NO MORE PLOTS; GO WITH WHAT YOU KNOW: DEVELOPING A FOREST LAND CLASSIFICATION SYSTEM FOR THE INTERIOR UPLANDS[1/]

Glendon W. Smalley[2/]

Abstract.--A five-level forest site classification system was developed for the 29 million acres of the Cumberland Plateau and Highland Rim physiographic provinces. Six published regional guides that describe the system and how it is used to classify and evaluate forest sites are available. Landtypes, the most detailed level, are described in terms of nine elements, are evaluated in terms of productivity and desirability of selected hardwoods and conifers for timber production, and are rated for five site-related problems. The system permits on-site determinations of site productivity and provides a framework for forest management planning, operations, and research.

Keywords: Cumberland Plateau, Highland Rim/Pennyroyal, landforms, land stratification, site productivity, soils, timber management.

INTRODUCTION

The Keynote Session for this Symposium provided an excellent historical perspective of ecological land classification in Canada and the United States. Suffice it to say that many methods have been employed, but no one system applicable to all the diverse forest sites, forest types, and forest conditions has been developed. In fact, Pierpoint (1984) suggested that "...it is unrealistic idealism to expect to develop a comprehensive so-called universal classification hierarchy that will serve all users, beyond providing a broad regional framework for broad land-use planning."

Professor Rowe (1984) has eloquently submitted that landform is a synthesizing supplement to vegetation and soils and argues that vegetation not be used as the basis for classifying forest land. In his words, "a universal system of forestland classification... will only develop if agreement is reached on concepts as to the nature of forestland, and on purposes to be served in dividing it and classifying it.... The managers of forestland need areal units defined according to criteria that make them relevant to such multi-use aspects of management as silviculture, tree harvesting, wildlife renewal, and watershed protection. Such needs subtly encourage classifiers to take account of climate, soil, and landform in addition to vegetation when devising their typologies. Even more important is the related conceptualizing of spatial ecosystems..., as landscape segments that are not shadowy extensions of vegetation and/or soil but real structure objects-of-interest based on landform. By its modification of the fluxes of solar energy and precipitation, the shape and substance of the land (landform) control the expression of local climate, biota, and soil in site-specific ways. Thus landform provides the integrating framework of other landscape components. Perceived covariances of vegetation and landform in the landscape patterns provide the means for mapping."

Today forest managers are faced with the challenge of producing more wood on diminishing acreage of commercial forest land, and the need for site classification and productivity information continues to be of "high priority"; witness this symposium.

Before the system developed for the Interior Uplands is described here, the title needs to be explained. The "no more plots; go with what you know" was a restriction placed on this author by the then Assistant Director of the USDA Forest Service's Southern Station, James L. Stewart,

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[2/]Principal Soil Scientist (retired), Southern Forest Experiment Station, Forest Service, U.S. Department of Agriculture, Sewanee, TN, and Consultant--Forest Land Classification and Evaluation, Route 1, Box 541, Sewanee, TN 37375.

after it had been determined that development of a forest land classification system was feasible and of high priority, i.e., this author was not to initiate any new plot research, but rather was to base all efforts on personal experience, familiarity with the region, and existing information.

CONDITIONS AND RATIONALE

The Cumberland Plateau and Highland Rim physiographic provinces (fig 1) extend from central and eastern Kentucky and southwest Virginia through middle Tennessee and northwest Georgia into northern and central Alabama (Fenneman . The Plateau is bordered on the east by the Ridge and Valley province. The Highland Rim, called the Pennyroyal in Kentucky, lies west and north of the Cumberland Plateau, surrounds the Nashville Basin in Tennessee, and borders on the Bluegrass and Western Coalfields in Kentucky. On the west, both the Plateau and Rim border on the Upper Coastal Plain.

