Gleason, H. A. 1963. The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada. Vol. I, 482 pp.; Vol. II, 655 pp.; Vol. III, 586 pp. Third printing, slightly revised. Published for the New York Botanical Garden by Hafner Publishing Co., New York.
Hitchcock, A. S. and A. Chase. 1950. Manual of Grasses of the United States. U. S. Dept. of Agriculture Misc. Pub. No. 200. 1,051 pp.
Jones, S. B., Jr. and N. C. Coile. 1979. List of Georgia Plants in the University of Georgia Herbarium. Univ. of Georgia, Athens. 53 pp.
Mahler, W. F. 1970. Manual of the Legumes of Tennessee. Journ. Tenn. Acad. Sci. 45(3):65-96
McCollum, J. L. and D. R. Ettman. 1977. Georgia's Protected Plants. Georgia Dept. of Natural Resources, Atlanta. 64 pp.
Radford, A. E., H. E. Ahles and C. R. Bell. 1971. Manual of the Vascular Flora of the Carolinas. Univ. of North Carolina Press, Chapel Hill 1,183 pp.
Sharp, A. J., R. E. Shanks, H. L. Sherman and D. H. Norris. 1960. A Preliminary Checklist of Dicots in Tennessee. Univ. of Tennessee, Knoxville. (unpublished) 114 pp.
Small, J. K. 1933. Manual of the Southeastern Flora. Published by the author, New York. Reprinted in 1953 by the Univ. of North Carolina Press, Chapel Hill. 1,554 pp.
Tennessee Division of Geology. 1979. Geology of Hamilton Co., Tennessee. Bulletin 79. 128 pp.
Tennessee Heritage Program. 1977. Elements of Natural Diversity—Plants. Tennessee Dept. of Conservation, Nashville. 7 pp.
U. S. National Oceanic and Atmospheric Administration. 1978. Comparative Climatic Data Through 1977. National Climatic Center, Md. 99 pp.
Van Horn, G. S. 1980. Additions to the Cedar Glade Flora of Northwest Georgia. Castanea 45(2):134-137
_____ 1981. The Success of Alien Angiosperm Species in Chickamauga Battlefield. Journ. Tenn. Acad. Sci. 56(1):1-4

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FOREST CHARACTERIZATION AND BIOMASS ESTIMATES FOR TWO SITES ON THE CUMBERLAND PLATEAU

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ABSTRACT

Quantitative descriptions of stand characteristics and above- and belowground biomass for two *Quercus*-dominated watersheds have been developed. The two study sites are comparable in terms of species composition and biomass for the dominant forest cover type. Differences in species composition and biomass of the minor forest cover types appears to be primarily a function of topography and previous land-use.

INTRODUCTION

Small experimental watersheds which define practical ecosystems may be used to evaluate the impact of atmospheric emissions on individual ecosystem processes as well as the integrated response of the total system. Comparisons of biochemical data from natural ecosystems with those that have been impacted by man's activities can provide information about the functional efficiency of an ecosystem (Likens et al. 1977). As a first step in such a comparison, two similar forested watersheds typical of those found on the Cumberland Plateau were chosen as study sites. The purpose of this paper is to provide a quantitative description of species diversity, plant associations and above- and belowground biomass for the two sites.

STUDY AREAS

Location

The two study areas—Cross Creek and Camp Branch—are 19 and 95 km northwest of a coal-fired power plant located at Stevenson, Alabama. The Widows Creek Plant is a 1,958-megawatt installation, operational since 1952.

The Cross Creek Watershed is in the Marion-Franklin State Forest in Marion County, Tennessee (35°4′ N; 85°51′ W). The study area encompasses the major portion of the area drained by a tributary of the east fork of Cross Creek. The watershed occupies a total of 36 ha and ranges in elevation from 573.5 to 495.4 m.

The Camp Branch Watershed is in Fall Creek Falls State Park in Bledsoe County, Tennessee (35°38′ N; 85°18′ W). The study area encompasses the major portion of the area drained by the south fork of Camp Branch. The watershed occupies a total of 94 ha and ranges in elevation from 597.5 to 518.3 m.

Climate, Topography and Soils

The climate of the Cumberland Plateau is temperate and continental. Precipitation is well distributed over the year averaging 150 cm.

