

Composition and Structure of Bottomland Forest Vegetation at the Tiak Research Natural Area, McCurtain County, Oklahoma

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ABSTRACT

Although southeastern Oklahoma has substantial areas of bottomland forest, few studies exist of this vegetation type. We analyzed forest community structure at the Tiak Research Natural Area of the Ouachita National Forest on the Upper Gulf Coastal Plain. Vegetation data were collected from 24 12m x 8m macroplots. Percent cover data were recorded for ferns, fern-allies, and herbaceous angiosperms. Tree sapling and shrub species were recorded in diameter classes, and numbers of stems in estimated height classes were recorded for midlevel and canopy trees. One hundred fifty-two taxa of woody and herbaceous plants were encountered. *Toxicodendron radicans* and *Arundinaria gigantea* were the common understory species. *Acer rubrum*, *A. saccharum*, *Carpinus caroliniana*, *Carya alba*, *C. texana*, *Cornus florida*, *Fraxinus americana*, *Liquidambar styraciflua*, and *Nyssa sylvatica* were common as mid-level species. *Quercus lyrata* and *Q. phellos* were the most common canopy layer trees.

INTRODUCTION

The constituent tree species of bottomland forests in Oklahoma varies from east to west, as does the upland vegetation. Some tree species can be found in bottomland forests at most localities throughout the state, such as *Acer negundo*, *A. saccharum*, *Celtis laevigata*, *Fraxinus pennsylvanica*, and *Ulmus americana* (Bruner 1931, Blair and Hubbell 1938, Collins et al. 1981). But the most diverse assemblages of bottomland forest tree species occur in eastern Oklahoma, which is fostered by numerous oak species (i.e., *Quercus lyrata*, *Q. nigra*, *Q. michauxii*, *Q. pagoda*, *Q. palustris*, *Q. phellos*, and *Q. texana*). *Quercus lyrata*, *Q. michauxii*, and *Q. texana* are restricted to the Upper Gulf Coastal Plain (UGCP) extension of southeastern Oklahoma (Blair and Hubbell 1938). Other bottomland tree

species limited to this area are *Pinus taeda* and *Taxodium distichum* (Bruner 1931).

Despite the diversity of woody and understory species in the bottomland forests of the UGCP in southeastern Oklahoma, few vegetation studies have focused on this area. The dominant species in this forest type are water tolerant *Carya* and *Quercus* species, as well as *Acer rubrum*, *Liquidambar styraciflua*, and *Nyssa sylvatica* (Bruner 1931; Brabander, et al. 1985). A quantitative analysis of woody vegetation at the Little River National Wildlife Refuge (LRNWR), located in McCurtain County, identified three major forest types: *Quercus phellos*, *Carpinus caroliniana*, and *Taxodium distichum*. Co-dominant trees at the LRNWR included *A. rubrum*, *Liquidambar styraciflua*, and *Quercus alba* (Hoagland et al. 1996).

The objective of this study was to quantify species composition and aspects of forest community structure at the TRNA of

the Ouachita National Forest. The data collected are intended to serve as a baseline for analysis of temporal change in bottomland hardwood forests. This research area occupies 80.9 ha in North Caney Creek, McCurtain County, Oklahoma (Fig. 1). It was established in June of 1990 to protect the bottomland hardwood forest community and was the first Research Natural Area representing the Society of American Foresters (SAF) type 88 willow oak - water oak - diamondleaf oak cover type (Devall 1989).

The TRNA is located within the UGCP physiographic province of southeastern Oklahoma (Hunt 1974, Curtis et al. 2008). The region is composed of deep alluvial deposits underlain by limestones and shales of the Washita and Kiamichi formations (Davis 1960). Relief ranges from 100.9 to 102.1 m above sea-level. Soils are composed of deep alluvial deposits of Guyton silt loam group, a poorly drained soil type found on floodplains throughout southeastern McCurtain County (Reasoner 1974). The climate is Subtropical Humid (Trewartha 1968) with warm humid summers and a mean July temperature of 26.9 °C (80 °F) and short, mild winters with a mean January temperature of 4.0 °C (39 °F). Mean annual precipitation is 136 cm (53.5 in.; Oklahoma Climatological Survey 2009).

METHODS

In order to evaluate habitat structure and establish baseline stand conditions, it is necessary to collect data listing the species present, the number of individuals, and area occupied. These types of data are of use to ecologists, foresters, and zoologists, as well as botanists.

Prior to field data collection, the locations of macroplots were equidistantly spaced and established on a 1:24,000 scale topographic map. Macroplots were then located and established in the field. Plots were established in April of 1993 and data

collected in late April, mid July, and early October of the 1993 field season.

Understory Vegetation data were collected from units referred to as macroplots, each of which measured 12 m x 8 m with long axis oriented north to south. Microplots, measuring 1.0 m x 1.0 m, were placed in each corner of each macroplot. All species present in the microplot were recorded and percent cover visually estimated in 5% increments. The percent cover of bryophytes, forest litter, open water, and exposed soil was recorded. Cover data for ferns, fern-allies, and herbaceous angiosperms were also recorded.