On the Plateau, soils are derived from thick, mostly horizontal strata of sandstones, siltstones, and shales. Topography, ranging from gentle to rugged and complex, is characterized by

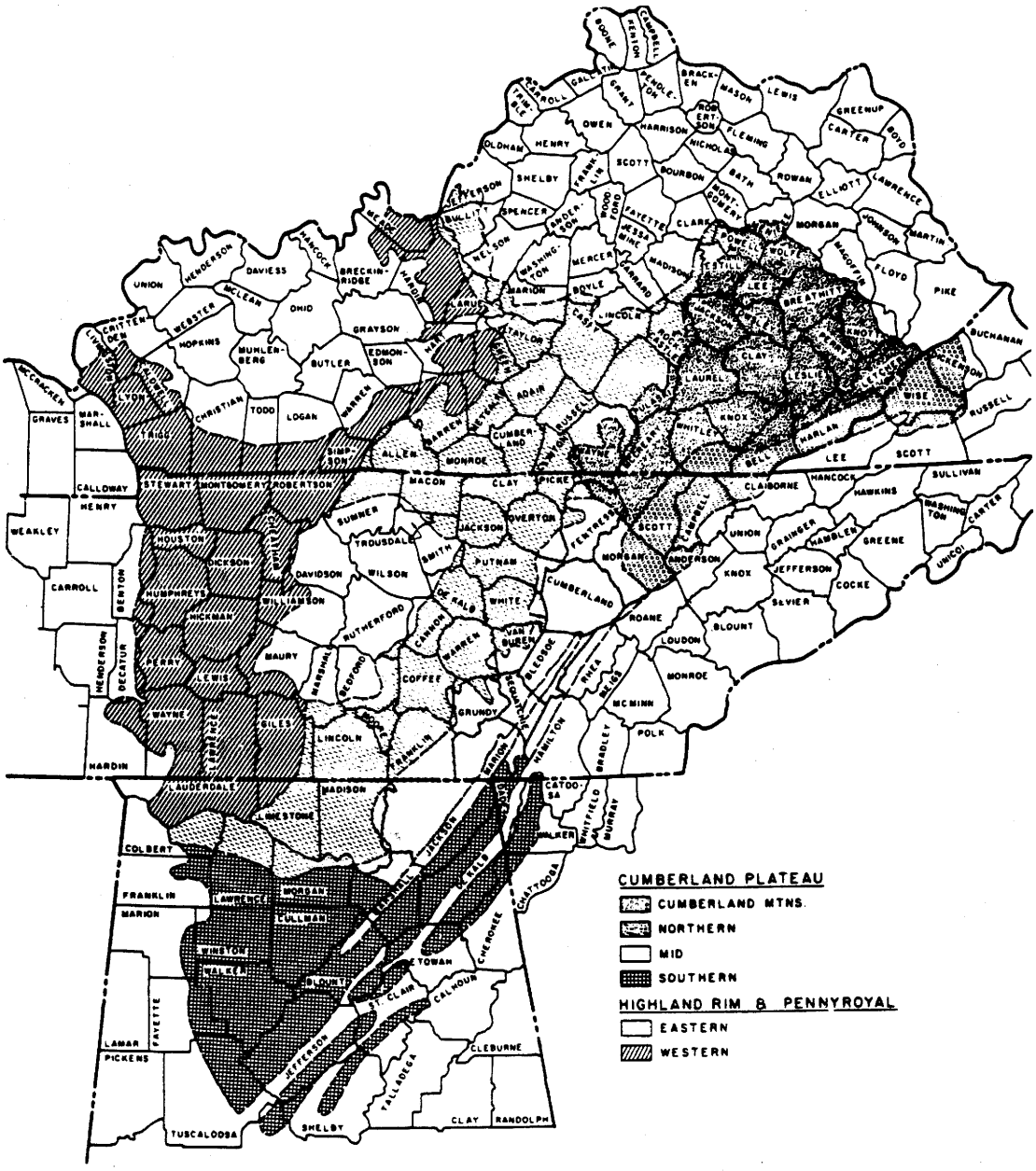


Figure 1. Physiographic provinces and regions of the Interior Uplands.