Topographically, the Cumberland Plateau has an undulating surface, submaturely dissected by young valleys. The upper third of the Camp Branch site is weakly dissected, resulting in broad areas with poorly drained soils (swales). As elevation along the main stream course drops below approximately 540 m, dissection increases rapidly with percent slope values ranging from 5 to 50. Swale development at Cross Creek is limited to narrow strips confined to the stream course and upper source areas. Degree of dissection and slope steepness also increase rapidly below 540 m.

Most of the upland soils are residual, having formed from weathered sandstone (Elder et al. 1958). With the exception of the swale soils, most soils are well drained, highly leached, acid, shallow, and low in fertility. The swale soils, formed from alluvium, remain at or above saturation for more than half the year.

Vegetation

The original upland vegetation of the plateau surface—dominated by white oak (*Quercus alba*), black oak (*Q. velutina*), hickory (*Carya spp.*) and sourwood (*Oxydendrum arboreum*)—has given way to poor quality second growth stands of white oak, scarlet oak (*Q. coccinea*) and post oak (*Q. stellata*) mixed with Virginia pine (*Pinus virginiana*) and shortleaf pine (*P. echinata*) at some locations (Braun 1950). Yellow poplar

(*Liriodendron tulipifera*), red maple (*Acer rubrum*) and sourwood are commonly found mixed with the mesophytic oaks in the swales and drainage ways (Caplenor 1965).

Smith (1977) described eight forest types on the flat to rolling surface of the plateau; while Wade (1977) described nine community types on ridgetops, upper slopes, cliff edges and dry, flat topographic positions on the rolling surfaces. Smith (1977) found red maple to be the most important species in draw and stream-site positions and white oak to be most important on lower and middle slope positions. Hinkle (1978) further confirmed the importance of white oak when he compared twelve upland forest types with twelve types from the ravines. He found red maple to dominate poorly drained sites and classified the dry forests into a variety of oak and pine cover type.

METHODS

A grid system was superimposed on each watershed area at a grid interval of 100 m. Mapping of the forest overstory was done from the ground using the grid system as a reference. Each grid square was classified according to dominant species and delineated on the map. A composite forest cover map was then created for each watershed (Fig. 1). The cover maps were used as a base for distributing 1-ha study plots to obtain quantitative data on species compositions within each forest cover type. On both the Camp Branch and Cross Creek Watersheds, two sample plots were located in areas classified as upland oak-mixed hardwood, two were located in the mesic mixed hardwood type, two were located in the transition areas between these two cover types, and one was located in the pine cover type.

Each one-hectare study plot was subdivided into 100 ten by ten meter plots within which each woody stem 2.5 cm DBH and above was measured to the neast cm. Basal area (cm^2/ha), relative basal area, density, relative density, frequency and importance values were calculated for each species (Oosting 1956).

Measurements of diameter at breast height (DBH) were used to determine biomass values for components of each cover type through the use of whole-tree harvest regression techniques (Attiwill and Ovington 1968). A total of 30 trees representing 6 species were cut at the Cross Creek site for dimension analysis during the winter of 1977. Thirty trees representing 10 species were also harvested at the Camp Branch site during the same period. Trees were cut at ground level, the boles and branches cut into manageable units, and a fresh weight determined. Subsamples were taken for fresh to dry weight conversion and to partition the bole into bark, sapwood and heartwood. Subsamples were oven-dried at 80°C to a constant weight.

Estimates of root biomass were obtained by combining DHB regression to estimate root crown weights with core samples (Harris, Goldstein and Henderson 1973). Root core samples used to quantify the mass of roots occurring at distances greater than 50 cm from a tree base, were collected at 4 locations within 24 of the subplots used to quantify each forest cover type at both study sites. Samples were taken at depth intervals of 0-10, 10-30, 30-50, 50-70, and 70-100 cm. Cores were returned to the laboratory, oven-dried, and the roots extracted according to the procedure described by Kelly (1975). The root crown estimate is based on the extraction of ten root systems at each location. Each stump was freed of soil, trimmed to a diameter of 100 cm, and a fresh weight determined. Subsamples were then taken for oven-dry weight conversion. A DBH regression was then developed to estimate root crown weight according to the procedure of Harris et al. (1973).