Data for **Tree Saplings and Shrub** species were collected from a subplot within the macroplot measuring 8.0 m x 6.0 m (26.25 ft. x 19.69 ft). Woody species were assigned to the following classes based on diameter-at-breast-height (DBH): CL1 = 0 - 2.0 cm, CL2 = 2.1- 6.0 cm, and CL3 = 6.1 - 10.0 cm. These data were collected to characterize shrub composition and regeneration potential of canopy tree species.

Data for **Mid-level and Canopy** species were collected from the entire macroplot. The species names of all trees in the macroplot were recorded and the height of each estimated and assigned to the mid-level category, defined as trees and shrubs 3.0 - 15.0m in height; or "canopy", defined as trees in excess of 15.1 m in height. Taxonomy follows that of the USDA Plants Database (USDA-NRCS 2009). No voucher specimens were prepared.

RESULTS AND DISCUSSION

One hundred fifty-two taxa of woody and herbaceous plants were encountered at the TRNA in the 1993 field season. Thirty-four were trees or shrubs (22.4%), 12 woody vines (7.9%), and 106 were herbaceous plants (69.7%). There were 134 (89.3%) perennials, 11 (7.3%) annuals, and 6 (4.0%) biennials. *Carex* and *Quercus* were the

largest genera with 10 and 7 species, respectively. *Galium aparine*, *Lonicera japonica*, *Morus alba*, *Vicia villosa*, and *Trifolium dubium* were non-native species present at the TNRA. The Oklahoma Natural Heritage Inventory (2009) tracks nine species at the TRNA as state rare, though globally secure: *Aralia spinosa* (G5S1S2), *Aristolochia reticulata* (G4S2), *Bignonia capreolata* (G5S1), *Carex debilis* (G5S1), *Desmodium pauciflorum* (G5S1), *Justicia ovata* (G5S?), *Quercus texana* (G4G5S1), *Triadenum tubulosum* (G4S1S2), and *Uvularia sessilifolia* (G5S1). No federally listed threatened or endangered species were present.

Understory Vegetation

Of the 152 species encountered in the microplots, 44 (28.9%) were recorded from all three sample dates, 50 (32.9%) in two seasons, and 58 (38.2%) in one season only (Table 1). Of the taxa recorded in one season, 23 (39.7%) were in spring only, 21 (36.2%) in summer, and 14 (24.3%) only in fall. The highest mean covers were “litter” (49.2%) and “exposed soil” (16.20%).

Seven plant taxa scored annual mean cover values greater than 1.0%: *Toxicodendron radicans* (5.33%), *Arundinaria gigantea* (2.23%), *Vitis vulpina* (1.94%), *Parthenocissus quinquefolia* (1.75%), *Quercus phellos* seedlings (1.63%), *Carex* sp. (1.20%), and *Acer rubrum* (1.15%). A total of 11 *Carex* species were identified, with mean cover values ranging from 0.55% (*C. graviora*) to 0.01% (*C. laxiflora*).

Mean cover values for each sample period were comparable; spring, 41%; summer, 38%; fall, 33%. There was greater variance in the number of species encountered between sampling periods. The most species were recorded for the summer (108), followed closely by the spring (101), and fall (83). *Toxicodendron radicans* had the highest mean cover for all three sampling periods. In the spring, *T. radicans* (6.94%), *Parthenocissus quinquefolia* (3.5%), and *Vitis*

vulpina (3.46%) had the largest average cover. Likewise in the summer, *Toxicodendron radicans* (7.58%) had a substantially larger cover average value than *Arundinaria gigantea* (3.82%) and *Quercus phellos* seedlings (2.43%). Fewer species were recorded in the fall. Only in the fall data did other species outscore *T. radicans* in average cover: *A. gigantea* (2.01%), *Carex* sp. (1.74%), *Q. phellos* (1.65%) and *Q. nigra* (1.50%) seedling *T. radicans* (1.47%), and *Chasmanthium latifolium* (1.46%). Nevertheless, litter and bare ground had the highest percent cover in all seasons.

Tree Sapling and Shrub

Nineteen woody species and 281 stems were recorded in the shrub/sapling plots (Table 2). All 19 species were represented in CL1, but only 13 in CL2 and 10 in CL3. Nine species occurred in all three DBH classes; *Acer rubrum*, *A. saccharum*, *Carpinus caroliniana*, *Carya alba*, *C. texana*, *Cornus florida*, *Fraxinus americana*, *Liquidambar styraciflua*, and *Nyssa sylvatica*. With the exception of *C. texana*, these species are typical of bottomland forest habitats on the UGCP.

Each of the three species with 20 or more stems represents one level in the forest: *Rhododendron canescens*, shrub; *Ostrya virginiana*, mid-level; and *Nyssa sylvatica*, canopy. No tree species exceeded 20 stems in the remaining DBH classes. *Liquidambar styraciflua*, a species of second growth bottomland forests, had the greatest number of stems in CL2 and *Carpinus caroliniana*, a common understory tree of bottomland forests, in CL3.