Ùdendritic drainage patterns with winding, narrow ridges and deep, narrow valleys. In places, the degree of dissection is weaker, and broader interfluves are common. The southern end of the Plateau in Alabama is also well dissected but is less rugged. The Plateau is bounded on the east and west by prominent sandstone escarpments. Elevation ranges from about 1,000 feet in the south to 3,000 feet in the Cumberland Mountains; a few peaks exceed 4,000 feet. Local relief ranges from 100 to 150 feet in the smoother places to 1,000 feet at the Plateau margins and to nearly 2,000 feet in the vicinity of the tallest mountains.

On the Rim, topography ranges from gentle to rugged and complex, and slope gradient ranges from nearly level to very steep. Degree of dissection ranges from young to mature; sinkholes are common in some areas. Elevation ranges from 800 to 1,100 feet over most of the Rim but diminishes to about 500 feet south of the Tennessee River in northern Alabama. Local relief ranges from 200 to 400 feet but is 50 feet or less in the smoothest parts.

Much of the Rim is covered with 2 to 4 feet of loess. Soils are derived from this loess and several strata of limestone of varying purity. Soils with fragipans are common on parts of the Rim. Along the boundary with the Upper Coastal Plain, soils are topographically stratified on the basis of parent material--loess; unconsolidated sands, gravels, and clays; and cherty limestone.

The Interior Uplands have a temperate climate characterized by long, moderately hot summers and short, mild to moderately cold winters. According to Thornthwaite's (1948) classification of climate, it is humid mesothermal. Daily and seasonal weather is controlled largely by alternating cold, dry continental air masses from Canada and warm, moist air from the Gulf of Mexico. During the summer, complete exchanges of air masses are few, and tropical maritime air masses persist for extended periods.

Mean temperature ranges from 55 to 61 °F. The frost-free period is 200 or more days in north-central Alabama and 160 to 180 days in the Cumberland Mountains and on the Northern Cumberland Plateau. Annual precipitation, ranging from 46 to 61 inches with a decreasing trend south to north, is ordinarily well distributed all year, but short periods of very wet or very dry weather are common. Precipitation is highest from December through March and lowest from August through October. Thunderstorms with high-intensity rainfall and occasional hail occur on more than 50 days each year, mostly in late spring and summer. Snowfall seldom exceeds 6 inches and melts in a few days; it is greater and persists for longer periods at the highest elevations.

The Interior Uplands encompass about 29 million acres, and over half is forest land. This area, like much of the eastern hardwood forest region, has a long history of indiscriminate cutting, burning, grazing, and clearing for agriculture. Parts of the Plateau and Rim have been cleared, farmed, and abandoned several times. Some abandoned land now supports forests over 100 years old. Much of the steeper land was never cleared, but it was logged, burned, and grazed. Also, the demise of American Chesnut has drastically altered forest composition and structure. Consequently, the existing forests are a mosaic of stand conditions, with seemingly fortuitous species composition. Productivity is far below potential because of poor stocking, an undesirable mix of species, and the presence of defective and low-vigor trees. Too few suitable stands exist to obtain a direct measure of site potential.

At the onset of this project, very little tree-soil-site information was available, and practically none of that was applicable to the Plateau and Rim. Available information was developed mostly by the factorial approach, which was not always successful. Often, sample selection and statistical manipulation were much less sound than they appeared to be. Also, products of these studies were graphs and equations, but the tools necessary for forest planning and management are maps and inventories.

Less than a quarter of the Plateau and Rim counties had had soil surveys published since 1967, and less than half of these surveys contained "Woodland Suitability" sections. Lack of communication between foresters and soil scientists has resulted in surveys that appeal to soil taxonomists but disappoint forest managers, who find little information or guidance on how to apply soil surveys to their specific and pragmatic goals for managing forest resources.