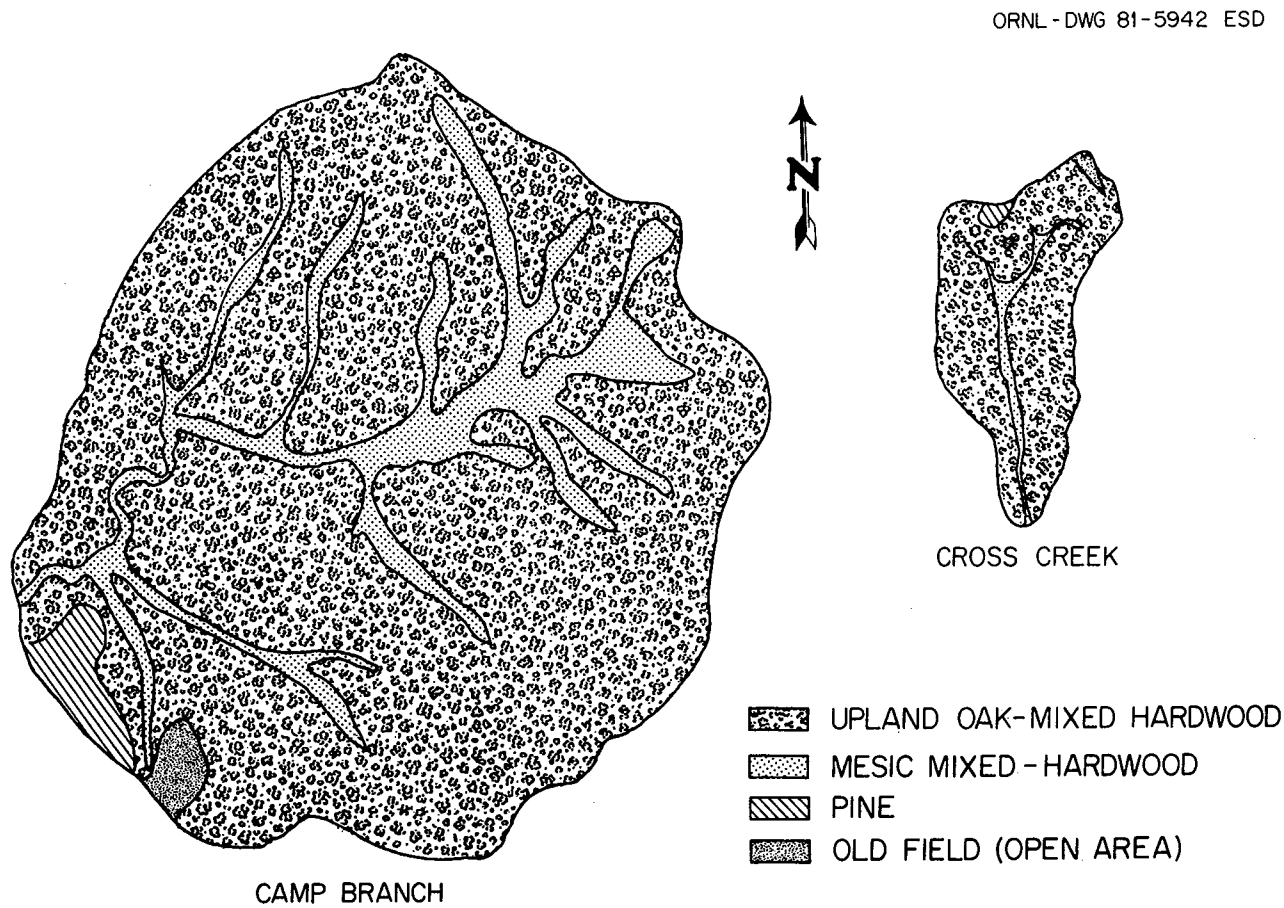

FIGURE 1. *Forest cover map, Camp Branch and Cross Creek Watersheds.*

Regression equations were developed by pooling the data sets from both study sites. Using the basic equation $\ln y = a + b \cdot \ln x$; where y is biomass (kg) of the tree component, x is DBH (cm), and a and b are regression constants. Actual values used are presented in Table 1. Branch weight was determined by the difference in the total tree weight and bole weight values.

