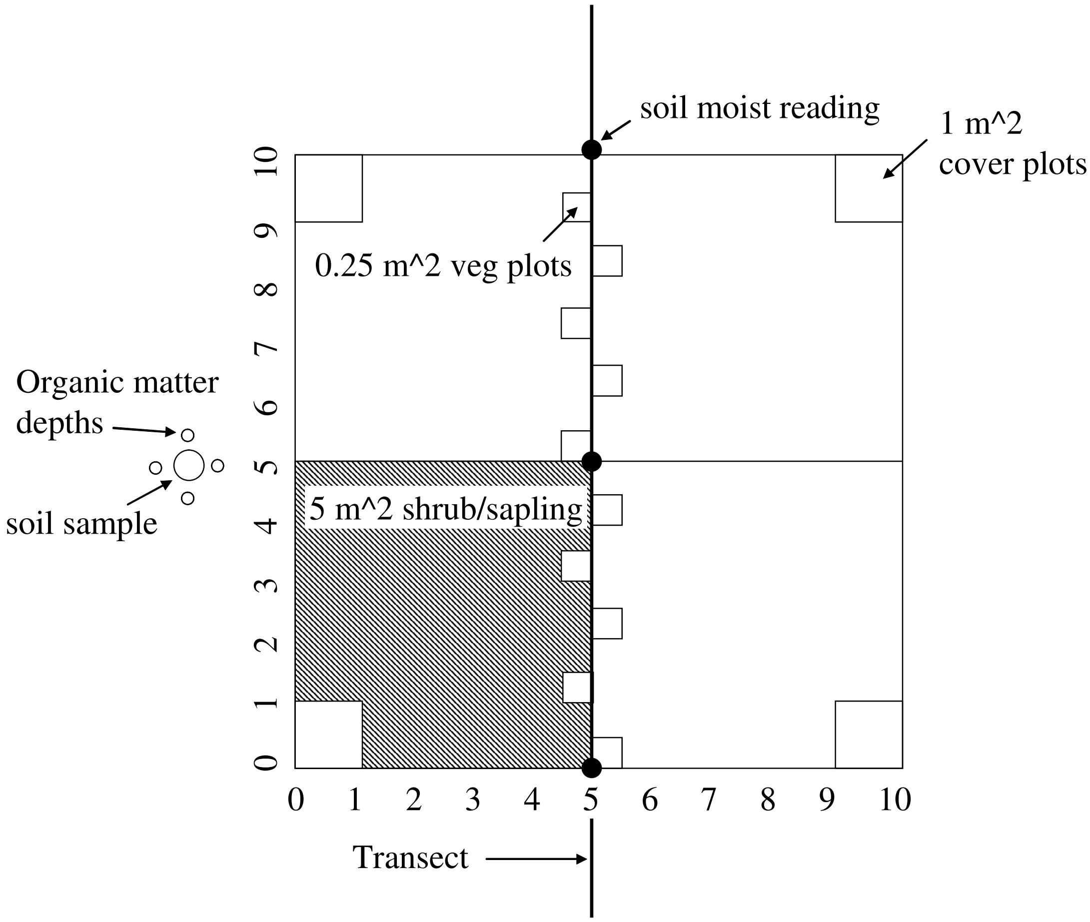

Figure 2. Layout of 10x10m sampling plot, illustrating nested vegetation plots and locations for soil sampling and soil moisture readings.

Soil and Environmental Measurements

A series of soil measurements were recorded at each plot. Soil samples were taken outside the plot with an Oakfield soil sampler (Oakfield Apparatus Inc.) (Figure 2). Depth to A horizon, depth to B horizon, and percent clay in the B horizon were recorded. Four measurements of the litter (Oi) and duff (Oe and Oa) layers were identified and measured. Landscape information such as aspect and slope percent was also recorded.

Soil Moisture

Soil moisture measurements were collected in August 2006. In order to reduce variability due to weather, the moisture readings were taken over a one day period at each location. A Theta Probe Moisture Meter (Delta- T Devices, Ltd.) was used to measure soil moisture at a depth of 6cm. The Theta Probe conducts a 100MHz signal into the soil, where the resistance is measured through a series of four metal rods, giving a raw voltage reading in millivolts. Soil moisture readings were taken along the transect in 5 locations for each plot: top, center, bottom, 5m upslope of the plot, and 5m downslope of the plot (Figure 2). The litter, fermentation, and humus layers were removed at the place of the moisture measurement in order to keep the 6cm depth of the Theta Probe consistent throughout locations. A conversion equation was used to calculate soil moisture percent for each specific soil type found throughout the two locations (see Conversion and Calibration section).

Data Analysis

PC-Ord

Ordination

Nonmetric multidimensional scaling (NMS) was performed using PC-ORD to compare vegetative composition between and within locations. First, presence/absence data of vegetative species found in the 0.25x0.25m subplots for both locations was organized by plot in a matrix spreadsheet. This data was then coupled with environmental variables from each plot including plot location, aspect, slope, soil depth to A horizon, depth to B horizon, and average depth of the litter and duff layers. The NMS, which groups plots according to similarity, was run using the slow and thorough setting. After discovering unanticipated compositional differences between the two locations, the presence/absence data for each location was run separately with corresponding environmental data.

Indicator Species Analysis

The Indicator Species Analysis (ISA) was performed using PC-Ord. With ISA, a value from 1 to 100 (zero indication to perfect indication) is given to each species according to how strong of an indicator it is for the group defined. Indicator species were identified for several groups including location, burn treatment, community type, and treatment combination. One thousand randomizations were used for the Monte Carlo test where p-values were defined as $\alpha<0.100$.

Analysis of Variance

Analysis of variance (ANOVA) was used to detect differences (α<0.100) among community types and between burn treatments within each location for data including: species richness, functional group cover (graminoids, forbs, vines, woody), litter layer depth, duff layer depth, soil moisture content, average total shrub cover, average total sapling basal area, and average total tree basal area. The Proc Mixed procedure from Statistical Analysis Software (SAS, Version 9.13, SAS Institute, Inc.) was used for all statistical analyses. Underlying assumptions of normality were checked using the Shapiro-Wilk test for normality (α<0.100).

Conversion and Calibration

Soil Moisture

Soil moisture was converted from voltage, a measurement taken by the Theta Probe Moisture Meter, to percent soil moisture by a using a series of equations. The linear relationship of the probe output (V) defined as the dielectric constant ($\sqrt{\varepsilon}$) is established with the equation (Delta-T Devices, Ltd.):

$$\sqrt{\varepsilon} = 1.1 + 4.44 * V \qquad (1)$$

The relationship between the volumetric water content (θ) and $\sqrt{\varepsilon}$ is of the form:

$$\sqrt{\varepsilon} = a_0 + a_1 * \theta \qquad (2)$$

where a_0 and a_1 are coefficients to be determined.

The clay content of the soil B layer was quantified at each site and put in one of the following clay percentage classifications: <27%, 27-40%, and >40%. At each location, a representative sample of each texture classification was taken from each of the three community types. The wet voltage reading (V_w) of each of these samples was taken in the field. This measurement was used in equation (1) to find $\sqrt{\varepsilon_w}$. The soil sample was then taken back to the lab where the wet weight (W_w) was taken and the sample volume (L) was measured. After drying the soil samples in the oven at 80° C for one week, the dry voltage reading (V_d) and dry weight (W_d) were taken. Equation (1) was used to find $\sqrt{\varepsilon_d}$ which is equal to the coefficient a_0. The dry weight was then used to determine the volumetric water content (θ_w) of each sample with the following equation:

$$\theta_w = \frac{(W_w - W_d)}{L} \tag{3}$$

The a_1 coefficient was then calculated using the following equation:

$$a_1 = \frac{\sqrt{\varepsilon_w} - \sqrt{\varepsilon_d}}{\theta_w} \tag{4}$$

Percent soil moisture was determined by using an inverted form of equation (2) with substitution from equation (1) of the following form:

$$\theta = \frac{(1.1 + 4.44 * V) - a_0}{a_1} \tag{5}$$

This formula was then applied to each representative sample, accounting for all B clay content classifications, all community types, and both locations. The correct formula version was then applied to each plot according to its B clay content classification (Table A.1).

Transformations

A square root transformation was used to normalize the duff layer depth data for both locations. Square root transformation was also used on the private plantation shrub cover data and tree basal area data. A Logarithmic transformation was used on the richness data for both locations and the soil moisture content data for the private plantation. The following transformation was used on functional group cover data for graminoids, forbs, vines, and woody plants <1 meter in height.

$$\sqrt{x + \frac{3}{8}} \tag{6}$$

Results

Composition

NMS grouped similar plots and revealed compositional differences between locations (Figure 3). A trendline indicates that some of the differences between locations could be due to varying levels of clay in the soil B horizon layer.

When analyzed separately, both locations revealed compositional differences between B and U plots for both locations. The FMNF plots show more distinct separation due to differences in species composition between B and U plots. The trendline also indicates that the differences between the two burn treatments may be influenced by the clay content of the soil B horizon layer (Figure 4). The private plantation showed less separation due to species composition between B and U. Trendlines on the private plantation ordination indicate that the separation that exists could be influenced by both soil B horizon clay content and slope (Figure 5). There is still a distinct separation between B and U when ordinating treatment combinations at the FMNF. Also, there is distinction between community types while the ecotone falls between the hardwood and pine plots for both burn treatments (Figure 6). On the treatment combination ordination of the private plantation, the burn treatments still do not have distinct grouping. However, the separation between the community types is similar for both burn treatments, with ecotone plots being ordinated between hardwood and pine plots (Figure 7).

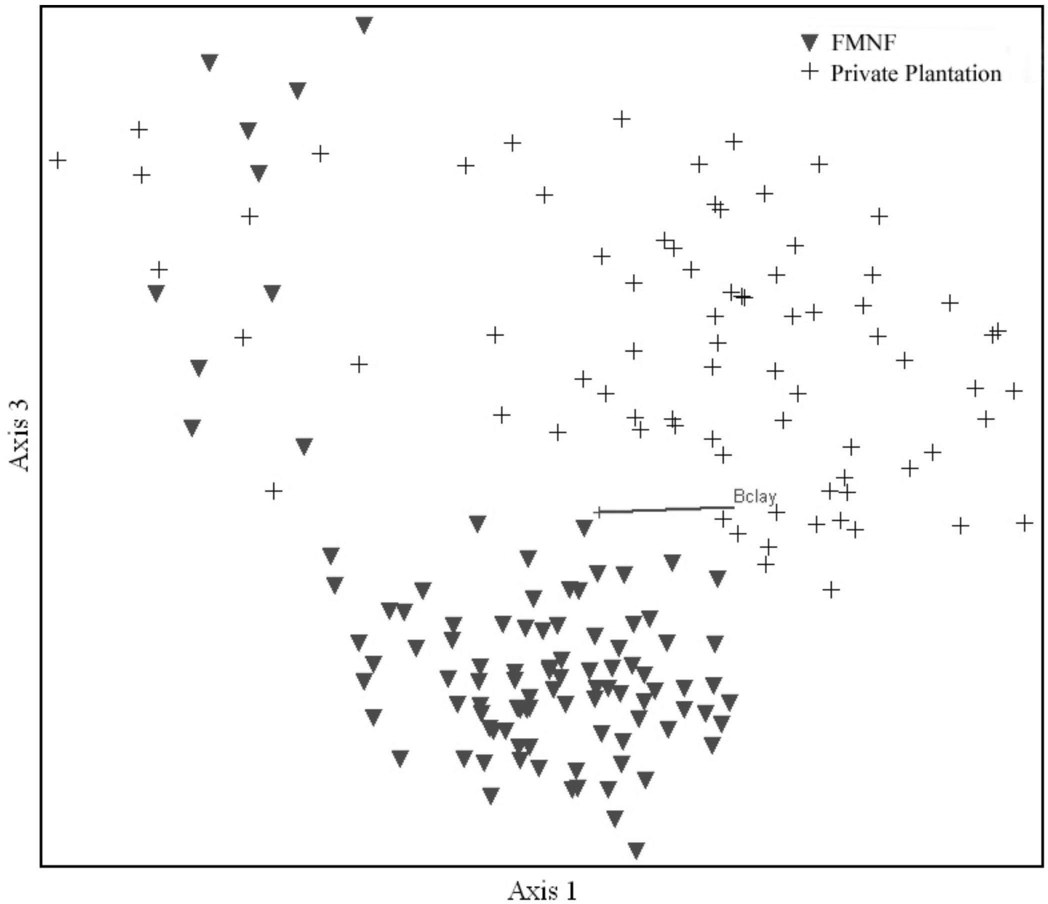

Figure 3. NMS ordination illustrating the difference in species composition between the two locations. Each point represents a plot.

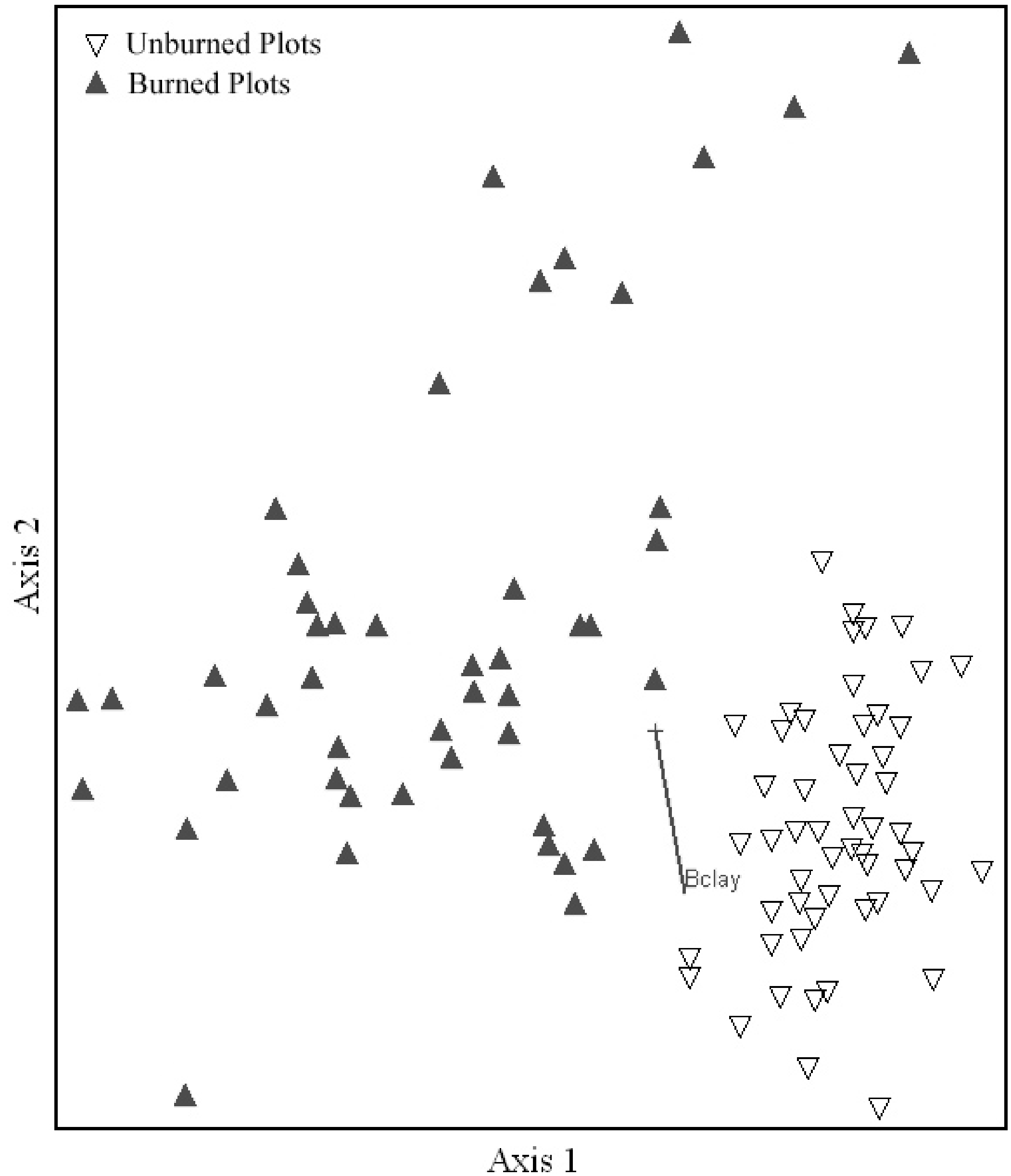

Figure 4. NMS ordination of FMNF, burned vs. unburned plots.

