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NATURAL HISTORY AND LAND USE HISTORY OF CUMBERLAND PLATEAU FORESTS IN TENNESSEE

SPECIAL REPORT NO. 06-01

FEBRUARY 2006

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PRESIDENT'S NOTE

Over the past decade, environmental advocacy groups have invested considerable time and effort in "market campaigns" against forest products companies and their customers. These campaigns are often based on allegations that the forestry practices of one or more companies are irresponsible and causing major harm to forest ecosystems in a particular area or region. The campaigners use websites, paid advertisements, and free press coverage to publicize their allegations and demands. They also seek direct contacts and negotiations with forest products companies and their customers.

Several environmental groups are supporting an ongoing campaign against forest products companies that manage woodlands and/or purchase wood on the Cumberland Plateau in Tennessee. The campaigners allege that companies are harvesting far too much wood on the Plateau and replacing too many acres of hardwood forests with pine plantations. The campaigners are pressuring paper purchasers to demand products that do not contain virgin fiber from the Cumberland Plateau.

This Special Report reviews the natural history of the Cumberland Plateau and what is known about the effects of human activities on Plateau forests in Tennessee. It is clear that intentional burning and other human activities have had major effects on these forests for many centuries. After 1950, fire control programs and other factors resulted in substantial changes in several measures of forest condition. These changes have been documented by the Forest Inventory and Analysis program (FIA) in the USDA Forest Service. FIA's 16-county Plateau survey unit encompasses most of the Plateau forests in Tennessee. Volume of forest growing stock in this unit increased by more than a factor of four between 1950 to 1999. Hardwood forest area increased from 1.4 million acres to 2.3 million acres during the same period, while the combined area of pine and pine-hardwood mixtures declined from 1.6 to 0.7 million acres. Total forest area remained fairly steady from 1950 to 1999 at about 3 million acres. Pine plantations occupied about 0.15 million acres in 1999 or about 5% of the total forest area. The annual rate of timber harvest increased sharply during the 1990s, but forest growth still exceeded harvest by a factor of two.

Recent trends in population growth, development, forest ownership, and other factors are raising new concerns about the future of forests and other natural resources on the Plateau. Effects of these trends on Plateau forests will become apparent in FIA data and reports. An FIA report summarizing data collected from 2000 to 2005 is expected in 2007.

Ronald A. Yeske

February 2006

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MOT DU PRÉSIDENT

Au cours de la dernière décennie, les groupes de défense de l'environnement ont consacré beaucoup de temps et d'efforts à la mise sur pied de « campagnes commerciales » contre des sociétés de produits forestiers et leurs clients. Ces campagnes reposent souvent sur des allégations selon lesquelles les pratiques d'une ou plusieurs sociétés sont irresponsables et causent de sérieux dommages aux écosystèmes forestiers d'un territoire donné ou d'une région particulière. Ces défenseurs de l'environnement font appel à des sites Web, à des publicités payées et aux reportages gratuits pour publiciser leurs allégations et leurs revendications. Ils cherchent également à prendre contact et à négocier directement avec les sociétés de produits forestiers et leurs clients.

Plusieurs groupes environnementaux soutiennent présentement une campagne en cours contre les sociétés de produits forestiers qui gèrent des territoires forestiers du Plateau Cumberland situés au Tennessee, achètent du bois récolté sur ce plateau ou l'obtiennent des deux façons. Ils allèguent que ces sociétés récoltent trop de bois sur le Plateau et remplacent un grand nombre d'acres de forêts de feuillus par des plantations de pins. Ils font pression sur les acheteurs de papier afin que ces derniers s'approvisionnent en papier qui ne contient aucune fibre vierge provenant du Plateau Cumberland.

Le présent rapport spécial examine l'histoire naturelle du Plateau Cumberland et les connaissances actuelles sur les effets des activités humaines sur les forêts du Plateau situées au Tennessee. Il est clair que le brûlage intentionnel et les autres activités humaines ont eu d'importantes répercussions sur ces forêts depuis de nombreux siècles. Après 1950, les programmes de protection contre le feu et d'autres facteurs ont donné lieu à des changements considérables dans un certain nombre de mesures de la condition des forêts. Le programme *Forest Inventory and Analysis* (FIA) du Service des forêts du département de l'Agriculture des États-Unis (*USDA Forest Service*) a permis de documenter ces changements. L'enquête réalisée dans le cadre du FIA avait une unité d'enquête de 16 comtés et comprenait la plupart des forêts du Plateau situées au Tennessee. Dans cette unité, le volume de matériel sur pied des forêts a augmenté de plus de 400 pourcent entre 1950 et 1999. La superficie des forêts de feuillus est passée de 1,4 millions d'acres à 2,3 millions d'acres au cours de la même période alors que la superficie combinée des forêts de pins et des forêts constituées d'un mélange de pins et de feuillus est passée de 1,6 à 0,7 millions d'acres. Entre 1950 et 1999, la superficie totale de la zone forestière est demeurée relativement la même à environ 3 millions d'acres. Le taux annuel de récolte forestière a soudainement augmenté au cours des années 90, mais la croissance de la forêt a quand même dépassé la récolte par un facteur de deux.

Les tendances récentes en matière de croissance de la population, de développement, de droits de propriété des forêts ainsi que d'autres facteurs font naître de nouvelles craintes concernant l'avenir des forêts et des autres ressources naturelles du Plateau. Les effets de ces tendances sur les forêts du Plateau se préciseront avec les données et les rapports du FIA. La publication d'un rapport du FIA qui résume les données recueillies entre 2000 et 2005 est prévue pour 2007.

Ronald A. Yeske

Février 2006

NATURAL HISTORY AND LAND USE HISTORY OF CUMBERLAND PLATEAU FORESTS IN TENNESSEE

SPECIAL REPORT NO. 06-01
FEBRUARY 2006

ABSTRACT

This report reviews the natural history of the Cumberland Plateau and the effects of human activities on Plateau forests in Tennessee. Information is synthesized by considering the physiography of the Plateau and the history of human influence on Plateau forests both pre- and post-European settlement. We also provide an intensive analysis of six cycles (1950-1999) of USDA Forest Service Forest Inventory and Analysis (FIA) data for the 16-county Cumberland Plateau survey unit.

The Plateau occupies more than two million acres in Tennessee. It can be divided into two parts: the Plateau surface and the escarpment. The surface and south-facing escarpment support forest types that tolerate dry conditions including pines, oaks, and mixtures of pines and hardwoods. Soil productivity is moderate to poor and tree growth is generally slow. These sites have a propensity to burn with frequencies and intensities that maintain disturbance-dependent species such as pines. The north-facing escarpment, upland depressions, and coves provide more mesic conditions for hardwood growth. Here fires are less frequent and less intense.

Harsh environmental conditions and inaccessibility limited human population growth and development on the Plateau. Native Americans used the Plateau mainly for hunting and other endeavors during the warmer months and generally did not build villages on the Plateau. Europeans also found that making a subsistence living on the Plateau was difficult and few people permanently inhabited the area initially.

The Cumberland Plateau, because of its location and topography, inhibited migrations from east to west. Western migration was predominantly via the Tennessee and Cumberland Rivers, not across the Plateau. Agricultural development was limited because most soils on the Plateau surface are of moderate to low fertility, with limited soil depth and moisture-holding capacity. The lack of surface water was also a limiting factor. The Plateau remains relatively sparsely populated, the largest community on the Plateau surface being Crossville with a population of 1,000 people in the 1900 Census and less than 10,000 people in the 2000 Census.

For more than 12,000 years, humans have affected the forests of the Plateau primarily through their use of fire, land clearing, and later through harvesting. Native Americans used fire to control ground vegetation, maintain openings, and improve grazing. With the introduction of European diseases, populations of Native Americans declined precipitously and forests grew for a time with minimal cultural influence. When Europeans arrived in the mid 1700s, many forests seemed undisturbed. Settlers subsequently cut, cleared, and burned frequently the forests again. The forests regrew again after much of the land was abandoned in the 1800s.

With the first railroad crossing the Plateau in 1900, markets for the region's coal and timber reserves developed rapidly. There was a local demand for timber for railroad crossties, mine props, and buildings as well as a regional market for building materials in more urban areas of Nashville, Chattanooga, and Atlanta. The best and most easily accessible material was harvested first. The greatest demand was for pine because of its straightness and lighter weight compared to hardwoods. This was a time of resource extraction, first to support economic expansion during the early 1900s, and subsequently as a source of funds during the Great Depression in the 1930s.

Plateau forest resources were depleted severely by heavy logging and by the chestnut blight during the first half of the 20th century. Most stands were relatively sparse and understocked. In 1950, average sawtimber stocking on forested lands was 1200 board feet per acre and average basal area was 54 square feet per acre. Fire protection programs and investments in tree planting helped the forests recover and regrow. By 1999, average sawtimber stocking had increased to 5600 board feet per acre and average basal area had risen to 101 square feet per acre. However, the effects of past misuse are still evident in many degraded stands in need of management.

When fire was common, pines were a major component of the Plateau forests. In recent decades, fire protection programs, southern pine beetle attacks, and natural forest succession from pines to hardwoods have reduced the extent of pine forests on the Plateau from more than 900,000 acres in 1950 to less than 300,000 acres today. There has been a corresponding increase in hardwood acreage.

The total amount of forest land in the Plateau counties was approximately 3 million acres throughout the period from 1950 to 1999. More recent information indicates a gradual reduction in forest land due to urbanization, development, and parcelization.

Most Plateau forests are privately owned. In 1999, 59% of the forest land in the Plateau counties was owned by private citizens; 13% was owned by corporations outside the forest products industry; and 17% was owned by forest industry (companies with wood processing facilities). Forest ownership by public agencies increased from 198,000 acres (6%) in 1971 to 332,000 acres (11%) in 1999.

Reliance on natural resources has long been an important aspect of the Cumberland Plateau's identity and economy. From coal mining and agriculture to forestry and resource-based tourism, residents and visitors alike recognize the value of natural resources to the Plateau. Recent debates have been centered on the status of these resources and the sustainability of current management activities. Available information suggests that the Cumberland Plateau will continue to be an important region for forestry and resource-based industries and tourism. The overall condition of Plateau forests in Tennessee is better today than it was fifty years ago. Current conditions and trends suggest that these forests are capable of providing a wide range of values into the foreseeable future.

KEYWORDS

biodiversity, ecology, FIA, fire, market campaigns

RELATED NCASI PUBLICATIONS

None

L'HISTOIRE DE L'ÉVOLUTION ET DE L'AMÉNAGEMENT DES FORÊTS DU PLATEAU CUMBERLAND SITUÉES AU TENNESSEE

RAPPORT SPÉCIAL NO. 06-01
FÉVRIER 2006

RÉSUMÉ

Le présent rapport examine l'histoire naturelle du Plateau Cumberland et les effets des activités humaines sur les forêts du Plateau situées au Tennessee. Il fait la synthèse des aspects de géographie physique du Plateau et l'histoire de l'influence humaine sur les forêts du Plateau avant et après l'établissement des Européens. Il contient également une analyse détaillée de six cycles (1950-1999) de données recueillies par le Service des forêts du département de l'Agriculture des États-Unis (*USDA Forest Service*) pour les 16 comtés du Plateau Cumberland faisant partie de l'unité d' enquête définie dans le cadre du programme *Forest Inventory and Analysis* (FIA).

Le Plateau occupe une superficie de plus de deux millions d'acres au Tennessee. Il se compose de deux parties : la surface du plateau et l'escarpement. Les forêts de la surface et de l'escarpement sud (forêts de pins, de chênes, et d'un mélange de pins et de feuillus) tolèrent des conditions sèches. La productivité du sol est modérée à faible et la croissance des arbres est généralement lente. Ces secteurs ont tendance à brûler à des fréquences et à des intensités qui favorisent la présence d'essences tributaires de milieux perturbés tels que le pin. L'escarpement nord, les dépressions des hautes-terres et les vallons encaissés offrent des conditions plus mésiques favorisant ainsi la croissance des feuillus. Dans ces secteurs, les feux sont moins fréquents et moins intenses.

Les conditions environnementales difficiles et l'inaccessibilité du territoire ont limité la croissance de la population humaine et son développement sur le Plateau. Les autochtones ont principalement utilisé le Plateau pour la chasse et pour d'autres activités durant les mois plus chauds et n'y ont généralement pas construit de villages. Les Européens ont aussi constaté qu'il était difficile de pourvoir à leur subsistance sur le Plateau. C'est pourquoi, peu de gens ont initialement habité ce territoire en permanence.