TABLE 1. *Regression coefficient, R^2 values, and slope standard error values for Camp Branch and Cross Creek biomass equations.*

	a	b	R^2	Slope std. error
Total tree weight (kg)	—3.1455	2.3319	0.97	0.05
Bole weight (kg)	—3.1669	2.2996	0.96	0.06
Root crown weight (kg)	—0.8911	1.9428	0.93	0.20

History

The upland oak-mixed hardwood cover type dominates both watersheds contributing 85.9% of the total cover at Camp Branch and 91.3% at Cross Creek (Fig. 1). The other major cover types—mesic mixed hardwoods and pine—contribute 11.3 and 2.0%, respectively, at Camp Branch and 5.9 and 1.5% at Cross Creek. The remaining areas at both locations are old-field communities in early successional stages.

There is no evidence of disturbance on the Camp Branch site since the park was established in 1935. However, old roads and trails and the nature of the vegetation suggest that there has been extensive logging and some rowcrop agriculture. Agricultural activities were confined to the old-field and pine cover types. The forest cover at Cross Creek also reflects past logging and agricultural activities, but there are no indications of recent disturbance. Both sites appear to be similar in their previous land-use history and are also representative of the mixed oak forests of the Plateau.

Species Diversity

Fifty-one species of woody plants greater than 2.5 cm DBH occur on the two watersheds. Of these, 22 species occur on both watersheds, 18 only at Camp Branch, and 11 only at Cross Creek. Of the species found only on one watershed, only southern red oak (*Q. falcata*) and blackjack oak (*Q. marilandica*) have importance values greater than 1.0 (Tables 2, 3). Although Camp Branch exhibits a greater range of possible habitats in terms of soil type, exposure, and moisture relationships; greater species diversity is observed at Cross Creek. The extent, severity, timing, and amount of recovery from past disturbances may also contribute to the differences in diversity.

TABLE 2. *Basal area, relative basal area, density, relative density, and frequency values for the upland oak-mixed hardwood cover type on Camp Branch Watershed.*

Species	Basal area (cm^2/ha)	Relative basal area	Density	Relative density	Frequency	Importance value
Quercus coccinea	43,784	22.2	155	8.8	68	31.0
Quercus stellata	40,833	20.7	120	6.9	68	27.6
Quercus velutina	29,710	15.0	322	18.4	86	33.4
Quercus alba	16,006	8.1	199	12.3	59	20.4
Oxydendrum arboreum	15,763	8.0	206	12.7	59	20.7
Carya spp.	12,602	6.4	41	2.3	58	8.7
Quercus marilandica	8,168	4.1	41	2.3	25	6.4
Pinus virginiana	7,053	3.5	26	1.4	19	4.9
Quercus prinus	6,161	3.1	32	1.8	13	4.9
Quercus falcata	4,170	2.1	95	5.4	41	7.5
Acer rubrum	3,739	1.9	114	6.5	40	8.4
Cornus florida	3,137	1.6	121	6.9	43	8.5
Nyssa sylvatica	3,052	1.5	106	6.0	52	7.5
Sassafras albidum	2,469	1.2	165	8.6	61	10.0
Liriodendron tulipifera	198	0.1	2	0.1	1	0.2
Other species	174	<0.1	7	0.3		
Total:	19.70 (m^2/ha)		1752			

TABLE 3. *Basal area, relative basal area, density, relative density, and frequency values for the upland oak-mixed hardwood cover type on Cross Creek Watershed.*

Species	Basal area (cm^2/ha)	Relative basal area	Density	Relative density	Frequency	Importance value
Quercus alba	41,721	18.9	240	11.6	78.2	30.5
Carya spp.	35,317	16.0	143	6.9	66.2	22.9
Quercus prinus	31,544	14.3	150	7.3	51.8	21.6
Quercus velutina	28,383	12.9	104	5.0	53.6	17.9
Quercus coccinea	27,769	12.6	49	2.4	32.4	15.0
Oxydendrum arboreum	13,981	6.4	310	15.0	84.2	21.4
Acer rubrum	13,751	6.2	434	21.0	78.2	27.2
Nyssa sylvatica	8,622	3.9	149	7.2	61.2	11.1
Cornus florida	7,246	3.3	214	10.4	61.4	13.7
Quercus stellata	4,041	1.8	9	0.4	6.8	2.2
Sassafras albidum	2,494	1.1	120	5.8	42.8	6.9
Liriodendron tulipifera	2,034	0.9	14	0.7	8.2	1.6
Kalmia latifolia	775	0.4	77	3.7	15.6	4.1
Pinus echinata	748	0.3	3	0.2	0.4	0.5
Ilex opaca	548	0.2	5	0.2	2.2	0.4
Quercus alba x Q. stellata	465	0.2	2	0.1	1.6	0.2
Other species	888	<0.1	43	2.1		
Total:	22.03 (m^2/ha)		2066			