From a practical standpoint, there is little justification for making the usual medium-intensity soil survey (typical county survey) for most forest management activities associated with "regulated forests" (Stone 1975). Bartelli and DeMent (1970) concluded that low-intensity surveys would provide a reasonable balance between cost and value of the survey for forest management purposes. Boundaries of soil mapping units in low-intensity surveys more often coincide with natural features of the landscape.

Because soils are closely related to landforms and topography, a strong argument can be made for subdividing landscapes instead of mapping soils. Even where soils are to be identified and mapped, the mapping is more meaningful when done by landform. In rugged terrain, landforms may have as many, or even more, recognizable relationships with tree growth than do soil series. Landforms can be easily recognized by foresters and other potential users of land classification systems without formal training in soil science. Rowe (1984) has suggested "...that forest land managers need a scheme that sorts out the patterns of landscapes with which they deal. Climate, soil, vegetation, and landform are all important, but in themselves they are not enough. Forestland managers need defined terrain units or elements of land that comprise all four components in interaction. [Furthermore]...landforms are the spatial synthesizers of site components, and only in the context of landforms can forestland patterns make sense."

Commercial forest land in the five-state area is owned primarily by private individuals. Tract size varies as much as the occupations and/or interests of the owners. Land owned by forest industries and various Federal, State, and local government agencies represents only a small percentage of the total. Considerable acreage of the privately owned land receives no professional forestry input and qualifies as "unmanaged or exploited forests," but some can be classed as "regulated." Most of the forest industry acreage Ùcan be classed as "intensively managed or domesticated" (Stone 1975).

Thus, this author endeavored to devise a forest site classification system that was practical, relatively easy to use, flexible in application, and integrated--not a system consisting of a compilation of site components but rather one composed of discrete units of the landscape with reasonably homogeneous potential for growing trees and/or for management limitations and hazards. The system should be applicable to all sizes and classes of ownership. It should have a mapping capability, and the scale and detail of delineations should be appropriate to meet the management objectives of both "regulated" and "domesticated" forests. Lastly, the system should be hierarchical so the units can be aggregated or disaggregated to meet the needs of land managers as well as regional, State, national, or corporate planners and executives.

DESCRIPTION OF THE SYSTEM

This site classification system was adapted from Wertz and Arnold's (1975) Land System Inventory. The system can best be described as a process of successive stratifications of the landscape. Stratifications were based on the author's knowledge of the interactions and controlling influences of ecosystem components--physiography, climate, geology, soils, topography, and vegetation. Macroclimate does not vary much across both physiographic provinces, but microclimate does vary because of local relief. Vegetation was relegated to a position of minor importance because, generally, existing forests do not indicate site potential, and present stand boundaries may or may not coincide with site boundaries.

The five levels of this system (proceeding from the least detailed to the most detailed) are: physiographic province, region, subregion, landtype association, and landtype. Landtypes are visually identifiable areas that have resulted from similar climatic, geologic, and pedologic processes.

The Cumberland Plateau was divided into four regions--Cumberland Mountains and Northern, Mid- and Southern Plateau (fig.2 and table 1). The Highland Rim was divided into two regions--Eastern and Western. A guide for each of these six regions (Smalley 1979a, 1980, 1982, 1983, 1984b, 1986a) plus a combined edition (Smalley 1986b) have been