En raison de son emplacement et de sa topographie, le Plateau Cumberland a freiné la migration est-ouest des personnes qui passaient plutôt par les rivières Tennessee et Cumberland, et non par le Plateau. Le développement agricole était peu répandu car la plupart des sols de la surface du Plateau étaient peu ou moyennement fertiles, étaient peu profonds et avaient une faible capacité de rétention d'eau. Le manque d'eau à la surface constituait aussi un facteur limitatif. Le Plateau demeure encore un endroit relativement peu densément peuplé. La communauté la plus importante vivant sur la surface du Plateau est Crossville qui avait une population de 1 000 habitants lors du recensement de 1990 et moins de 10 000 lors du recensement de 2000.

Pendant plus de 12 000 ans, les humains ont exercé leur action sur les forêts du Plateau principalement par l'utilisation du feu, le défrichement et, plus tard, la récolte. Les autochtones se sont servis du feu pour contrôler la végétation au sol, maintenir des passages et améliorer les conditions de pâturage. Les maladies introduites par les Européens ont ensuite entraîné un déclin rapide des populations autochtones ce qui a permis aux forêts de croître pendant un certain temps avec un minimum d'influence culturelle. À l'arrivée des Européens au milieu du 18^{e} siècle, de nombreuses forêts semblaient intactes. Puis, les colons ont encore une fois coupé, éclairci et brûlé les forêts à maintes reprises. Au 19^{e} siècle, les colons abandonnaient une grande partie du territoire ce qui favorisait de nouveau la repousse forestière.

Lorsque la première ligne de chemin de fer a traversé le Plateau en 1900, les marchés pour le charbon et les réserves de bois de la région se sont développés rapidement. Il y avait une demande locale de bois pour la construction de traverses de chemin de fer, d'étançons de mine et de bâtiments et une demande régionale dans les régions plus urbaines de Nashville, Chattanooga et d'Atlanta pour des matériaux de construction. On récoltait en premier la matière ligneuse la meilleure et celle qui était la plus facilement accessible. L'essence la plus demandée était le pin parce que dernier était droit et plus léger que les feuillus. On a alors assisté à une période marquée par l'extraction de la ressource pour, initialement, soutenir l'expansion économique du début du 20e siècle, puis pour générer des revenus durant la crise des années 30.

La récolte intensive du bois et la brûlure du châtaignier ont grandement épuisé les ressources forestières du Plateau au cours de la première moitié du 20e siècle. Il restait peu de peuplements et ils étaient relativement déficients. En 1950, la densité relative moyenne du bois de sciage sur ces territoires forestiers était de 1 200 pieds mesure de planche par acre et la surface terrière moyenne était de 54 pieds carrés par acre. Des programmes de protection contre le feu et des investissements dans le reboisement ont contribué au rétablissement de la forêt et à sa repousse. En 1999, la densité relative moyenne du bois de sciage était de 5 600 pieds mesure de planche par acre et la surface terrière de 101 pieds carrés par acre. Malheureusement, l'impact de la mauvaise utilisation de la ressource dans le passé se voit encore dans de nombreux peuplements dégradés qui ont besoin d'être aménagés.

Durant les périodes où les feux étaient nombreux, le pin constituait l'essence principale des forêts du Plateau. Au cours des dernières décennies, les programmes de protection contre le feu, les infestations par le dendroctone du pin du sud et les changements naturels successifs entre le pin et les feuillus ont réduit l'étendue de la superficie des forêts occupées par le pin sur le Plateau qui était de plus de 900 000 acres en 1950 à moins de 300 000 acres aujourd'hui. On a également noté une augmentation proportionnelle dans le nombre d'acres de feuillus.

La superficie totale du territoire forestier dans les comtés se trouvant sur le Plateau était d'environ 3 millions d'acres au cours de la période allant de 1950 à 1999. Des données plus récentes indiquent qu'il y a une régression progressive du territoire forestier pour des raisons d'urbanisation, de développement et de morcellement du territoire.

La plupart des forêts du Plateau sont situées sur des terres privées. En 1999, les particuliers détenaient 59% du territoire forestier du Plateau tandis que les sociétés n'œuvrant pas dans l'industrie des produits forestiers en détenaient 13% et l'industrie (c'est-à-dire les sociétés ayant des installations de traitement du bois) en détenaient 17%. Les agences publiques ont augmenté la superficie des territoires forestiers qu'elles possèdent, passant de 198 000 acres (6%) en 1971 à 332 000 acres (11%) en 1999.

L'utilisation des ressources naturelles a longtemps été un aspect important de l'identité et de l'économie du Plateau Cumberland. Les résidents et les visiteurs reconnaissent la valeur des ressources naturelles du Plateau, de l'extraction du charbon à l'agriculture en passant par la foresterie et le tourisme axé sur les ressources. Récemment, le statut de ces ressources et la durabilité des activités actuelles d'aménagement ont fait l'objet de débats. Les renseignements présentement disponibles laissent penser que le Plateau Cumberland continuera à être une importante région pour la foresterie, les industries primaires et le tourisme. Les conditions globales des forêts de la partie du Plateau située au Tennessee sont meilleures aujourd'hui qu'il y a cinquante ans. Les conditions et tendances actuelles semblent indiquer que ces forêts ont la capacité d'offrir une plus-value dans un avenir rapprochée.

MOTS CLÉS

biodiversité, campagnes commerciales, écologie, feu, FIA

CONTENTS

TABLES

FIGURES

NATURAL HISTORY AND LAND USE HISTORY OF CUMBERLAND PLATEAU FORESTS IN TENNESSEE

1.0 INTRODUCTION

This report reviews the natural history of the Cumberland Plateau and the effects of human activities on Plateau forests in Tennessee. Our research supports two important conclusions: 1) Plateau forests have been disturbed severely and repeatedly by human activities for many centuries; and 2) Plateau forests are resilient and capable of providing a wide variety of goods and services in the future.

The analyses and conclusions in this report were synthesized from information that is available from literature searches and public data. Most of our pre-1900 information is from secondary sources, while most information for years after 1900 is from primary sources.

We begin by describing the physiography of the Cumberland Plateau (Section 2) and the prehistory of southern forests (Section 3). We then provide an overview of the early recorded history of the Cumberland Plateau landscape (Section 4) and a somewhat more detailed account of the Plateau's forests from 1900 to 1950 (Section 5). We conclude with an examination of Plateau forests since 1950 (Section 6) and some thoughts on the future (Section 7).

Sources and methods used in Section 6 merit some explanation. We relied heavily on peer-reviewed publications from the Forest Inventory and Analysis (FIA) program that is conducted by the USDA Forest Service. Analyses of trends are based on FIA surveys in 1948-1950 (Wheeler 1952), 1961 (Sternitzke 1962), 1971 (Hedlund and Earles 1971; Murphy 1972), 1980 (U.S. Dept. of Agriculture, Forest Service 1982; Birdsey 1983), 1989 (May and Vissage 1989; May 1991) and 1999 (Schweitzer 2000). We focus primarily on the Mid-Cumberland Plateau in Tennessee (Figures 1 and 2) (Smalley 1982) which occupies most of the area in 16 counties in FIA's Plateau Survey Unit (Figure 3) (Schweitzer 2000).

The area of the 16-county FIA Plateau Unit does not correspond directly with the physical Cumberland Plateau. The following observations were developed by comparing the Plateau Unit with the region's physiographic boundaries (Smalley 1979, 1982, 1983, 1984, 1986a).

1. Hamilton, Rhea, and Roane counties on the eastern escarpment are not within the Plateau FIA Unit.

2. All of Campbell County is in the Cumberland Mountains Physiographic Province, not the Cumberland Plateau. However, Campbell County is included in the Plateau FIA unit.

3. Some of Scott and Morgan Counties in the Plateau Unit are in the Cumberland Mountains; the remainder is on the Cumberland Plateau.

4. Coffee County has a small acreage of land on the Plateau, but is not included in the Plateau FIA unit.

5. More than half of the land area in Warren, White, Putnam, Pickett, Franklin, and Overton Counties on the west side of the Plateau Unit is in the Eastern Highland Rim physiographic province.

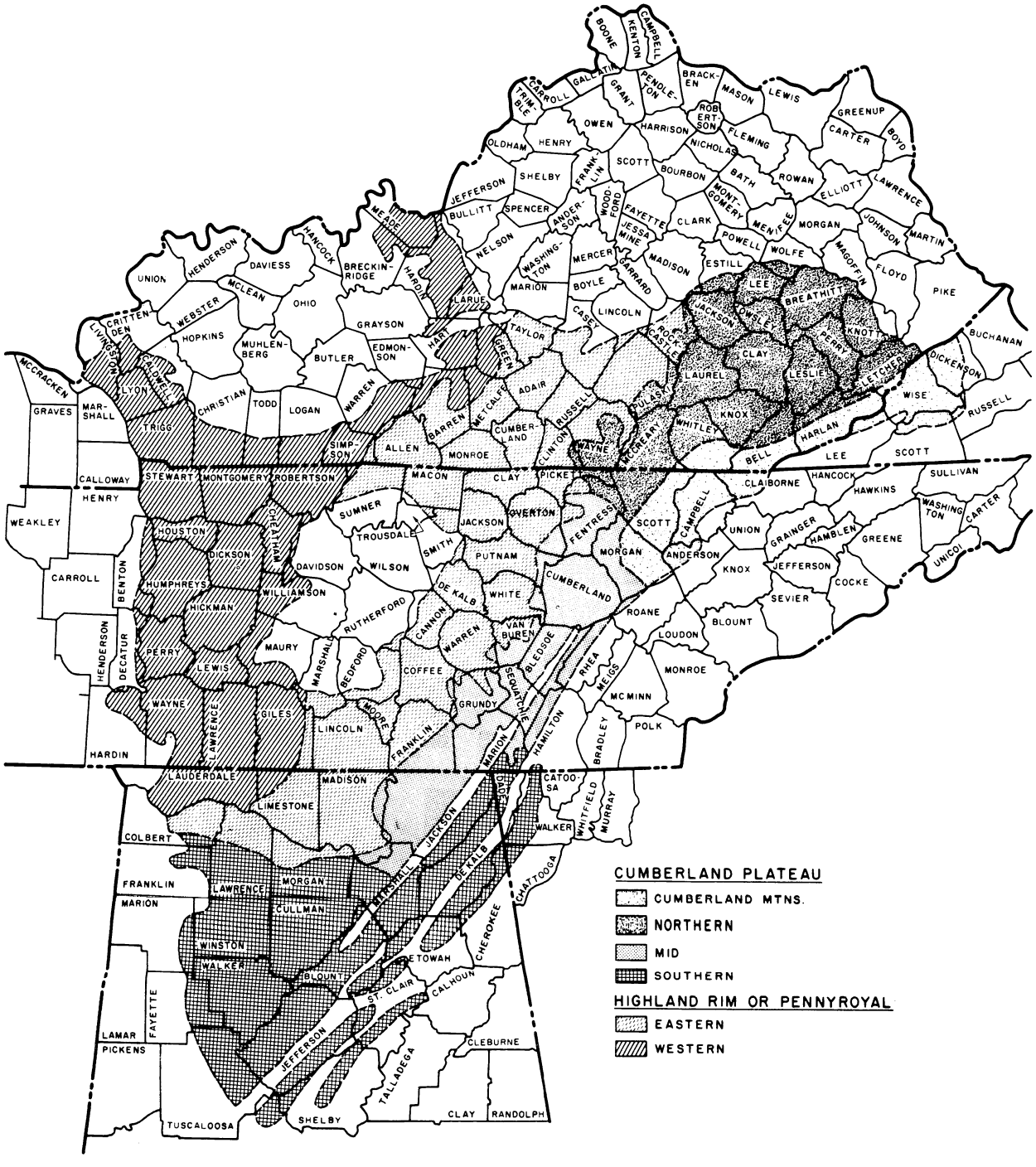

Figure 1. Physiographic Provinces and Regions of the Interior Uplands Consisting of the Cumberland Plateau and the Highland Rim or Pennyroyal (Smalley 1982)