Plant Communities

Using basal area as a measure of dominance, both watersheds are dominated by oak species. A comparison of the estimates for the upland oak-mixed hardwood cover type (Tables 2, 3) indicates that scarlet oak is the dominant oak species at Camp Branch contributing 22.2% of the basal area and 8.8% of the density, while at Cross Creek White oak is the dominant with 18.9% of the basal area and 11.6% of the density. All species of oak combined contribute 51.1% of the basal area at Camp Branch and 60.8% at Cross Creek. Hickory with 16.0% of the basal area at Cross Creek and 6.4% at Camp Branch is the first and second largest non-oak contributor, respectively. Total basal areas calculated for the upland oak-mixed hardwood cover type are similar.

Oaks also dominate the basal area values in the mesic mixed-hardwood cover type (Tables 4, 5). White oak contributes 36.2% of the basal area in this forest type at Cross Creek and 22.4% at Camp Branch. Red maple is the largest contributor at Camp Branch with 44.7% of the basal area. It is evident (Tables 2, 3) that even though both of these areas have been mapped as the same forest cover type, there is little similarity in relative species importance. This difference in community development can probably be attributed to differences in topography and soils between the two sites. Soils in the mesic mixed-hardwood area at Cross Creek are better drained than their counterpart at Camp Branch. This drainage difference, along with other considerations, has had an impact on species composition and total basal area (Tables 4, 5). The difference in basal area is probably the result of a limited number of microsites suitable for seedling establishment and growth.

TABLE 4. *Basal area, relative basal area, density, relative density, and frequency values for the mesic mixed-hardwood cover type on Camp Branch Watershed.*

Species	Basal area (cm^2/ha)	Relative basal area	Density	Relative density	Frequency	Importance value
Acer rubrum	47,889	44.7	376	31.5	95	76.2
Quercus alba	23,937	22.4	199	16.7	69	39.1
Nyssa sylvatica	17,837	16.7	272	22.9	76	39.6
Liriodendron tulipifera	5,378	5.0	122	10.3	49	15.3
Quercus falcata	3,898	3.6	21	1.8	13	5.4
Quercus stellata	3,625	3.4	20	1.7	13	5.1
Oxydendrum arboreum	2,913	2.7	113	9.5	46	12.2
Liquidambar styraciflua	1,140	1.1	36	3.0	12	4.1
Tsuga carolinensis	180	0.2	1	0.08	1	0.2
Cornus florida	144	0.1	9	0.7	9	0.5
Carya spp.	121	0.1	7	0.6	5	0.7
Other species	215	<0.1	13	1.1		
Total:	10.71 (m^2/ha)		1189			

TABLE 5, *Basal area, relative basal area, density, relative density, and frequency value for the mesic mixed-hardwood cover type on Cross Creek Watershed.*

Species	Basal area (cm^2/ha)	Relative basal area	Density	Relative density	Frequency	Importance value
Quercus alba	79,335	36.2	319	20.6	89	56.8
Carya spp.	52,665	24.1	120	7.7	62	31.8
Quercus velutina	24,358	11.1	69	4.5	42	15.6
Cornus florida	17,317	7.9	362	23.4	92	31.3
Nyssa sylvatica	15,163	6.9	150	9.7	65	16.6
Acer rubrum	11,665	5.3	254	16.4	66	21.7
Oxydendrum arboreum	6,796	3.1	123	7.9	54	11.0
Quercus coccinea	6,358	2.9	8	0.5	8	3.4
Liriodendron tulipifera	2,655	1.2	69	4.5	27	5.7
Quercus prinus	2,038	0.9	23	1.5	23	2.4
Sassafras albidum	924	0.4	38	2.5	31	2.9
Prunus serotina	147	0.1	4	0.2	4	0.3
Amelanchier laevis	75	0.3	8	0.5	4	0.8
Total:	21.95 (m^2/ha)		1547			

On the Camp Branch Watershed, the Virginia pine cover type is the result of succession from rowcrop agriculture (Table 6). The large number of small hardwoods under the pine are early invaders of a hardwood forest. Tree age indicates that the field has been abandoned at least fifty years.