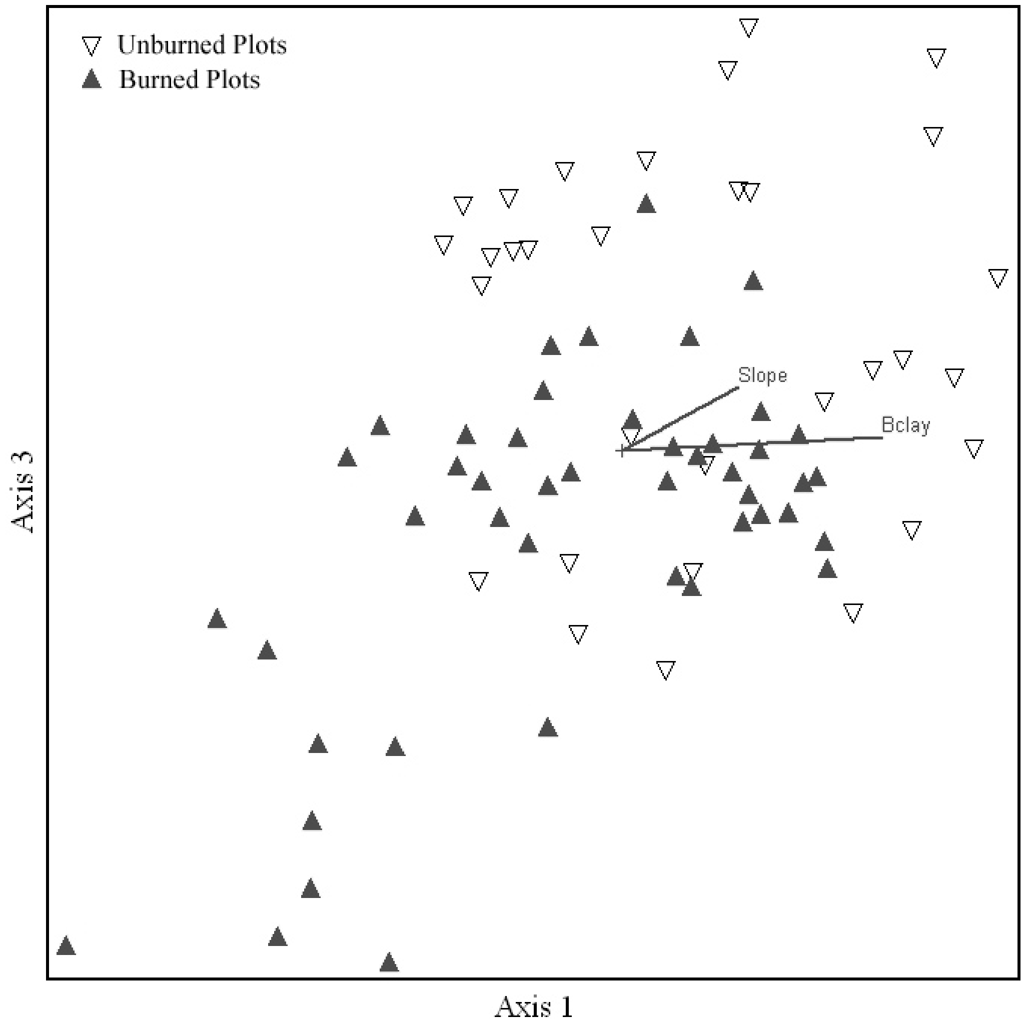

Figure 5. NMS ordination of private plantation, burned vs. unburned plots.

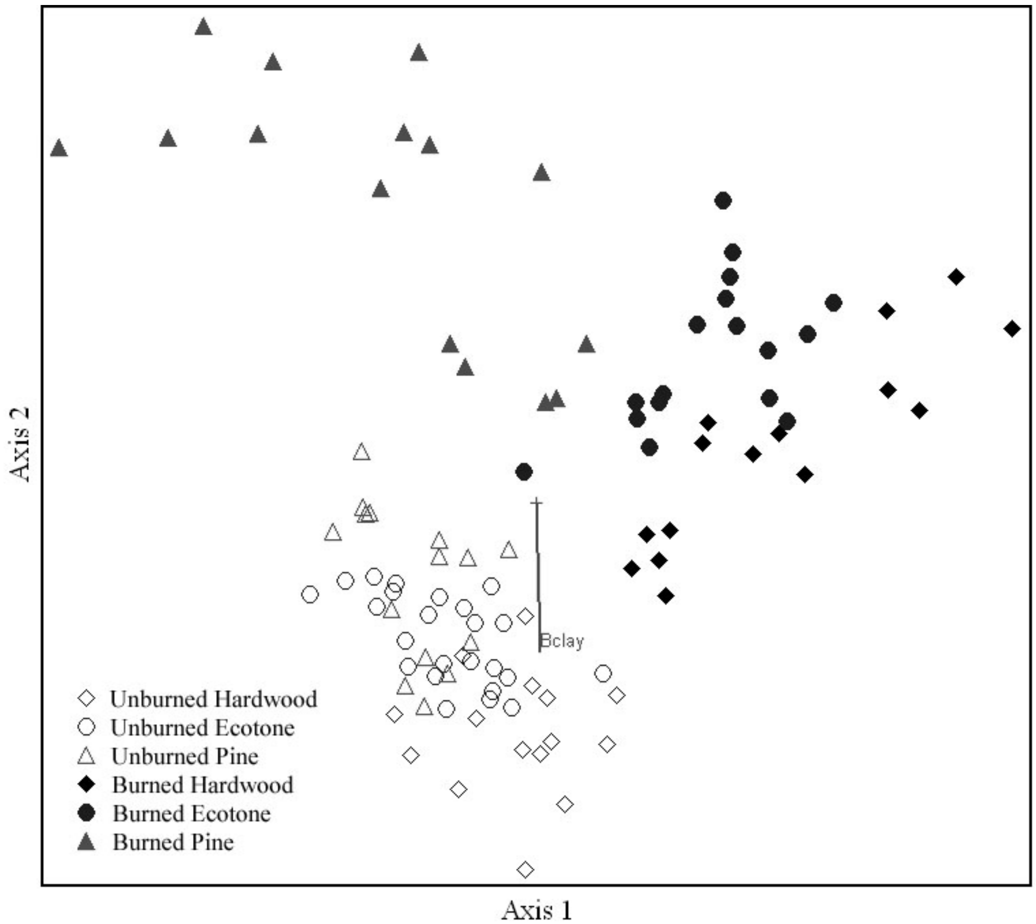

Figure 6. NMS ordination of FMNF treatment combinations, each point represents a plot.

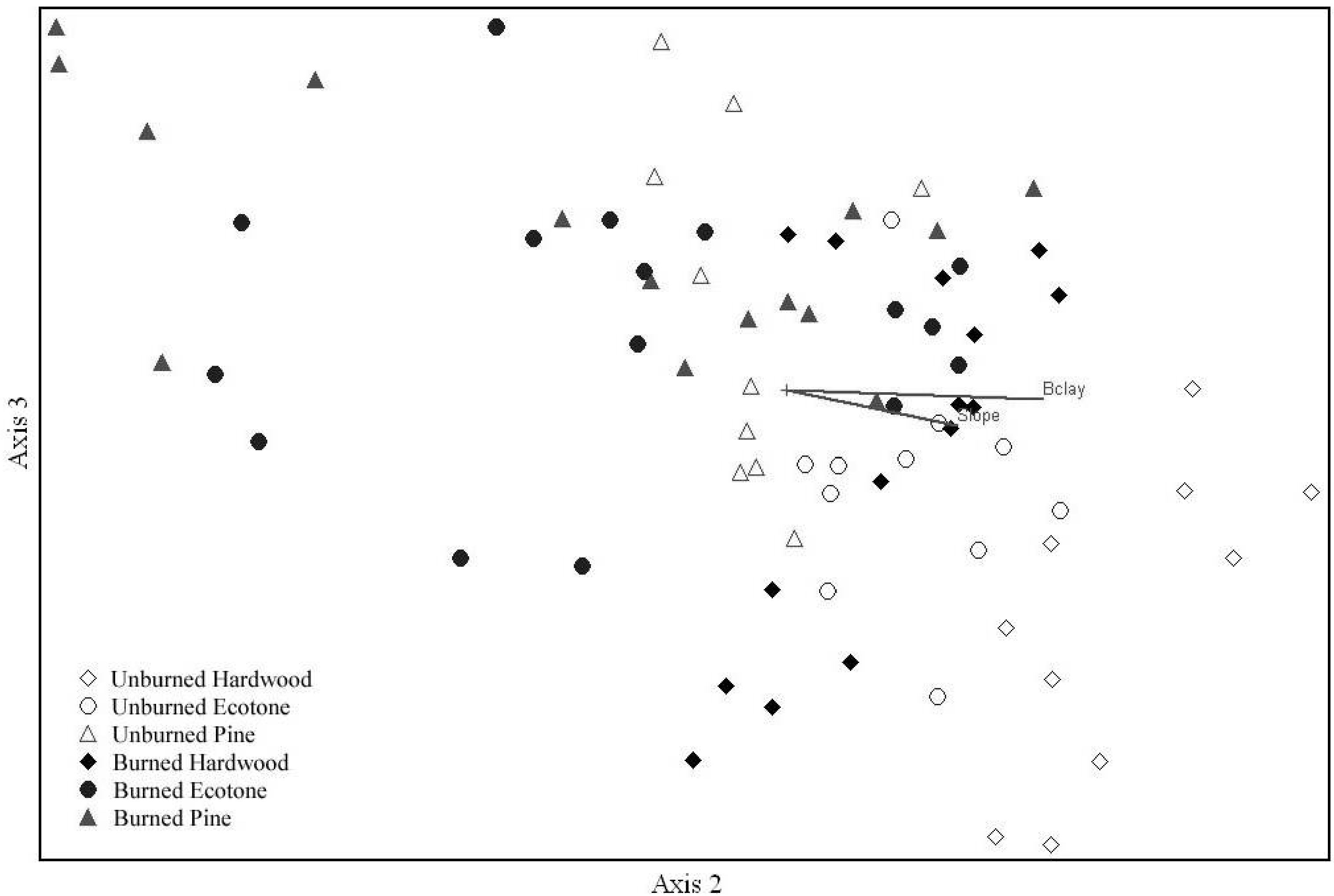

Figure 7. NMS ordination of private plantation treatment combinations, each point represents a plot

Species Richness

Over 400 species were identified between the two locations (Table A.2). The analysis of average species richness at the FMNF indicated no difference between B and U sites (p=0.111) or between community types (p=0.920), and a higher richness range for U sites. In contrast, the private plantation B sites had increased species richness when compared to the U sites (p=0.070), with a total B richness range of 5.9 to 13. There was also a significant difference in richness between pine and hardwood community types (p=0.008) and ecotone and hardwood community types (p=0.019) at the private plantation, but not between ecotone and pine communities (p=0.477) (Table 1).

The richness ranges at the private plantation are well above those at the FMNF (Table 1). The average species richness for the B sites at the private plantation is more than double what is found at the FMNF. However, the U sites resulted in more similar comparisons, with lower minimum values at the FMNF but similar averages at both locations.

Table 1. Species richness ranges and averages for all treatment combinations in both locations.

		FMNF			Private plantation		
		Min	Max	Average	Min	Max	Average
Burned	Ecotone	2.8	6.6	4.1	6.6	10.4	8.6
	Pine	0.4	7.4	3.7	7.4	13.0	9.6
	Hardwood	1.8	5.3	3.4	5.9	9.1	7.4
	Total	0.4	7.4	3.8	5.9	13.0	8.9
Unburned	Ecotone	2.1	10.3	7.9	5.6	8.2	6.7
	Pine	1.5	11.1	6.6	6.2	8.0	7.1
	Hardwood	3.0	12.0	7.6	5.8	7.0	6.3
	Total	1.5	12.0	8.2	5.6	8.2	6.9

Indicator Species

Indicator species were identified between locations. *Ilex opaca, Mitchella repens*, and *Gelsium sempervirens* all had indicator values (IV) at the FMNF above 50 with p-values all equal to 0.001 (Table A.3). The private plantation had indicator values above 50 for *Carex glauca*, *Liquidambar styraciflua*, and *Scleria* spp. (p=0.001) (Table A.4).

Selecting for specific community types, the FMNF ecotone had significant indicator values for three tree species: *Pinus taeda* (IV=38.1, p=0.006), *Quercus nigra* (IV=34.9, p=0.008), and *Robinia pseudoacacia* (IV=19.5, p=0.004) (Table A.5). The ecotone occurring in B sites at the FMNF also had many species indicators with significant p-values. *Osmunda cinnamomea* had the highest indicator value (48.2, p=0.001), while *Arundinaria gigantea* (IV=25.9, p=0.004) and native grass *Xyris caroliniana* (IV=29.7, p=0.001) were also significant (Table A.11). The U ecotone sites had significant indicator values for three tree species: *Robinia pseudoacacia* (IV=33.3, p=0.001), *Quercus pagoda* (IV=27.4, p=0.002), and *Ulmus americana* (IV=24.3, p=0.005). The only significant forb in the U ecotone at the FMNF was *Stellaria* spp. (IV=43.9, p=0.001) (Table A.12).

The ecotone at the private plantation had no significant indicator values (Table A.6). However, when selecting for the B ecotone, several species were found to have significant indicator values, including *Smilax glauca* (IV= 26.0. p=0.007), *Vernonia angustifolia* (IV=25.8, p=0.010), *Erechtites hieraciifolia* (IV= 25.0, p=0.011), *Centella erecta* (IV=20.8, p=0.018), and *Dichanthelium* spp. (IV=23.2, p=0.002) (Table A.13). On the U sites at the private plantation, the ecotone had significant species indicator values for *Chasmanthium laxum* (IV=30.1, p=0.002), *Bignonia capreolata* (IV=23.5, p=0.014), and *Solidago* spp. (IV=18.2, p=0.045) (Table A.14).

The FMNF had significant indicator values in the hardwoods for *Smilax rotundifolia* (IV=42.8, p=0.001) and *Cyperus* spp. (IV=39.9, p=0.001) (Table A.5). At the private plantation *Quercus hemisphaerica* (IV=43.5, p=0.001) and *Lyonia lucida* (IV=20.0, p=0.008) were found to be the most important in the hardwoods (Table A.6). Analysis of the pine plots at the FMNF indicated the graminoid species *Andropogon virginicus* (IV=42.3, p=0.001) and *Andropogon* spp. (IV=38.3, p=0.001), along with the woody vine *Rhus copallinum* (IV=42.3, p=0.001), had the three highest indicator values (Tables A.5). In pine plots at the private plantation, the tree species *Pinus palustris* (IV=29.9, p=0.001) and several aster species including *Eupatorium leucolepis* (IV=34.9, p=0.002), *Pityopsis graminifolia* (IV=31.0, p=0.001), and *Aster walteri* (IV=24.7, p=0.001) had high indicator values (Table A.6).

Several species were significant for all B treatment sites at the FMNF. *Persea borbonia* (IV=89.7), *Clethera* spp. (IV=83.0), and *Lyonia lucida* (IV=68.1) had the highest indicator values for B sites with p-values equal to 0.001 (Table A.7). In contrast, *Smilax rotundifolia* (IV=56.8, p=0.001), *Dichanthelium* spp. (IV=55.2, p=0.002), and *Smilax glauca* (IV=54.7, p=0.001) had the highest indicator values for B sites on the private plantation. (Table A.9). *Smilax bona-nox* (IV=86.7, p=0.001), *Carpinus caroliniana* (IV=79.6, p=0.001), and *Parthenocissus quinquefolia* (IV=77.9, p=0.001) had highest indicator values for the U sites at the FMNF (Table A.8). There was also an invasive species, *Lonicera japonica*, found to be an indicator species at the FMNF U sites (IV=37.3, p=0.001). *Campsis radicans* (IV=49.5, p=0.002), *Smilax laurifolia* (IV=45.8, p=0.001), and *Quercus hemisphaerica* (IV=35.3, p=0.003) had the highest indicator values for the U sites at the private plantation (Table A.10).

Functional Groups

At the FMNF, an analysis of the functional cover group of graminoids resulted in an interaction (p=0.032). Therefore, all treatment variables were investigated individually. A difference was detected between community types in B plots only (p=0.019). Burned pine plots had the largest amount of graminoid cover, followed by hardwood, and the ecotone plots had the lowest amount of graminoid cover. Ecotone and hardwood plots on B sites were not significantly different from each other (p=0.208), while pine plots were significantly different from ecotone and hardwood plots (p=0.006, 0.0525, respectively). Pine plots were also the only community type to display a significant difference between B and U (p=0.052) (Figure 9). The private plantation resulted in no interaction between burn treatments and community types (p=0.939). There were no significant differences found between burn treatments or among community types (p=0.349, 0.414, respectively) (Figures 8, 9, 10).

The FMNF forbs cover data did not result in an interaction between burn treatments and community types (p=0.898). The only significant difference in forbs cover was found between burn treatments, with B having a significantly higher amount of forbs cover (p=0.027). There were no significant differences found among community types (p=0.946). The private plantation forbs cover analysis did not result in an interaction between burn treatments and community types (p=0.742). There were also no significant differences between burn treatments or among community types (p=0.434, 0.485, respectively) (Figures 8, 9, 10).

The vine cover data at the FMNF resulted in no interaction between burn treatments and community types (p=0.348). There was a significant difference between burn treatments, with more vine cover on U sites (p=0.047). No significant differences were found among community types (p=0.584). The private plantation vine cover data resulted in an interaction between burn treatments and community types (p=0.084). Therefore, the treatment variables were investigated individually. The only significant difference detected was among community types on B sites only (p=0.025). Burned ecotone plots were significantly different than both B pine and B hardwood plots (p=0.016, 0.020, respectively), with B ecotone having the largest amount of vine cover. However, B pine and B hardwood had similar amounts of vine cover and were not significantly different (p=0.897) (Figures 8, 9, 10).

The woody cover at the FMNF resulted in no interaction between burn treatments and community types (p=0.184) However, there were significant differences in woody cover between burn treatments, with higher amounts of woody cover on the B plots (p=0.002). There were no significant differences among community types (p=0.201).

Cover analysis of woody cover on the private plantation showed no interaction between burn treatments and community types (p=0.352). There were significant differences between burn treatments, with B sites having higher amounts of woody cover (p=0.053). Also, significant differences were found among community types, with pine plots having the most woody cover, and hardwood plots having the least (p=0.049). The woody cover in ecotone plots was not significantly different from pine or hardwood (p=0.327, 0.282, respectively), but pine and hardwood plots had significant differences (p=0.041) (Figures 8, 9, 10).