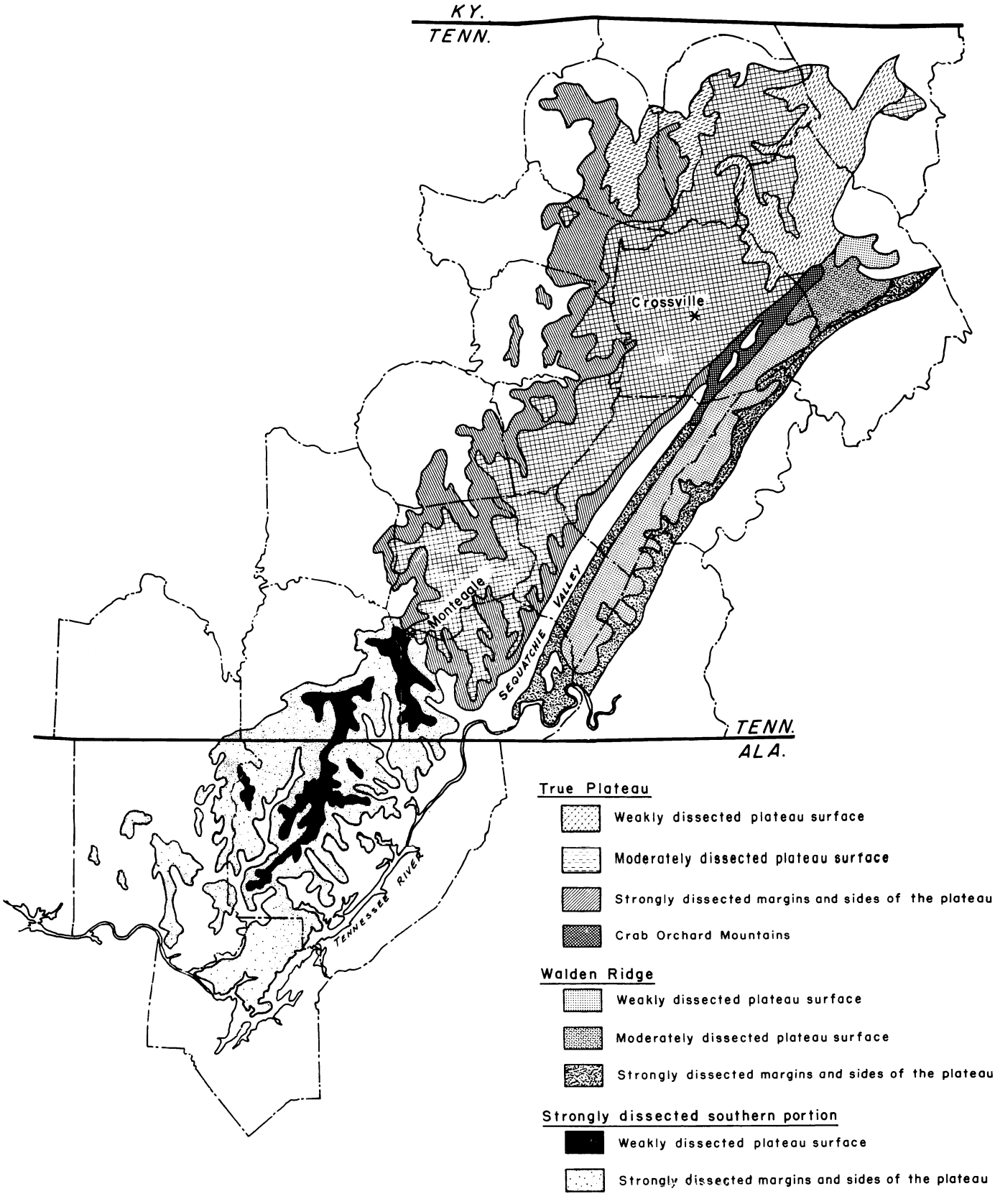

Figure 2. Subregions and Landtype Associations of the Mid-Cumberland Plateau Region (Smalley 1982)

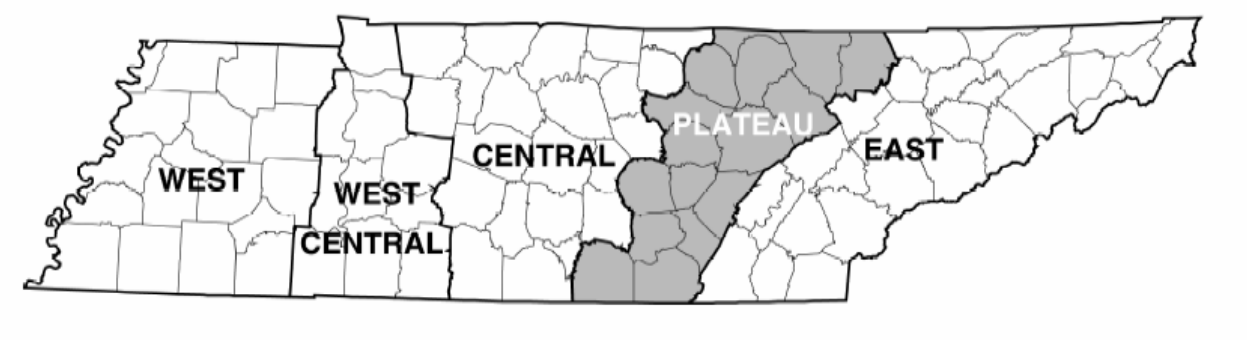

Figure 3. Forest Survey Regions in Tennessee (Schweitzer 2000)

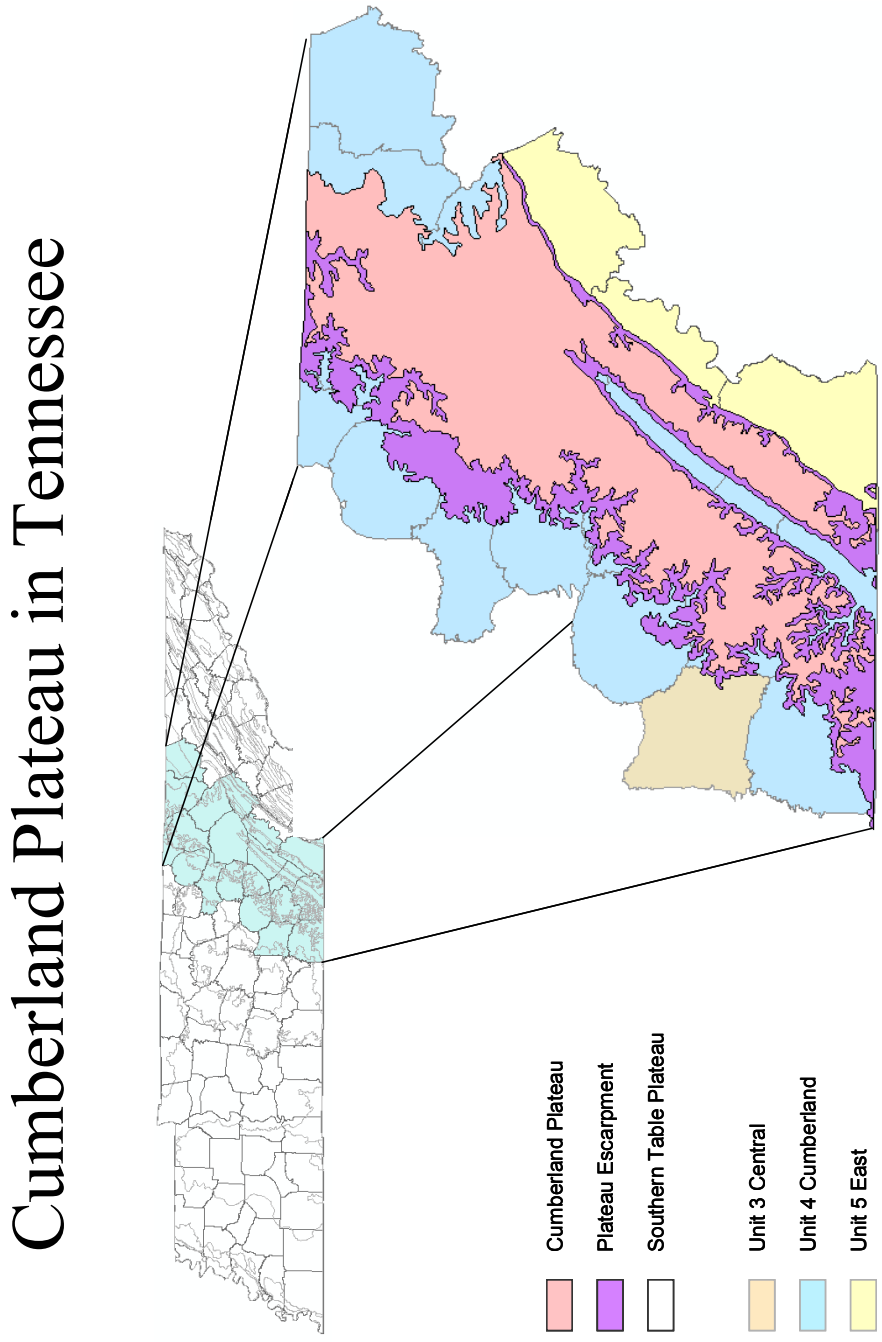

Figure 4. Cumberland Plateau Surface and Escarpment from EPA Ecoregion Coverage

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Ideally, we would be able to subdivide the FIA plot data and use only the plots that are located on the physical Plateau. Unfortunately, this was not feasible with limited resources because the raw data for older FIA surveys is stored in various formats and would be difficult to retrieve, sort, and recombine. Therefore, the only practical approach to trend analysis was to use published summary statistics for the Plateau Unit.

To evaluate the extent to which the FIA Plateau Unit represents the physical Plateau, the following procedure was used.

1. An Environmental Protection Agency (EPA) geographic information system (GIS) ecoregion digital coverage depicting the Plateau surface and the escarpment (physical Plateau) was overlaid on a digital coverage of the FIA Plateau unit (Figure 4).
2. The FIA plots surveyed in 1999 that occurred within the physical Plateau coverage were used to calculate forest statistics.

The physical Plateau coverage contained 519 FIA plots. Our analysis of these plots overestimated the total land area of the physical Plateau by 17,000 acres or about 0.3% of the total area. The total land area in the EPA GIS file for the physical Plateau is 2,920,000 acres versus the FIA county-based expansion factor plot area of 2,937,000 acres. These acreage totals exclude the Cumberland Mountains and the Sequatchie Valley (Figure 4).

We compared percentage acreage estimates of forest land, ownership and forest types between the 519 plots for the physical Plateau and the 786 plots for entire FIA Plateau Unit (Table 1).

Table 1. Comparison of Land Area Estimates from Two Datasets Containing 1999 FIA Survey Plots: The FIA Plateau Unit and the Physical Plateau EPA GIS Ecoregion Coverage. Numbers in parentheses are percentages of the total.

	FIA Plateau Unit	Physical Plateau
Number of FIA Plots	786	519
Total Land Area (acres M)	4403	2937
Forested Land excluding reserves (acres M)	2994 (71)	2344 (83)
Forest Types (acres M)		
Pine	340 (11)	284 (12)
Mixed Hardwood-Pine	376 (13)	425 (18)
Hardwood	2278 (76)	1635 (70)
Forest Ownership (acres M)		
Private, Non-Industrial	2164 (72)	1689 (72)
Industry	498 (19)	441 (17)
Public	332 (11)	215 (9)

The ownership and forest type percentages are similar for the two sets of plots. The proportion of forest land is slightly greater for the physical Plateau (82%) than for the entire FIA unit (71%). This difference was expected because agricultural and urban land uses are less prevalent on the Plateau than in adjacent areas.

Based on the above analysis, we conclude that the land area proportions between the two databases are similar enough that the FIA Plateau Unit statistics can be used to represent the forest resource estimates for the Cumberland Plateau. Thus, the authors are confident that the data and peer reviewed publications from the 16-county FIA Plateau Unit are the best available information to analyze forest resource trends and land use on the Cumberland Plateau in Tennessee.

In contrast, Natural Resources Defense Council (http://www.savebiogems.org/cumberland/) includes the Southern Appalachian Highlands in West Virginia, Virginia, North Carolina, South Carolina, and north Georgia as part of their Cumberland Plateau biogem. The Landscape Analysis Lab at the University of the South at Sewanee (http://lal.sewanee.edu/) based their study completed in 2002 on seven counties on the southern Plateau in Tennessee. Their analysis was limited to the Plateau surface; i.e., the escarpment and coves were excluded. Our data include the Plateau surface, coves, and escarpment, i.e., the commonly accepted geographic definition of the Plateau in Tennessee.

2.0 PHYSIOGRAPHY OF THE CUMBERLAND PLATEAU IN TENNESSEE

The Cumberland Plateau is the southern part of a large land mass that stretches from Pennsylvania to Alabama. The northern part (north of the watershed boundary of the Kentucky River in Kentucky) has traditionally been called the Allegheny Plateau while the southern part has traditionally been called the Cumberland Plateau (Fenneman 1938). A small northwestern part of the Allegheny Plateau was once glaciated during the Wisconsin Period.