On the Cross Creek site the pine area (Fig. 1) is a small segment of a loblolly pine (*P. taeda*) plantation. This plantation, established in 1957, has a total basal area value of 121.58 m^2/ha) (Table 7), compared to 41.83 m^2/ha in the Camp Branch pine type. This difference can be attributed primarily to the high stocking rate in the loblolly plantation.

TABLE 6. *Basal area, relative basal area, density, relative density, and frequency values for the pine cover type on Camp Branch Watershed.*

Species	Basal area (cm^2/ha)	Relative basal area	Density	Relative density	Frequency	Importance value
Pinus virginiana	327,535	78.3	1220	39.6	100	178.3
Cornus florida	38,870	9.3	770	25.1	90	99.3
Acer rubrum	23,733	5.7	680	22.2	100	105.7
Liriodendron tulipifera	18,034	4.3	80	2.6	40	44.3
Oxydendrum arboreum	7,736	1.8	280	9.1	30	10.9
Juniperus virginiana	2,270	0.5	20	0.5	10	1.0
Nyssa sylvatica	212	0.1	30	0.9	30	0.9
Total:	41.83 (m^2/ha)		3080			

TABLE 7. *Basal area, relative basal area, density, relative density, percent relative density and frequency values for the pine cover type on Cross Creek Watershed.*

Species	Basal area (cm^2/ha)	Relative basal area	Density	Relative density	Percent relative density	Frequency	Importance value
Pinus taeda	1,078,080	88.7	1000	23.5	0.100	100	158.7
Sassafras albidum	110,310	9.0	1300	30.6	0.130	100	109.0
Oxydendrum arboreum	7,535	0.6	100	2.4	0.010	100	100.6
Nyssa sylvatica	5,350	0.4	350	8.2	0.035	100	100.4
Diospyros virginiana	5,100	0.4	450	10.6	0.045	100	100.4
Cornus florida	4,500	0.3	350	8.2	0.035	100	100.3
Liriodendron tulipifera	1,815	0.1	50	1.2	0.005	—	—
Other species	3,141	<0.1	650	15.3			
Total:	121.58 (m^2/ha)		4250				

Aboveground Biomass

Total aboveground biomass estimates in the upland oak-mixed hardwood cover type at 116,120 and 135,131 kg/ha at Camp Branch and Cross Creek, respectively (Table 8) are comparable to the 117,500 kg/ha estimate for an oak-hickory stand at nearby Walker Branch Watershed (Harris et al. 1973). Johnson and Risser (1974) report a somewhat higher value of 188,709 kg/ha for a post oak-blackjack oak forest in Oklahoma. The Walker Branch pine forest estimate (117,800 kg/ha) was approximately 38 and 48 kg/ha below the Cross Creek and Camp Branch values (Table 8).

Aboveground biomass estimates for the mesic mixed-hardwood cover type exhibit the greatest difference betwen sites of the three cover types compared (Table 8). The Camp Branch value is 2.3 times greater than the mesic site value (120,000 kg/ha) reported by Harris et al. (1973), while the Cross Creek estimate is approximately 75% of the Harris et al. (1973) value and 32% of the Camp Branch estimate. These differences may be partly explained by topographically-controlled soil moisture and fertility differences. The large difference observed between the Camp Branch and Cross Creek values may also be due to sampling error due to a relatively small number of samples in this cover type.

TABLE 8. *Aboveground biomass by component and cover type for the Camp Branch and Cross Creek Watersheds.*

	kg/ha									
	Upland oak-mixed hardwood		Mesic mixed-hardwood		Pine		Weighted total		Percent of weighted total	
Component	Camp Branch	Cross Creek	Camp Branch	Cross Creek	Camp Branch	Cross Creek	Camp Branch	Cross Creek	Camp Branch	Cross Creek
Heart	33,075	37,194	68,479	24,392	32,012	26,528	36,789	38,898	27.2	27.5
Sap	50,504	58,427	139,243	40,734	91,770	88,957	60,951	53,255	45.0	43.3
Bark	8,605	9,625	17,248	6,581	8,971	7,404	9,519	8,772	7.1	7.1
Branches	23,934	29,883	61,241	19,522	33,115	32,230	28,141	27,236	20.7	22.1
Total:	116,120	135,131	286,214	91,232	165,869	155,120	135,400	123,161		

