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Woody Vegetation of the Crystal Mountains Region

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ABSTRACT

Arms-length rectangle transects and nested quadrats were used to sample overstory, understory and shrub layers on south-facing mountains, north-facing mountains and flat areas along Collier and Montgomery Creeks in Montgomery County, Arkansas. Data were collected and used to calculate importance values for trees and density values for shrubs. These data indicate that the shortleaf pine-oak forest type occurs on south-facing mountains while variants of white oak-black oak-northern red oak type occur on north-facing mountains and flat areas. Beech (*Fagus grandifolia* Var. *caroliniana* [Loud.] Fern and Rehd.) is common along Collier Creek and is completely absent from Montgomery Creek watershed. The presence of beech in the Collier watershed, may be due to reduced evaporation caused by less west to east surface air movement.

INTRODUCTION

Numerous studies have been made of special areas in Arkansas such as Devil's Den State Park (Bullington, 1962), Crowley's Ridge (Clark, 1977), Roth and Konecny prairies (Irving and Brenholts, 1977), Grassy lake (Huffman, 1974), Mississippi delta (Putnam and Bull,1932) and the Black swamp (Fogleman, 1981). Many environmental inventories and impact statements have provided important information on vegetation in many river watersheds but in most of these studies lists of species have been prepared without showing community associations.

Literature reviews on the vegetation of Arkansas (Dale, 1963; Pell, 1980) list few reports of studies from the Ouachita Mountains Natural Division (Foti, 1974). Except for the study by Dale and Watts (1980) on the vegetation of Hot Springs National Park, information from this region of Arkansas is usually general and obtained from reconnaissance. A general description of Ouachita Mountain flora is given by Braun (1964).

The Crystal Mountains area has outstanding natural beauty of vegetation and terrain and has for many years provided the authors as well as many local residents with untold hours of pleasure. It is located at T3S, R24W and T3S, R25W in the Central Ouachita Mountains Subdivision of the Ouachita Mountains Natural Division (Foti, 1974). The sampling of plant communities was limited to Collier Creek and Montgomery Creek watersheds which are contiguous and separated by a divide located between Bear mountain and High Peak mountains. This region is greatly dissected by ravines between east-west mountains which rise 400 to 600 feet above creek channels.

The purpose of this study was to determine forest cover types, obtain information on the distribution of woody species and to compare the vegetation of similar areas of the Collier and Montgomery Creek watersheds.

METHODS

Norman and Caddo Gap Quadrangles (7.5 minute topographic maps, U.S. Department of the Interior Geological Survey) were used to select sites for three south-facing and three north-facing transects in each of the two watersheds (Collier Creek and Montgomery Creek). Each transect consisted of a continuous sequence of 2 x 25m arms-length rectangles (Penfound and Rice, 1957) from the base of a mountain to the top. Nested quadrats (Oosting, 1956; Phillips, 1959) were used to sample flat areas along streams (10 x 10 m for overstory and understory and 5 x 5 for shrubs) which were chosen by site inspection. During both types of sampling procedures, overstory and understory trees were named and measured (dbh) as they were encountered in sample plots. For purposes of this study, overstory formed the canopy; understory trees were distinctly shorter than canopy but more than fifteen feet in height and shrubs were considered as woody plants in the four to fifteen foot height range.

Field data for overstory and understory trees were converted to relative frequency, relative density and relative basal area. The relative values were than summed for each species to produce an importance value (Curtis and McIntosh, 1951). Data from three transects were compiled to form a composite picture of vegetation on south-facing and north-facing mountains in each watershed. Likewise, data from three sites were used to form a composite of vegetation on low flats and high flats in the two watersheds.

RESULTS AND DISCUSSION

Arkansas lies entirely within the temperate deciduous forest biome (Oosting, 1956) and forest cover for the Ouachita Mountains Natural Division is generally designated as Shortleaf Pine — Upland Hardwoods (Lang and Stevens, 1942; Braun, 1964) with combinations of various types of oaks and hickories mixed with pine as determined by moisture conditions (Moore, 1972; Pell, 1984). Dale and Watts (1980) identified four types of forest cover in the Hot Springs National Park. These were designated as Upland Hardwood, Pine-Oak Hickory, Oak Hickory-Pine and Mixed Forest and occurrence depended primarily on slope and exposure.

Moore (1972) lists Shortleaf Pine-Oak-Hickory and White Oak-Red Oak-Black Oak types as important or common forest cover types for the Ouachita Mountains.