2.1 Geology

The Cumberland Plateau is underlain by nearly level Pennsylvanian strata that were formed 285-325 million years before present (YBP). These strata are dominated by sandstones with siltstones, shales, and coal belonging to the Gizzard, Crab Orchard Mountains, and Crooked Fork Groups (Swingle et al. 1966). Below the Pennsylvanian rocks are older Mississippian strata (325-350 million YBP) dominated by limestone and dolomite with some siltstone, shale, and a thin strata of sandstone. Most of these Mississippian rocks are covered with colluvium. The Monteagle limestone is exposed only on the lower slopes of the Plateau escarpment and in river gorges. Below the Monteagle are the St. Louis and Warsaw limestone which form the rolling surface of the Eastern Highland Rim to the west of the Cumberland Plateau. These older Mississippian rocks plus Silurian and Ordovician strata (>350 million YBP) are exposed along the margins of the Sequatchie Valley anticline and along the plateau escarpment facing east into the Ridge and Valley province.

The Sequatchie Valley, which bisects the Plateau, is a subsidiary (deeper seated) break in the Cumberland Plateau overthrust system. Rocks from the southeast were pushed up over rocks to the northwest along a break that is now the east side of the Sequatchie Valley. This overriding block was folded into an arch or anticline. The southeast flank dips gently, but the northwest flank is steep and locally even vertical. Along most of the crest of this anticline, resistant Pennsylvania rocks were broken or finally eroded, exposing less resistant carbonate rocks, into which the Sequatchie River has cut. At the head of the Valley, Pennsylvania strata have been locally breached and erosion has cut into the underlying Mississippian carbonate rocks, forming Grassy and Crab Orchard Coves. Essentially, Grassy Cove is a 3800-acre sinkhole (Lane 1953). Northeast of these coves are the Crab Orchard Mountains, representing the unbreached portion of the Sequatchie Valley anticline. Other lower mountains (Peavine, Hatfield, Chestnut Ridge, and Cardiff Ridge) represent the remains of

surficial anticlines of the Cumberland Mountain overthrust sheet (Wilson and Stearns 1958). The Cumberland Mountains to the northeast are considered a separate physiographic province (Smalley 1984).

2.2 Topography

The Plateau is essentially a tableland bounded on both the east and west by sheer rock cliffs (escarpment). The eastern escarpment is relatively straight while the western escarpment is irregular with numerous coves. The Plateau surface is weakly to moderately dissected with undulating to rolling topography. The Plateau surface averages 1700 to 2000 ft. above sea level, but declines southward to less than 1500 ft. in northern Alabama. Some crests of ridges, particularly the Crab Orchard Mountains, exceed 2000 ft. Highest elevations are associated with the mountains at the northern end of the Sequatchie Valley. Several peaks exceed 2600 ft; Hinch Mountain is the highest with an elevation of 3040 ft. The floor of Grassy Cove is about 1600 ft. Topography ranges from gentle to rugged and complex, and slope varies from nearly level to very steep. Depressions are common on the undulating Plateau surface. Sinkholes have developed along the ragged western edge and on the deeply dissected southern portion, where the sandstone caprock is thin or absent and limestone exposed. Relief is commonly 100 to 400 ft. in the interior of the Plateau, and is 1000 ft. or more near the Crab Orchard Mountains and at the escarpments bordering the Highland Rim and Ridge and Valley physiographic provinces.

Most streams are intermittent and flow in U- or broad V-shaped valleys. Near the escarpment, the stream channels become narrow, V-shaped, and rock-strewn. When flowing, these streams plunge over the nearly vertical sandstone escarpment in dramatic waterfalls. The larger creeks and streams have cut into the plateau surface and flow in relatively deep gorges of varying width. Below the escarpment are steep talus slopes extending one-half to two-thirds of the distance down to the adjacent valleys. These slopes are strewn with boulders and punctuated with narrow benches. The lower escarpment slopes are dominated by limestone ledges and in places limestone rockland. Aspect is of minor significance on the undulating to rolling Plateau surface, but is a significant site factor on the slopes of the higher ridges and mountains and on the steep escarpment slopes.

2.3 Drainage Network

The Plateau is drained by two major river systems—the Tennessee on the east, south, and southwest; and by the Cumberland on the west. Both of these rivers are dammed providing hydro-electric power generation, flood control, bulk transportation by barges, waterfowl habitat, and recreation. The Tennessee cuts through part of the Plateau west of Chattanooga in a spectacular gorge. Major tributaries of the Tennessee River starting at the junction with the Cumberland Mountains in Morgan County and proceeding in a clockwise direction are the Obed and Emory Rivers and Dunlap, Piney, Roaring, and Suck Creeks. The Sequatchie River drains the upper Sequatchie Valley. Because of its anticlinal origin, very few large creeks drain into the Sequatchie River. Battle and Crow Creeks drain the southern end of the Plateau along the Alabama border. The Elk and Collins Rivers drain the southwest side of the Plateau. Major tributaries of the Cumberland are Cane Creek, Caney Fork, Obey River, and Big South Fork of the Cumberland.

2.4 Soils

Soils on the uplands vary from deep to shallow and are mostly well drained. All are acid and low in fertility (Francis and Loftus 1977). There are no extensive floodplains or terraces associated with the drainage network, but where present, soils are deep, moderately well drained to well drained, and moderately fertile. On the steep, rock-strewn colluvial slopes below the escarpment, and on the lower slopes of the higher ridges and mountains, soils are deep to very deep.

Residual soils common to the Plateau surface and the crest and upper slopes of the higher ridges are mostly siliceous and mesic Ultisols and Inceptisols. Textural class varies from fine-loamy to coarse-loamy and loamy-skeletal. The deep colluvial soils common to the upper escarpment slopes of the Plateau are siliceous and mesic Ultisols with high coarse fragment content. Mixed, thermic Alfisols and occasionally Mollisols formed in the exposed Mississippian limestone on the lower sides of the Plateau. These soils are shallow to deep with loamy-skeletal texture (Springer and Elder 1980). Modern soil surveys of Plateau counties are available, e.g., Bledsoe County (Davis 1993), Grundy County (Prater 2001), and Pickett and Fentress Counties (Campbell and Newton 1995).

2.5 Forests

Nearly all of the forests on the Plateau have a history of tree cutting, burning, grazing, and clearing for subsistence farming. The current forests are a mosaic of stand conditions with seemingly fortuitous species composition. Generally, productivity is below potential due to poor stocking, a less than desirable mix of species, and a high proportion of defective and low-vigor trees. Few stands exist that represent site potential (see Section 5).

In general, natural stands on the undulating surface of the Plateau, on south-facing slopes of the higher ridges, and on the south-facing upper escarpment slopes are composed of mixed red and white oaks (*Quercus* sp.) or mixtures of hardwoods with shortleaf pine (*Pinus echinata*) and/or Virginia pine (*P. virginiana*). On upland drainages and depressions, sweetgum (*Liquidambar styraciflua),* red maple (*A. rubrum*), white oak (*Q. alba*), and yellow poplar (*Liriodendron tulipifera*) are common, depending on soil drainage. A mixed mesophytic forest (Hinkle et al. 1993) is common on north-facing upper escarpment slopes, in shaded gorges, and on north facing slopes of the higher ridges and mountains. Mixtures of hardwoods with red cedar (*Juniperus virginiana*) are common on the lower escarpment slopes.

Most of the published literature on the vegetation of the Plateau is on the mixed mesophytic forest associated with the gorges and northern escarpment of the Plateau (Caplenor 1965; Quarterman, Turner, and Hemmerly 1972; Schmalzer 1988; McGee 1984). Unfortunately, the preponderance of the literature on Plateau forests gives the false impression that mixed mesophytic forests predominate on the Plateau. The majority of the Plateau, especially the Plateau surface and the southern escarpment (Figure 4) is composed of mixed oaks and pines, indicative of poorer productivity and moisture-limited sites (Smalley 1982; Hinkle 1989).

2.6 Forest Sites (Habitats) of the Cumberland Plateau

Smalley (1986b, 1991a) has developed a forest land classification system for the Cumberland Plateau and adjacent Highland Rim physiographic provinces. It enables wild land managers to divide the landscape into relatively homogeneous units. Because of the degraded condition of the Plateau forests, Smalley relied mostly on the physical features of the landscape. It is a process of successive stratifications of the landscape based on the interactions and controlling influences of ecosystem components: climate, geology, soils, topography, and to a minor extent, vegetation. Macro-climate does not vary much across both physiographic provinces, but microclimate varies because of local relief.

The five levels of Smalley's hierarchical system are analogous to the lower five levels of the National Hierarchical Framework of Ecological Units (Avers et al. 1993; Bailey et al. 1994; McNab and Avers 1994). In Smalley's system, landtypes are the most detailed level. They represent distinct units of the landscape and are mapped at a scale of 1:24,000 or larger. A summary of landtypes in the Mid-Cumberland Plateau Region is shown in Table 2.

Table 2. Estimated Productivities for the Mid-Cumberland Plateau Landtypes, Tennessee (Smalley 1982)

Location	Land type	Description	Slope	Site Index[1]	Typical Soil Series
Above Escarpment	1	Undulating Sandstone Uplands	< 10%	Pine = 65 - 75 Upland Oak = 60 YP = 85	Lonewood & Lily
	2	Broad Sandstone Ridges	6 to 20%	Pine = 60 - 75 Upland Oak = 65 YP = 80	Lonewood & Lily
	5	North Sandstone Slopes	12 to 45%	Pine = 60 - 70 Upland Oak = 75 YP = 85 - 95	Ramsey & Lily
	6	South Sandstone Slopes	12 to 45%	Pine = 55 - 60 Upland Oak = 60	Ramsey & Lily
	14	Stream Bottoms with Good Drainage	0 to 15%	Pine = 80 - 90 Upland Oak = 80 SGM = 90 YP = 100	Sewanee
	15	Stream Bottoms with Poor Drainage	0 to 3%	Pine = 85 White Oak = 80 SGM = 90	Bonair
Below Escarpment	16	Upper Sandstone Slopes & Benches - North	5 to 70%	Upland Oak = 80 YP = 100	Bouldin
	17	Upper Sandstone Slopes & Benches - South	5 to 70%	Pine = 65 - 70 Upland Oak = 60	Bouldin
	18	Lower Limestone Slopes & Benches - North	2 to 75%	Upland Oak = 60	Talbott
	19	Lower Limestone Slopes & Benches - South	2 to 75%	ERC = 45 Upland Oak = 50	Talbott

[1] Estimated site index (average height of dominants and co-dominants) at 50 years
Pine includes eastern white, shortleaf, loblolly, and Virginia pines
Upland oak includes white, chestnut, post, northern red, scarlet, black, and southern red oaks
YP = yellow poplar
SGM – sweetgum
ERC = eastern red cedar

Work is in progress to map all 15 state forests in Tennessee at the landtype level (Smalley 1991b). At least one forest occurs in each of eight physiographic provinces. The six state forests on the Plateau have been completed (Smalley, Todd, and Tarkington in press). Thirty-nine landtypes were identified on the six state forests (unpublished reports on file with Tennessee Division of Forestry). On the Franklin, Prentice Cooper, and Pickett forests, about equal acreage occurs above and below the escarpment. On the Bledsoe and Scott forests, nearly 85% of the land is above the escarpment. On Lone Mountain, nearly two-thirds of the land is above the escarpment, but about one-half of that acreage is technically in the Cumberland Mountains (Smalley 1984). All of the acreage above the escarpment can be assigned to one of seven landtypes (LTs)—1, 2, 5, 6, 7, 14, and 15. Landtypes 1 and 2 are nearly level to undulating Plateau top. Landtypes 5 and 6 represent north- and south-facing slopes where the dominant slope exceeds 6%. All four of these landtypes have moderately deep to deep soils. Most of LT-7 (Sandstone Outcrops and Shallow Soils) occurs as very small units (often too small to delineate at a scale of 1:24,000) embedded in LTs 1, 2, 5, and 6 or as narrow units along the margin of the plateau. Landtypes 14 and 15 constitute 1st -, 2nd -, and possibly 3rd - order streams with good and poor internal drainage, respectively. In most cases these landtypes are recognized as (comparable to) streamside management zones.

2.7 What Land Was Converted to Pine Plantations?

Nearly all of the land converted to pine plantations on the Plateau in Tennessee is on the weakly dissected surface of the True Plateau and Walden Ridge (Smalley 1982, Figure 2 and Table 2). Little if any acreage on the moderately dissected surface has been converted. None of the strongly dissected margins and sides of the plateau were converted. Choice of land for conversion from degraded native forests to pine plantations was dictated by accessibility and by topography amenable for machine harvesting and site preparation; essentially Landtypes 1, 2, 5, and 6.