Heartwood accounts for 28% of the total aboveground biomass in the upland oak-mixed hardwood cover type, sapwood 43%, bark 79% and branches 22% at both study sites. Harris et al. (1973) reported 77% of the biomass in boles and 23% in branches for the Walker Branch oak-hickory stand compared to 78 and 22% for both Plateau study sites. Johnson and Risser (1974) found 37% of the aboveground biomass in branches. In the mesic mixed-hardwood cover type there are small percentage differences in both heartwood (24 vs 27%) and sapwood (49 vs 45%) at Camp Branch and Cross Creek, respectively. Bark and branch values at 7 and 21%, respectively, are the same at both locations. The bole (79%) and branch (21%) contribution to total aboveground biomass was the same at Camp Branch, Cross Creek, and Walker Branch (Harris et al. 1973). The relative values from the pine cover type are quite similar for both study locations with heartwood contributing 19% of the total at Camp Branch and 17% at Cross Creek. Sapwood percentage at Camp Branch was 55% and 57% at Cross Creek. Bark (5%) and branch (21%) values were identical at both sites. Two observations can be drawn from these data relating to community development. One, the relatively large percentage of sapwood occurring in all three cover types at both study locations would suggest young aggrading systems; and second, since the percentage distributions for the

most part are quite similar within individual cover types, it appears the aboveground parts of the systems are aggrading at approximately the same rate.

Belowground Biomass

Total belowground biomass in the upland oak-mixed hardwood cover type at Cross Creek was 30% higher than at Camp Branch (Table 9), compared to a 15% difference between the two sites in aboveground biomass (Table 8). Comparison of fibrous root distribution with depth (Table 9) indicates a tendency toward a higher concentration of roots in the top 30 cm of the profile at both sites, with 65% of the root mass occurring in this layer at Camp Branch and 49% at Cross Creek. The total belowground biomass estimate for Camp Branch was comparable to the 49,800 kg/ha reported by Harris et al. (1973) and 17% higher than the value of Johnson and Risser (1974).

TABLE 9. *Belowground biomass values by cover type and depth for the Camp Branch and Cross Creek Watersheds.*

kg/ha

Component	Depth (cm)	Upland oak-mixed hardwood		Mesic mixed-hardwood		Pine		Weighted total		Percent of weighted total	
		Camp Branch	Cross Creek	Camp Branch	Cross Creek	Camp Branch	Cross Creek	Camp Branch	Cross Creek	Camp Branch	Cross Creek
Fibrous roots	0-10	15,464	18,445	19,328	19,790	9,878	19,950	15,665	16,815	34.1	27.6
	10-30	14,711	15,022	7,385	9,270	14,146	17,702	13,753	13,692	29.9	22.4
	30-50	6,253	10,646	6,392	13,494	2,775	11,913	6,149	9,706	13.3	15.9
	50-70	3,626	10,272	2,983	8,634	1,480	11,359	3,481	9,362	7.6	15.4
	70-100	3,801	9,868	2,171			1,566	3,510	8,990	7.7	14.8
Root crown		2,840	2,574	7,200	2,094	6,201	3,016	3,377	2,346	7.3	3.9
Total:		46,697	66,828	45,461	53,284	34,482	65,509	45,935	60,911		

Belowground biomass estimates for the mesic mixed-hardwood cover type are more comparable than the upland oak values. The Cross Creek total value is 15% higher than the Camp Branch total, or 45,461 vs 53,284 kg/ha. This is in direct contrast to the aboveground estimates where the Camp Branch value was 69% higher than the Cross Creek value (Table 8). Compared to the Walker Branch data of Harris et al. (1977), total belowground biomass is 21 to 32% higher at the Plateau sites. The distribution of fibrous roots in the top 30 cm of the soil profile is quite similar at both sites in this cover type with 59% of the fibrous roots occurring in the top 30 cm at Camp Branch and 55% at Cross Creek. Harris et al. (1977) found approximately 90% of the root mass in the top 30 cm of a mesic site soil on Walker Branch.

The pine forest cover type presents still another contrast with 70% of the fibrous root system located in the top 30 cm of the soil at Camp Branch compared to 58% at Cross Creek. In terms of total root biomass, the pine plantation at Cross Creek has approximately twice the mass of roots as the Camp Branch pine site, but 30 to 72% of the mass of a pine plantation studied by Harris *et al.* (1977).