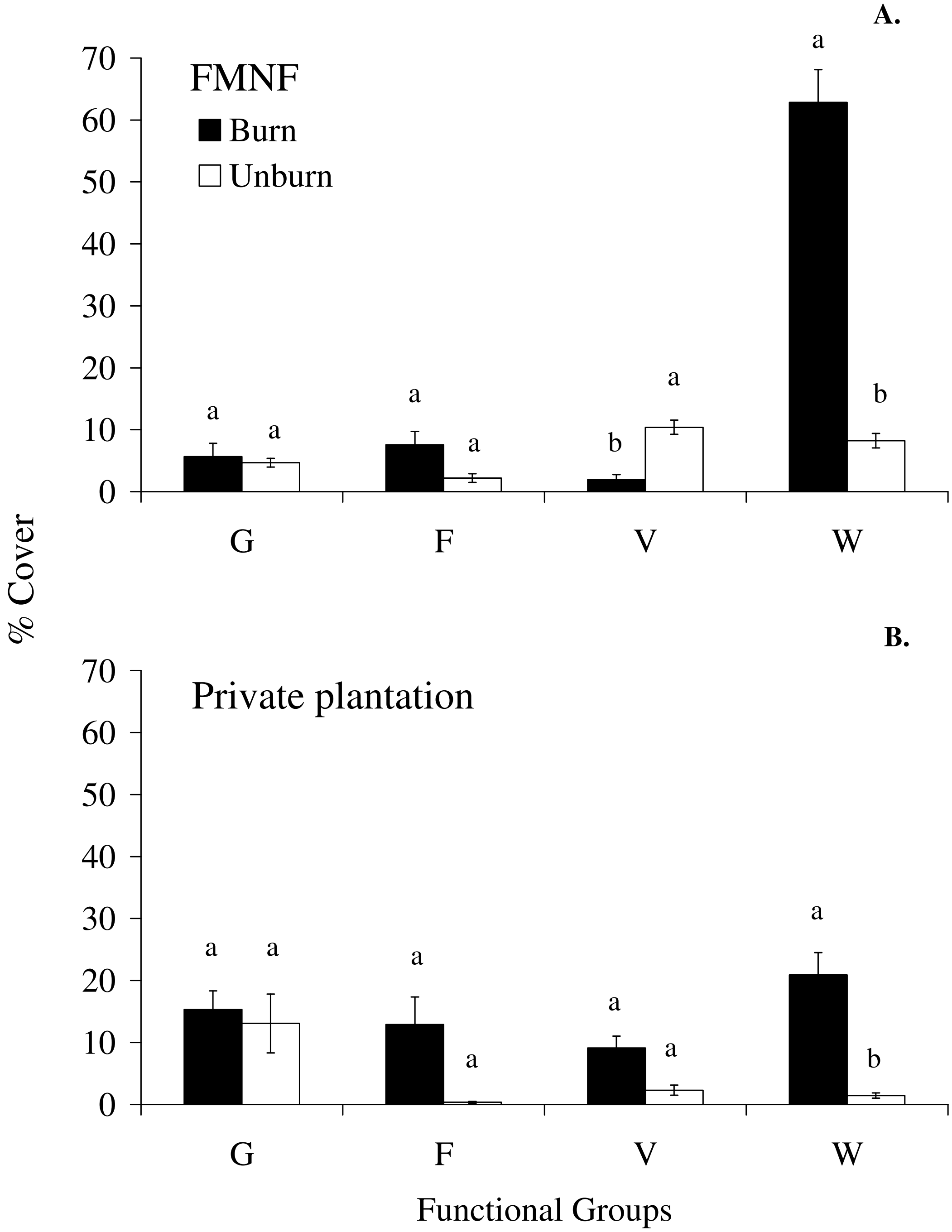

Figure 8. Percent cover of functional groups (G=graminoids, F=forbs, V=vines, W=woody) in ecotone plots for both locations. Error bars represents standard error.

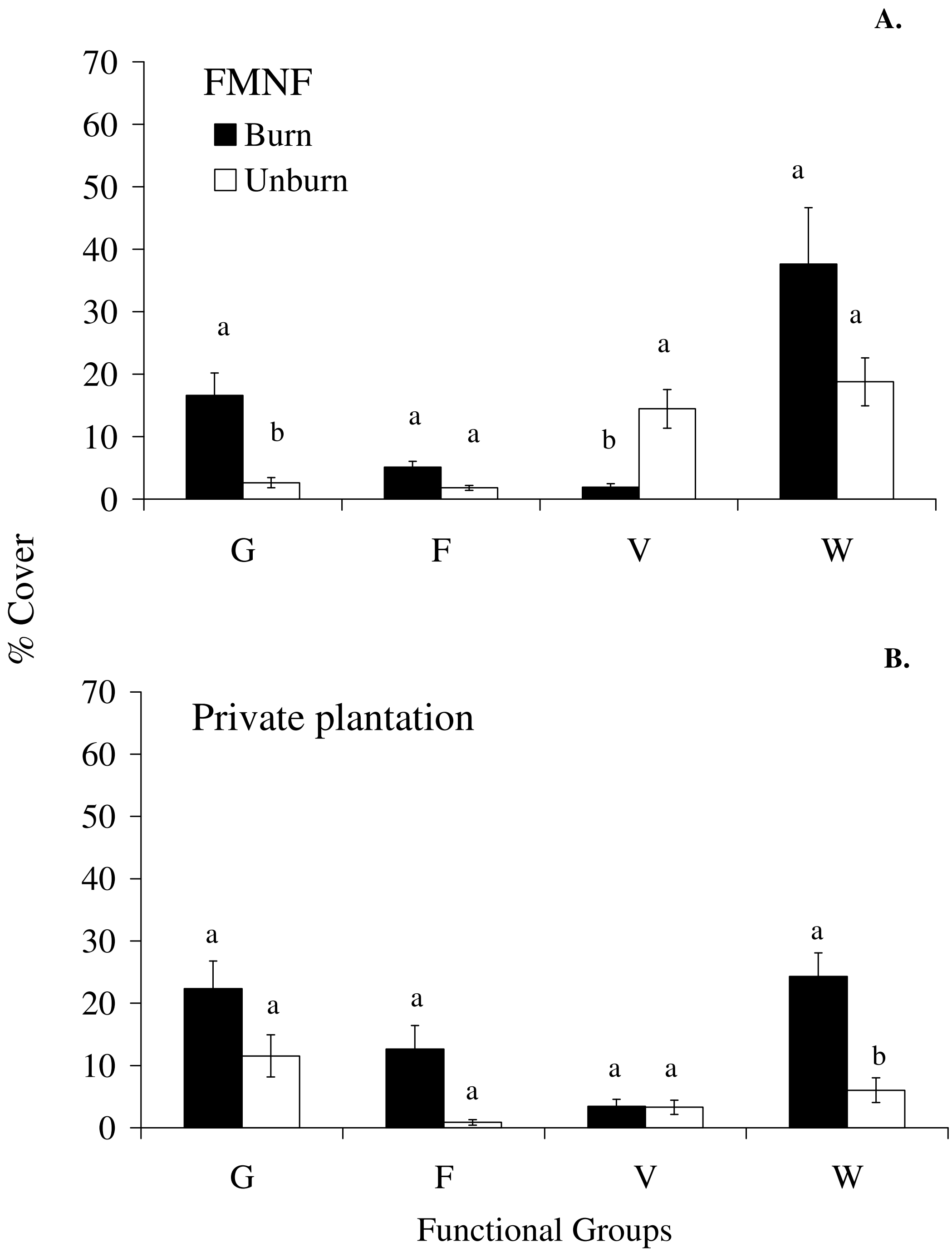

Figure 9. Percent cover of functional groups (G=graminoids, F=forbs, V=vines, W=woody) in pine plots for both locations. Error bars represent standard error.

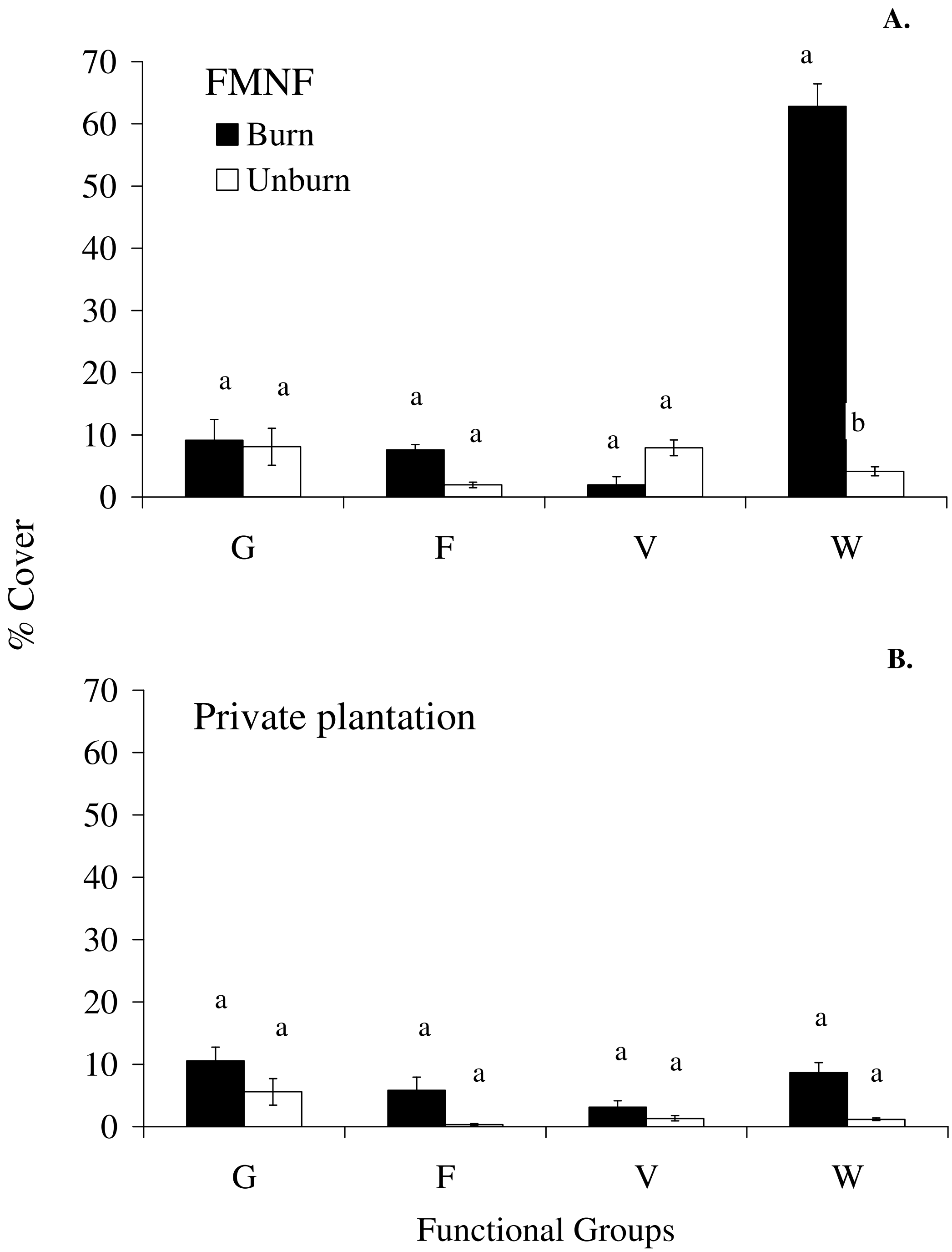

Figure 10. Percent cover of functional groups (G=graminoids, F=forbs, V=vines, W=woody) in hardwood plots for both locations. Error bars represent standard error.

Litter Layer

Analysis of average litter layer depth at the FMNF resulted in no differences between B and U (p=0.372) or among community types (p=0.790). At the private plantation there was an interaction between burn treatments and community types (p=0.095). Therefore, burn treatments and community types were analyzed separately. Significant differences were only detected between B and U in pine plots (p=0.050), with U having significantly greater depth. Community types displayed significant differences only on the U sites (p=0.014). Comparisons showed that the ecotone was significantly different than the pine (p=0.069) and the hardwood (p=0.071), which were also significantly different from each other (p=0.005). The pine had the greatest litter depth, and the hardwoods had the least litter depth.

Duff Layer

There was an interaction between community type and burn treatment for the duff layer depth at the FMNF (p=0.008). Burn treatments and community types were then analyzed independently. On the B sites, there is a significant difference among community types (p=0.007). Pine plots were significantly different from both ecotone and hardwood plots (p=0.016, 0.003, respectively), while ecotone and hardwood plots were not significantly different from each other (p=0.330). Burned hardwood plots had the highest duff depth and B pine plots had the lowest duff depth. The U sites had no significant differences among community types (p=0.267). When comparing the different burn treatments, both pine and hardwood displayed differences between B and U (p=0.016, 0.018, respectively), with B hardwood plots having higher duff depths than U, and U pine plots having higher duff depths than B. There was no significant differences between B and U for ecotone plots at the FMNF (p=0.459).

The private plantation had no significant interactions between burn treatment and community type for duff layer depth (p=0.221). There were also no significant differences between burn treatments or among community types (p=0.864, 0.990, respectively).

Soil Moisture

The FMNF soil moisture data yielded no significant interactions between burn treatments and community types. There were significant differences in soil moisture between B and U sites with B plots having higher soil moisture content than U plots (p<0.001). There were no significant interactions at the private plantation and also no significant differences between burn treatments (p=0.534). However, significant differences were found between hardwood and pine plots (p=0.021). There was no difference found between ecotone and hardwood plots (p=0.233) or ecotone and pine plots (p=0.126). Hardwood plots had the highest moisture content, followed by ecotone plots, and then pine plots.

Shrub Layer

Analyses of the FMNF total shrub cover resulted in no indication of an interaction between the burn treatments and community types (p=0.711). There were also no significant differences for either burn treatment or community (p=0.854, 0.546, respectively).

The private plantation resulted in no interaction between burn treatments and community types for the total shrub cover (p=0.976). There were no significant differences between B and U (p=0.201), but there was a significant difference between community types (p=0.025), with the pine plots having a significantly larger amount of total shrub cover than both ecotone (p=0.045) and hardwood plots (p=0.063). Ecotone and hardwood plots were not significantly different (p=0.734).

Sapling Layer

The total average basal area for saplings at the FMNF yielded no significant differences between B and U (p=0.111) or among the three community types (p=0.901). Similar to the FMNF, the total average basal area of saplings at the private plantation had nearly significant differences between B and U with a p-value equal to 0.107. No significant differences were found among the community types at the private plantation (p=0.930).

Canopy Layer

Total average tree basal area at the FMNF resulted in no interactions between burn treatments and community types (p=0.234). There were no significant differences between B and U (p=0.210). However, there were significant differences among community types (p=0.066). The pine plots had the lowest basal area, followed by the ecotone plots, and the highest basal area occurred on hardwood plots. The private plantation showed no significant differences in total average basal area between B and U (p=0.461) or among the three community types (p=0.791) and no significant interactions were evident (p=0.887).

Discussion

Composition

The differences in species composition between the two locations were unanticipated. Hedman et al. (2000) suggest that long-term land-use history has a greater effect on both composition and structure than more recent management history. I hypothesize that earlier fire history helped define the different structure and composition found on each site. Management records show that the FMNF had a considerable period of fire exclusion during the mid 20th century. It has been observed that exclusion of fire from fire-dependent ecosystems can result in a loss of herbaceous species and shift vegetative composition (Drewa et al. 2002, Abrahamson & Abrahamson 1996, Gilliam & Christensen 1986). Even with the reintroduction of fire, dispersal limitation may occur due to habitat fragmentation, successfully reducing the likelihood of attaining the original plant composition (Glitzenstein et al. 2001). This is what, I hypothesize, led to the similar species compositions between B and U, and treatment combinations at the FMNF. In contrast, the private plantation had a steady fire prescription for more than a century, supporting the coexistence of many species and resulting in less similar species compositions between B and U, and treatment combinations (Gilliam & Platt 1999).

The dissimilarity in plant composition between B and U at the private plantation may become more pronounced over time, and the contrast could gravitate towards that seen at the FMNF. These results emphasize the importance of historical events having persistent effects on current and future vegetation composition and structure.

Species Richness

Due to the intermittent fire exclusion that occurred at the FMNF, finding no significant differences in species richness values among treatments at the FMNF was not an unexpected result (Gilliam & Christensen 1986). The larger richness ranges on U sites also coincides with the longer period of fire exclusion on the U sites at the FMNF. The private plantation had expected results for an area that has a long history of uninterrupted prescribed fire, which usually results in significantly higher species richness (Gilliam & Christensen 1986).

Other studies have found that ecotone sites often have the highest species richness in relation to their surrounding communities (Gottfried et al. 1998). Although it didn't have the highest richness value, the B ecotone at the private plantation was found to be more similar to that of B pine plots and significantly different from the hardwood plots. This finding supports our research hypothesis; frequent burning may have encouraged migration of species from the adjacent pines into the ecotone.

Indicator Species

Ilex opaca, the indicator species most highly associated with the FMNF, has also been associated with coastal plain small stream swamp ecosystems (Sorrie et al. 2006). Vine species have been known to have sensitivity to fire, and therefore negative association with burned plots (Kush et al. 1999). Supporting this is a vine species, *Gelsium sempervirens*, which is highly associated with the U sites at the FMNF. On the other hand, the private plantation had *Liquidambar styraciflua* and two graminoid species most highly associated with it. A strong association with graminoid species could be a result of a persistent and frequent fire history (Brockway et al. 2005, Brockway & Lewis 1997).

Indicator species found in the B ecotones at both locations have been associated with fire dependent ecosystems in other studies. The FMNF had a significant indicator value for *Arundinaria gigantea*, which is commonly associated with fire dependent ecotones occurring between upland and lowland ecosystems (Carter et al. 1994, Frost et al. 1986). A significant indicator value for *Xyris caroliniana* is also interesting, as this species has been associated with mesic pine savannas (Sorrie et al. 2006). *Vernonia angustifolia* was found to have a significant indicator value at the private plantation. This species has been associated with pine/scrub oak sandhill sites and xeric sandhill scrub sites (Sorrie et al. 2006). *Centella erecta*, also an indicator species for B ecotones at the private plantation, is a small forb often associated with small depression drawdown meadow/savannas (Sorrie et al. 2006).

Functional Groups

More significant differences of functional groups between B and U at the FMNF are consistent with a prolonged period of fire exclusion on the U sites (Drewa et al. 2002). Higher amounts of graminoid cover on the B pine community type at the FMNF agrees with findings of Brockway et al. (2005) and Brockway and Lewis (1997). Although an increase in graminoid cover is similarly expected on B ecotone plots (Frost et al. 1986), the B ecotone community type appears more similar to the hardwood plots with regard to graminoid cover. This unexpected result could be due to the variable fire history or the presence of old plowed fire lines located in or near the ecotone plots at the FMNF. The lack of significant differences in graminoid cover at the private plantation is also an unexpected result. However, this could be due to the differences in fire frequency and variable moisture gradients.

A larger amount of forb cover is expected on B sites than U. Similarly, more forb cover is expected in B pine plots than hardwood plots (Glitzenstein et al. 2003, Waldrop et al. 1992). At the FMNF, higher forb cover was found on the B sites, however, there was a lack of differences among community types. The lack of differences between the community types at the FMNF and the complete lack of significant differences at the private plantation, concerning forb cover, could be explained by site variability.