South Facing Mountains

Shortleaf Pine *(Pinus echinata)* is the most dominant species on south-facing mountains in both Collier and Montgomery Creek Watersheds (Table 1). This is indicated by high importance values in both overstory and understory as well as significant presence in the shrub stratum. Northern red oak *(Quercus rubra)*, white oak *(Quercus alba)*, black oak *(Quercus velutina)* and post oak *(Quercus stellata)* are important secondary species. These data place the forest cover type on south-facing mountains of both watersheds as Type 76 (Shortleaf Pine-Oak) described by White (1980). However, Dale and Watts (1980) separate this type into Pine-Oak Hickory if pine has an importance value of 160 or more and Oak Hickory-Pine if Pine has an importance value less than 160

Table 1. Woody vegetation on south-facing mountains of Collier Creek and Montgomery Creek watersheds. Importance values are given for overstory (OS) and understory (US) species and density (#/ha) for shrubs (Sh).

SPECIES	COLLIER OS	US	Sh	MONTGOMERY OS	US	Sh
Pinus echinata Mill.	168.2	64.0	90	114.6	48.0	180
Quercus rubra L.	64.8	38.6	143	21.7	4.9	62
Quercus alba L.	32.6	36.2	52	60.4	37.6	21
Quercus velutina Lam.	-	-	-	32.7	18.1	10
Quercus stellata Wang.	3.6	7.7	-	27.4	33.8	-
Carya tomentosa Nutt.	16.5	19.0	138	-	25.2	72
Carya texana Buckl.	3.5	19.8	14	15.3	32.4	31
Quercus marilandica Muenchh.	7.5	27.7	33	5.1	24.6	36
Nyssa sylvatica Marsh.	-	55.2	329	11.9	37.2	477
Quercus falcata Michx.	-	-	-	5.8	-	-
Robinia pseudoacacia L.	-	-	24	5.3	5.9	-
Tilia americana L.	3.5	3.3	5	-	-	-
Acer rubrum L.	-	10.8	110	-	6.9	21
Cornus florida L.	-	3.9	19	-	10.6	41
Ostrya virginana (Mill.) Koch.	-	-	10	-	9.1	26
Liquidambar styraciflua L.	-	2.3	19	-	3.6	41
Amelanchier arborea (Michx. f.) Fern	-	2.6	43	-	-	21
Castanea ozarkensis Ashe.	-	-	-	-	2.2	5
Prunus serotina Ehrh.	-	2.1	5	-	-	15
Celtis laevigata Willd.	-	6.9	-	-	-	-
Vaccinium arboreum Marsh.	-	-	381	-	-	846
Sassafras albidum (Nutt.) Nees.	-	-	38	-	-	26
Diospyros virginiana L.	-	-	19	-	-	5
Viburnum rufidulum Raf.	-	-	14	-	-	10
Ulmus alata Michx.	-	-	14	-	-	15
Vaccinium sp.	-	-	-	-	-	139
Rhus copallina L.	-	-	14	-	-	21
Rhus glabra L.	-	-	-	-	-	51
Crataegus sp.	-	-	10	-	-	26
Prunus americana Marsh.	-	-	-	-	-	5
Aralia spinosa L.	-	-	10	-	-	-
Ulmus rubra Muhl.	-	-	5	-	-	-
Fraxinus americana L.	-	-	5	-	-	-

and the aggregate importance value of oaks and hickories is greater than that of pine. According to this designation, Pine-Oak Hickory type is present on south-facing mountains of Collier Creek watershed and Oak Hickory-Pine on south-facing Montgomery Creek mountains. When using data from transects, chance placement may easily account for either of these pine-oak types. Generally pine is concentrated at the middle region of these mountains but will fluctuate upward or downward according to steepness of slope. The importance values for shortleaf pine were 170, 195, 130 and 14, 179, 152, for the lower, middle and upper regions of Collier and Montgomery mountains respectively. Accordingly, white oak *(Q. alba)* is most important in both overstory and understory on the lower one-third, blackjack oak *(Q. marilandica)* reaches its greatest importance on the middle one-third and post oak *(Q. stellata)* on the upper one-third in these south-facing mountains.

North-facing Mountains

Dale and Watts (1980) considered an importance value of 75 or more to establish dominance for overstory species. Likewise, importance values of 25-74 indicated important secondary species. Due to greater diversity in understory species, an importance value of 50 or more should indicate dominance and 20-49 should designate important secondary species.