3.0 PREHISTORY OF SOUTHERN FORESTS

Buckner (1989, 1995) and Delcourt and Delcourt (2004) present excellent reviews of the prehistory of southern forests and the role of fire in these landscapes. Table 3 presents a timeline for the major temporal periods, the use of fire, and the influence of humans on the landscape. We begin with the Mississippian period and the first contacts between European explorers and Native American cultures.

The Mississippian culture dominated much of the region that is now the Southern United States from approximately 900 AD to 1500 AD. Aspects of this culture included farming communities, earthworks, and complex religious and artistic traditions (http://www.cr.nps.gov/seac/outline/05-mississippian/index.htm).

Estimates of the numbers of Native Americans in North America in 1492 vary widely, ranging from a few million to more than 100 million (Dobyns 1983). It is thought that routine use of fire by Native Americans in the South resulted in frequent landscape-scale fires of varying intensities. The end result was a highly diverse landscape containing many vegetative types, successional stages, and habitat conditions (Denevan 1992).

Factors contributing to the varying rates and intensities of fire included fuel buildup, fuel moisture, relative humidity, wind speed and direction, slope angle and position, aspect, temperature, and days since last rain. Since fuels were more or less continuous (except for streams), fires often burned for weeks, covering large areas with highly variable results. A wide range of conditions were created: grasslands and woodlands with varying successional stages and stand structures (Buckner 1989; Delcourt and Delcourt 1988, 1991). Williams (1990) indicates a highly disturbed landscape: "…certainly, the frequent references by European explorers and settlers to 'meadows,' 'fields,' 'openings,' 'flats,' and 'savannahs' leave little doubt that clearing and thinning of the forest by repeated firing was extensive."

Table 3. Relationship between major temporal periods and fire-related and vegetative conditions in the southern United States (adapted from Buckner 1989 and Buckner and Turrill 1999)

Temporal Period	Date	Fire-Related and Vegetative Conditions
Present Day	1990 - 2000	Most unintended fires suppressed, the role of natural and prescribed fire being evaluated
Technological Age	1950-1990	All unintended fires suppressed; Smokey Bear reigns supreme
Birth and Implementation of a Conservation Ethic and Movement	1900 – 1950	Widespread exploitation of resources, massive fires burning largely in logging slash; destructive wildfires stimulate interest in, and action toward, a conservation movement
Post-Civil War	1865 - 1900	Discovery and exploitation of forest resources; forest fires commonly followed logging; land cleared for agriculture
The Settlement Period	1800-1865	Land ownership changes from Native Americans to EuroAmericans; Native American impacts much reduced due to disease and/or displacement
The Post-Columbian Era	1500 - 1800	Landscape initially a mosaic of many forest types, seral stages and vegetative conditions, from open grasslands to closed forests due to frequent landscape fires. During this period forests closed due to pandemics that largely eliminated cultural burning
The Mississippi Period	900 - 1500 AD	Mound-building with highly-structured Native American societies; landscape character largely controlled by use of fire for agricultural and other purposes. Fire was also used in hunting and to maintain an open landscape for ease-of-travel and defense purposes
The Woodland Period	1000 BC – 900 AD	Cultures increasingly agrarian; fire used to maintain grasses in the landscapes for grazing animals and later, to clear land for agriculture
The Archaic Period	8000 – 1000 BC	The beginning of agriculture with fire used to clear suitable sites; high population numbers widely dispersed throughout the eastern U.S. Increased summer warmth and drought. Rise of the "southern" pineries
The Paleoindian Period	12000 – 8000 BC	Primary food source was the megafauna (mastodons, wooly mammoths, etc) that became extinct at the end of this period. Landscape conditions were tundra/boreal forest. Fire was used in hunting these large animals. All North American cultures used fire for cooking and heating. Temperate deciduous forests begin to displace boreal forests
Quaternary Period, Holocene Epoch	15,000 YBP[1]	Boreal forest species (spruce, fir, jack pine) are the primary forest types as far south as Tennessee
Wisconsin Glacial	18,000 YBP	Full glacial maxima

[1] Years Before Present

The incursion by Cortez into Mexico in 1519 introduced smallpox, influenza, typhoid fever, malaria, and other virulent diseases into the Americas. These explorers were relatively immune to the diseases they carried, but the Native Americans, having had no previous exposure, quickly caught the extremely virulent diseases. Estimates of mortality among Native Americans from diseases (pandemics) run as high as 90% (Dobyns 1983).

These epidemics affected the native peoples to such a degree that between 1520 and 1700 there was a return to a more forested landscape in the South due to the reduced cultural pressure on the land. By the 18th century, old Native American fields and fire-maintained uplands were supporting 50- to 150-year-old forests (Buckner 1989). With 50-200 years to regenerate, many areas may have looked like "virgin" forests to European settlers and naturalists.

This history is compatible with recorded observations indicating that many southern forests were dominated by yellow pines in the 18th century even though hardwoods are the potential natural climax species on most sites (Kuchler 1964). Pines are pioneer species on disturbed sites in the South and are gradually replaced by hardwoods in the absence of fire. Large-scale human use of fire prior to 1600 followed by a period with less burning is the best explanation for the existence of pine forests and prairie over broad areas after 1700. Archeological and paleoecological studies have provided further support for this view of history (Delcourt and Delcourt 2004).

It is worth noting here that natural fire is probably less important in the southern forests than in drier western forests. The climate of the South is defined by long, hot growing seasons, abundant rain, occasional droughts, and the most frequent wind and lightning storms in North America (Cry 1965; Komarek 1964; Mueller and Grimes 1998). Before the arrival of Native Americans, fires probably occurred infrequently and were usually caused by lightning from spring and summer thunderstorms (Robbins and Myers 1992). Lightning strikes are more common at higher elevations, which result in less-intense, down-slope burns and are generally accompanied by rainfall and/or high humidity.

Nevertheless, some natural fires probably were far ranging due to their association with dry weather fronts (Wade et al. 2000). Barden (1997) suggests that periodic lightning, wind-driven fires, severe-drought fires, and Native American fires created the open woodlands, numerous smoke columns, and extensive smoke and haze referred to by early European explorers.

Evidence that fires were frequent in southern landscapes prior to European settlement comes from a) archaeological excavations (Keel 1976); b) pollen diagrams indicating pioneer species in many early landscapes (Delcourt 1979; Delcourt et al. 1986); c) historical accounts by early European settlers of the role fire played in native culture (Stewart 1956); and d) integration and synthesis of ecology, archaeology, and Quaternary paleoecology disciplines (Delcourt and Delcourt 2004).

Almost exclusively, fire altered the landscape to the advantage of native cultures (Buckner and Turrill 1999). Humans exerted influence by igniting or suppressing fires and Native Americans have used fire extensively for thousands of years. Holocene records of fossil pollen and charcoal (Delcourt 1979; Delcourt et al. 1986) provide evidence of the effects of pre-historic Native Americans on vegetation through their use of fire. Today, other than land clearing for urban development, no disturbance is more common in southern forests than fire set by humans (Wear, Abt, and Mangold 1998).

4.0 EARLY RECORDED HISTORY OF THE CUMBERLAND PLATEAU

The general history of southern forests summarized in Section 3 has considerable relevance to the Cumberland Plateau. We begin with evidence that fire was used as a means to maintain an open landscape on the Plateau prior to European settlement.

Delcourt (1979) reported a marked increase in ragweed pollen (circa 1790) in cores from Anderson Pond in White County, just adjacent to the Plateau escarpment. This discovery lends support to the existence of open grasslands on or near the Plateau.

Evidence that "...fire was the cause of the spacious meadows of Kentucky and Tennessee..." and that "...barrens have been invaded by woods with the cessation of burning..." can be found in Guffey (1977), Lewis and Kneberg (1946), and Ramsey (1860, 1967).

The Plateau was not permanently inhabited by Native Americans because of its harsh winter environment, scarcity of water, infertile soils, and relatively difficult travel up the steep slopes of the escarpment from adjacent valleys. Nevertheless, there is archaeological evidence of Native American presence on the Plateau. Stone hearths, middens (trash piles), and pottery have been found in rock shelters used as temporary homes and camps by Native Americans, especially on the edge of the Plateau (Buckner 1989; Sanderson 1956; Van West 1998).

The Plateau served primarily as a seasonal hunting ground for the Cherokee and Shawnee tribes. Sanderson (1956) states that at the time of European settlement, the Scott County area was a neutral hunting ground used by Native American peoples of Tennessee and Kentucky. Small parties of Cherokee braves would travel on horseback from their town sites in the East Tennessee Valley, up and over the Cumberland Plateau, and down to the Highland Rim in middle Tennessee each spring. This was done in part for setting fires that would clear the underbrush and make buffalo hunting from horseback easier. At the time of the first explorations by Europeans, portions of the area were occupied or claimed as hunting grounds by Chickasaws, Cherokees, and Shawnees.

Several French and English explorers and traders ventured into the Cumberlands during the early 1700s (Van West 1998). The most prominent was Dr. Thomas Walker in 1749 who was sent by the Loyal Land Company. He was to locate and claim lands for future settlement. Walker left Virginia with six companions, passed through the Cumberland Gap, crossed the Cumberland Plateau, and followed the Cumberland River into middle Tennessee. He named each of these features after the Duke of Cumberland, then the prime minister of England (Folmsbee, Corlew, and Mitchell 1960; Van West 1998).

The rugged topography of the Plateau made migration from the east very difficult and dangerous. There were no standard trails or roads across the Plateau and many feared the Native Americans. There were three ways of reaching the remote Cumberland country: by land through the Cumberland Gap; by water down the "whirls" of the Cumberland River; and again by water through the rapids, shoals and "sucks" of the Tennessee River (Bullard and Krechniak 1956). All were long, strenuous, and roundabout.

The Cumberland Plateau remained a mostly inaccessible wilderness until after the Revolutionary War. Once the Cherokees surrendered most of their land in east Tennessee through the Treaty of Hopewell in 1785 and the Third Treaty of Tellico of 1805 (Camp 1997; Dickinson 1987; Nicholson 1982; Robnett 1993) and Tennessee became the 16th state to be admitted to the United States in 1796, two roads were commissioned to be built across the Plateau to provide easier access and travel: the Avery Trace that went over the escarpment near Kingston and the Walton Road that climbed the Plateau near Rockwood (Bullard and Krechniak 1956). The Walton Road and Avery's Trace

intersected slightly north of Crossville's present location (Webb 1956). Both of these roads helped to bring people into the central portions of Tennessee and beyond.

Following are some early descriptions (dating from 1780 to 1810) of land on the Plateau in the vicinity of Crab Orchard in Cumberland County:

> The area between Crab Orchard and Daddy's Creek was "for the most part denuded of wood and overgrown with grass" (Dickinson 1992)
>
> Some Moravian missionaries traveling from Knoxville to Nashville through Kingston and Crab Orchard referred to the area west of the Clinch River as "wilderness." It was "a stretch of country entirely uninhabited" (Dickinson 1987)
>
> "...The top of the mountain [Crab Orchard] is described as being then a vast upland prairie, covered with a most luxuriant growth of native grasses, pastured over as far as the eye could see, with numerous herds of deer, elk and buffalo, gamboling in playful security over these secluded plains, scarcely distributed in their desert wilds at the approach of man, and exhibiting little alarm at the explosion of a rifle or fright at the victim falling before its deadly aim..." (Ramsey 1860 as referenced by Bullard and Krechniak 1956).

The information and knowledge gained by early explorers encouraged migration into the region. Their stories of rich land and plentiful game were essential in bringing a rush of settlement that began even before the Revolution and statehood. Many settlers were disappointed once they arrived on the Plateau because of the harsh living conditions, relatively poor agricultural land, and the lack of water sources. Most migrated westward to middle Tennessee (Nicholson 1982). By the 1820s, very little land remained unclaimed in the state (Van West 1998).

Forest conditions on the Plateau during the early 19th century were shaped by natural variation in soils and topography as well as by the activities of human populations. Aspect and slope position strongly influenced both soil and surface moisture conditions and, in turn, fire behavior. The Plateau surface, upper slopes, and those facing south to west dry more rapidly and burn with greater frequency and intensity, thus maintaining disturbance-dependent species such as the yellow pines. Later successional types were common on lower north to eastern slopes, where fire was less frequent and less intense (Buckner 1995). At the end of the 19th century, the Cumberland Plateau was likely a mosaic of grasslands, savannahs, open forests and closed forests (Bullard and Krechniak 1956).