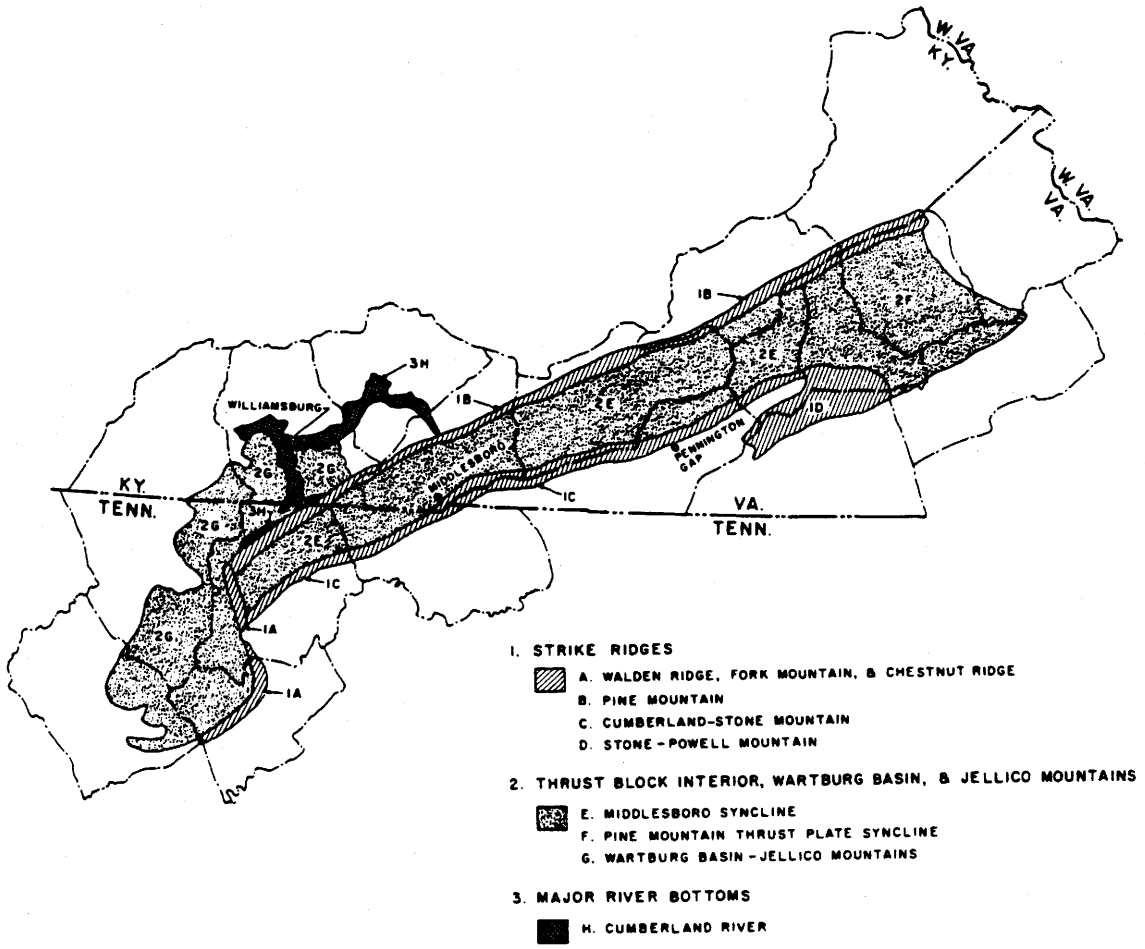


Figure 2.--Subregions and landtype associations of the Cumberland Mountains region.

Table 1.--Regions, subregions, and landtype associations of the Cumberland Plateau and Highland Rim/Pennyroyal.