Due to the lack of fire resistance of vines, it was not a surprising result to find higher cover amounts of vines on the U sites of the FMNF (Kush et al. 1999). However, vine cover at the private plantation did not follow this trend. Instead, there were no differences between burn treatments. Significant differences were only found on the B sites, where the ecotone plots had the highest vine cover amounts. One explanation for this trend could be that fire is limiting vine cover in the pine plots (Kush et al. 1999). Low availability of support for vine species to climb on may be limiting vine cover in the hardwood plots (Collins & Wein 1993). The ecotone exists in the middle where there is very low fire intensity which in turn could result in a higher availability of support plants for vine species to climb.

Concerning woody cover, the FMNF and the private plantation both had the anticipated result of higher woody cover in B plots. Due to the prolific sprouting of hardwood species in response to fire, higher amounts of woody cover <1m in height is expected in B sites (Waldrop et al. 1992). Also, higher amounts of woody cover in pine plots, with low intensity fires, is anticipated (Waldrop et al. 1992). Although this result was not found at the FMNF, it was found at the private plantation.

Organic Matter

Finding no differences in the litter layer at the FMNF was an unanticipated result (Kirkman et al. 2001). However, there were significant differences found on the B sites among community types in duff layer depth. Burned hardwood plots had the deepest duff layer, while the B pine plots had the thinnest duff layer. Burning may have proportionally consumed more duff on the pine sites due to drier conditions. Lack of difference between B and U may be explained by time since the last burn on the B sites. Since the FMNF burns on a biannual cycle, significant litter could have accumulated in the interval between burns, resulting in a lack of difference between B and U.

The litter depth results at the private plantation were expected; there was significantly more litter depth on U sites. In contrast to the duff layer at the FMNF, the litter layer on the U sites at the private plantation displayed differences among community types. The greatest depth of litter was found in the pine plots. This could be attributed to a combination of slow decomposition rates of pine needles compared to fast decomposition rates in the hardwood plots due to high moisture. Similar to the FMNF litter depth results, there were no significant differences found in duff layer depth amongst treatments.

Soil Moisture

Differences found between the locations in soil moisture content emphasize the inherent site differences of the relatively close locations. The FMNF had differences between B and U, while the private plantation did not. This could be a result of dissimilar B and U sites selected at the FMNF and more similar sites compared at the private plantation. There were also no significant differences among community types at the FMNF, while the private plantation produced the expected result of higher soil moisture in the lower elevation hardwoods and lowest soil moisture in the more upland pine plots (Jacqmain et al. 1999). However, due to variability in coastal weather conditions, the lack of significant differences among community types at the FMNF could be due to the prolonged dry period on the sites before taking soil moisture measurements. Similarly, the differences found at the private plantation between the community types could be due to an increase in rain activity just before taking soil moisture measurements. Only one series of soil moisture measurements were taken. One way to provide a more accurate analysis would be to use a data logger to record soil moisture measurements throughout the year, which could lead to a more complete picture of the soil moisture in and between both locations.

Mid and Upper Canopy Layers

The private plantation produced an expected result for the average total shrub cover. The pine plots had more shrub cover than both the ecotone and the hardwoods. Similar to woody functional group cover, the shrub layer is also often a result of sprouting due to fire (Waldrop et al. 1992). Given that the pine plots generally have a more open canopy, a larger amount of shrub cover is to be expected. The lack of any difference at the FMNF could be a result of very dense U sites throughout all community types and variability in stand age.

The sapling layer for both locations had nearly significant differences between B and U, with the U having slightly higher basal areas in both locations. Higher sapling basal areas at the U sites are expected because canopies tend to close in the absence of fire, while understory seedlings and shrubs advance into the sapling layer (Waldrop et al. 1992, Waldrop et al. 1987). The lack of significant differences could be contributed to time since burning, resulting in a more prevalent sapling layer on B sites. The lack of any significant differences in the canopy layer between B and U was an expected result. The differences found in community types at the FMNF was also anticipated due to the characteristic open canopy, thus lower basal area, typical of pine stands in the southeast

(Glitzenstein et al. 2001). The overall lack of similarity between locations could again be a consequence a combination of the inherent site differences along with the contrast in burning histories of the two locations (Hedman et al. 2000).

PRE/POST BURN MEASUREMENTS COMPARISON

Materials and Methods

Data Collection

During the dormant season months of January to March, 2006, prescribed burns were conducted on all B sites. Sites were revisited shortly after the time of the burn to assess burn severity. Vegetation and soil were reassessed during the summer of 2006 in order to examine short-term burn effects on the B sites. The U sites were also remeasured to provide a control treatment for comparison.

Fire Severity

Due to the time of year and frequency of the prescribed burns conducted on the sites, the fires were most often low intensity with low flame heights. Low intensity fires cause minimal mortality to trees and have less negative effects on vegetation than fires with higher intensities (Elliott et al. 1999, Glitzenstein et al. 1995).

To quantify the severity of the prescribed burns conducted on the study sites, two transects were established 5m to either side of the original plot transects. At each of the $1m^2$ nested cornerplots, burn severity was classified by examining fire damage to the vegetation and the forest floor. Vegetation damage was assessed by ocularly estimating the percent scorched and percent consumed. Forest floor consumption was assessed by estimating the percent cover in the following classes: partially consumed litter, fully consumed litter/partially consumed duff and fully consumed duff. The distance the fire extended along the transect, from the upland pine into the ecotone and hardwood before extinguishing, was also recorded.

Data Analysis

Fire Severity Variables

None of the prescribed burns extended into the hardwood plots, therefore a t-test was used to compare differences between ecotone and pine community types for fire severity data including scorched vegetation, consumed vegetation, scorched litter, consumed litter/partially consumed duff, and fully consumed duff. A t-test was also used to analyze the distance the fire extended along the transect before being extinguished. All analyses were done using SAS.

Correlation of Fire Severity to Functional Group Cover Change

Statistical analysis was used to quantify the relationships between fire severity variables (scorched vegetation, consumed vegetation, partially consumed litter, fully consumed litter/partially consumed duff) and change in percent cover of function groups (graminoids, forbs, vines, woody). Correlation matrices determined the relationship between fire severity variables and functional group cover change. Scatterplots and regressions provided further information on the correlation relationships. Statistical analysis was done with SYSTAT (Version 10.2, SYSTAT Software, Inc.) and SAS.

Analysis of Covariance

Analysis of covariance (ANCOVA) with a 90% confidence interval (CI) was used to detect differences between years for each treatment combination within each location for variables including: species richness, functional group cover, duff layer depth, total average shrub cover, total average sapling basal area, and total average tree basal area. This analysis took into account the influence of the initial value or amount found in 2005. Significant differences were found by slope comparisons through the use of Proc Diff in SAS.

Analysis of Variance

The average litter depth and average duff depth for both locations, along with the average total sapling basal area had slopes not significantly different from zero. Therefore, an ANOVA with a randomized complete block design (RCBD) was employed with the use of Proc Mixed in SAS.

Transformations

A square root transformation was used in order to normalize data for many of the observed variables including: species richness, functional group cover of graminoids, forbs, vines, and woody plants <1m in height, litter, duff, shrub, sapling (FMNF only), and tree data.

Results

Fire Severity

Burn severity analysis at the FMNF resulted in no significant differences between ecotone and pine sites for average percent scorched vegetation ($p=0.431$) or average percent litter partially consumed ($p=0.107$). However, there were differences between ecotone and pine for average percent vegetation consumed ($p=0.051$) and for average percent litter fully consumed/duff partially consumed ($p=0.066$). Pine had higher levels of both vegetation consumption and litter consumption than the ecotone.

The private plantation had no significant differences between pine and ecotone for average percent scorched vegetation, average percent consumed vegetation, or average percent consumed fully consumed litter/partially consumed duff (p=0.437, 0.898 and 0.462, respectively). There was a significant difference between ecotone and pine for the average percent partially consumed litter, with pine having significantly more consumption ($p=0.024$). There was no significant amount of duff consumed in pine or ecotone for either location. Analysis of fire stop data resulted in no significant differences between locations ($p=0.595$).

Correlation of Fire Severity Variables with Functional Group Cover Change

Correlation matrices using Pearson's correlation coefficients revealed that fire severity variables are poorly correlated with change in functional group cover. The only significant correlation was average percent vegetation scorch to change in percent woody cover ($R^2=0.222$, $p<0.001$). Graminoid, forb, and vine percent cover change were not well correlated with the average percent scorch vegetation (R^2=0.030, 0.006, 0.006, respectively) (Figure 11).

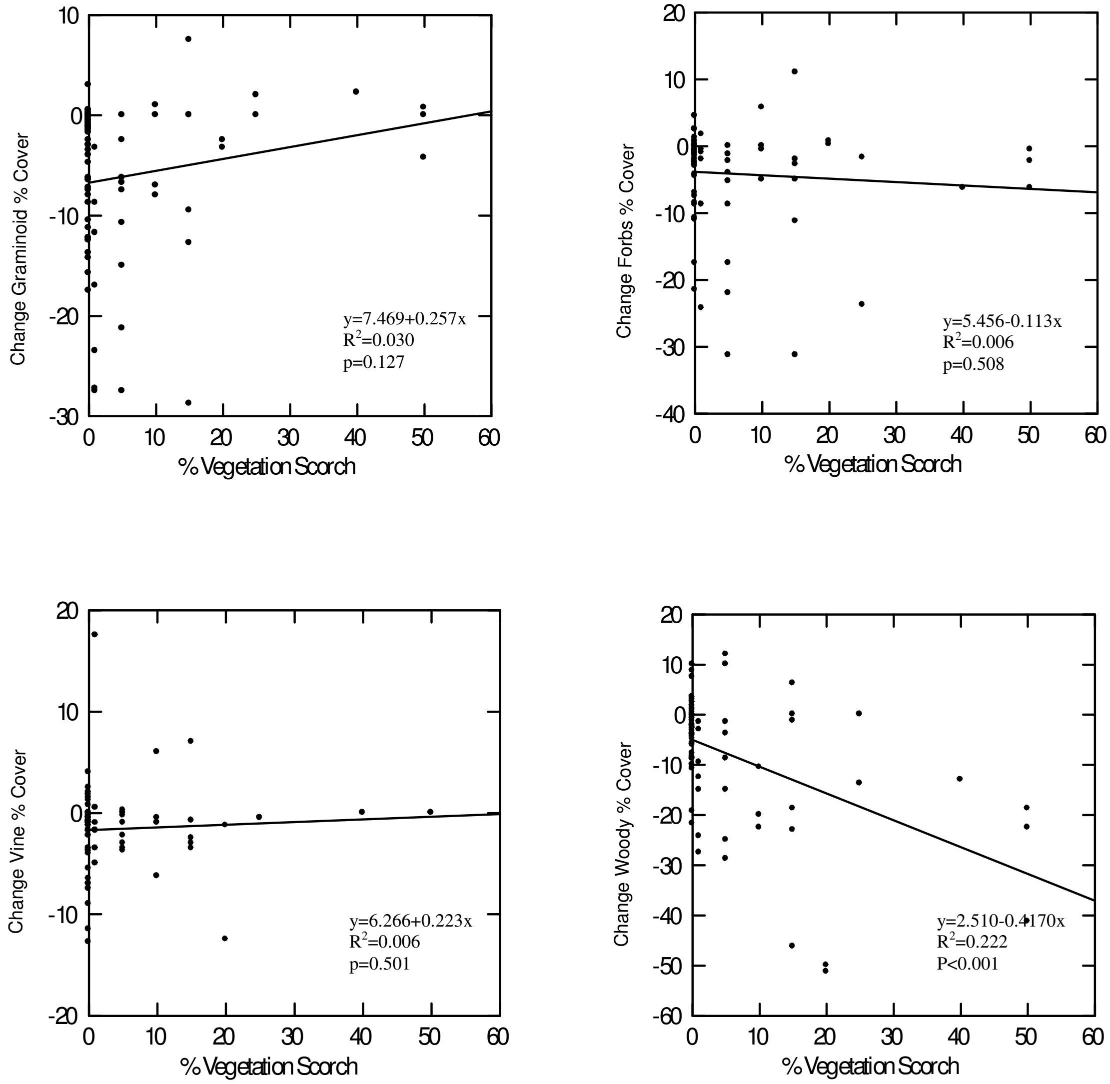

Figure 11. Scatterplots with regression lines and R^2 values for change in functional group percent cover vs. average percent scorch vegetation.

Species Richness

The FMNF comparisons of average species richness values revealed significant differences between years for some of the treatment combinations. At a 90% CI, B ecotone and B hardwood both had an increase in species richness, while B pine had no significant differences. There was also a slight decrease in species richness in the U hardwood sites, and no significant differences between years for U ecotone or U pine ($p<0.100$).

The private plantation revealed no significant differences in species richness between years for B sites. Unburned hardwood and U pine also resulted in no significant differences between years. The U ecotone revealed an increase of 30% from 2005 to 2006, with a CI of 90%.

Functional Groups

Comparisons were made between years for each treatment combination for all functional groups (graminoids, forbs, vines and woody) at both locations. Graminoid cover at the FMNF had significant reductions from 2005 to 2006 in all B community types, with cover reductions of up to 45% in the B pine sites ($p<0.100$). The U pine site also had a 41% reduction in graminoid cover ($p<0.100$). There were no significant differences in U ecotone or U hardwood plots at a 90% CI. At the private plantation, significant reductions in graminoid cover were evident across all treatment combinations ($p<0.100$).

The forbs cover layer at the FMNF showed significant differences between years for B pine, B hardwood, U ecotone, and U hardwood at a CI of

90%. All of these treatment combinations had a reduced amount of cover in 2006 compared to 2005.

Several of the treatment combinations at the private plantation had a reduction in forb cover from 2005 to 2006. All B community types had a 50% reduction, as well as the U pine ($p<0.100$). Unburned ecotone and U hardwood had no significant differences between years ($p<0.100$).

The vine cover group at the FMNF was significantly reduced in the B pine plots and the B hardwood plots ($p<0.100$). Unburned ecotone and U hardwood plots also had significant reductions in vine cover ($p<0.100$). There were no significant differences in the B ecotone or U pine treatment combinations. Comparisons between years at the private plantation revealed differences in vine cover between all treatment combinations. Burned ecotone and B pine both had a 52% reduction in vine cover ($p<0.100$). Burned hardwood had a 43% reduction in vine cover ($p<0.100$). Unburned ecotone had a 65% reduction in vine cover ($p<0.100$), while U hardwood and U pine revealed a 50% reduction in vine cover from 2005 to 2006 ($p<0.100$).

The FMNF had significant reductions in woody cover <1m in B pine and U ecotone ($p<0.100$). All other treatment combinations at the FMNF had no significant differences for the woody cover functional group. At a 90% CI, there were no significant differences at private plantation from 2005 to 2006 in woody cover for any of the treatment combinations.

Litter Layer

Due to an interaction at the FMNF between year and treatment combination ($p=0.048$) in the ANOVA, each treatment combination was examined individually. Burned pine had a 0.6cm reduction in average litter depth from 2005 to 2006 ($p=0.083$). On the other hand, both U ecotone and U hardwood had 0.4cm and 0.5cm increases in average litter depth, respectively ($p=0.071$ and 0.024, respectively). All other treatment combinations had no significant changes in average litter depth.

The private plantation also had an interaction between year and treatment combination in the ANOVA ($p<0.001$). Several treatment combinations had significant differences between years. Burned pine was the only treatment combination with a significant reduction in average littler layer depth from 2005 to 2006 ($p=0.013$, reduction=0.6cm). Burned hardwood, U ecotone, and U hardwood all had significant increases in average litter depth ($p<0.001$ and $p=0.042$, 0.001, respectively). Burned ecotone and U pine did not have significant differences in the litter layer between years ($p=0.550$ and 0.740, respectively).

Duff Layer

The analysis for the FMNF average duff depth also revealed significant interaction between year and treatment combination ($p=0.027$). The only significant difference found between years was in the B ecotone treatment combination. There was a significant reduction of 0.5cm from 2005 to 2006 (p<0.001). No significant differences were observed for any other treatment combination.

At the private plantation, the average duff depth analysis also resulted in an interaction between year and treatment combination (p=0.004). The year to year comparison resulted in significant differences in B hardwood (p=0.002) and U pine (p=0.024). However, there was a decrease in average duff depth in the B hardwood, and an increase in average duff depth in the U pine. All other treatment combinations had no significant differences.

Shrub Layer

There was a significant reduction (30%) in shrub cover layer between 2005 and 2006 in B pine (p<0.100). Burned ecotone had a 70% reduction in average shrub cover between years and B hardwood had a 30% reduction (p<0.100). All U sites had an average shrub cover reduction of around 25% (p<0.100).

The private plantation average shrub cover analysis revealed a decrease in shrub cover of 65% in both B pine and B ecotone from 2005 to 2006 (p<0.100). There was also a 24% decrease in average shrub cover in U pine sites (p<0.100). All other treatment combinations had no significant differences between years.

Sapling Layer

Analysis at the FMNF of the sapling average total basal area resulted in no interactions between year and treatment combination (p=0.969). There were also no differences found between 2005 and 2006 for any of the treatment combinations ($p=0.548$).

At the private plantation, there were significant differences in average sapling basal area between years in the B pine ($p<0.001$) and in the U ecotone ($p<0.001$). These treatment combinations resulted in reductions of 25% and 10%, respectively. There were no significant differences observed in the rest of the treatment combinations.

Canopy Layer

At a CI of 90%, both locations revealed there were no significant differences in average tree basal area for any of the treatment combinations.

Discussion

Fire Severity

The fire severity data support the assumption that fires are more intense in the upland pine and taper out in the ecotone, which acts as a natural fire buffer between the fire dependent pine ecosystem and the bottomland hardwoods (Oosterhoorn & Kappelle 2000). Although the species compositions are different at each location, the fire stopping point is expected to be located within the ecotone independent of species composition. Hence, the lack of significant differences between locations of fire stopping point was an expected result.