5.0 FORESTS OF THE PLATEAU FROM 1900 TO 1950

The Cumberland Plateau, with its harsh environment, was not a hospitable place to reside at the start of the 20th century. The United States Census of 1900 (U.S. Dept. of Commerce, Bureau of the Census 1995) shows a total population for the 16-county Cumberland Plateau area of 177,200 (Table 4). Considering that these counties encompass 4.4 million acres, the population density was less than 26 people per square mile. Most of the larger communities in these counties (Cookeville, Sparta, McMinnville, Winchester, Livingston, South Pittsburg) are not located on the Plateau, but on the Eastern Highland Rim and in the Sequatchie Valley. If the populations of those communities are not included in the totals, then the population density for the 16 Plateau counties is less than 16 people per square mile. In 1900, the largest community on the Cumberland Plateau was Crossville, with less than 1000 people.

Table 4. Population by Decennial Census for Cumberland Plateau Counties in Tennessee: 1900 to 2000

County	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
	thousands										
Bledsoe	6.6	6.3	7.2	7.1	8.4	8.6	7.8	7.6	9.5	9.7	12.8
Campbell	17.3	27.4	28.2	26.8	31.1	34.3	27.9	26.0	34.9	36.1	40.5
Cumberland	8.3	9.3	10.1	11.4	15.6	11.4	19.1	20.7	28.7	34.7	50.1
Fentress	6.1	7.4	10.4	11.0	14.3	14.9	13.3	12.6	14.8	14.7	17.0
Franklin	20.4	20.5	20.6	21.8	23.9	25.4	25.5	27.2	32.0	34.7	40.7
Grundy	7.8	8.3	9.8	9.7	11.6	12.6	11.5	10.6	13.8	13.3	14.5
Marion	17.3	18.8	17.4	17.5	19.1	20.5	21.0	20.6	24.4	24.9	27.7
Morgan	9.6	11.5	13.3	13.6	15.2	15.7	14.3	13.6	16.6	17.3	20.1
Overton	13.4	15.8	17.6	18.1	18.9	17.6	14.7	14.9	17.6	17.6	20.4
Pickett	5.4	5.1	5.2	5.6	6.2	5.1	4.4	3.8	4.4	4.5	4.9
Putnam	16.9	20.0	22.2	23.8	26.2	29.9	29.2	35.5	47.7	51.3	66.0
Scott	11.1	12.9	13.4	14.1	16.0	17.3	15.4	14.7	19.3	18.4	21.8
Sequatchie	3.3	4.2	3.6	4.0	5.0	5.7	5.9	6.3	8.6	8.9	12.3
Van Buren	3.1	2.8	2.6	3.5	4.1	4.0	3.7	3.8	4.7	4.8	5.5
Warren	16.4	16.5	17.3	20.2	19.8	22.3	23.1	27.0	32.7	33.0	39.6
White	14.2	15.4	15.7	15.5	16.0	16.2	15.6	17.1	19.6	20.1	23.9
Total	*177.2*	*202.2*	*214.6*	*189.8*	*251.4*	*261.5*	*252.4*	*262.0*	*329.3*	*344.0*	*417.8*

SOURCES: U.S. Dept. of Commerce, Bureau of the Census 1995 (http://www.census.gov/population/cencounts/tn190090.txt)
U.S. Dept. of Commerce, Bureau of the Census 2000 (http://www.census.gov)

Even though Native Americans had left the Plateau almost 100 years previously, forest fires continued to be used by local inhabitants. An excerpt in the 1887 *Crossville Times* chastised farmers for ruining their soil and timber by burning the woods. "...if anyone wants to know, how the surface of this county would appear had it not been for these destructive fires, let him visit the north side of Potts' Knob..." (Bullard and Krechniak 1956). Cultural fires were often used for faster "green-up" of ground vegetation during the spring for grazing animals, to control the undergrowth for better visibility and accessibility, and to control insects, especially ticks. In areas where fire and other disturbances were infrequent, trees continued to grow.

Land speculators continued in their attempts to entice more people to the Plateau. Captain Lina Beecher was known as the king of all these promoters, speculators, operators and plungers (Bullard and Krechniak 1956). Advertisements appeared in the *Crossville Times* in 1889 concerning prospective land sales in Genesis, Tennessee, about 10 miles north of Crossville.

GENESIS

(Cumberland County)