Mid-level and Canopy

Twenty-three species and 3,797 stems were included in the two height categories (Table 3). Twelve species occurred in both the mid-level and canopy categories. Twenty-two species and the majority of stems (2,087; 55%) were in the mid-level category. *Liquidambar styraciflua* had the most

stems (385; 18.4%). The stem counts for *Acer rubrum* (275, 13.2%), *C. texana* (245, 11.7%), *Q. alba* (220, 10.5%), and *N. sylvatica* (210, 10.1%) were also high, but substantially less than *L. styraciflua*.

The canopy category consisted of 12 species and 1,710 (45%) stems. *Quercus texana* was the only species in the canopy category that was not in the mid-level category. *Quercus lyrata* (330 stems, 19.3%) and *Q. phellos* (315 stems, 18.4%) were the most abundant species in the canopy layer. *Quercus rubra* (265 stems, 15.5%) and *Liquidambar styraciflua* (260 stems, 15.2%) were also common in the canopy of TRNA. *Acer rubrum*, represented by 275 stems in the mid-level, had only 30 stems (1.8%) in the canopy. Of the most prominent trees in the mid-level, only *Quercus alba* had similar numbers of stems in the canopy (220 vs. 195).

CONCLUSIONS

Fewer woody plant species were found at the TRNA (27) than the Little River National Wildlife Refuge (LRNWR; 47; Hoagland et al. 1996). Furthermore, with the exception of *Asimina triloba* and *Rhododendron canescens*, all woody species reported from TRNA were present at the LRNWR. The disparity in species numbers is intriguing. Although the LRNWR is larger than the TRNA, it was sampled with fewer plots. The greater number of species at LRNWR might reflect a higher degree of habitat variability. The TRNA is predominately inundated to seasonally inundated habitat, but also includes upland vegetation, though limited to the southeast (plots 4, 5, 8, and 9) and northeast corners of the site (plots 19, 20, 21, and 22; see Fig. 1).

The macroplot approach adopted for this study was successful for assessing the predominant plant species present at the TRNA, and data collected from microplots for herbaceous species were informative.

However there are shortcomings in the types of data collected for woody plant species. Rather than assigning species to pre-established classes, actual measurement of tree and shrub DBH and height would allow for thorough analysis of woody species composition and forest structure. Likewise, a detailed inventory of vascular plants in the TRNA would benefit future monitoring projects.

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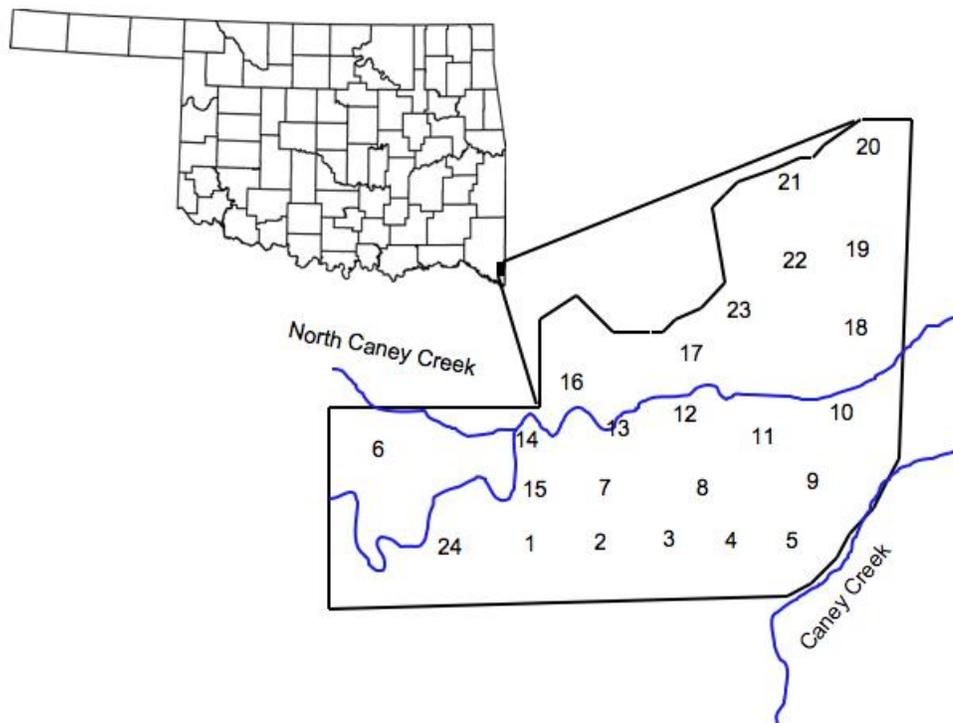


Figure Location of the Tiak Research Natural Area, Ouachita National Forest, McCurtain County, Oklahoma. Numbers indicate locations of macroplots.