Anticipated correlation between fire severity and functional group cover data was not found. The only significant correlation was between average percent scorched vegetation and average percent woody change, accounting for only 22% of the variability. The lack of correlation may be accounted for by considering the time period of the post-burn sampling of the functional cover groups. Considerably more cover would be found towards the end of the growing season, as opposed to what was found in early summer.

Species Richness

Overall, the B sites at FMNF had a positive species richness response to one fire event, but also revealed some interesting results. The only B community type not to have a significant increase in species richness was B pine. Of all the B community types, B pine may be the most likely to have an increase in species richness due to short-term fire effects because of the vegetative composition that exists (Sparks et al. 1998). However, the ecotone and hardwood may have increased richness due to the availability of a seed source from the pine sites with a combination of the right site conditions due to the fire.

The increase in species richness in the U ecotone sites at the private plantation was unexpected, but could be an indication of an increase of weedy, less fire tolerant species. The rest of the sites having no significant differences was not surprising as this was a short-term event occurring on sites that have had the same management history for many decades. The community compositions found at the private plantation may be better established than those occurring in stands having a less regular burn history.

Functional Groups

It has been found that fire increases cover of both graminoids and forbs (Brockway et al. 2005, Glitzenstein et al. 2003, Brockway & Lewis 1997, Nuzzo et al. 1996, Waldrop et al. 1992, Frost et al. 1986). However, all functional cover groups at the FMNF were significantly reduced from 2005 to 2006 in B pine plots. This is also true at the private plantation except for woody cover which had no significant differences between years. The period of measurement in this study was in spring and midsummer. For a more clear idea of functional group recovery, measuring towards the end of the growing season would be more appropriate (Streng et al. 1993). Similar to the B pine plots, the B ecotone plots at the private plantation had significant cover reductions in all but the woody cover class. The lack of significant differences in woody cover contradicts Waldrop et al. (1992). One possible explanation is very low fire intensities not effectively killing the hardwood sprouts <1m tall in either the pine or the ecotone sites.

In contrast, the FMNF had cover reductions in B ecotone plots for graminoids only. Many of the functional cover classes also revealed significant reductions in the U sites as well. Because of the many similarities in functional cover reduction across burn treatments, a definitive conclusion of cover reduction due to burning cannot be certain.

Organic Matter

High frequency fire is known to remove, or significantly reduce the litter layer on pine sites in the southeast (Kirkman et al. 2001). Dormant season fires, similar to the study sites burns, have also been found to consume litter layers more effectively than growing season fires (Sparks et al. 2002). This coincides with findings on B pine plots where there was a highly significant reduction in average litter depth of 0.6cm on both locations. On the other hand, absence of fire on sites causes litter loading, or an accumulation of litter (Boring et al. 2004). This was also found on the U sites in the ecotone and hardwood community types. The similarities across locations agree with expected results of litter layer reduction due to fuel consumption at the time of burning, indicating that pine sites experience more extensive burning than both the ecotone and the hardwood.

Similar to expectation results of the litter layer, a decrease in duff layer on B sites due to fire is anticipated, especially in the pine community type. However, there were no significant differences in the B pine plots at either location. Instead, a decrease in duff cover was observed in the B ecotone at the FMNF and in the B hardwood at the private plantation. An expected increase in duff depth was found in the U pine at the private plantation as well. A lack of significant differences in the B pine plots could be due low intensity fires not having the impact a hotter fire would have.

Shrub Layer

An anticipated decrease in shrub cover was found in all B pine and ecotone sites. Several studies conducted in southeastern pine stands have shown that winter burning, similar to those conducted on the study sites, is effective in causing top-kill of small hardwoods (Elliott et al. 1999, Waldrop et al. 1992, Waldrop et al. 1987, Waldrop & Lloyd 1991). An increase in shrub cover from 2005 to 2006 was observed in the U pine at the private plantation, while all U community types at the FMNF revealed a decrease in shrub cover. These observations could be attributed to a slightly earlier sampling period occurring at the FMNF and to inherent differences between the locations.

Sapling Layer

The lack of significant differences in the sapling layer at the FMNF is interesting in that there is no observable short-term succession within the layer, as well as no significant mortality due to prescribed fire in the B sites. Cain and Shelton (2002) found that frequent winter burns were effective at stagnating sapling succession in southeastern pine sites, while Plocher (1999) observed 84%

mortality in the sapling layer during a longleaf pine study. The private plantation results agree with this, having significant sapling basal area reductions in the B pine. This could also be an indication that the fires occurring on these sites burned hotter, coinciding with the fire severity data. There was an observed decrease in sapling basal area in the U ecotone, this could be an indication of succession involving either mortality to saplings or succession into the tree classification.

Canopy Layer

Although an initial reintroduction to fire would cause significant mortality within pine stands, frequent burns with low fire intensity are not expected to have a significant effect on pine overstories (Elliott et al. 1999, Glitzenstein et al. 1995). The findings at both locations agree, there were no significant differences between years in the canopy layer.

CONCLUSION AND IMPLICATIONS

Results and analysis indicate that this particular ecotone is often unpredictable, with some variables being more similar to pine stands, others more similar to hardwood stands, and still others are unique from both adjacent ecosystems. Contrary to prior hypothesis, unique species were not found in the ecotone. Instead, unique plant assemblages and vegetative structure was found in the ecotone community types, evidenced by the NMS ordinations and dissimilarity to surrounding ecosystems. The variable results in regard to ecotone similarity to the surrounding ecosystems are likely influenced by several factors, including long-term land history events, recent management practices (including plowed fire lines), and uneven fire behavior occurring within the ecotone.

The perceived similarities between locations turned out to be lacking. Initially, this appeared to be a set back in the analysis. However, the differences in location called for a deeper investigation into the driving forces of these ecosystems, allowing for an inquiry into the land management history. The period of prolonged fire absence that occurred at the FMNF in the mid 20th century most likely altered vegetative communities, including species composition and stand structure. Even with the reintroduction of fire, studies have found that ecosystem recovery to the natural state is not guaranteed and takes much effort on the part of the land manager (Abrahamson & Abrahamson 1996, Menges et al. 1993).

Fire tolerant species may have been lost during the time of fire suppression at the FMNF, resulting in similarity between B and U plots. In contrast, the private plantation had a steady fire prescription for more than a century, supporting the coexistence of many species and comparatively higher richness for B ecotone sites.

More significant differences of functional groups between B and U at the FMNF is consistent with a longer period since a fire event on the U sites. In contrast, the private plantation displayed less structural differences between B and U for all community types. The dissimilarity in plant composition and structure between B and U at the private plantation, evidenced by the NMS ordination, may become more pronounced over time and the contrast could develop similarly to that seen on the FMNF.

For the investigating of short-term burn response, the private plantation results may be more indicative of what is really happening due to the time period of measurement (towards the end of the growing season). The many significant reductions in species cover are evidence of this. This is one of the issues with having many variables measured by percent cover. Apart from conducting cover estimations at the end of the growing season, there are some alternative methods of sampling to employ in order to avoid this, including presence/absence of species or by stem count for shrubs and saplings.

The findings of this study suggest that historical events have persistent effects on current and future vegetation composition and structure. This is yet another reminder to land managers that management strategies put into practice at the present can further support and restore, or similarly hinder not only this often overlooked ecotone, but all ecosystems used and inhabited by humans.

APPENDIX

Table A. 1. Soil moisture conversion coefficients based on clay content (%) of B horizon layer and community type at both locations.

Location	Community Type	Clay % of B Layer	a_0	a_1
FMNF	Ecotone	<27	1.260	7.073
FMNF	Ecotone	27-40	1.402	8.582
FMNF	Ecotone	>40	1.326	8.644
FMNF	Hardwood	<27	1.238	6.190
FMNF	Hardwood	27-40	1.193	6.647
FMNF	Hardwood	>40	1.389	7.423
FMNF	Pine	<27	1.437	5.236
FMNF	Pine	27-40	1.411	9.068
FMNF	Pine	>40	1.517	8.802
Private plantation	Ecotone	<27	1.326	8.184
Private plantation	Ecotone	27-40	1.437	9.167
Private plantation	Ecotone	>40	1.313	6.558
Private plantation	Hardwood	<27	1.238	6.190
Private plantation	Hardwood	27-40	1.269	6.176
Private plantation	Hardwood	>40	1.278	7.934
Private plantation	Pine	<27	1.366	8.026
Private plantation	Pine	27-40	1.362	8.859
Private plantation	Pine	>40	1.517	8.802

Table A. 2. Total species list for all locations.

Symbol	Scientific Name	Common Name	Functional Group
ACGR2	*Acalypha gracilens* Gray	slender threeseed mercury	Forb
ACRU	*Acer rubrum* L.	red maple	Woody
ACRUD	*Acer rubrum* L. var. *drummondii* (Hook. & Arn. ex Nutt.) Sarg.	Drummond's maple	Woody
AEPA	*Aesculus pavia* L.	red buckeye	Woody
AGSE3	*Agalinis setacea* (J.F. Gmel.) Raf.	threadleaf false foxglove	Forb
AGAR4	*Ageratina aromatica* (L.) Spach	lesser snakeroot	Forb
ALFA2	*Aletris farinosa* L.	white colicroot	Forb
ALPH	*Alternanthera philoxeroides* (Mart.) Griseb.	alligatorweed	Forb
AMPS	*Ambrosia psilostachya* DC.	Cuman ragweed	Forb
AMAR5	*Ampelopsis arborea* (L.) Koehne	peppervine	Vine
ANGL10	*Andropogon glaucopsis Ell.*	purple bluestem	Graminoid
ANGL2	*Andropogon glomeratus* (Walt.) B.S.P.	bushy bluestem	Graminoid
ANGY2	*Andropogon gyrans* Ashe	Elliott's bluestem	Graminoid
ANDRO2	*Andropogon* L.	bluestem	Graminoid
ANMO3	*Andropogon mohrii* (Hack.) Hack. ex Vasey	Mohr's bluestem	Graminoid
ANTE2	*Andropogon ternarius* Michx.	splitbeard bluestem	Graminoid
ANVI2	*Andropogon virginicus* L.	broomsedge bluestem	Graminoid
APCA	*Apocynum cannabinum* L.	Indianhemp	Forb
ARSP2	*Aralia spinosa* L.	devil's walkingstick	Woody
ARTR	*Arisaema triphyllum* (L.) Schott	Jack in the pulpit	Forb
ARBE7	*Aristida beyrichiana* Trin. & Rupr.	Beyrich threeawn	Graminoid
ARIST	*Aristida* L.	threeawn	Graminoid
ARPA26	*Aristida palustris* (Chapman) Vasey	longleaf threeawn	Graminoid
ARSE3	*Aristolochia serpentaria* L.	Virginia snakeroot	Forb
ARAR7	*Aronia arbutifolia* (L.) Pers.	>>Photinia pyrifolia	Woody
ARGI	*Arundinaria gigantea* (Walt.) Muhl.	giant cane	Graminoid
ASCLE	*Asclepias* L.	milkweed	Forb
ASMI12	Asclepias michauxii Dcne.	Michaux's milkweed	Forb

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
ASTO	*Asclepias tomentosa* Ell.	tuba milkweed	Forb
ASTU	*Asclepias tuberosa* L.	butterfly milkweed	Forb
ASPL	*Asplenium platyneuron* (L.) B.S.P.	ebony spleenwort	Forb
ASDU	*Aster dumosus* L.	>>Symphyotrichum dumosum	Forb
ASTER	*Aster* L.	aster	Forb
ASLI2	*Aster linariifolius* L.	>>Ionactis linariifolius	Forb
ASPA5	*Aster patens* Ait.	>>Symphyotrichum patens	Forb
ASPI2	*Aster pilosus* Willd.	hairy white oldfield aster	Forb
ASTO6	*Aster tortifolius* Michx.	>>Sericocarpus tortifolius	Forb
ASWA5	*Aster walteri* Alexander	>>Symphyotrichum walteri	Forb
ATFI	*Athyrium filix-femina* (L.) Roth	common ladyfern	Fern
BAHA	*Baccharis halimifolia* L.	eastern baccharis	Woody
BATI	*Baptisia tinctoria* (L.) R. Br. ex Ait. f.	horseflyweed	Forb
BESC	*Berchemia scandens* (Hill) K. Koch	Alabama supplejack	Vine
BICA	*Bignonia capreolata* L.	crossvine	Vine
BOCY	*Boehmeria cylindrica* (L.) Sw.	smallspike false nettle	Forb
BOBI	*Botrychium biternatum* (Sav.) Underwood	sparselobe grapefern	Fern
BOTRY	*Botrychium* Sw.	grapefern	Fern
BOVI	*Botrychium virginianum* (L.) Sw.	rattlesnake fern	Fern
CAOV6	*Cacalia ovata* Walt.	ovateleaf cacalia	Forb
CAAM2	*Callicarpa americana* L.	American beautyberry	Woody
CARA2	*Campsis radicans* (L.) Seem. ex Bureau	trumpet creeper	Vine
CAAB5	*Carex abscondita* Mackenzie	thicket sedge	Graminoid
CACO22	*Carex corrugata* Fern.	prune-fruit sedge	Graminoid
CACR8	*Carex crus-corvi* Shuttlw. ex Kunze	ravenfoot sedge	Graminoid
CADE5	*Carex debilis* Michx.	white edge sedge	Graminoid
CAFL5	*Carex floridana* Schwein.	Florida sedge	Graminoid
CAFR3	*Carex frankii* Kunth	Frank's sedge	Graminoid
CAGL5	*Carex glaucescens* Ell.	southern waxy sedge	Graminoid

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
CAREX	*Carex* L.	sedge	Graminoid
CALE10	*Carex leptalea* Wahlenb.	bristlystalked sedge	Graminoid
CALO5	*Carex longii* Mackenzie	Long's sedge	Graminoid
CAMA47	*Carex marginata* Willd.		Graminoid
CAPI21	*Carex pigra* Naczi	Tarheel sedge	Graminoid
CAST9	*Carex styloflexa* Buckl.	bent sedge	Graminoid
CAVE7	*Carex venusta* Dewey	darkgreen sedge	Graminoid
CARPH	*Carphephorus* Cass.	chaffhead	Forb
CAOD3	*Carphephorus odoratissimus* (J.F. Gmel.) Herbert	vanillaleaf	Forb
CAPA53	*Carphephorus paniculatus* (J.F. Gmel.) Herbert	hairy chaffhead	Forb
CACA18	*Carpinus caroliniana* Walt.	American hornbeam	Woody
CAAQ2	*Carya aquatica* (Michx. f.) Nutt.	water hickory	Woody
CAGL8	*Carya glabra* (P. Mill.) Sweet	pignut hickory	Woody
CARYA	*Carya* Nutt.	hickory	Woody
CATO6	*Carya tomentosa* (Lam. ex Poir.) Nutt.	>>Carya alba	Woody
CASSI	*Cassia* L.	cassia	Woody
CAAL10	*Castanea alnifolia* Nutt.	chinkapin	Woody
CEAM	*Ceanothus americanus* L.	New Jersey tea	Woody
CELA	*Celtis laevigata* Willd.	sugarberry	Woody
CEER2	*Centella erecta* (L. f.) Fern.	erect centella	Forb
CEVI2	*Centrosema virginianum* (L.) Benth.	spurred butterfly pea	Forb
CECA4	*Cercis canadensis* L.	eastern redbud	Woody
CHFA2	*Chamaecrista fasciculata* (Michx.) Greene	partridge pea	Forb
CHNI2	*Chamaecrista nictitans* (L.) Moench	sensitive partridge pea	Forb
CHLA6	*Chasmanthium laxum* (L.) Yates	slender woodoats	Graminoid
CHSE2	*Chasmanthium sessiliflorum* (Poir.) Yates	longleaf woodoats	Graminoid
CHMA3	*Chimaphila maculata* (L.) Pursh	striped prince's pine	Woody
CHVI5	*Chrysogonum virginianum* L.	green and gold	Forb
CHGO	*Chrysopsis gossypina* (Michx.) Ell.	cottony goldenaster	Forb

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
CHMA14	*Chrysopsis mariana* (L.) Ell.	Maryland goldenaster	Forb
CIHO2	*Cirsium horridulum* Michx.	yellow thistle	Forb
CLDI	*Cleistes divaricata* (L.) Ames	rosebud orchid	Forb
CLCR	*Clematis crispa* L.	swamp leather flower	Vine
CLETH	*Clethra* L.	sweetpepperbush	Vine
CLITO	*Clitoria* L.	pigeonwings	Forb
COVI3	*Commelina virginica* L.	Virginia dayflower	Forb
COCO13	*Conoclinium coelestinum* (L.) DC.	blue mistflower	Forb
COFA	*Coreopsis falcata* Boynt.	sickle tickseed	Forb
COREO2	*Coreopsis* L.	tickseed	Forb
COLI5	*Coreopsis linifolia* Nutt.	Texas tickseed	Forb
COMA6	*Coreopsis major* Walt.	greater tickseed	Forb
COAS2	*Cornus asperifolia* Michx.	toughleaf dogwood	Woody
COFL2	*Cornus florida* L.	flowering dogwood	Woody
COCO6	*Corylus cornuta* Marsh.	beaked hazelnut	Woody
CRFL2	*Crataegus flava* Ait.	yellowleaf hawthorn	Woody
CRMA5	*Crataegus marshallii* Egglest.	parsley hawthorn	Woody
CRPH	*Crataegus phaenopyrum* (L. f.) Medik.	Washington hawthorn	Woody
CYPER	*Cyperus* L.	flatsedge	Graminoid
CYRA	*Cyrilla racemiflora* L.	swamp titi	Woody
DECI	*Desmodium ciliare* (Muhl. ex Willd.) DC.	hairy small-leaf ticktrefoil	Forb
DESMO	*Desmodium* Desv.	ticktrefoil	Forb
DELA2	*Desmodium laevigatum* (Nutt.) DC.	smooth ticktrefoil	Forb
DELI2	*Desmodium lineatum* DC.	sand ticktrefoil	Forb
DENU5	*Desmodium nuttallii* (Schindl.) Schub.	Nuttall's ticktrefoil	Forb
DEOB5	*Desmodium obtusum* (Muhl. ex Willd.) DC.	stiff ticktrefoil	Forb
DEPA6	*Desmodium paniculatum* (L.) DC.	panicledleaf ticktrefoil	Forb
DEST2	*Desmodium strictum* (Pursh) DC.	pinebarren ticktrefoil	Forb
DETE3	*Desmodium tenuifolium* Torr. & Gray	slimleaf ticktrefoil	Forb