Tennessee

~~~~~~~~~~~~

Capt. Lina Beecher

dealer in

Cumberland Plateau Lands

100,000 Acres of

Wild and Cultivated Lands!

For Sale, consisting of

Town and Outside Lots,

Stock Ranches, Plantations,

Timber and Mineral Lands.

500 Town Lots in Genesis, Very desirable and well

located, for sale at a low figure.

The lack of soil productivity for agriculture and other land uses on the Plateau was noted by Killebrew (1874): "...the most striking fact in the farming operations is that no money crop is raised..." only subsistence self-sufficient farming. "...the Table Land, as an agricultural region is not in the best repute...the more mountain land a man owns, the poorer he is..." About the only profitable use of the land was for summer range of cattle and sheep for the farmers in the valley.

Around 1900, life on the Plateau began to change. Though the Plateau had a sparse population, it was rich in coal and second growth forests. The Plateau and Cumberland Mountains had some of the richest coal reserves outside of Pennsylvania. The coal was sought for rapidly expanding iron, steel, and other industries in the major population centers of Nashville, Atlanta, and Chattanooga (Camp 1997; Nicholson 1982).

The Louisville-Nashville (L&N) railroad and its subsidiaries to St. Louis and Chattanooga had spurs in Grundy, Campbell, Bledsoe, Claiborne, and Sequatchie counties during the 1890s. The railroads that became the Southern System in 1897 hauled coal from Scott, Morgan, Roane, Rhea, and Hamilton counties. The production of coal more than tripled from 1890 to 1907 (Figure 5) (Jones 1987).
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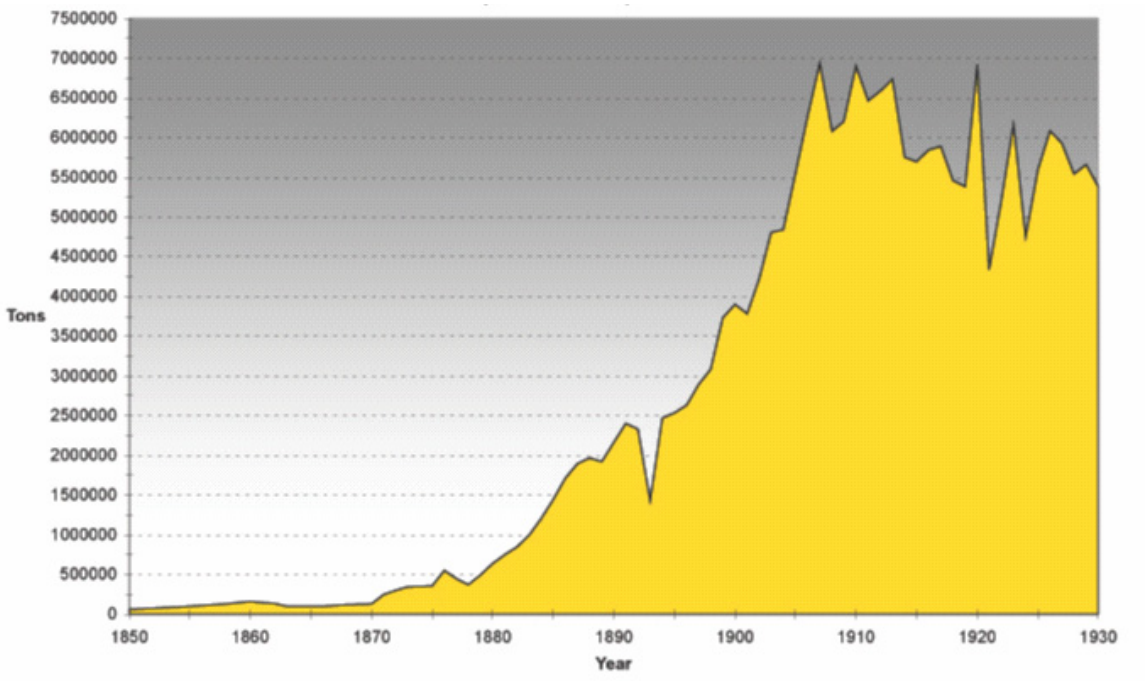

Figure 5. Cumberland Plateau Coal Production from 1850-1930 (Jones 1987)

Bullard and Krechniak (1956) listed many companies (whether legitimate or not) that were chartered in the vicinity of Cumberland County in 1900–1910 "to exploit coal, timber, oil and each other." Some of these were Grassy Cove Coal & Iron Company; Crossville Oil, Gas & Coal Company; Caney Fork Coal & Iron Company; Southern Land, Cattle & Mining Company; Sequatchie Valley Coal & Coke Company; Walden's Ridge Coal & Iron Company; Crab Orchard Coal & Coke Company; Cumberland Mountain Coal, Iron and Railway Company; Cumberland Plateau Coal & Land Company; Lantana Midland Coal & Coke Company; and Tip Top Land & Timber Company. Coal and timber were big business at the turn of the century.

The introduction of railroads expanded logging on the once inaccessible Plateau from the turn of the century through World War II (Ogden 1953). Wood was in great demand for building structures in expanding cities and towns, but also locally for mine props, new and replacement crossties, charcoal, and fence posts. Acid wood or tanbark for leather making was an important source of income. It took nearly 1,800 ties to build one mile of railroad track (MacCleery 1993). Fence posts were required once the open range laws were suspended in 1948 (Bullard and Krechniak 1956). Mining was expanding and more mine props were needed for the extraction of coal. Charcoal (also called chemical wood) was used for wood distillation processes.

Lumber became a major industry in Scott County at the turn of the century. Some timber was floated down rivers during spring rains (Sanderson 1956). The Tennessee Lumber and Coal Company began producing hardwood flooring in 1906. The mill at Norma was one of the largest hardwood mills in the eastern United States at that time. Sanderson (1956) estimates that the mills in Scott County produced over 10,000,000 board feet of lumber between 1925 and 1945.

The logging boom associated with railroads provided a more or less continuous cash income for many Plateau property owners that was not previously available. Many were delighted to have an additional source of income to supplement their sparse lifestyles. Railroads provided not only easy transportation for people, but additional markets for lumber and coal. Pine sawtimber was cut first, even in mixed pine-hardwood forests, because of its straightness and light weight for handling, sawing, and shipping.

Most of the pine on the Plateau was a result of the burning done much earlier by Native Americans and by settlers clearing and then abandoning marginal crop land and pasture. Unfortunately, harvesting the pine and leaving the hardwood did not create the favorable conditions needed to regenerate pine. The pine sawtimber resource was severely depleted by 1950 (Ogden 1953).

In the 1920s and 1930s, chestnut blight (*Cryphonectria parasitica*) killed most of the American chestnut (*Castanea dentata*) and altered somewhat the structure and composition of Plateau forests. Hinkle (1989) suggests that American chestnut was a minor species component on the Plateau surface and a slightly greater component in the depressions and ravines, following the descriptions of Ashe (1911). Braun (1950) indicates that chestnut was more abundant in the forests east and north of the Cumberland Plateau in Tennessee.

After the pines were cut, hardwoods were used especially for fence posts, mine timbers, and crossties. Little thought was given to regenerating these forests. Sawtimber was being cut faster than it was growing. Many lumber and coal companies began buying large tracts of land in the more remote sections of the Plateau to obtain timber on the surface and mineral rights below. Logging slash often was burned in the hope of converting to row crops or pasture. The combined effects of grazing and burning effectively prevented the reestablishment of woody vegetation on many tracts (Brender and Merrick 1950).

The depression in the 1930s had a dramatic effect on residents of the Plateau. Any stick of wood that could be used for any product was cut and sold for income. This exacerbated the depletion of Plateau forests caused by the railroad, mining and lumber booms during the first two decades of the 20th century. Many residents moved from the Plateau for opportunities elsewhere. The forests were exploited and severely understocked with little prospect for short-term future value. In 1950, a forest survey for Cumberland County revealed the following (Tennessee Valley Authority 1952, Ogden 1953).

- Cull trees composed 20% of the sawtimber, i.e., 1 of every 5 trees greater than 11 inches in diameter was a cull.
- Average sawtimber volume was 1500 board feet per acre.
- Average annual burn (1945 to 1950) was 11% of the forested land meaning approximately 50% of the forested land had burned in that 5 year period.
- Grazing occurred on 9% of the forested acres, compacting the soil, exposing tree roots and allowing little regeneration of trees.
- Grade 1 trees composed 9% of the total volume and Grade 2 trees composed 16%, indicating that 75% of the volume in trees remaining was defective.
- 20,000 acres of former forest land had been cleared in the previous 10 years, a reduction in the amount of forest land of 6%.

These statistics indicate that the forests in Cumberland County were sparse and severely understocked at this time. Most of the forests on the Plateau probably were in a similar condition.

6.0 FORESTS OF THE PLATEAU SINCE 1950

The best source of information on the condition of Plateau forests from 1950 to 1999 is the Forest Inventory and Analysis (FIA) program in the USDA Forest Service. FIA has summarized data from six periodic surveys of its 16-county Plateau unit that were conducted as part of statewide surveys of forests in Tennessee. Survey methods and results were published in 1952 (Wheeler), 1962 (Sternitzke), 1972 (Murphy), 1983 (Birdsey), 1991 (May), and 2000 (Schweitzer). A report on data collected since 2000 is expected in 2007.

A limitation of FIA data for purposes of this report is that the area of FIA's 16-county Plateau Unit does not correspond directly with the physical Cumberland Plateau. This limitation is discussed in detail in Section 1. An additional limitation is that changes in FIA methods over time introduce some uncertainty into estimates of change in forest conditions from one survey to the next. The effects of this uncertainty are impossible to quantify precisely but they are small in comparison to the real changes in forest conditions documented in this section.

Estimates of land area, forest types, ownership, size-class inventory, growing stock volume, net annual growth, annual removals and growth-drain ratio by survey completion date for the Plateau Unit are shown in Table 5. Forests occupied about 3 million acres in the Plateau Unit throughout the period from 1950 to 1999 (or about 70% of the total land area in 1999). Forest losses to development and agricultural development during this period were offset by afforestation of marginal cropland and pasture. In many cases, afforestation was achieved by planting pine seedlings. Plantations were established on forest industry land to serve as a reliable source of raw material. Government cost-share programs (e.g., Soil Bank, Conservation Reserve Program) encouraged tree planting and soil conservation on nonindustrial private lands.

Even though the amount of forest land in the Plateau Unit remained fairly constant from 1950 to 1999, there were substantial changes in the distribution of acreage among forest types (Table 5). The softwood or pine forest type occupied 900,000 acres in 1950 or about 30% of the total forest area. This forest type decreased rapidly in extent after 1950 and occupied only 340,000 acres in 1999 or about 11% of the forest land. The reduction in the acreage of pine can be attributed to several factors.

1. Shade intolerant pines cannot live in the understory and midstory beneath a dense pine overstory. Once pines die or are harvested, more shade tolerant hardwoods will dominate the regenerating stand unless silvicultural measures are taken to favor pines.

2. As pine was harvested, most landowners did not make necessary investments to regenerate their land back to pine.

3. Pines are fire tolerant and were able to regenerate and grow at the expense of fire intolerant species during the frequent fires prior to 1950. Pine seeds need bare mineral soil to regenerate. With the advent of statewide forest fire control in the early 1950s, conditions necessary to regenerate pine diminished.

4. Outbreaks of southern pine beetle have reduced pine acreage. Usually hardwoods or mixed stands replace pine types if provisions are not made to regenerate pine.

Table 5. Land Area, Forest Types, Ownership, Size-Class Inventory, Growing Stock Volume, Net Annual Growth, Annual Removals, Growth-Drain Ratio, Mean Sawtimber Volume and Mean Basal Area by Survey Completion Date for the Plateau Survey Unit, Tennessee. Numbers in parentheses are percentages of total.

	Survey Completion Date					
	1948-1950	**1961**	**1971**	**1980**	**1989**	**1999**
Land *(1000 acres)*						
All Land	4430	4406.2	4404.5	4448.7	4394.9	4403.5
Forest Land	3056.7 (67)	3178.0 (72)	3077.0 (70)	2972.6 (67)	3064.8 (70)	3106.2 (70)
Other Land	1373.3 (31)	1228.2 (28)	1327.5 (30)	1476.1 (33)	1330.1 (30)	1297.3 (30)
Forest Types *(1000 acres)*						
All Pine	923.8 (30)	NR[1]	258.8 (8)	251.3 (8)	348.9 (11)	340.3 (11)
Planted Pine	NR	NR	NR	NR	114.8	145.7
Mixed	728.1 (24)	NR	443.8 (14)	398.2 (13)	391.5 (13)	375.6 (13)
Hardwood	1404.8 (46)	NR	2374.4 (77)	2323.1 (78)	2324.4 (76)	2278.5 (76)
Total	3056.7	3178.0	3077	2972.6	3064.8	2994.4
Ownership *(1000 acres)*						
Public	NR	NR	198.0 (6)	196.6 (7)	326.4 (10)	332.2 (11)
Private						
Industry	NR	NR	443.6 (14)	408.8 (14)	333.5 (11)	497.7 (17)
Corporate	NR	NR	358.3 (12)	NR	620.0 (20)	399.4 (13)
Individual	NR	NR	2077.1 (67)	2367.2 (79)	1785.0 (58)	1765.0 (59)
Total	3056.7	3178.0	3077		3064.8	2994.5
Size-Class Inventory *(1000 acres)*						
Sawtimber	717.8 (24)	NR	878.6 (29)	1194.9 (40)	1568.2 (51)	1745.0 (58)
Poles	1986.9 (65)	NR	1111.2 (36)	1209.8 (41)	976.1 (32)	690.6 (23)
Seed/Sap	352.0 (11)	NR	1087.2 (35)	567.9 (19)	520.6 (17)	558.9 (19)
Total	3056.7	3178.0	3077	2972.6	3064.8	2994.5

(Continued on next page. See notes at end of table.)

Table 5. Continued

	Survey Completion Date					
	1948-1950	**1961**	**1971**	**1980**	**1989**	**1999**
Growing Stock Volume *(million cubic feet)*						
Pine	227.9 (20)	363.9 (20)	467.5 (19)	605.2 (20)	831.4 (21)	1041.6 (20)
Hardwood	904.5 (80)	1463.4 (80)	2056.1 (81)	2372.2 (80)	3167.4 (79)	4247.2 (80)
Total	1132.4	1827.3	2523.6	2977.4	3998.8	5288.8
Net Annual Growth *(million cubic feet)*						
Pine	14.3 (25)	NR	26.2 (23)	21.8 (20)	31.4 (20)	48.4 (27)
Hardwood	43.3 (75)	NR	88.3 (77)	88.9 (80)	121.3 (80)	132.2 (73)
Total	57.6	NR	114.5	110.7	152.7	180.6
Annual Removals *(million cubic feet)*						
Pine	17.4 (39)	12.3 (27)	5.6 (13)	8.3 (18)	8.9 (18)	26.7 (30)
Hardwood	26.6 (61)	32.5 (73)	37.7 (87)	37.8 (82)	39.7 (82)	61.6 (70)
Total	43.6	44.8	43.3	46.1	48.6	88.3
Growth-Drain Ratio						
Pine	0.82 : 1	NR	4.68 : 1	2.62 : 1	3.5 : 1	1.81 : 1
Hardwood	1.63 : 1	NR	2.34 : 1	2.35 : 1	3.05 : 1	2.14 : 1
Total	1.32 : 1	NR	2.64 : 1	2.40 : 1	3.14 : 1	2.04 : 1
Mean Sawtimber Volume *(bd ft/acre)*	1200	NR	2200	3100	4200	5600
Mean Basal Area *(square feet/acre)*	55	NR	81	88	94	101

[1] NR = Not Reported in the Forest Inventory and Analysis (FIA) published literature

Sources: Schweitzer 2000, May 1991, May and Vissage 1989, Birdsey 1983, USDA Forest Service 1982, Murphy 1971, Hedlund and Earles 1971, Sternitzke 1962, Wheeler 1952

It is worth noting here that the southern pine beetle (SPB) is a major natural force in southern pine forests. Recent SPB infestations in Tennessee occurred in 1973, 1988, and 1999-2001 (Tennessee Dept. of Agriculture, Forestry Division 2003). The most recent infestation affected about 90,000 acres of pine (both natural stands and plantations) in the Plateau Unit or about 30% of the total pine acreage. What will happen to this land is unknown or uncertain. Some may be replanted to pine, especially on forest products industry lands; some may be converted to non-forest uses on the flatter, more accessible areas; and some will probably succeed to hardwoods.

In 1999, the pine type was fairly well distributed among northern and southern counties of the FIA Plateau Unit. The northern counties (Cumberland County northward) contained 57% (193,000 acres) of the pine acreage and the remaining 43% (147,000 acres) of pine types were in the southern Plateau counties (Schweitzer 2000). Plantations represented about 40% (145,000 acres) of the total pine resource for the Plateau Unit in 1999 or about 4.8% of the total forest.

Hardwood forest types increased by almost a million acres from 1950 to 1971, replacing pine and mixed pine-hardwood types on many sites. The hardwood acreage remained fairly steady at 2.3 million acres from 1971 through 1999.

The mixed pine-hardwood forest type decreased from more than 720,000 acres (24% of total resource) in 1950 to 375,000 acres (13% of the resource) in 1999. Mixed stands are difficult to maintain because the shorter-lived pine is slowly being replaced by hardwoods.

In 1999, hardwoods occupied 76% of the 3 million forested acres in the Plateau Unit. Natural and planted pine totaled 11% and mixed pine-hardwood types occupied 13% of the forested land.

Tree size class distributions and tree stocking levels changed dramatically from 1950 to 1999 (Table 5). Sawtimber stands occupied only 23% of the forested area in 1950 and forests had very low average levels of sawtimber volume (1200 board feet per acre) and basal area (55 square feet per acre). These numbers indicate that most Plateau forests did not have closed canopies in 1950. Stocking was generally poor, spacing of the larger diameter trees was wide, and many stands were dominated by xeric and fire-tolerant species such as pines, oaks, and hickories (Wheeler 1952). After 1950, with the advent of forest management and fire protection, forest growth and average tree size increased steadily with each successive survey period. By 1999, sawtimber occupied 58% of the acreage or more than 1.7 million acres. During the 50 years from 1950 to 1999, mean sawtimber volume increased by more than 300% to 5600 board feet per acre and mean basal area increased by almost 100% to 101 square feet per acre. Today, many of the forests on the Plateau are maturing and perhaps are over-mature, placing them at increased risk of disturbance by insects, disease, and wildfire.

Improving forest conditions are also reflected in increasing levels of growing stock volume and net annual growth (growth – mortality) for both pine and hardwood from 1950 to 1999. Annual harvest removals increased slightly from 1950 to 1989 and then nearly doubled from 1989 to 1999. However, the growth-drain ratio in 1999 was strongly positive with growth exceeding harvest by a factor of two.