Table 1 Species composition of microplots at the Tiak Research Natural Area, Ouachita National Forest, McCurtain County, Oklahoma. Columns denoted represent average cover value for all seasons (MEAN), number of macroplots (n=24) in which a species was encountered (FREQ), and percentage or relative frequency (RF) of macroplots in which a species occurred. The remaining columns provided the same data for the spring (April), summer (July), and fall (October) sampling periods.

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Acalypha rhomboidea</i>	0.04	2	8.3	0.02	1	4	0.01	1	4	0.10	1	4
<i>Acer rubrum</i>	1.15	19	79.2	1.42	14	58	1.29	12	50	0.74	14	58
<i>Acer saccharum</i>	0.24	7	29.2	0.04	1	4	0.38	5	21	0.30	6	25
<i>Agrimonia parviflora</i>	0.09	2	8.3	0.23	2	8	0.04	1	4	0.00	0	0
<i>Agrostis hyemalis</i>	0.08	3	12.5	0.00	0	0	0.13	2	8	0.10	3	13
<i>Allium canadense</i>	0.14	5	20.8	0.41	6	25	0.00	0	0	0.00	0	0
<i>Aralia spinosa</i>	0.01	1	0.0	0.00	0	0	0.04	1	4	0.00	0	0
<i>Arisaema dracontium</i>	0.01	2	8.3	0.04	2	8	0.00	0	0	0.00	0	0
<i>Aristida sp.</i>	0.23	1	4.2	0.00	0	0	0.68	2	8	0.00	0	0
<i>Aristolochia reticulata</i>	0.04	2	8.3	0.00	0	0	0.05	1	4	0.06	2	8
<i>Arundinaria gigantea</i>	2.23	11	45.8	0.84	9	38	3.82	8	33	2.01	10	42
<i>Asimina triloba</i>	0.20	4	16.7	0.17	3	13	0.13	3	13	0.30	4	17
<i>Athyrium filix-femina</i>	0.01	1	4.2	0.04	1	4	0.00	0	0	0.00	0	0

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Berchemia scandens</i>	0.56	11	45.8	0.56	8	33	0.54	7	29	0.58	10	42
<i>Betula nigra</i>	0.03	1	4.2	0.00	0	0	0.00	0	0	0.10	1	4
<i>Bignonia capreolata</i>	0.28	5	20.8	0.00	0	0	0.26	3	13	0.59	5	21
<i>Boehmeria cylindrica</i>	0.30	4	16.7	0.00	0	0	0.78	5	21	0.12	4	17
<i>Botrychium virginianum</i>	0.11	5	20.8	0.05	1	4	0.00	0	0	0.27	7	29
<i>Callicarpa americana</i>	0.19	6	25.0	0.04	1	4	0.25	6	25	0.27	7	29
<i>Campsis radicans</i>	0.39	8	33.3	0.00	0	0	0.61	5	21	0.56	8	33
<i>Carex complanata</i>	0.55	15	62.5	1.54	14	58	0.00	0	0	0.10	1	4
<i>Carex debilis</i>	0.36	6	25.0	1.07	1	4	0.00	0	0	0.00	0	0
<i>Carex gravida</i>	0.65	18	75.0	0.81	11	46	0.51	10	42	0.63	12	50
<i>Carex grayi</i>	0.07	1	4.2	0.00	0	0	0.22	1	4	0.00	0	0
<i>Carex intumescens</i>	0.38	11	45.8	0.74	8	33	0.00	0	0	0.40	7	29
<i>Carex laxiflora</i>	0.01	0	0.0	0.00	0	0	0.02	1	4	0.00	0	0
<i>Carex lupulina</i>	0.54	15	62.5	0.10	2	8	1.35	13	54	0.18	2	8
<i>Carex oligocarpa</i>	0.18	9	37.5	0.00	0	0	0.43	8	33	0.10	1	4

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Carex sp.</i>	1.20	21	87.5	1.67	1	4	0.19	2	8	1.74	14	58
<i>Carex squarrosa</i>	0.03	3	12.5	0.04	1	4	0.06	2	8	0.00	0	0
<i>Carex tribuloides</i>	0.28	5	20.8	0.00	0	0	0.83	1	4	0.00	0	0
<i>Carpinus caroliniana</i>	0.39	10	41.7	0.42	5	21	0.38	6	25	0.39	4	17
<i>Carya alba</i>	0.05	4	16.7	0.02	1	4	0.13	3	13	0.00	0	0
<i>Carya aquatica</i>	0.05	3	12.5	0.11	2	8	0.04	1	4	0.00	0	0
<i>Carya sp.</i>	0.19	9	37.5	0.15	5	21	0.00	0	0	0.42	10	42
<i>Carya texana</i>	0.26	12	50.0	0.23	3	13	0.45	12	50	0.10	1	4
<i>Cercis canadensis</i>	0.05	1	4.2	0.06	1	4	0.00	0	0	0.10	1	4
<i>Chasmanthium latifolium</i>	0.05	2	8.3	0.00	1	4	0.15	2	8	0.00	0	0
<i>Chasmanthium laxum</i>	0.40	8	33.3	0.05	1	4	1.14	9	38	0.00	0	0
<i>Chasmanthium sessiliflorum</i>	0.53	10	41.7	0.00	0	0	0.12	2	8	1.46	11	46
<i>Clitoria mariana</i>	0.04	2	8.3	0.00	0	0	0.05	2	8	0.08	2	8
<i>Convolvulus sp.</i>	0.02	1	4.2	0.00	0	0	0.06	2	8	0.00	0	0
<i>Cornus florida</i>	0.15	7	29.2	0.24	6	25	0.21	3	13	0.00	0	0