Cumberland Plateau			Highland Rim/Pennyroyal		
Region	Subregion	Landtype association	Region	Subregion	Landtype association
Cumberland Mountains	1. Strike ridges	A. Walden Ridge, Fork Mountain, & Chestnut Ridge B. Pine Mountain C. Cumberland-Stone Mountain D. Stone-Powell Mountain	Eastern Highland Rim-Pennyroyal	1. Highland Rim Plateau	A. Strongly dissected plateau B. Moderate dissected plateau C. Weakly dissected plateau-gray soils (Barrens) D. Weakly dissected plateau-red soils
	2. Thrust block interior, Wartburg Basin, & Jellico Mountains	E. Middlesboro syncline F. Pine Mountain thrust plate syncline G. Wartburg Basin & Jellico Mountains		2. Highland Rim-Nashville Basin transition	E. Tennessee Knobs F. Outer Basin
	3. Major river bottoms	H. Cumberland River & major tributaries		3. Pennyroyal-Bluegrass transition	G. Western Kentucky Knobs H. Eastern Kentucky Knobs
Northern Cumberland Plateau	1. Mountains & coalfields	A. Rugged eastern area B. Low hills belt C. Western escarpment facing the Eastern Highland Rim/Pennyroyal D. Western escarpment facing the Bluegrass		4. Moulton Valley	I. Strongly dissected valley J. Weakly dissected valley-red soils K. Weakly dissected valley-brown soils
	2. Major river bottoms	E. Cumberland & Kentucky Rivers & major tributaries		5. Major river bottoms	L. Tennessee River M. Elk, Duck, & Cumberland Rivers N. Barren, Green, Rolling Fork, Salt, Kentucky, & Red Rivers
Mid-Cumberland Plateau	1. True plateau	A. Weakly dissected plateau surface B. Moderately dissected plateau surface C. Strongly dissected plateau surface D. Crab Orchard Mountains	Western Highland Rim-Pennyroyal	1. Highland Rim plateau	A. Strongly dissected plateau B. Moderately dissected plateau C. Weakly dissected plateau-gray soils D. Weakly dissected plateau-red soils
	2. Walden Ridge	A. Weakly dissected plateau surface B. Moderately dissected plateau surface C. Strongly dissected plateau surface		2. Highlnd Rim-Nashville Basin transition	E. Tennessee Knobs F. Outer Basin
	3. Strongly dissected southern portion	A. Weakly dissected plateau surface C. Strongly dissected plateau surface		3. Karst plain	G. Weakly dissected plain H. Moderately dissected plain I. Slump area
Couthern Cumberland Plateau	1. Table plateaus--Sand & Lookout Mountains	A. Weakly dissected plateau surface-sandstone B. Moderately dissected plateau surface-sandstone C. Strongly dissected plateau surface-sandstone		4. Major river bottoms	J. Tennessee River K. Buffalo River L. Cumberland, Harpeth, Duck, & Elk Rivers M. Green & Barren Rivers
	2. Moderately dissected plateau-Brindley & Little Mountains	A. Weakly dissected plateau surface-sandstone B. Moderately dissected plateau surface-sandstone C. Strongly dissected plateau surface-sandstone			
	3. Strongly dissected western portion	A. Weakly dissected plateau surface-sandstone B. Moderately dissected plateau surface-sandstone			
	4. Shale hills	C. Strongly dissected plateau surface-sandstone D. Moderately dissected plateau surface-shale E. Strongly dissected plaeau surface-shale			

published. Several published papers that describe the overall system and its use (Sims 1987; Smalley 1979b, 1984a, 1985, 1989) are available.

The division of the Cumberland Plateau into regions was mostly arbitrary except for the Cumberland Mountains, which are higher than the adjacent Cumberland Plateau and the Ridge and Valley physiographic provinces. The division of the Highland Rim follows the traditional partition made in Tennessee where the Nashville Basin nearly separates the Rim east and west at the Kentucky and Alabama boundaries. The east-west division extends into Kentucky on the basis of soil parent material--relatively high-grade limestone versus cherty and shaly limestones. In Alabama the division is arbitrary.

Subregions were defined mostly on the basis of well-recognized geographic, physiographic, or geologic areas (table 1). Upland landtype associations were defined mostly on the "degree of dissection" of the landscape and occasionally on broad soil groups. Landtype associations of major river bottoms reflect differences in mineralogy of the sediments. Landtype associations are equivalent to soil associations delineated at the state level by the Soil Conservation Service (SCS)

(Hajek, Gilbert, and Steers 1975; Perkins and Shaffer 1976; Soil Conservation Service 1975, 1979; Springer and Elder 1980.)

Landtype associations were divided into 193 landtypes--95 on the Plateau and 98 on the Rim. Some landtypes are common to more than one region, so the total number of distinct landtypes is probably about 150.