Tree quality or grade is another important indicator of forest condition. Grade is determined by the ratio of defective wood (knots, decay, crookedness, etc.) to “clear” wood in the first 12 to 16 feet of the tree bole. Tree grade has improved somewhat over time, but at a much slower pace than measures of stocking and growth. In 1999, 58% of the wood volume was in tree grades considered degraded and cull (grades 3, 4, and 5) (Schweitzer 2000) compared to 75% in 1950 (Wheeler 1952).

The prevalence of degraded trees in Plateau forests is a direct reflection of mediocre site productivity, tree damage by uncontrolled fires, and the long-term cumulative effects of high-grading (harvesting

the best and leaving the worst trees) (McGee 1982). Devastating wildfires continued into the 1950s. The worst fire year on the Plateau in recent memory was 1952, with more than 112,000 forested acres (17%) burned in Morgan and Cumberland Counties (Ogden 1953). Many of the older trees present today have defects and scars resulting from fire and harvesting injuries. Until these trees die or markets improve to utilize this degraded material, tree grade improvement will be slow. With better forest management and protection from fire, hardwood tree grade/quality should continue to slowly improve.

Most Plateau forests are privately owned. In 1999, 59% of the forest land in the Plateau counties was owned by private citizens; 13% was owned by corporations outside the forest products industry; and 17% was owned by forest industry (i.e., companies with wood processing facilities).

Forest ownership by public agencies increased from 198,000 acres (6% of Plateau forests) in 1971 to 332,000 acres (11%) in 1999. Major forested areas managed by state and federal agencies on the Plateau and in the Cumberland Mountains are listed Table 6. These areas comprise more than 440,000 acres and are managed primarily for scenic, wildlife, and recreational purposes (Table 6).

Since the 1999 FIA survey, there has been growing public concern on the Plateau about forest land sales. Some of the sales are attributable to population growth and increases in land values for development. The highest-value tracts are being subdivided and resold, thus increasing parcelization and fragmentation. Some of the more inaccessible, scenic, and recreational land has been acquired by or given to the state.

Current information suggests that forest industry land holdings have been declining sharply since 1999 (Tennessee Dept. of Agriculture, Forestry Division 2005) and may decline further in the near-term future (Alligood 2005). Factors contributing to this trend include a) a need by companies to reduce debt and redeploy capital following mergers/acquisitions and many years of weak prices for pulp and paper products; and b) opportunities to sell land to Real Estate Investment Trusts and Timberland Investment Management Organizations that operate with much lower tax rates on timberland profits compared to traditional forest products companies.

Researchers from the Department of Agricultural Economics at the University of Tennessee recently used the 2000 United States Census Data to determine the economic impacts of Tennessee's forests and forest products industry (English, Menard, and Jensen 2004). Data were reported by FIA unit and then summed by FIA region to obtain statewide values. For the Plateau unit (Table 7), 5737 individuals were employed by forest-based manufacturing (includes both primary and secondary forestry sectors). Primary forestry sectors are those that process logs: sawmills, papermills, and logging. The secondary forestry sectors are those businesses that take products from the primary sectors and process them further into products such as furniture, millwork, flooring, pallets, cabinets, boxes, and specialty papers. The payroll for both primary and secondary forestry sectors was $129 million. Production of forest products had a total value of $587 million, or about 6% of the annual total economic output for the counties in the Plateau unit (Table 8). Forest-based manufacturing is a significant component of the total economic activity for these Plateau counties.

Table 6. Public Forest Lands on the Cumberland Plateau and Mountains in Tennessee

Property	Area (acres)
Big South Fork National Recreation Area (includes both TN and KY)	125,300
Pickett State Park and State Forest	18,300
Scott State Forest	2,800
Catoosa Wildlife Management Area	82,000
Frozen Head State Natural Area	11,900
Cumberland Mountain State Park	1,800
Fall Creek Falls State Park	15,800
Bledsoe State Forest	7,100
Lone Mountain State Forest	3,600
Bridgestone/Firestone Wildlife Management Area	10,000
Mount Roosevelt Wildlife Management Area	1,500
Royal Blue Wildlife Management Area (all within the Cumberland Mountains)	125,000
Prentice Cooper State Forest	24,300
Franklin State Forest	6,800
Savage Gulf / South Cumberland State Park	12,400
TOTAL	**448,600**

Table 7. Direct Impacts from Forestry for the 16-County Forest Inventory and Analysis Plateau Unit, 2000 (English, Menard, and Jensen 2004)

Sector	TIO[1] *(million $)*	Employment *(number)*	Wages *(million $)*	TVA[2] *(million $)*
Forest & Forest Products, Logging				
Forest Products	15	455	0	3
Forestry Products	11	226	1	10
Logging Camps & Logging Contractors	48	380	8	18
Total	74	1,062	9	31
Primary Forestry				
Sawmills & Planning Mills	285	2,728	70	111
Paper, Pulp & Paperboard Mills	1	3	0	0
Total	286	2,731	70	111
Secondary Forestry				
Millwork, Veneer, Plywood & Structural Wood	46	486	12	18
Wood Containers	17	194	6	8
Wood Building & Mobile Homes	26	212	6	9
Miscellaneous Wood Products	55	404	9	16
Household Furniture	35	397	10	13
Wood Office Furniture	0	0	0	0
Public Building Furniture	0	2	0	0
Wood Partitions and Fixtures	1	9	0	1
Miscellaneous	0	0	0	0
Paperboard Containers and Boxes	46	237	7	9
Converted Paper & Paperboard Products	1	4	0	0
Total	227	1,944	50	74
Forestry Total	587	5,737	129	216

[1] Total Industry Output
[2] Total Value-Added

Table 8. Importance of Forestry to the Tennessee and the 16-County Plateau Economies (English, Menard, and Jensen 2004)

	State	Plateau
Total Economic Activity (*million $*)	330,218	15,225
Estimated Forest Industry Contributions to the State's Economy (*million $*)	21,750	908
Percentage	6.6	6.0

Statistical information about fishing, hunting and other wildlife-associated recreation in Tennessee is compiled on a statewide basis every five years (U.S. Dept. of Interior, Fish and Wildlife Service and U.S. Dept. of Commerce, U.S. Census Bureau 2003). Although these data are not specific to the counties in the Plateau Unit, recreation associated with wildlife is a significant activity considering the rural nature of the Plateau and the amount of land in public ownership, particularly Wildlife Management Areas (Table 6). In 2001, 2.7 million Tennessee residents and nonresidents fished, hunted, or watched wildlife in Tennessee. These participants spent more than $1.7 billion on wildlife recreation. Of that total, trip-related expenditures were $590 million, equipment purchases were $975 million, and $151 million was spent on licenses, contributions, leasing, and other items and services.

7.0 THE FUTURE OF PLATEAU FORESTS

Historically, pine has been a larger component of the forest types on the Plateau, but with recent southern pine beetle outbreaks and the lack of recent forest disturbances needed to regenerate shade-intolerant species, the acreage of pine has declined. Whether land affected by southern pine beetle in 1999-2001 will remain in a forest designation is unknown at this time as landowners are assessing whether to make additional investments to plant pines, change the land use to something else, or to allow the land to revert to hardwoods. There is also a bias among some members of the public about the perceived “unnaturalness” of pine plantations on the Plateau that has stimulated much debate and discussion. Pine provides many benefits from both an ecological and economic perspective (Cassidy 2005), especially on the drier and poorer surface sites of the Plateau where it is more productive than hardwoods (Smalley 1982; Kuers 2002, 2006 in press).

The Southern Forest Resource Assessment (SFRA) concludes that the greatest threat to maintaining intact forests in the southern United States is urbanization that increases parcelization and fragmentation of the forest (Wear and Greis 2002). Although the amount of land classified as forest on the Plateau remained steady from 1950 to 1999, there are indications that urbanization, parcelization, and fragmentation are increasing. Some large blocks of forest land owned by corporations are being divided into smaller parcels and converted to non-forest uses such as land development and/or pasture (cattle is the most profitable agricultural enterprise on the Plateau). Residential developers often prefer scenic parcels, especially along the escarpment. The number of owners of Plateau forest land is increasing, the amount of land per owner is decreasing, and the amount of forest land is decreasing as more “highly-valued and profitable uses” are sought.

Other factors driving development on the Plateau are retirement communities and coal mining. Crossville and Monteagle are prominent retirement communities. At least five major retirement communities are located in the Cumberland County-Crossville area and they continue to expand. Many retirees are buying summer homes on the Plateau for the cooler weather, and then moving to a second residence in warmer climates during the winter. All of this development is taking a toll on the limited water resources of the Plateau. The situation is not that much different from when Native Americans inhabited the area. The Plateau was a hospitable place to visit during the summer, but not during the winter.

The coal mining business on the Plateau declined after passage of the Surface Mining Control and Reclamation Act of 1977 (www.osmre.gov/smcra.htm). However, with recent increases in energy prices, coal mining is becoming more profitable. Several permits have been submitted to strip mine coal on the Plateau and in the Cumberland Mountains in the last year, which may influence forest resources in the region.

Threatened and endangered animal and plant species listed by state or federal agencies are shown in Table 9. Habitats for these species are often in or near water which is fairly scarce on the Plateau surface and escarpment. Regulatory and voluntary measures to conserve rare species and their habitats may have important effects on future development.

In response to much of the controversy associated with natural resources on the Plateau, several organizations are mounting campaigns to "preserve and protect" these resources. The Alliance for the Cumberlands is a coalition encouraging economic development and sustainability while conserving the environmental assets. The Alliance has yet to define their view of sustainable economic development and how it may affect the environment, especially the forest resource. Currently, the Alliance is promoting the establishment of a National Heritage Corridor on the Plateau. If a National Heritage Corridor is established, federal matching funds will become available. How the funding would be used is presently unknown, but the funds cannot be used to purchase land according to federal statutes. State and private organizations have allocated funds to match federal dollars.

The Governor of Tennessee proposed legislation in 2005 for a $10 million trust fund to be leveraged with federal and private dollars "to develop plans for sustainable nature-based, heritage-based, agricultural-based, and recreation-based opportunities while protecting and preserving unique resources of the region" (http://tennessee.gov/environment/news/release/2005/Feb/PlateauGrant.php). This legislation passed the 2005 session with the modification that the funds could be applied statewide and not restricted to lands on the Plateau. The legislation is now called the Tennessee Heritage Conservation Trust Fund (http://www.legislature.state.tn.us/bills/currentga/Summary.asp?BillNumber=SB2259).

Table 9. Animals and Plants on the Cumberland Plateau Listed as Threatened or Endangered by Division of Natural Heritage, Department of Environment and Conservation, Tennessee, 2004 (http://www.state.tn.us/environment/nh/plant_list.pdf and http://www.state.tn.us/environment/nh/animal_list_2004.pdf)

ANIMALS

Class	Common Name	Listing
Amphibians	Tennessee cave salamander	Threatened
Birds	Bachman's sparrow	Endangered
	Golden eagle	Threatened
	Peregrine falcon	Endangered
	Bewick's wren	Endangered
Fishes	2 Chubs	Threatened
	Jewel darter	Endangered
	2 Darters	Threatened
	Laurel Dace	Endangered
Mammals	Gray bat	Endangered
	Indiana bat	Endangered
Reptiles	Northern pine snake	Threatened
Crustaceans	Obey crayfish	Threatened
Mollusks	10 Mollusk species	Endangered

PLANTS[1]

Scientific Name	Common Name	Federal Listing
Arenaria cumberlandensis	Cumberland sandwort	Endangered
Asplenium scolopendium var. *americanum*	Hart's tongue fern	Threatened
Helianthus eggertii	Eggert's sunflower	Threatened
Isotria medeoloides	Small-whorled pogonia	Threatened
Sarracenia oreophila	Green pitcher plant	Endangered
Schwalbea americana	Chaffseed	Endangered
Scutellaria montana	Large-flowered skullcap	Threatened

[1] The Department of Natural Heritage lists 51 threatened and 51 endangered plants that occur on the Cumberland Plateau. Only seven species are federally listed as endangered or threatened.

At this time, it is not clear how conservation initiatives will affect land resources and private land ownership on the Plateau. Most of the processes and procedures to date have involved local groups, government agencies, and other interested parties, but not local private landowners who control most of the forest land on the Plateau (Table 5).

The Tennessee Nature Conservancy (TNC) has purchased land on both the Southern (Tennessee and Alabama) and Northern Plateau. Most of this purchased land is adjacent to public lands. TNC is also involved with promoting the establishment of Habitat Conservation Corridors on the Northern Plateau with funding from the U.S. Fish & Wildlife Service. The Conservation Fund along with the Tennessee Wildlife Resources Agency recently purchased the Sundquist State Wildlife Management Area from International Paper Company. Bowater Inc. recently donated land to the State of Tennessee for the Cumberland Trail (http://www.cumberlandtrail.org/ctc.html). The amount of forest land owned by forest industry has been decreasing and this trend is expected to continue (Alligood 2005).

Much of the current controversy surrounding the Plateau today is focused on ecological values, aesthetics and desired land uses as more and more people move into the region. “Permanent” land use changes such as development and urbanization as well as changes brought about by more ephemeral disturbances such as forest harvest and regeneration, agriculture and to some degree, mining require much more discussion (Wear and Greis 2002).

Information reviewed in this report suggests that the landscape diversity on the Plateau today is a result of disturbances provided by humans over time. If these disturbances had not occurred, the landscape diversity of the Plateau presumably would be less (i.e., intermediate disturbance hypothesis, Connell 1978). Current protection and preservation efforts could have the effect of reducing diversity in some Plateau forests by reducing disturbance and shifting stand age distributions toward older age classes.

The future of land use on the Plateau is unclear. Several interests are competing for their vision of the Plateau. Many communities are looking at economic development for their residents. Residents from retirement communities bring a different perspective to the equation. Other organizations look at tourism and recreation as opportunities for economic development. Still others are looking to preserve, protect, or otherwise conserve land. Many larger tracts of forest land are being sold and partitioned. What is sustainable and beneficial is open to debate. Regardless, land use on the Plateau will continue to change, especially with growing populations and increasing demands for housing and services. Forests are dynamic, not static. Whatever decisions are made about land use on the Cumberland Plateau, changes in forest resources are inevitable.

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