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Crataegus marshallii</i>	0.17	2	8.3	0.26	3	13	0.12	3	13	0.14	3	13
<i>Desmodium nudiflorum</i>	0.07	2	8.3	0.00	0	0	0.10	2	8	0.10	1	4
<i>Desmodium pauciflorum</i>	0.03	1	4.2	0.00	0	0	0.00	0	0	0.10	2	8
<i>Desmodium sp.</i>	0.08	4	16.7	0.00	0	0	0.13	4	17	0.10	1	4
<i>Dichanthelium acuminatum</i> var. <i>fasciculatum</i>	0.01	2	8.3	0.00	0	0	0.03	2	8	0.00	0	0
<i>Dichanthelium boscii</i>	0.18	12	50.0	0.03	1	4	0.52	12	50	0.00	0	0
<i>Dioscorea quaternata</i>	0.68	16	66.7	0.95	10	42	0.98	14	58	0.10	1	4
<i>Diospyros virginiana</i>	0.07	3	12.5	0.11	2	8	0.00	0	0	0.08	2	8
<i>Elephantopus carolinianus</i>	0.12	6	25.0	0.00	0	0	0.23	5	21	0.13	5	21
<i>Elephantopus tomentosus</i>	0.01	2	8.3	0.00	0	0	0.04	1	4	0.00	0	0
<i>Elymus virginicus</i>	0.02	0	0.0	0.05	1	4	0.00	0	0	0.00	0	0
<i>Euonymus americana</i>	0.16	7	29.2	0.07	2	8	0.27	6	25	0.13	4	17
<i>Fraxinus americana</i>	0.07	3	12.5	0.13	1	4	0.04	1	4	0.05	1	4
<i>Galium aparine</i>	0.07	5	20.8	0.13	2	8	0.08	3	13	0.00	0	0

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Galium circaezans</i>	0.08	3	12.5	0.24	4	17	0.00	0	0	0.00	0	0
<i>Galium concinnum</i>	0.14	6	25.0	0.42	6	25	0.00	0	0	0.00	0	0
<i>Geum canadense</i>	0.15	6	25.0	0.26	3	13	0.10	3	13	0.10	2	8
<i>Gillenia stipulata</i>	0.01	1	4.2	0.00	0	0	0.02	1	4	0.00	0	0
<i>Gratiola neglecta</i>	0.03	2	8.3	0.08	2	8	0.00	0	0	0.00	0	0
<i>Hypericum hypericoides</i>	0.17	6	25.0	0.05	1	4	0.15	5	21	0.29	7	29
<i>Hypericum mutilum</i>	0.03	0	0.0	0.00	0	0	0.00	0	0	0.10	0	0
<i>Hypericum punctatum</i>	0.03	1	4.2	0.00	0	0	0.00	0	0	0.10	1	4
<i>Ilex opaca</i>	0.14	4	16.7	0.11	3	13	0.17	3	13	0.14	4	17
<i>Impatiens capensis</i>	0.50	13	54.2	1.49	13	54	0.00	0	0	0.00	0	0
<i>Juncus coriaceus</i>	0.01	1	4.2	0.04	1	4	0.00	0	0	0.00	0	0
<i>Justicia ovata</i>	0.64	5	20.8	1.62	1	4	0.20	4	17	0.09	2	8
<i>Lactuca canadensis</i>	0.02	2	8.3	0.03	2	8	0.04	1	4	0.00	0	0
<i>Lactuca floridana</i>	0.03	3	12.5	0.06	2	8	0.02	1	4	0.00	0	0
<i>Lactuca sp.</i>	0.01	1	4.2	0.00	0	0	0.04	1	4	0.00	0	0