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
DICHA2	*Dichanthelium* (A.S. Hitchc. & Chase) Gould	rosette grass	Graminoid
DIAC	*Dichanthelium aciculare* (Desv. ex Poir.) Gould & C.A. Clark	needleleaf rosette grass	Graminoid
DICO2	*Dichanthelium commutatum* (J.A. Schultes) Gould	variable panicgrass	Graminoid
DICO4	*Dichanthelium consanguineum* (Kunth) Gould & C.A. Clark	blood panicgrass	Graminoid
DIDID	*Dichanthelium dichotomum* (L.) Gould var. dichotomum	cypress panicgrass	Graminoid
DIEN	*Dichanthelium ensifolium* (Baldw. ex Ell.) Gould	>>Dic dic var. ensifolium	Graminoid
DILA11	*Dichanthelium lanuginosum* (Ell.) Gould	>>Dic acuminatum v. fasciculatum	Graminoid
DILA9	*Dichanthelium laxiflorum* (Lam.) Gould	openflower rosette grass	Graminoid
DIMA9	*Dichanthelium mattamuskeetense* (Ashe) Mohlenbrock	>>Dic dic var. dic	Graminoid
PANO3	*Dichanthelium nodatum* (A.S. Hitchc. & Chase) Gould	Sarita rosette grass	Graminoid
DIRA	*Dichanthelium ravenelii* (Scribn. & Merr.) Gould	Ravenel's rosette grass	Graminoid
DISP2	*Dichanthelium sphaerocarpon* (Ell.) Gould	roundseed panicgrass	Graminoid
DISTL	*Dichanthelium strigosum* (Muhl. ex Ell.) Freckmann var. *leucoblepharis*	roughhair rosette grass	Graminoid
DIVI7	*Dichanthelium villosissimum* (Nash) Freckmann	whitehair rosette grass	Graminoid
DIODI	*Diodia* L.	buttonweed	Forb
DIFL4	*Dioscorea floridana* Bartlett	Florida yam	Vine
DIOSC	*Dioscorea* L.	yam	Vine
DIOP	*Dioscorea oppositifolia* L.	Chinese yam	Vine
DIVI4	*Dioscorea villosa* L.	wild yam	Vine/Forb
DIVI5	*Diospyros virginiana* L.	common persimmon	Woody
DYOB	*Dyschoriste oblongifolia* (Michx.) Kuntze	oblongleaf snakeherb	Forb
ELMI2	*Eleocharis microcarpa* Torr.	smallfruit spikerush	Graminoid
ELCA3	*Elephantopus carolinianus* Raeusch.	Carolina elephantsfoot	Forb
ELEPH	*Elephantopus* L.	elephantsfoot	Forb
ELTO2	*Elephantopus tomentosus* L.	devil's grandmother	Forb
EREL	*Eragrostis elliottii* S. Wats.	field lovegrass	Graminoid
ERHI2	*Erechtites hieraciifolia* (L.) Raf. ex DC.	American burnweed	Forb
ERVE	*Erigeron vernus* (L.) Torr. & Gray	early whitetop fleabane	Forb

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
ERYU	*Eryngium yuccifolium* Michx.	button eryngo	Forb
ERHE4	*Erythrina herbacea* L.	redcardinal	Woody
EURA5	*Eubotrys racemosa* (L.) Nutt.	swamp doghobble	Woody
EUAM7	*Euonymus americana* L.	strawberry bush	Forb
EUAN4	*Eupatorium anomalum* Nash	Florida thoroughwort	Forb
EUCA5	*Eupatorium capillifolium* (Lam.) Small	dogfennel	Forb
EUCO6	*Eupatorium coelestinum* L.	>>Conoclinium coelestinum	Forb
EUCO7	*Eupatorium compositifolium* Walt.	yankeeweed	Forb
EUPAT	*Eupatorium* L.	thoroughwort	Forb
EULE	*Eupatorium leucolepis* (DC.) Torr. & Gray	justiceweed	Forb
EUMO4	*Eupatorium mohrii* Greene	Mohr's thoroughwort	Forb
EUPI2	*Eupatorium pilosum* Walt.	rough boneset	Forb
EURE3	*Eupatorium recurvans* Small	>>Eupatorium mohrii	Forb
EURO4	*Eupatorium rotundifolium* L.	roundleaf thoroughwort	Forb
EUSE	*Eupatorium semiserratum* DC.	smallflower thoroughwort	Forb
EUPHO	*Euphorbia* L.	spurge	Forb
EUMI6	*Euthamia minor* (Michx.) Greene	slender goldentop	Forb
EUTE7	*Euthamia tenuifolia* (Pursh) Nutt.	slender goldentop	Forb
FESU3	*Festuca subverticillata* (Pers.) Alexeev	nodding fescue	Graminoid
FLIN2	*Fleischmannia incarnata* (Walt.) King & H.E. Robins.	pink thoroughwort	Forb
FOGA	*Fothergilla gardenii* L.	dwarf witchalder	Woody
FRCA3	*Fraxinus caroliniana* P. Mill.	Carolina ash	Woody
FRPE	*Fraxinus pennsylvanica* Marsh.	green ash	Woody
FRPR	*Fraxinus profunda* (Bush) Bush	pumpkin ash	Tree
GAVO	*Galactia volubilis* (L.) Britt.	downy milkpea	Vine/Forb
GAAP2	*Galium aparine* L.	stickywilly	Forb
GAHI	*Galium hispidulum* Michx.	coastal bedstraw	Forb
GAPU5	*Galium punctatum* Pers.	hairy bedstraw	Forb
GAPU3	*Gamochaeta purpurea* (L.) Cabrera	spoonleaf purple everlasting	Forb

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
GADU	*Gaylussacia dumosa* (Andr.) Torr. & Gray	dwarf huckleberry	Woody
GAFR2	*Gaylussacia frondosa* (L.) Torr. & Gray ex Torr.	blue huckleberry	Woody
GESE	*Gelsemium sempervirens* (L.) St. Hil.	evening trumpetflower	Vine/Woody
GECA10	*Gentiana catesbaei* Walt.	Elliott's gentian	Forb
GNOB	*Gnaphalium obtusifolium* L.	rabbit-tobacco	Forb
GRPI	*Gratiola pilosa* Michx.	shaggy hedgehyssop	Forb
GYAM	*Gymnopogon ambiguus* (Michx.) B.S.P.	bearded skeletongrass	Graminoid
GYBR	*Gymnopogon brevifolius* Trin.	shortleaf skeletongrass	Graminoid
HAVI4	*Hamamelis virginiana* L.	American witchhazel	Woody
HEAU	*Helenium autumnale* L.	common sneezeweed	Forb
HEVE	*Helenium vernale* Walt.	savannah sneezeweed	Forb
HECA4	*Helianthemum carolinianum* (Walt.) Michx.	Carolina frostweed	Forb
HEAN2	*Helianthus angustifolius* L.	swamp sunflower	Forb
HEAT	*Helianthus atrorubens* L.	purpledisk sunflower	Forb
HETER8	*Heterotheca* Cass.	false goldenaster	Forb
HEAR6	*Hexastylis arifolia* (Michx.) Small	littlebrownjug	Forb
HIMA	*Hieracium ×marianum* Willd.	Maryland hawkweed	Forb
HIGR3	*Hieracium gronovii* L.	queendevil	Forb
HYBO	*Hydrocotyle bonariensis* Comm. ex Lam.	largeleaf pennywort	Forb
HYMA	*Hydrophyllum macrophyllum* Nutt.	largeleaf waterleaf	Forb
HYCR3	*Hypericum crux-andreae* (L.) Crantz	St. Peterswort	Forb
HYGY	*Hypericum gymnanthum* Engelm. & Gray	claspingleaf St. Johnswort	Forb
HYHY	*Hypericum hypericoides* (L.) Crantz	St. Andrew's cross	Woody
HYNU	*Hypericum nudiflorum* Michx. ex Willd.	early St. Johnswort	Woody
HYSE	*Hypericum setosum* L.	hairy St. Johnswort	Forb
HYHI2	*Hypoxis hirsuta* (L.) Coville	common goldstar	Forb
ILAM	*Ilex ambigua* (Michx.) Torr.	Carolina holly	Woody
ILCO	*Ilex coriacea* (Pursh) Chapman	large gallberry	Woody
ILDE	*Ilex decidua* Walt.	possumhaw	Woody

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
ILGL	*Ilex glabra* (L.) Gray	inkberry	Woody
ILOP	*Ilex opaca* Ait.	American holly	Woody
ILVO	*Ilex vomitoria* Ait.	yaupon	Woody
IOLI2	*Ionactis linariifolius* (L.) Greene	flaxleaf whitetop aster	Forb
IPPA	*Ipomoea pandurata* (L.) G.F.W. Mey.	man of the earth	Vine/Forb
IRIS	*Iris* L.	iris	Forb
ITVI	*Itea virginica* L.	Virginia sweetspire	Woody
JUNCU	*Juncus* L.	rush	Graminoid
JUCO6	*Juniperus communis* L.	common juniper	Woody
LAAN	*Lachnocaulon anceps* (Walt.) Morong	whitehead bogbutton	Forb
LEMI	*Lechea minor* L.	thymeleaf pinweed	Forb
LEOR	*Leersia oryzoides* (L.) Sw.	rice cutgrass	Graminoid
LEBI2	*Lespedeza bicolor* Turcz.	shrubby lespedeza	Woody
LECA8	*Lespedeza capitata* Michx.	roundhead lespedeza	Forb
LECU	*Lespedeza cuneata* (Dum.-Cours.) G. Don	Chinese lespedeza	Woody/Forb
LEHIH2	*Lespedeza hirta* (L.) Hornem. ssp. *hirta*	hairy lespedeza	Forb
LEPR	*Lespedeza procumbens* Michx.	trailing lespedeza	Forb
LERE2	*Lespedeza repens* (L.) W. Bart.	creeping lespedeza	Forb
LIGR10	*Liatris graminifolia* Willd.	>>Liatris pilosa var. pilosa	Forb
LIFL	*Linum floridanum* (Planch.) Trel.	Florida yellow flax	Forb
LIST2	*Liquidambar styraciflua* L.	sweetgum	Woody
LITU	*Liriodendron tulipifera* L.	tuliptree	Woody
LOEL	*Lobelia elongata* Small	longleaf lobelia	Forb
LONU	*Lobelia nuttallii* J.A. Schultes	Nuttall's lobelia	Forb
LOJA	*Lonicera japonica* Thunb.	Japanese honeysuckle	Vine
LONIC	*Lonicera* L.	honeysuckle	Vine/Woody
LUAL2	*Ludwigia alternifolia* L.	seedbox	Forb
LUHE5	*Ludwigia hexapetala* (Hook. & Arn.) Zardini, Gu & Raven	>>Ludwigia uruguayensis	Forb
LUHI	*Ludwigia hirtella* Raf.	spindleroot	Forb

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
LUMA4	*Ludwigia maritima* Harper	seaside primrose-willow	Forb
LUPI	*Ludwigia pilosa* Walt.	hairy primrose-willow	Forb
LURE2	*Ludwigia repens* J.R. Forst.	creeping primrose-willow	Forb
LUVI2	*Ludwigia virgata* Michx.	savannah primrose-willow	Forb
LYAN3	*Lycopus angustifolius* Ell.	>>Lycopus rubellus	Forb
LYCOP4	*Lycopus* L.	waterhorehound	Forb
LYJA	*Lygodium japonicum* (Thunb. ex Murr.) Sw.	Japanese climbing fern	Fern
LYFR3	*Lyonia fruticosa* (Michx.) G.S. Torr.	coastal plain staggerbush	Woody
LYLI	*Lyonia ligustrina* (L.) DC.	maleberry	Woody
LYLU3	*Lyonia lucida* (Lam.) K. Koch	fetterbush lyonia	Woody
LYTHR	*Lythrum* L.	loosestrife	Forb
MAGR4	*Magnolia grandiflora* L.	southern magnolia	Woody
MAVI2	*Magnolia virginiana* L.	sweetbay	Woody
MASP2	*Malaxis spicata* Sw.	Florida adder's-mouth orchid	Forb
MAAN3	*Malus angustifolia* (Ait.) Michx.	southern crabapple	Woody
MEAC	*Mecardonia acuminata* (Walt.) Small	axilflower	Forb
MIVI	*Microstegium vimineum* (Trin.) A. Camus	Nepalese browntop	Graminoid
MISC	*Mikania scandens* (L.) Willd.	climbing hempvine	Vine
MIRE	*Mitchella repens* L.	partridgeberry	Forb
MOCA7	*Morella caroliniensis* (P. Mill.) Small	southern bayberry	Woody
MORU2	*Morus rubra* L.	red mulberry	Woody
MYCE	*Myrica cerifera* L.	>>Morella cerifera	Woody
NYSY	*Nyssa sylvatica* Marsh.	blackgum	Woody
OLUN	*Oldenlandia uniflora* L.	clustered mille graines	Forb
ONSE	*Onoclea sensibilis* L.	sensitive fern	Fern
OPHIS	*Oplismenus hirtellus* (L.) Beauv. ssp. *setarius* (Lam.) Mez ex Ekman		Graminoid
OSCI	*Osmunda cinnamomea* L.	cinnamon fern	Fern
OSRE	*Osmunda regalis* L.	royal fern	Fern

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
OXST	*Oxalis stricta* L.	common yellow oxalis	Fern
OXVI	*Oxalis violacea* L.	violet woodsorrel	Forb
OXAR	*Oxydendrum arboreum* (L.) DC	sourwood	Woody
PAGL17	*Packera glabella* (Poir.) C. Jeffrey	butterweed	Forb
PAAN	*Panicum anceps* Michx.	beaked panicgrass	Graminoid
PANIC	*Panicum* L.	panicgrass	Graminoid
PAVE2	*Panicum verrucosum* Muhl.	warty panicgrass	Graminoid
PAQU2	*Parthenocissus quinquefolia* (L.) Planch.	Virginia creeper	Vine
PAFL4	*Paspalum floridanum* Michx.	Florida paspalum	Graminoid
PASPA2	*Paspalum* L.	crowngrass	Graminoid
PALU2	*Passiflora lutea* L.	yellow passionflower	Vine/Forb
PEBO	*Persea borbonia* (L.) Spreng.	redbay	Woody
PEPA37	*Persea palustris* (Raf.) Sarg.	swamp bay	Woody
PEHY7	*Persicaria hydropiperoides* (Michx.) Small	>>Polygonum hydropiperoides	Forb
PHCA19	*Phlox carolina* L.	thickleaf phlox	Forb
PHYSA	*Physalis* L.	groundcherry	Forb
PHVI5	*Physalis virginiana* P. Mill.	Virginia groundcherry	Forb
PIEL	*Pinus elliottii* Engelm.	slash pine	Woody
PIPA2	*Pinus palustris* P. Mill.	longleaf pine	Woody
PISE	*Pinus serotina* Michx.	pond pine	Woody
PITA	*Pinus taeda* L.	loblolly pine	Woody
PIAV	*Piptochaetium avenaceum* (L.) Parodi	blackseed speargrass	Graminoid
PIGR4	*Pityopsis graminifolia* (Michx.) Nutt.	narrowleaf silkgrass	Forb
PLAQ	*Planera aquatica* J.F. Gmel.	planertree	Woody
PLVI	*Plantago virginica* L.	Virginia plantain	Forb
PLCL	*Platanthera clavellata* (Michx.) Luer	small green wood orchid	Forb
PLCR	*Platanthera cristata* (Michx.) Lindl.	crested yellow orchid	Forb
PLPO2	*Pleopeltis polypodioides* (L.) Andrews & Windham	resurrection fern	Fern
PLFO	*Pluchea foetida* (L.) DC.	stinking camphorweed	Forb

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
POLU	*Polygala lutea* L.	orange milkwort	Forb
POLYG4	*Polygonum* L.	knotweed	Forb
POAC4	*Polystichum acrostichoides* (Michx.) Schott	Christmas fern	Fern
POSI2	*Potentilla simplex* Michx.	common cinquefoil	Fern
PRENA	*Prenanthes* L.	rattlesnakeroot	Forb
PRSE	*Prenanthes serpentaria* Pursh	cankerweed	Forb
PRPA3	*Proserpinaca palustris* L.	marsh mermaidweed	Forb
PRVUL2	*Prunella vulgaris* L. ssp. *lanceolata* (W. Bart.) Hultén	lance selfheal	Forb
PRSE2	*Prunus serotina* Ehrh.	black cherry	Woody
PTAQ	*Pteridium aquilinum* (L.) Kuhn	western brackenfern	Fern
PTAL2	*Pterocaulon alopecuroideum* (Lam.) DC.	>>Pterocaulon virgatum	Forb
PYNU	*Pycnanthemum nudum* Nutt.	coastal plain mountainmint	Forb
QUAL	*Quercus alba* L.	white oak	Woody
QUAU	*Quercus austrina* Small	bastard white oak	Woody
QUCO2	*Quercus coccinea* Muenchh.	scarlet oak	Woody
QUFA	*Quercus falcata* Michx.	southern red oak	Woody
QUHE2	*Quercus hemisphaerica* Bartr. ex Willd.	Darlington oak	Woody
QULA2	*Quercus laevis* Walt.	turkey oak	Woody
QULA3	*Quercus laurifolia* Michx.	laurel oak	Woody
QULY	*Quercus lyrata* Walt.	overcup oak	Woody
QUMA6	*Quercus margarettiae* Ashe ex Small	runner oak	Woody
QUMA3	*Quercus marilandica* Muenchh.	blackjack oak	Woody
QUMI	*Quercus michauxii* Nutt.	swamp chestnut oak	Woody
QUNI	*Quercus nigra* L.	water oak	Woody
QUPA5	*Quercus pagoda* Raf.	cherrybark oak	Woody
QUPA2	*Quercus palustris* Muenchh.	pin oak	Woody
QUPH	*Quercus phellos* L.	willow oak	Woody
QUSI2	*Quercus similis* Ashe	bottomland post oak	Woody
QUST	*Quercus stellata* Wangenh.	post oak	Woody