Northern red Oak *(Quercus rubra)* and white Oak *(Q. alba)* are overstory dominants on north-facing mountains (Table 2). Blackgum *(Nyssa sylvatica)* and mockernut hickory *(Carya tomentosa)* may in some areas attain the status of important secondary species. Northern red oak, white oak, and red maple *(Acer rubrum)* are dominant understory species as blackgum, mockernut hickory and red maple are important secondary species. The shrub stratum is dominated by young overstory and understory species as well as flowering dogwood *(Conrus florida)*, hophornbeam *(Ostrya virginana)*, witch-hazel *(Hamamelis sp.)*, azalea, *(Rhododendron sp.)* and basswood *(Tilia americana)*.

Importance values computed separately for overstory species on lower, middle and upper regions of these north-facing mountains show northern red oak to be an important dominant in all three while white oak is more important at the middle region and blackgum becomes more

Table 2. Vegetation on north-facing mountains of Collier Creek and Montgomery Creek watersheds. Importance values are given for overstory (OS) and understory (US) species and density (#/ha) for shrubs (Sh).

	COLLIER OS	US	Sh	MONTGOMERY OS	US	Sh
Quercus rubra L.	189.5	54.1	105	100.8	53.1	389
Quercus alba L.	61.6	51.8	133	105.7	84.0	106
Nyssa sylvatica Marsh.	13.8	35.5	571	43.4	37.7	856
Carya tomentosa Nutt.	-	32.6	190	28.0	39.6	172
Acer rubrum L.	13.5	67.0	286	5.2	42.1	889
Liquidambar styraciflua L.	10.5	3.2	24	5.3	8.4	39
* *Fagus grandifolia*	6.3	-	43	-	-	-
Pinus echinata Mill.	-	8.1	5	5.9	-	-
Fraxinus americana L.	-	-	24	5.3	-	150
Robinia pseudoacacia L.	4.8	8.2	14	-	-	-
Cornus florida L.	-	17.6	324	-	4.3	366
Ostrya virginana (Mill.) Koch.	-	5.9	100	-	17.5	1039
Magnolia acuminata L.	-	-	-	-	7.5	28
Magnolia tripetala L.	-	-	-	-	4.3	139
Amelanchier arborea (Michx. f.) Fern.	-	4.5	19	-	-	367
Carya texana Buckl.	-	2.6	-	-	4.3	39
Quercus stellata Wang.	-	2.3	-	-	-	-
Prunus serotina Ehrh.	-	2.3	38	-	-	22
Prunus americana Marsh.	-	2.3	-	-	-	-
Ulmus rubra Muhl.	-	2.0	14	-	-	-
Rhododendron sp.	-	-	-	-	-	733
Hamamelis sp.	-	-	229	-	-	561
Tilia americana L.	-	-	100	-	-	306
Asimina triloba (L.) Dunal.	-	-	5	-	-	244
Euonymus americanus L.	-	-	-	-	-	178
Hydrangea arborescens L.	-	-	-	-	-	72
Ilex vomitoria Ait.	-	-	62	-	-	-
Juniperus virginiana L.	-	-	29	-	-	* -
Carpinus caroliniana Walt.	-	-	-	-	-	33
Rhamnus caroliniana Walt.	-	-	-	-	-	22
Ulmus alata Michx.	-	-	24	-	-	-
Ulmus americana L.	-	-	-	-	-	17
Aralia spinosa L.	-	-	-	-	-	22
Bumelia lanuginosa (Michx.) Pers.	-	-	5	-	-	-
Pinus strobus L.	-	-	-	-	-	17
Sassafras albidum (Nutt.) Nees.	-	-	19	-	-	-
Platanus occidentalis L.	-	-	5	-	-	-
Viburnum rufidulum Raf.	-	-	5	-	-	-

* *Fagus grandifolia* Var. *caroliniana* (Loud.) Fern. and Rehd.

Table 3. Vegetation of low flat areas in Collier Creek and Montgomery Creek watersheds. Importance values are given for overstory (OS) and understory (US) species and density (#/ha) for shrubs (Sh).