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Liquidambar styraciflua</i>	0.43	15	62.5	0.30	9	38	0.42	11	46	0.56	13	54
<i>Lonicera japonica</i>	0.03	2	8.3	0.00	0	0	0.00	0	0	0.08	3	13
<i>Maianthemum racemosum</i>	0.03	1	4.2	0.06	1	4	0.02	1	4	0.00	0	0
<i>Matelea biflora</i>	0.08	3	12.5	0.23	3	13	0.00	0	0	0.00	0	0
<i>Mitchella repens</i>	0.23	7	29.2	0.11	3	13	0.15	2	8	0.44	6	25
<i>Monarda punctata</i>	0.02	1	4.2	0.00	0	0	0.00	0	0	0.05	1	4
<i>Monarda sp.</i>	0.03	1	4.2	0.00	0	0	0.00	0	0	0.10	1	4
<i>Monarda russeliana</i>	0.01	0	0.0	0.00	0	0	0.04	1	4	0.00	0	0
<i>Morus alba</i>	0.05	2	8.3	0.04	1	4	0.02	1	4	0.10	1	4
<i>Morus rubra</i>	0.03	1	4.2	0.00	0	0	0.00	0	0	0.10	1	4
<i>Muhlenbergia sp.</i>	0.03	2	8.3	0.00	0	0	0.08	2	8	0.00	0	0
<i>Nyssa sylvatica</i>	0.12	6	25.0	0.00	0	0	0.31	5	21	0.05	2	8
<i>Oligoneuron nitidum</i>	0.19	0	0.0	0.09	2	8	0.26	1	4	0.20	2	8
<i>Onoclea sensibilis</i>	0.02	2	8.3	0.04	1	4	0.01	1	4	0.00	0	0
<i>Ostrya virginiana</i>	0.42	8	33.3	0.50	7	29	0.66	5	21	0.10	1	4

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Oxalis stricta</i>	0.13	9	37.5	0.40	10	42	0.00	0	0	0.00	0	0
<i>Packera obovata</i>	0.02	2	8.3	0.02	1	4	0.04	1	4	0.00	0	0
<i>Panicum anceps</i>	0.25	12	50.0	0.56	10	42	0.00	0	0	0.19	5	21
<i>Parthenocissus quinquefolia</i>	1.75	16	66.7	3.50	15	63	1.64	12	50	0.10	1	4
<i>Passiflora lutea</i>	0.09	7	29.2	0.00	0	0	0.18	6	25	0.10	2	8
<i>Penstemon digitalis</i>	0.09	1	4.2	0.24	3	13	0.04	1	4	0.00	0	0
<i>Penthorum sedoides</i>	0.02	1	4.2	0.00	0	0	0.05	1	4	0.00	0	0
<i>Poa autumnalis</i>	0.14	9	37.5	0.31	7	29	0.11	2	8	0.00	0	0
<i>Podophyllum peltatum</i>	0.01	1	4.2	0.02	1	4	0.00	0	0	0.00	0	0
<i>Polygonatum biflorum</i>	0.01	1	4.2	0.00	0	0	0.01	1	4	0.00	0	0
<i>Polygonum hydropiperoides</i>	0.01	1	4.2	0.00	0	0	0.02	1	4	0.00	0	0
<i>Polygonum virginianum</i>	0.17	5	20.8	0.11	2	8	0.18	5	21	0.21	6	25
<i>Prunella vulgaris</i>	0.01	1	4.2	0.00	0	0	0.03	1	4	0.00	0	0
<i>Prunus serotina</i>	0.05	2	8.3	0.06	2	8	0.04	1	4	0.05	2	8
<i>Pycnanthemum tenuifolium</i>	0.04	1	4.2	0.08	2	8	0.04	1	4	0.00	0	0

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Quercus alba</i>	0.23	10	41.7	0.20	6	25	0.40	9	38	0.10	2	8
<i>Quercus lyrata</i>	0.05	4	16.7	0.00	0	0	0.10	5	21	0.06	1	4
<i>Quercus nigra</i>	0.92	17	70.8	0.32	7	29	0.95	13	54	1.50	13	54
<i>Quercus phellos</i>	1.63	20	83.3	0.83	18	75	2.43	13	54	1.65	10	42
<i>Quercus rubra</i>	0.02	3	12.5	0.05	3	13	0.01	1	4	0.00	0	0
<i>Quercus sp.</i>	0.33	16	66.7	0.36	11	4	0.00	0	0	0.62	11	46
<i>Quercus velutina</i>	0.11	1	4.2	0.33	1	4	0.00	0	0	0.00	0	0
<i>Ranunculus abortivus</i>	0.03	3	12.5	0.10	3	13	0.00	0	0	0.00	0	0
<i>Rhododendron canescens</i>	0.24	6	25.0	0.40	6	25	0.20	3	13	0.14	2	8
<i>Rosa sp.</i>	0.05	3	12.5	0.03	1	4	0.05	2	8	0.06	3	13
<i>Rubus trivialis</i>	0.29	9	37.5	0.38	6	25	0.20	2	8	0.30	6	25
<i>Salvia lyrata</i>	0.03	3	12.5	0.06	3	13	0.03	2	8	0.00	0	0
<i>Sanicula canadensis</i>	0.04	4	16.7	0.00	0	0	0.13	5	21	0.00	0	0
<i>Sassifras albidum</i>	0.03	1	4.2	0.07	1	4	0.02	1	4	0.00	0	0
<i>Saururus cernuus</i>	0.33	3	12.5	0.25	2	8	0.47	3	13	0.26	1	4