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
QUVE	*Quercus velutina* Lam.	black oak	Woody
QUVI	*Quercus virginiana* P. Mill.	live oak	Woody
RHAL4	*Rhexia alifanus* Walt.	savannah meadowbeauty	Forb
RHEXI	*Rhexia* L.	meadowbeauty	Forb
RHMA	*Rhexia mariana* L.	Maryland meadowbeauty	Forb
RHNA	*Rhexia nashii* Small	maid Marian	Forb
RHAT	*Rhododendron atlanticum* (Ashe) Rehd	dwarf azalea	Woody
RHAU	*Rhododendron austrinum* (Small) Rehd.	orange azalea	Woody
RHVI2	*Rhododendron viscosum* (L.) Torr.	swamp azalea	Woody
RHCO	*Rhus copallinum* L.	flameleaf sumac	Woody
RHRE	*Rhynchosia reniformis* DC	dollarleaf	Forb
RHDE2	*Rhynchospora debilis* Gale	savannah beaksedge	Graminoid
RHEL	*Rhynchospora elliottii* A. Dietr.	Elliott's beaksedge	Graminoid
RHFA	*Rhynchospora fascicularis* (Michx.) Vahl	fascicled beaksedge	Graminoid
RHGL2	*Rhynchospora globularis* (Chapman) Small	globe beaksedge	Graminoid
RHGR	*Rhynchospora gracilenta* Gray	slender beaksedge	Graminoid
RHIN4	*Rhynchospora inexpansa* (Michx.) Vahl	nodding beaksedge	Graminoid
RHMI9	*Rhynchospora mixta* Britt.	mingled beaksedge	Graminoid
RHPL3	*Rhynchospora plumosa* Ell.	plumed beaksedge	Graminoid
ROPS	*Robinia pseudoacacia* L.	black locust	Woody
ROCA4	*Rosa carolina* L.	Carolina rose	Forb
ROMI	*Rosa micrantha* Borrer ex Sm.	smallflower sweetbrier	Woody
RUAR2	*Rubus argutus* Link	sawtooth blackberry	Vine
Ruerect	*Rubus* L., erect	blackberry	Vine
Rutrail	*Rubus* L., trailing	blackberry	Vine
RUHI2	*Rudbeckia hirta* L.	blackeyed Susan	Vine
RUCA4	*Ruellia caroliniensis* (J.F. Gmel.) Steud.	Carolina wild petunia	Forb
RUELL	*Ruellia* L.	wild petunia	Forb
SAMI8	*Sabal minor* (Jacq.) Pers.	dwarf palmetto	Monocot

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
SAQU	*Sabatia quadrangula* Wilbur	fourangle rose gentian	Forb
SAST	*Sacciolepis striata* (L.) Nash	American cupscale	Graminoid
SAGR	*Sagittaria graminea* Michx.	grassy arrowhead	Forb
SALY2	*Salvia lyrata* L.	lyreleaf sage	Forb
SAVAP	*Samolus valerandi* L. ssp. *parviflorus* (Raf.) Hultén	seaside brookweed	Forb
SACA15	*Sanicula canadensis* L.	Canadian blacksnakeroot	Forb
SAGR6	*Sanicula gregaria* Bickn.	>>Sanicula odorata	Forb
SARU4	*Sarracenia rubra* Walt.	sweet pitcherplant	Forb
SAAL5	*Sassafras albidum* (Nutt.) Nees	sassafras	Woody
SACE	*Saururus cernuus* L.	lizard's tail	Forb
SCSC	*Schizachyrium scoparium* (Michx.) Nash	little bluestem	Graminoid
SCTA2	*Schoenoplectus tabernaemontani* (K.C. Gmel.) Palla	softstem bulrush	Graminoid
SCLER2	*Scleria* Berg.	nutrush	Graminoid
SCEL	*Scutellaria elliptica* Muhl. ex Spreng.	hairy skullcap	Forb
SCIN2	*Scutellaria integrifolia* L.	helmet flower	Forb
SIEL	*Sida elliottii* Torr. & Gray	Elliott's fanpetals	Forb
SIAS2	*Silphium asteriscus* L.	starry rosinweed	Forb
SMBO2	*Smilax bona-nox* L.	saw greenbrier	Vine
SMGL	*Smilax glauca* Walt.	cat greenbrier	Vine
SMHI	*Smilax hispida* Muhl. ex Torr.	bristly greenbrier	Vine
SMLA	*Smilax laurifolia* L.	laurel greenbrier	Vine
SMPU	*Smilax pumila* Walt.	sarsparilla vine	Vine
SMRO	*Smilax rotundifolia* L.	roundleaf greenbrier	Vine
SOAM4	*Solanum americanum* auct. non P. Mill.	nightshade	Forb
SOCA3	*Solanum carolinense* L.	Carolina horsenettle	Forb
SOAR	*Solidago arguta* Ait.	Atlantic goldenrod	Forb
SOCA4	*Solidago caesia* L.	wreath goldenrod	Forb
SOFI	*Solidago fistulosa* P. Mill.	pinebarren goldenrod	Forb
SOLID	*Solidago* L.	goldenrod	Forb

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
SOLE5	*Solidago leavenworthii*	Leavenworth's goldenrod	Forb
SOOD	*Solidago odora* Ait.	anisescented goldenrod	Forb
SOPU	*Solidago puberula* Nutt.	downy goldenrod	Forb
SORU2	*Solidago rugosa* P. Mill.	wrinkleleaf goldenrod	Forb
SOST	*Solidago stricta* Ait.	wand goldenrod	Forb
SOTO2	*Solidago tortifolia* Ell.	twistleaf goldenrod	Forb
SPPE3	*Sphenopholis pensylvanica* (L.) A.S. Hitchc.	swamp wedgescale	Graminoid
SPHEN	*Sphenopholis* Scribn.	wedgescale	Graminoid
SPIGE	*Spigelia* L.	pinkroot	Forb
SPOD	*Spiranthes odorata* (Nutt.) Lindl.	marsh ladies'-tresses	Forb
SPCL	*Sporobolus clandestinus* (Biehler) A.S. Hitchc.	rough dropseed	Graminoid
STELL	*Stellaria* L.	starwort	Forb
STUM2	*Strophostyles umbellata* (Muhl. ex Willd.) Britt.	pink fuzzybean	Vine/Forb
STPA8	*Stylisma patens* (Desr.) Myint	coastalplain dawnflower	Forb
STBI2	*Stylosanthes biflora* (L.) B.S.P.	sidebeak pencilflower	Forb
STAM4	*Styrax americanus* Lam.	American snowbell	Woody
SYCO3	*Symphyotrichum concolor* (L.) Nesom	eastern silver aster	Forb
SYDU2	*Symphyotrichum dumosum* (L.) Nesom	rice button aster	Forb
SYLA4	*Symphyotrichum lateriflorum* (L.) A.& D. Löve	calico aster	Forb
SYPAP2	*Symphyotrichum patens* (Ait.) Nesom var. patens	late purple aster	Forb
SYTI	*Symplocos tinctoria* (L.) L'Hér.	common sweetleaf	Woody
TAAS	*Taxodium ascendens* Brongn.	pond cypress	Woody
TADI2	*Taxodium distichum* (L.) L.C. Rich.	bald cypress	Woody
TEHI2	*Tephrosia hispidula* (Michx.) Pers.	sprawling hoarypea	Forb
TESP	*Tephrosia spicata* (Walt.) Torr. & Gray	spiked hoarypea	Forb
TEVI	*Tephrosia virginiana* (L.) Pers.	Virginia tephrosia	Forb
TITI2	*Tipuana tipu* (Benth.) Kuntze	tipa	Woody
TORA2	*Toxicodendron radicans* (L.) Kuntze	eastern poison ivy	Vine
TRDI	*Trachelospermum difforme* (Walt.) Gray	climbing dogbane	Vine

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
TRAGI	*Tragia* L.	noseburn	Forb
TRUR	*Tragia urens* L.	wavyleaf noseburn	Forb
TRVI2	*Triadenum virginicum* (L.) Raf.	Virginia marsh St. Johnswort	Forb
TRSE6	*Triadica sebifera* (L.) Small	Chinese tallow	Woody
ULAL	*Ulmus alata* Michx.	winged elm	Woody
ULAM	*Ulmus americana* L.	American elm	Woody
ULRU	*Ulmus rubra* Muhl.	slippery elm	Woody
VAAR	*Vaccinium arboreum* Marsh.	farkleberry	Woody
VAAT	*Vaccinium atrococcum* (Gray) Heller	>>Vaccinium fuscatum	Woody
VAEL	*Vaccinium elliottii* Chapman	Elliott's blueberry	Woody
VAFO	*Vaccinium formosum* Andr.	southern blueberry	Woody
VAFU	*Vaccinium fuscatum* Ait.	black highbush blueberry	Woody
VAST	*Vaccinium stamineum* L.	deerberry	Woody
VATE3	*Vaccinium tenellum* Ait.	small black blueberry	Woody
VAVI2	*Vaccinium virgatum* Ait.	smallflower blueberry	Woody
VEAC	*Vernonia acaulis* (Walt.) Gleason	stemless ironweed	Forb
VEAN	*Vernonia angustifolia* Michx.	tall ironweed	Forb
VERE2	*Vernonia recurva* Gleason	tall ironweed	Forb
VERON	*Veronica* L.	speedwell	Forb
VIDE	*Viburnum dentatum* L.	southern arrowwood	Woody
VINU	*Viburnum nudum* L.	possumhaw	Woody
VIPR	*Viburnum prunifolium* L.	blackhaw	Woody
VIRU	*Viburnum rufidulum* Raf.	rusty blackhaw	Woody
VICA2	*Vicia caroliniana* Walt.	Carolina vetch	Vine/Forb
VIPR4	*Viola ×primulifolia* L. (pro sp.) [*lanceolata × macloskeyi*]		Forb
VIBI	*Viola bicolor* Pursh	field pansy	Forb
VIOLA	*Viola* L.	violet	Forb
VILA4	*Viola lanceolata* L.	bog white violet	Forb
VIPE	*Viola pedata* L.	birdfoot violet	Forb

Table A. 2. Continued

Symbol	Scientific Name	Common Name	Functional Group
VISE4	*Viola septemloba* Le Conte	southern coastal violet	Forb
VIRO3	*Vitis rotundifolia* Michx.	muscadine	Vine
WIFR	*Wisteria frutescens* (L.) Poir.	American wisteria	Vine
XYCA	*Xyris caroliniana* Walt.	Carolina yelloweyed grass	Forb

Table A. 3. Species indicator values for the FMNF.

Species	Location	Indicator Value	Mean	S.Dev	P-value
Ilex opaca Ait.	FMNF	74.0	24.7	2.62	0.001
Mitchella repens L.	FMNF	63.4	32.3	2.67	0.001
Gelsemium sempervirens (L.) St. Hil.	FMNF	54.8	20.5	2.63	0.001
Vitis rotundifolia Michx.	FMNF	50.4	28.5	2.68	0.001
Panicum anceps Michx.	FMNF	49.8	23.7	2.75	0.001
Smilax rotundifolia L.	FMNF	46.5	37.4	2.53	0.002
Bignonia capreolata L.	FMNF	45.7	19.6	2.49	0.001
Persea borbonia (L.) Spreng.	FMNF	43.6	15.2	2.34	0.001
Parthenocissus quinquefolia (L.) Planch.	FMNF	43.3	22.0	2.50	0.001
Carpinus caroliniana Walt.	FMNF	42.6	14.9	2.42	0.001
Berchemia scandens (Hill) K. Koch	FMNF	42.3	15.6	2.32	0.001
Clethra L.	FMNF	38.6	13.7	2.25	0.001
Stellaria L.	FMNF	38.3	14.3	2.30	0.001
Vaccinium stamineum L.	FMNF	37.6	13.5	2.23	0.001
Callicarpa americana L.	FMNF	34.2	13.7	2.29	0.001
Carya tomentosa (Lam. ex Poir.) Nutt.	FMNF	33.1	14.6	2.30	0.001
Euonymus americana L.	FMNF	30.7	11.2	2.11	0.001
Vaccinium elliottii Chapman	FMNF	30.4	11.9	2.16	0.001
Viola L.	FMNF	30.2	14.3	2.35	0.001
Gaylussacia frondosa (L.) Torr. & Gray ex Torr.	FMNF	29.4	11.6	2.22	0.001
Galium aparine L.	FMNF	29.2	13.4	2.31	0.001
Cornus florida L.	FMNF	27.5	10.9	2.05	0.001
Quercus michauxii Nutt.	FMNF	26.7	10.2	2.00	0.001
L*yonia lucida* (Lam.) K. Koch	FMNF	26.3	13.1	2.28	0.001
Ulmus rubra Muhl.	FMNF	24.5	13.0	2.23	0.002
Elephantopus tomentosus L.	FMNF	24.4	10.7	2.06	0.001
Aristolochia serpentaria L.	FMNF	22.8	8.7	1.90	0.001
Ulmus alata Michx.	FMNF	22.8	8.8	2.03	0.001
Magnolia virginiana L.	FMNF	22.4	11.2	2.08	0.001
Quercus pagoda Raf.	FMNF	22.4	11.3	2.07	0.002
Quercus hemisphaerica Bartr. ex Willd.	FMNF	21.5	11.6	2.20	0.002
Onoclea sensibilis L.	FMNF	21.4	10.2	1.97	0.001

Table A. 4. Species indicator values for the private plantation.

Species	Location	Indicator Value	Mean	S.Dev	P-value
Quercus phellos L.	Private Planation	62.9	32.2	2.62	0.001
Carya glabra (P. Mill.) Sweet	Private Planation	60.1	16.4	2.32	0.001
Liquidambar styraciflua L.	Private Planation	56.9	43.1	2.26	0.001
Scleria Berg.	Private Planation	51.6	27.3	2.63	0.001
Chasmanthium laxum (L.) Yates	Private Planation	45.5	12.6	2.25	0.001
Campsis radicans (L.) Seem. ex Bureau	Private Planation	36.6	20.5	2.56	0.001
Andropogon L.	Private Planation	32.0	21.1	2.49	0.002
Eupatorium leucolepis (DC.) Torr. & Gray	Private Planation	28.0	9.4	1.93	0.001
Quercus laevis Walt.	Private Planation	25.9	12.3	2.23	0.001
Smilax laurifolia L.	Private Planation	24.7	7.5	1.81	0.001
Pinus elliottii Engelm.	Private Planation	22.1	6.8	1.73	0.001

Table A. 5. Species indicator values for community types at the FMNF.

Species	Ecological Community	Indicator Value	Mean	S.Dev	P-value
Pinus taeda L.	Ecotone	38.1	29.0	2.79	0.006
Quercus nigra L.	Ecotone	34.9	25.5	3.32	0.008
Robinia pseudoacacia L.	Ecotone	19.5	6.4	2.72	0.004
Smilax rotundifolia L.	Hardwood	42.8	30.6	2.58	0.001
Cyperus L.	Hardwood	39.9	21.8	3.50	0.001
Onoclea sensibilis L.	Hardwood	37.8	13.4	3.42	0.001
Nyssa sylvatica Marsh.	Hardwood	37.2	27.0	2.95	0.004
Andropogon virginicus L.	Pine	42.3	9.9	3.18	0.001
Rhexia alifanus Walt.	Pine	42.3	9.7	3.02	0.001
Andropogon L.	Pine	38.3	14.1	3.42	0.001
Diospyros virginiana L.	Pine	38.2	16.9	3.33	0.001
Gelsemium sempervirens (L.) St. Hil.	Pine	36.7	24.8	3.23	0.003
Hypericum crux-andreae (L.) Crantz	Pine	33.5	17.4	3.43	0.002
Galactia volubilis (L.) Britt.	Pine	33.3	7.3	2.85	0.001
Pityopsis graminifolia (Michx.) Nutt.	Pine	33.3	7.3	2.78	0.001
Tephrosia spicata (Walt.) Torr. & Gray	Pine	31.1	7.7	2.67	0.001
Pinus palustris P. Mill.	Pine	30.0	6.8	2.69	0.001
Elephantopus tomentosus L.	Pine	27.5	14.0	3.10	0.003
Lespedeza procumbens Michx.	Pine	26.7	6.4	2.62	0.001
Vaccinium arboreum Marsh.	Pine	26.5	11.5	3.23	0.002
Gaylussacia dumosa (Andr.) Torr. & Gray	Pine	24.8	12.1	3.25	0.006
Pterocaulon alopecuroideum (Lam.) DC.	Pine	23.3	6.0	2.58	0.001
Quercus falcata Michx.	Pine	22.5	7.1	2.64	0.002
Quercus marilandica Muenchh.	Pine	21.1	6.3	2.62	0.002
Solidago odora Ait.	Pine	20.0	5.5	2.60	0.002
Cassia L.	Pine	20.0	5.4	2.59	0.001
Coreopsis major Walt.	Pine	20.0	5.3	2.49	0.001
Stylisma patens (Desr.) Myint	Pine	20.0	5.4	2.43	0.001

Table A. 6. Species indicator values for community types at the private plantation.

Species	Ecological Community	Indicator Value	Mean	S.Dev	P-value
Quercus hemisphaerica Bartr. ex Willd.	Hardwood	43.5	17.0	3.97	0.001
Lyonia lucida (Lam.) K. Koch	Hardwood	20.0	6.3	3.14	0.008
Diospyros virginiana L.	Pine	40.3	20.4	3.79	0.001
Eupatorium leucolepis (DC.) Torr. & Gray	Pine	34.9	15.9	3.80	0.002
Pityopsis graminifolia (Michx.) Nutt.	Pine	31.0	12.6	3.73	0.001
Pinus palustris P. Mill.	Pine	29.9	11.3	3.62	0.001
Andropogon virginicus L.	Pine	29.5	14.8	3.89	0.004
Desmodium laevigatum (Nutt.) DC.	Pine	28.7	8.8	3.36	0.001
Coreopsis linifolia Nutt.	Pine	26.0	9.3	3.46	0.002
Aster walteri Alexander	Pine	24.7	8.1	3.20	0.001
Stylosanthes biflora (L.) B.S.P.	Pine	24.0	6.9	3.12	0.002
Rhus copallinum L.	Pine	23.8	11.6	3.71	0.007
Quercus stellata Wangenh.	Pine	20.0	9.1	3.30	0.008
Desmodium strictum (Pursh) DC.	Pine	20.0	6.2	3.08	0.006

Table A. 7. Species indicator values for burned sites at the FMNF.