Ratio of Below- to Aboveground Biomass

Roots constitute 29 and 33% of the total biomass in the upland oak-mixed hardwood cover type at Camp Branch and Cross Creek, respectively. These values are comparable to the 29% reported by Harris et al. (1973) for the oak-hickory cover type at Walker Branch. In the study reported by Johnson and Risser (1974), roots contributed only 18% of the total. In the mesic cover type, roots contribute 14% of total biomass at Camp Branch and 37% at Cross Creek, compared to 22% at Walker Branch (Harris et al. 1977). Pine values exhibit a similar trend at 17 and 30% compared to 19% at Walker Branch (Harris et al. 1977).

Rodin and Bazilevich (1967) report that the percentage contribution of roots to total biomass in deciduous stands tends to stabilize at 20% as total biomass approaches 300,000 kg/ha. For coniferous stands, Rodin and Bazilevich (1967) report a value of 22.5% when total biomass exceeds 75,000 kg/ha. Comparison of these values with those observed in this study would tend to further substantiate the observation that the forests at both Camp Branch and Cross Creek are young aggrading systems.

SUMMARY AND CONCLUSIONS

The data presented indicate that both study sites are dominated by mixed oak forests with limited areas of mesic hardwood and pine forest. The degree of disturbance at both sites appears to have been about the same and to have occurred during essentially the same time period. The data presented indicate that both sites represent systems which are aggrading at approximately the same rate. The two study sites appear to be reasonably comparable in terms of species composition and biomass estimates for the dominant forest type. However, unexplained differences in the magnitude of biomass allocation occur in the mesic mixed-hardwoods and pine cover types.

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LITERATURE CITED

Attiwill, P. M., and J. D. Ovington. 1968. Determination of forest biomass. Forest Sci. 14(11):13-15.

Braun, E. L. 1950. Deciduous forests of Eastern North America. The Blakiston Co., Philadelphia. 596 pp.

Caplenor, D. 1965. The vegetation of the gorges of the Fall Creek Falls State Park in Tennessee. Jour. Tn. Acad. Sci. 49(1):27-39.

Elder, J. A., E. K. Yates, I. B. Epley, and L. E. Odom. 1958. Soil Survey of Marion County, TN. USDA-SCS Series 1950, No. 2. 88 pp.

Harris, W. F., R. A. Goldstein, and G. S. Henderson. 1973. Analysis of forest biomass pools, annual primary production and turnover of biomass for a mixed deciduous forest watershed. IN H. Young (ed.), Proceedings of the Working Party on Forest Biomass of IUFRO. Univ. of Maine Press, Orono. pp. 41-64.

Harris, W. F., R. S. Kinerson, and N. T. Edwards. 1977. Comparison of belowground biomass of natural deciduous forest and loblolly pine plantations. Pedobiologia 17:382-388.

Hinkle, C. R. 1978. The relationship of forest communities and selected species to edaphic and topographic factors on the Cumberland Plateau in Tennessee. Ph.D. Dissertation, Univ. of Tennessee, Knoxville. 206 pp.

Johnson, F. L., and P. G. Risser. 1974. Biomass, annual net primary production, and dynamics of six mineral elements in a post oak-blackjack oak forest. Ecology 55:1246-1258.

Kelly, J. M. 1975. Dynamics of root biomass in two eastern Tennessee old-field communities. Amer. Midl. Natur. 94(1): 54-61.

Likens, G. E., F. H. Bormann, R. S. Pierce, J. S. Eaton, and N. M. Johnson. 1977. Biogeochemistry of a forested ecosystem. Springer-Verlag. New York. 146 pp.

Oosting, H. J. 1956. The study of plant communities. W. H. Freeman Co. San Francisco. 440 p.

Rodin, L. E., and N. I. Bazilevich. 1967. Production and mineral cycling in terrestrial vegetation. Oliver and Boyd. London. 288 pp.

Smith, L. R. 1977. The swamp and mesic forests of the Cumberland Plateau in Tennessee. M. S. Thesis, University of Tennessee, Knoxville. 121 pp.

Wade, G. L. 1977. Dry phase vegetation of the uplands of the Cumberland Plateau of Tennessee. M.S. Thesis, University of Tennessee, Knoxville. 116 pp.