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Scleria oligantha</i>	0.18	8	33.3	0.00	0	0	0.55	9	38	0.00	0	0
<i>Sisyrinchium angustifolium</i>	0.01	1	4.2	0.03	1	4	0.00	0	0	0.00	0	0
<i>Smilax bona-nox</i>	0.24	14	58.3	0.34	10	42	0.37	9	38	0.00	0	0
<i>Smilax glauca</i>	0.32	16	66.7	0.05	1	4	0.15	3	13	0.76	17	71
<i>Smilax rotundifolia</i>	0.48	18	75.0	0.35	11	46	0.70	15	63	0.39	9	38
<i>Smilax</i> sp.	0.05	4	16.7	0.00	0	0	0.06	3	13	0.10	1	4
<i>Solidago</i> sp.	0.09	2	8.3	0.00	0	0	0.00	5	21	0.28	3	13
<i>Symphotrichum cordifolium</i>	0.02	1	4.2	0.00	0	0	0.05	1	4	0.00	0	0
<i>Symphotrichum praealtum</i>	0.08	3	12.5	0.05	1	4	0.18	4	17	0.02	1	4
<i>Symphotrichum pratens</i>	0.01	0	0.0	0.00	0	0	0.04	1	4	0.00	0	0
<i>Symphotrichum</i> sp.	0.18	4	16.7	0.10	1	4	0.02	1	4	0.41	4	17
<i>Thalictrum thalictroides</i>	0.02	1	4.2	0.03	1	4	0.04	1	4	0.00	0	0
<i>Tilia americana</i>	0.17	4	16.7	0.31	1	4	0.10	3	13	0.50	1	4
<i>Toxicodendron radicans</i>	5.33	21	87.5	6.94	19	79	7.58	18	75	1.47	16	67
<i>Tradescantia ohiensis</i>	0.10	2	8.3	0.23	3	13	0.06	2	8	0.00	0	0

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Triadenum tubulosum</i>	0.19	2	8.3	0.00	0	0	0.35	3	13	0.22	2	8
<i>Trifolium dubium</i>	0.03	0	0.0	0.00	0	0	0.00	0	0	0.10	1	4
<i>Ulmus alata</i>	0.03	2	8.3	0.00	0	0	0.00	0	0	0.08	2	8
<i>Ulmus rubra</i>	0.18	10	41.7	0.00	0	0	0.00	0	0	0.54	12	50
<i>Ulmus serotina</i>	0.11	5	20.8	0.10	1	4	0.21	6	25	0.00	0	0
<i>Uvularia sessiliflora</i>	0.01	1	4.2	0.04	1	4	0.00	0	0	0.00	0	0
<i>Vaccinium corymbosum</i>	0.05	2	8.3	0.04	1	4	0.10	1	4	0.00	0	0
<i>Vaccinium stamineum</i>	0.60	3	12.5	0.21	3	13	0.94	3	13	0.65	4	17
<i>Viburnum rufidulum</i>	0.02	1	4.2	0.06	1	4	0.00	0	0	0.00	0	0
<i>Vicia villosa</i>	0.02	2	8.3	0.05	2	8	0.00	1	4	0.00	1	4
<i>Viola bicolor</i>	0.33	13	54.2	0.99	13	54	0.00	0	0	0.00	0	0
<i>Viola pubescens</i>	0.01	1	4.2	0.02	1	4	0.00	0	0	0.00	0	0
<i>Viola sp.</i>	0.05	3	12.5	0.05	1	4	0.11	4	17	0.00	0	0
<i>Vitis aestivalis</i>	0.12	2	8.3	0.03	1	4	0.25	2	8	0.08	1	4
<i>Vitis vulpina</i>	1.94	19	79.2	3.46	13	54	1.02	13	54	1.34	18	75

	<u>ANNUAL</u>			<u>SPRING</u>			<u>SUMMER</u>			<u>FALL</u>		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
<i>Woodwardia areolata</i>	0.13	2	8.3	0.00	0	0	0.33	2	8	0.05	1	4
<i>Zizea aurea</i>	0.08	4	16.7	0.23	4	17	0.00	0	0	0.00	0	0
Bryophytes	4.61	8	33.3	3.87	5	21	5.95	8	33	4.01	7	29
Exposed soil	16.29	20	83.3	18.19	18	75	20.02	20	83	10.65	20	83
Organic litter	49.24	19	79.2	18.19	19	79	57.57	22	92	71.98	19	79
Pooled water	1.90	4	16.7	2.53	3	13	0.04	1	4	3.13	1	4

Table 2 Tree sapling and shrub species composition at the Tiak Research Natural Area, Ouachita National Forest, McCurtain County, Oklahoma. Columns denoted number of stems within each DBH class (CL1 = 0-2.0 cm, CL2 = 2.1-6.0 cm, and CL3 = 6.1-10.0 cm), number of macroplots (n=24) in which a species was encountered (FREQ), and percentage or relative frequency (RF) of macroplots in which a species occurred.