SPECIES	COLLIER OS	US	Sh	MONTGOMERY OS	US	Sh
Carya cordiformis (Wang.) K. Koch	68.7	14.8	-	29.3	31.7	-
* *Fagus grandifolia*	49.3	37.1	400	-	-	-
Quercus alba L.	-	29.1	-	57.9	36.2	-
Liquidambar styraciflua L.	49.2	7.0	171	30.1	34.8	36
Quercus rubra L.	29.6	15.3	-	23.8	7.7	-
Quercus muehlenbergii Engelm.	22.3	-	-	30.7	6.7	-
Platanus occidentalis L.	21.7	-	-	24.1	-	-
Nyssa sylvatica Marsh.	17.2	8.2	-	43.0	-	291
Acer rubrum L.	14.0	24.7	57	7.6	-	-
Fraxinus americana L.	9.4	22.8	114	17.0	9.9	36
Tilia americana L.	-	9.6	171	19.0	9.9	764
Juglans nigra L.	-	-	-	9.6	-	-
Ulmus rubra Muhl.	9.4	-	-	-	-	-
Ostrya virginana (Mill.) Koch.	9.1	27.8	57	-	54.1	800
Carpinus caroliniana Walt.	-	37.8	57	7.6	34.6	436
Cornus florida L.	-	23.5	286	-	-	581
Cercis canadensis L.	-	16.3	57	-	-	-
Magnolia tripetala L.	-	12.4	229	-	26.8	73
Ulmus americana L.	-	7.0	-	-	6.7	36
Alnus rugosa (DuRoi) Spreng.	-	7.0	171	-	-	255
Carya tomentosa Nutt.	-	-	-	-	21.4	73
Morus rubra L.	-	-	-	-	13.9	-
Bumelia lanuginosa (Michx.) Pers.	-	-	-	-	5.3	36
Ilex opaca Ait.	-	-	114	-	-	-
Cornus Drummondi Meyer	-	-	57	-	-	-
Ulmus alata Michx.	-	-	57	-	-	-
Lindera Benzoin (L.) Blume	-	-	57	-	-	-
Asimina triloba (L.) Dunal.	-	-	-	-	-	800

* *Fagus grandifolia* Var. *caroliniana* (Loud.) Fern. and Rehd.

Table 4. Vegetation of high flat areas in Collier Creek and Montgomery Creek watersheds. Importance values are given for overstory (OS) and understory (US) species and density (#/ha) for shrubs (Sh).

	COLLIER			MONTGOMERY		
	OS	US	Sh	OS	US	Sh
Quercus rubra L.	106.9	18.1	-	26.0	-	-
Quercus alba L.	55.6	128.7	50	79.1	27.4	57
Nyssa sylvatica Marsh.	13.6	27.0	350	64.9	-	-
Liquidambar styraciflua L.	20.6	-	200	36.9	-	-
Pinus echinata Mill.	65.5	-	-	-	-	-
Carya tomentosa Nutt.	11.5	50.1	150	29.2	77.6	57
Carya cordiformis (Wang.) K. Koch	-	-	-	28.8	45.5	57
Fraxinus americana L.	10.4	-	50	15.7	19.1	571
* *Fagus grandifolia*	15.7	-	150	-	-	-
Magnolia acuminata L.	-	-	-	10.3	-	-
Acer rubrum L.	-	30.4	-	9.0	22.7	171
Magnolia tripetala L.	-	12.5	250	-	60.8	629
Ostrya virginiana (Mill.) Koch	-	11.5	50	-	-	1486
Tilia americana L.	-	8.8	150	-	-	286
Cornus florida L.	-	6.5	500	-	47.0	514
Sassafras albidum (Nutt.) Nees	-	6.5	50	-	-	-
Hamamelis sp.	-	-	150	-	-	114
Vaccinium arboreum Marsh.	-	-	100	-	-	-
Rhamnus caroliniana Walt.	-	-	50	-	-	-
Bumelia lanuginosa (Michx.) Pers.	-	-	50	-	-	-
Prunus americana Marsh.	-	-	50	-	-	-
Euonymus americanus L.	-	-	50	-	-	-
Carpinus caroliniana Walt.	-	-	-	-	-	228
Asimina triloba Dunal.	-	-	-	-	-	228
Quercus muehlenbergii Engelm.	-	-	-	-	-	114

* *Fagus grandifolia* Var. *caroliniana* (Loud.) Fern. and Rehd.

important on the upper region.

This cover type is classified as White Oak-Northern Red Oak, a variant of Type 52 (white oak-black-oak-northern red oak) which is probably climax in the Ozark-Ouachita highlands and highly variable in species composition of all strata (Sander, 1980).