Species	Burn Treatment	Indicator Value	Mean	S.Dev	P-value
Persea borbonia (L.) Spreng.	B	89.7	26.0	3.52	0.001
Clethra L.	B	83.0	23.5	3.42	0.001
Lyonia lucida (Lam.) K. Koch	B	68.1	20.0	3.37	0.001
Osmunda cinnamomea L.	B	55.3	16.7	3.10	0.001
Malus angustifolia (Ait.) Michx.	B	49.7	17.2	3.17	0.001
Gaylussacia frondosa (L.) Torr. & Gray ex Torr.	B	47.4	19.4	3.27	0.001
Liriodendron tulipifera L.	B	40.4	12.8	2.87	0.001
Vaccinium stamineum L.	B	39.5	22.9	3.43	0.002
Vaccinium atrococcum (Gray) Heller	B	34.4	12.6	3.02	0.001
Symplocos tinctoria (L.) L'Hér.	B	33.4	13.9	3.00	0.001
Pteridium aquilinum (L.) Kuhn	B	30.2	11.3	2.72	0.001
Hexastylis arifolia (Michx.) Small	B	29.8	10.2	2.60	0.001
Onoclea sensibilis L.	B	28.6	16.4	3.28	0.007
Andropogon virginicus L.	B	26.5	11.5	2.83	0.001
Ilex coriacea (Pursh) Chapman	B	25.5	9.0	2.44	0.001
Rhododendron austrinum (Small) Rehd.	B	25.1	11.9	3.04	0.003
Ilex glabra (L.) Gray	B	21.7	8.9	2.41	0.002
Pityopsis graminifolia (Michx.) Nutt.	B	21.3	8.0	2.55	0.002
Aronia arbutifolia (L.) Pers.	B	21.3	7.9	2.32	0.001

Table A. 8. Species indicator values for unburned sites at the FMNF.

Species	Burn Treatment	Indicator Value	Mean	S.Dev	P-value
Smilax bona-nox L.	U	86.7	29.4	3.47	0.001
Carpinus caroliniana Walt.	U	79.6	25.5	3.52	0.001
Parthenocissus quinquefolia (L.) Planch.	U	77.9	32.0	3.51	0.001
Ampelopsis arborea (L.) Koehne	U	74.1	23.9	3.41	0.001
Stellaria L.	U	74.1	24.0	3.27	0.001
Toxicodendron radicans (L.) Kuntze	U	65.5	32.7	3.46	0.001
Vitis rotundifolia Michx.	U	63.4	38.7	3.32	0.001
Galium aparine L.	U	63.0	20.8	3.23	0.001
Carya tomentosa (Lam. ex Poir.) Nutt.	U	62.7	23.1	3.48	0.001
Berchemia scandens (Hill) K. Koch	U	59.6	26.2	3.53	0.001
Mitchella repens L.	U	58.7	44.7	2.86	0.001
Dichanthelium (A.S. Hitchc. & Chase) Gould	U	55.7	45.0	2.59	0.001
Liquidambar styraciflua L.	U	55.7	38.5	3.28	0.001
Ilex opaca Ait.	U	55.6	41.2	3.07	0.001
Smilax rotundifolia L.	U	54.8	43.0	2.99	0.002
Ulmus rubra Muhl.	U	53.5	19.4	3.30	0.001
Cyperus L.	U	52.8	28.6	3.59	0.001
Viola L.	U	51.8	21.9	3.45	0.001
Bignonia capreolata L.	U	51.1	30.5	3.46	0.001
Quercus pagoda Raf.	U	50.0	17.4	3.16	0.001
Nyssa sylvatica Marsh.	U	46.2	36.9	3.27	0.010
Quercus phellos L.	U	45.2	22.1	3.37	0.001
Callicarpa americana L.	U	43.8	22.5	3.34	0.001
Euonymus americana L.	U	42.7	19.4	3.24	0.001
Aristolochia serpentaria L.	U	42.6	15.2	3.13	0.001
Ulmus alata Michx.	U	38.7	15.2	3.08	0.001
Rubus L., erect	U	37.4	23.8	3.27	0.003
Lonicera japonica Thunb.	U	37.3	17.8	3.35	0.001
Trachelospermum difforme (Walt.) Gray	U	37.0	13.6	2.91	0.001
Cornus florida L.	U	35.9	18.3	3.24	0.003
Crataegus marshallii Egglest.	U	35.2	13.0	2.95	0.001
Desmodium Desv.	U	33.3	12.5	2.84	0.001
Sabal minor (Jacq.) Pers.	U	33.3	12.4	2.79	0.001
Campsis radicans (L.) Seem. ex Bureau	U	33.2	14.5	2.98	0.001
Ilex decidua Walt.	U	33.2	13.5	2.88	0.001

Table A. 9. Species indicator values for the burned treatments at the private plantation.

Species	Burn Treatment	Indicator Value	Mean	S.Dev	P-value
Smilax rotundifolia L.	B	56.8	33.0	4.07	0.001
Dichanthelium (A.S. Hitchc. & Chase) Gould	B	55.2	41.9	3.42	0.002
Smilax glauca Walt.	B	54.7	25.6	4.01	0.001
Hypericum crux-andreae (L.) Crantz	B	39.7	22.5	4.27	0.003
Rhus copallinum L.	B	30.4	13.1	3.34	0.002
Erechtites hieraciifolia (L.) Raf. ex DC.	B	27.5	14.0	3.62	0.005
Solidago stricta Ait.	B	26.1	11.9	3.62	0.007

Table A. 10. Species indicator values for the unburned treatments at the private plantation.

Species	Burn Treatment	Indicator Value	Mean	S.Dev	P-value
Campsis radicans (L.) Seem. ex Bureau	U	49.5	30.9	4.27	0.002
Smilax laurifolia L.	U	45.8	16.8	3.74	0.001
Quercus hemisphaerica Bartr. ex Willd.	U	35.3	21.0	3.86	0.003
Ulmus rubra Muhl.	U	19.4	7.1	2.68	0.006
Bignonia capreolata L.	U	19.4	7.0	2.46	0.003
Persicaria hydropiperoides (Michx.) Small	U	16.1	6.1	2.66	0.009
Quercus laurifolia Michx.	U	16.1	6.1	2.67	0.005

Table A. 11. Species indicator values for burned treatment combinations at the FMNF (BE=burned ecotone, BH=burned hardwood, BP=burned pine).

Species	Treatment Combination	Indicator Value	Mean	S.Dev	P-value
Osmunda cinnamomea L.	BE	48.2	10.5	3.30	0.001
Clethra L.	BE	40.5	12.8	3.08	0.001
Gaylussacia frondosa (L.) Torr. & Gray ex Torr.	BE	39.9	11.4	3.21	0.001
Lyonia lucida (Lam.) K. Koch	BE	38.6	11.6	3.21	0.001
Persea borbonia (L.) Spreng.	BE	36.0	13.5	2.93	0.001
Xyris caroliniana Walt.	BE	29.7	6.4	3.43	0.001
Rhododendron austrinum (Small) Rehd.	BE	28.4	8.7	3.26	0.001
Pteridium aquilinum (L.) Kuhn	BE	28.1	8.5	3.31	0.003
Aronia arbutifolia (L.) Pers.	BE	27.7	7.1	3.37	0.001
Arundinaria gigantea (Walt.) Muhl.	BE	25.9	13.7	3.15	0.004
Myrica cerifera L.	BE	20.4	15.1	2.65	0.038
Magnolia virginiana L.	BH	37.9	10.7	3.26	0.001
Liriodendron tulipifera L.	BH	36.9	9.2	3.31	0.001
Onoclea sensibilis L.	BH	34.4	10.4	3.34	0.001
Vaccinium atrococcum (Gray) Heller	BH	32.4	8.8	3.33	0.001
Malaxis spicata Sw.	BH	22.2	6.6	3.32	0.004
Ilex coriacea (Pursh) Chapman	BH	21.2	7.7	3.25	0.007
Pityopsis graminifolia (Michx.) Nutt.	BP	66.7	7.2	3.39	0.001
Andropogon virginicus L.	BP	60.9	8.7	3.39	0.001
Pinus palustris P. Mill.	BP	60.0	6.9	3.34	0.001
Galactia volubilis (L.) Britt.	BP	54.0	7.2	3.41	0.001
Tephrosia spicata (Walt.) Torr. & Gray	BP	50.8	7.3	3.43	0.001
Pterocaulon alopecuroideum (Lam.) DC.	BP	46.7	6.3	3.20	0.001
Coreopsis major Walt.	BP	40.0	6.0	3.01	0.001
Solidago odora Ait.	BP	40.0	6.2	3.31	0.001
Stylisma patens (Desr.) Myint	BP	40.0	6.2	3.26	0.001
Aster linariifolius L.	BP	33.3	5.7	3.15	0.001
Tragia L.	BP	33.3	5.8	3.29	0.001
Andropogon L.	BP	31.8	10.7	3.33	0.002
Diospyros virginiana L.	BP	30.6	12.2	3.13	0.001
Euthamia tenuifolia (Pursh) Nutt.	BP	26.7	5.3	3.45	0.001
Gaylussacia dumosa (Andr.) Torr. & Gray	BP	22.1	9.7	3.28	0.003
Hypericum crux-andreae (L.) Crantz	BP	21.1	12.3	3.12	0.012
Aster walteri Alexander	BP	20.0	4.9	3.41	0.012
Aster tortifolius Michx.	BP	20.0	4.8	3.47	0.015

Table A. 12. Species indicator values for unburned treatment combinations at the FMNF (UE=unburned ecotone, UH=unburned hardwood, UP= unburned pine).

Species	Treatment Combination	Indicator Value	Mean	S.Dev	P-value
Stellaria L.	UE	43.9	12.8	2.92	0.001
Robinia pseudoacacia L.	UE	33.3	6.7	3.42	0.001
Quercus pagoda Raf.	UE	27.4	10.9	3.38	0.002
Crataegus marshallii Egglest.	UE	25.9	9.2	3.27	0.002
Ulmus alata Michx.	UE	24.3	10.0	3.21	0.005
Mitchella repens L.	UE	20.4	17.7	1.57	0.007
Baptisia tinctoria (L.) R. Br. ex Ait. f.	UE	20.0	7.0	3.53	0.009
Wisteria frutescens (L.) Poir.	UE	20.0	6.7	3.52	0.009
Carpinus caroliniana Walt.	UH	36.8	13.4	2.94	0.001
Sabal minor (Jacq.) Pers.	UH	35.1	8.9	3.43	0.001
Smilax bona-nox L.	UH	34.9	14.4	2.81	0.001
Ampelopsis arborea (L.) Koehne	UH	34.7	13.0	2.91	0.001
Spiranthes odorata (Nutt.) Lindl.	UH	33.3	5.7	3.11	0.001
Ulmus rubra Muhl.	UH	30.9	11.6	3.16	0.001
Cyperus L.	UH	30.6	14.3	2.83	0.001
Toxicodendron radicans (L.) Kuntze	UH	29.7	15.5	2.68	0.001
Bignonia capreolata L.	UH	28.7	14.8	2.93	0.002
Campsis radicans (L.) Seem. ex Bureau	UH	28.4	9.5	3.30	0.002
Hydrocotyle bonariensis Comm. ex Lam.	UH	26.7	5.5	3.48	0.003
Sphenopholis pensylvanica (L.) A.S. Hitchc.	UH	25.6	7.4	3.37	0.001
Viola L.	UH	22.3	12.4	3.12	0.011
Berchemia scandens (Hill) K. Koch	UH	21.5	13.5	3.01	0.014
Smilax rotundifolia L.	UH	21.4	17.6	1.74	0.002
Euonymus americana L.	UH	20.5	11.5	3.16	0.010
Saururus cernuus L.	UH	20.3	6.1	3.07	0.003
Carya aquatica (Michx. f.) Nutt.	UH	20.0	4.8	3.29	0.007
Dichanthelium (A.S. Hitchc. & Chase) Gould	UH	20.0	17.8	1.47	0.020
Elephantopus tomentosus L.	UP	35.1	10.8	3.34	0.001
Galium aparine L.	UP	34.8	11.9	3.19	0.001
Galium hispidulum Michx.	UP	33.3	5.8	3.32	0.001
Parthenocissus quinquefolia (L.) Planch.	UP	31.6	15.2	2.63	0.001
Carya tomentosa (Lam. ex Poir.) Nutt.	UP	31.1	12.6	3.15	0.001
Vaccinium arboreum Marsh.	UP	31.1	9.4	3.47	0.001
Callicarpa americana L.	UP	29.4	12.6	3.27	0.001
Rhus copallinum L.	UP	28.0	8.4	3.28	0.001
Oxalis stricta L.	UP	25.7	9.5	3.26	0.002
Liquidambar styraciflua L.	UP	24.8	16.8	2.12	0.001
Vitis rotundifolia Michx.	UP	24.8	16.8	2.19	0.001
Euphorbia L.	UP	23.7	7.7	3.41	0.001
Pinus taeda L.	UP	23.5	17.1	2.07	0.001
Ilex opaca Ait.	UP	22.7	17.3	1.99	0.003
Desmodium Desv.	UP	21.8	9.0	3.38	0.006
Gelsemium sempervirens (L.) St. Hil.	UP	21.7	15.6	2.61	0.013
Cornus florida L.	UP	21.5	11.2	3.41	0.014

Table A. 13. Species indicator values for burned treatment combinations at the private plantation (BE=burned ecotone, BH=burned hardwood, BP=burned pine).

Species	Treatment Combination	Indicator Value	Mean	S.Dev	P-value
Smilax glauca Walt.	BE	26.0	14.5	3.65	0.007
Vernonia angustifolia Michx.	BE	25.8	8.0	4.33	0.010
Erechtites hieraciifolia (L.) Raf. ex DC.	BE	25.0	10.7	4.17	0.011
Dichanthelium (A.S. Hitchc. & Chase) Gould	BE	23.2	18.0	2.16	0.002
Rubus L., trailing	BE	21.8	12.0	4.02	0.032
Vitis rotundifolia Michx.	BE	21.5	11.7	3.96	0.033
Centella erecta (L. f.) Fern.	BE	20.8	9.2	4.40	0.018
Lyonia lucida (Lam.) K. Koch	BH	33.3	7.6	4.23	0.001
Smilax rotundifolia L.	BH	28.4	16.4	3.13	0.003
Lonicera L.	BH	27.8	7.9	4.15	0.002
Iris L.	BH	21.6	9.4	4.02	0.012
Viburnum nudum L.	BH	20.3	10.7	4.12	0.031
Eupatorium leucolepis (DC.) Torr. & Gray	BP	27.1	12.5	3.84	0.002
Ruellia caroliniensis (J.F. Gmel.) Steud.	BP	25.4	9.5	4.92	0.011
Centrosema virginianum (L.) Benth.	BP	22.8	9.9	5.06	0.024
Chamaecrista nictitans (L.) Moench	BP	22.8	9.9	5.06	0.024
Eupatorium rotundifolium L.	BP	21.3	8.5	4.04	0.013
Aster L.	BP	21.3	8.5	4.16	0.016
Pterocaulon alopecuroideum (Lam.) DC.	BP	21.3	8.6	4.20	0.016
Lespedeza cuneata (Dum.-Cours.) G. Don	BP	21.3	8.4	3.99	0.017
Andropogon glomeratus (Walt.) B.S.P.	BP	21.3	8.5	4.31	0.020
Botrychium biternatum (Sav.) Underwood	BP	21.2	8.6	4.35	0.028
Solidago stricta Ait.	BP	20.6	10.0	4.42	0.026
Desmodium ciliare (Muhl. ex Willd.) DC.	BP	20.0	6.7	4.04	0.012
Desmodium lineatum DC.	BP	20.0	6.7	4.14	0.017

Table A. 14. Species indicator values for unburned treatment combinations at the private plantation (UE=unburned ecotone, UH=unburned hardwood, UP= unburned pine).

Species	Treatment Combination	Indicator Value	Mean	S.Dev	P-value
Chasmanthium laxum (L.) Yates	UE	30.1	15.1	3.59	0.002
Bignonia capreolata L.	UE	23.5	7.9	4.24	0.014
Solidago L.	UE	18.2	6.5	3.83	0.045
Smilax laurifolia L.	UE	17.0	11.6	3.90	0.076
Persicaria hydropiperoides (Michx.) Small	UH	32.6	7.6	4.39	0.003
Quercus laevis Walt.	UH	28.1	13.4	4.20	0.007
Saururus cernuus L.	UH	25.8	8.1	4.04	0.003
Desmodium strictum (Pursh) DC.	UP	34.3	7.7	4.54	0.004
Diospyros virginiana L.	UP	31.8	14.6	3.51	0.002
Toxicodendron radicans (L.) Kuntze	UP	31.7	14.2	3.69	0.001
Aristida beyrichiana Trin. & Rupr.	UP	30.0	6.9	4.24	0.002
Campsis radicans (L.) Seem. ex Bureau	UP	29.9	15.9	3.41	0.003
Parthenocissus quinquefolia (L.) Planch.	UP	25.0	9.8	4.19	0.008
Quercus pagoda Raf.	UP	22.5	7.3	4.19	0.012
Pinus taeda L.	UP	22.3	18.2	2.18	0.010
Desmodium laevigatum (Nutt.) DC.	UP	21.9	8.8	4.42	0.008
Sida elliottii Torr. & Gray	UP	21.1	8.5	4.40	0.023
Myrica cerifera L.	UP	20.5	16.0	3.27	0.085
Carex floridana Schwein.	UP	20.0	6.7	4.01	0.032
Apocynum cannabinum L.	UP	20.0	6.7	4.06	0.037
Solidago rugosa P. Mill.	UP	20.0	6.8	4.21	0.041

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