	<u>CL1</u>			<u>CL2</u>			<u>CL3</u>		
	#Stems	FREQ	RF	#Stems	FREQ	RF	#Stems	FREQ	RF
<i>Acer rubrum</i>	15	11	45.8	3	2	8.3	5	4	16.7
<i>Acer saccharum</i>	16	5	20.8	3	1	4.2	2	2	8.3
<i>Asimina triloba</i>	4	1	4.2	0	0	0.0	0	0	0.0
<i>Carpinus caroliniana</i>	19	8	33.3	7	7	29.2	8	7	29.2
<i>Carya alba</i>	11	6	25.0	7	6	25.0	6	5	20.8
<i>Carya aquatica</i>	1	1	4.2	0	0	0.0	0	0	0.0
<i>Carya texana</i>	12	9	37.5	9	6	25.0	2	2	8.3
<i>Cersis canadensis</i>	3	1	4.2	0	0	0.0	0	0	0.0
<i>Cornus florida</i>	6	3	12.5	1	1	4.2	1	1	4.2
<i>Euonymus americana</i>	1	1	4.2	0	0	0.0	0	0	0.0

	<u>CL1</u>			<u>CL2</u>			<u>CL3</u>		
	#Stems	FREQ	RF	#Stems	FREQ	RF	#Stems	FREQ	RF
<i>Fraxinus americana</i>	2	2	8.3	2	2	8.3	1	1	4.2
<i>Ilex opaca</i>	8	5	20.8	1	1	4.2	0	0	0.0
<i>Liquidambar styraciflua</i>	7	6	25.0	10	5	20.8	6	5	20.8
<i>Nyssa sylvatica</i>	25	12	50.0	8	5	20.8	5	4	16.7
<i>Ostrya virginiana</i>	21	9	37.5	1	1	4.2	0	0	0.0
<i>Quercus alba</i>	3	3	12.5	0	0	0.0	1	1	4.2
<i>Quercus nigra</i>	1	1	4.2	0	0	0.0	0	0	0.0
<i>Rhododendron canescens</i>	21	4	16.7	1	1	4.2	0	0	0.0
<i>Ulmus alata</i>	7	4	16.7	7	4	16.7	0	0	0.0
Total stems	184			60			37		

Table 3 Woody species composition within Mid-level and Canopy height classes at the Tiak Research Natural Area, Ouachita National Forest, McCurtain County, Oklahoma. Mid-level woody plants are defined as trees and shrubs 3-15 m in height and Canopy as trees in excess of 16 m. The first column in each category represents the number of macroplots (n=24) in which a species was encountered (FREQ), followed by the percentage or relative frequency (RF) of macroplots in which a species occurred, the total number of stems (#Stems) and mean number of stems (MStems) for a species.

	<u>Mid-level</u>				<u>Canopy</u>			
	FREQ	RF	#Stems	MStems	FREQ	RF	#Stems	MStems
<i>Acer rubrum</i>	10	42	275	11.4	0	0	30	1.2
<i>Acer saccharum</i>	3	13	55	2.3	0	0	0	0.0
<i>Carpinus caroliniana</i>	4	17	100	4.2	0	0	0	0.0
<i>Carya alba</i>	4	17	105	4.4	0	0	0	0.0
<i>Carya aquatica</i>	1	4	35	1.5	1	4	40	1.7
<i>Carya texana</i>	11	46	245	10.2	1	4	25	1.0
<i>Cornus florida</i>	3	13	15	0.6	0	0	0	0.0
<i>Euonymus americana</i>	1	4	20	0.8	0	0	0	0.0
<i>Fraxinus americana</i>		4	25	1.0	0	0	0	0.0
<i>Ilex opaca</i>	2	8	45	1.9	0	0	0	0.0

	<u>Mid-level</u>				<u>Canopy</u>			
	FREQ	RF	#Stems	MStems	FREQ	RF	#Stems	MStems
<i>Liquidambar styraciflua</i>	13	54	385	16.0	9	38	260	10.8
<i>Nyssa sylvatica</i>	10	42	210	8.8	2	8	45	1.9
<i>Ostrya virginiana</i>	2	8	65	2.7	0	0	0	0.0
<i>Quercus alba</i>	8	33	220	9.2	6	25	195	8.1
<i>Quercus lyrata</i>	3	13	65	2.7	7	29	330	13.8
<i>Quercus nigra</i>	1	4	15	0.6	2	8	60	2.5
<i>Quercus texana</i>	0	0	0	0.0	2	8	70	2.9
<i>Quercus phellos</i>	3	13	25	1.0	6	25	315	13.1
<i>Quercus rubra</i>	3	13	70	2.9	8	33	265	11.0
<i>Quercus sp.</i>	1	4	15	0.6	3	13	45	1.9
<i>Rhododendron canescens</i>	2	8	35	1.5	0	0	0	0.0

	<u>Mid-level</u>				<u>Canopy</u>			
	FREQ	RF	#Stems	MStems	FREQ	RF	#Stems	MStems
<i>Tilia americana</i>	2	8	17	0.7	0	0	0	0.0
<i>Ulmus serotina</i>	2	8	45	2.7	1	4	30	13.8
Total Stems			2,087				1,710	