Species composition on north-facing mountains of Collier and Montgomery Creek watersheds are very similar and differences are probably due to the great diversity and chance distribution in areas of this type. However, Eastern white pine *(Pinus strobus)* and cucumber magnolia *(Magnolia acuminata)* were not sampled or observed in Collier Creek watershed and beech *(Fagus grandifolia)* was not sampled or observed in Montgomery Creek watershed at any site (Tables 2, 3, and 4).

Flat Areas

Low flats (0-2 m above low water level) are subject to flooding but duration of flooding is usually short in the mountains. Overstory vegetation is diverse and does not show a dominant species in either watershed. Combinations of bitternut hickory *(Carya cordiformis)*, beech (in Collier only), sweetgum *(Liquidambar styraciflua)*, northern red oak, white oak, chinkapin oak *(Quercus muehlenbergii)* and blackgum may occur at different locations as important secondary species (Table 3). Any of these overstory species, hophornbeam *(Ostrya virginana)*, American hornbeam *(Carpinus caroliniana)* and umbrella magnolia *(Magnolia tripetala)* may be important secondary species in a diverse understory (Table 3). Any of these overstory and understory species and pawpaw *(Asimina triloba)*, flowering dogwood, American basswood, blackgum and alder *(Alnus rugosa)* may be present in a well developed shrub layer.

The woody vegetation of these low flat areas are similar to the mixed forest types described by Dale and Watts (1980).

High flats (2-10 m above low water level) are seldom if ever flooded but receive runoff from mountain slopes. Collier high flats show one dominant species (Northern red oak) while Montgomery high flats have white oak as a dominant. In both cases here these two species are important secondary species when not dominant (Table 4). Various combinations of shortleaf pine, blackgum, sweetgum, mockernut hickory and bitternut hickory may be associated as important secondary species. These overstory species, red maple, and flowering dogwood are important secondary species of the understory. In fact, umbrella magnolia and mockernut hickory are dominants in the Montgomery Creek watershed understory. The prolific shrub layer is mostly small overstory and understory species.

The forest cover type of these flat areas is modified northern red-oak-white oak (Type 52) where improved site conditions (moisture and soil) have increased diversity and decreased dominance. This is most easily seen in the species composition of high flats (Table 4). The vegetative cover of these two watersheds reflects the effects of decreasing moisture from the low flats which are the most mesic to high flats to north-facing mountain slopes to the most xeric south-facing mountains. Slope and exposure which greatly influence evaporation are responsible for different associations of species in the different areas.

Basically the forest cover types are the same in the Collier and Montgomery Creek Watersheds. Chance variations in species composition do occur within each watershed as well as betwen watersheds.

The most conspicuous difference is the presence of American beech (*Fagus grandifolia* Var. *caroliniana* [Loud.] Fern and Rehd.) in the Collier Creek watershed and its total absence from Montgomery Creek watershed. The sporatic occurrence of beech in the Ouachita Mountains is well known (Braun, 1964; Moore, 1972), and in this instance, it is common on low and high flats as well as precipitous slopes at low elevations along Collier Creek. It was not found to occur in these areas along Montgomery Creek even though they would appear to be environmentally similar. Harlow and Harrar (1968) state that beech is found on a wide variety of soil types but appears to be limited by moisture conditions particularly rapid surface drying. The ravines of Montgomery Creek are exposed to air movement from the west, southwest and northwest which could increase evaporation from soil and decrease relative humidity. Collier Creek ravines are not directly exposed to this prevailing air movement but are exposed to the south which would increase afternoon isolation. This slight difference in exposure could be controlling presence and absence of beech for it is well known that small difference in critical factors have profound effects near the edge of a species' range of distribution.

Eastern white pine *(Pinus strobus)* was sampled in a Montgomery north-facing mountain transect (Table 2). Scattered specimens ranging in size from seedlings to mature trees were observed in the Montgomery watershed, mostly on high flats. This species was not observed in Collier watershed. It was transplanted into the Montgomery watershed through a government project during the early 1900's (Personal communication from Bob McClane, a retired forester).

Other observed species of limited distribution which probably occur in both watersheds are filbert (*Corylus americana* Marsh.) along roadsides, Ozark chinkapin (*Castanea ozarkensis* Ashe.) on south-facing slopes and near top of mountains (Very limited), cucumber magnolia (*Magnolia acuminata* L.) which was very occasional on high flats and one small grove of leatherwood (*Dirca palustris* L.) on a well drained bank of Montgomery Creek.

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