LANDTYPE DESCRIPTIONS

Each landtype is described in terms of nine elements. A sample description (Landtype 24 in the Cumberland Mountains) is shown in table 2. The GEOGRAPHIC SETTING provides an overall description of the landtype, specifying both where it occurs on the landscape and its relation to other landtypes.

The most prevalent soil series are listed under DOMINANT SOILS. These series reflect the most recent designations in soil classification and link this site classification system to county soil surveys published by SCS.

The kind of BEDROCK or PARENT MATERIAL of the soil and DEPTH TO BEDROCK are given next. TEXTURE of the surface soil is described in terms of the 12 conventional classes (Soil Survey Staff 1951).

Internal SOIL DRAINAGE is described in terms of the seven conventional classes (Soil Survey Staff 1951). RELATIVE SOIL WATER SUPPLY of each landtype is rated in five classes: very low, low, medium, high, and very high. This qualitative rating is based on the available water-holding capacity of the dominant soils, but allowances are made for the influence of soil drainage, topographic position, and aspect.

SOIL FERTILITY is described on the basis of seven classes: very low, low, moderately low, moderate, moderately high, high, and very high. Because most soils of the Plateau and Rim are fairly acid and derived from rocks having limited weatherable minerals, soils with high or very high fertility are not common.

The most common woody species in approximate order of abundance are listed under VEGETATION; some distinctive shrub and herbaceous species are included.

FOREST MANAGEMENT INTERPRETATIONS

In the regional guides opposite each landtype description is a table summarizing information on the PRODUCTIVITY of selected tree species, severity ratings for five MANAGEMENT PROBLEMS that can affect forest operations, and SPECIES DESIRABILITY ratings for timber production (e.g., table 3).

Productivity

Productivity of commercially valuable species is expressed as site index and as average annual cubic growth. With few exceptions, site indices for naturally occurring species are the means of values from soil survey interpretations issued by SCS for the dominant soils in each landtype. Curves for most species are based on 50 years, although

Table 2.--A sample landtype description. From Smalley 1984b

Description of Landtype 24: Colluvial mountain slopes, benches, and coves--north aspect

Geographic setting	Deep, loamy, often gravelly, cobbly, or stony soils on sloping to steep lower two-thirds to three-fourths of north slopes in Subregions 1 and 2. The linear to concave slopes range from 15 to 60 percent. Soils formed in loamy colluvium from acid siltstone, shale, and sandstone. Landtype 24 is more common in LTA's E and G than in LTA's D and F, and it occurs below Landtype 22 and above Landtypes 19 and 20. Surface mines (Landtype 26) occur extensively in association with Landtype 24. In places, this landtype merges with major river bottoms (Landtypes 29 and 30).
Dominant Soils	Jefferson, Grimsley, Shelocta, and Rigley. Zenith and Cutshin occur at higher elevations (above 2,500 ft) on slopes and in coves, particularly in LTA's E and G. Often mapped as soil complexes.
Bedrock	Siltstone, shale, coal, and clay; possibly sandstone and conglomerate.
Depth to Bedrock	Forty to 120 inches or more.
Texture	Loam, fine sandy loan, and silt loam; occasionally sandy clay loam and clay loam. Rock fragment content varies considerably over short distances. Boulders and cobbles are common on the surface, particularly in coves.
Soil drainage	Well-drained.
Relative soil water supply	Medium to high.
Soil fertility	Moderate to moderately high.
Vegetation	Yellow-poplar, northern red oak, white oak, hickories, black oak, red maple, and American beech; occasional sugar maple, cucumbertree, yellow buckeye, eastern hemlock, eastern white pine, white ash, blackgum, white basswood, and black birch. Flowering dogwood, mountain-laurel, American hornbeam, vacciniums, grape, viburnums, hydrangea, alder, and smilax are common understory species.

Table 3.--A sample table of forest management interpretations. From Smalley 1984b

Forest management interpretations for Landtype 24: Colluvial mountain slopes, benches, and coves--north aspect

PRODUCTIVITY

Species	Site index (feet)	Average annual growth (cubic feet per acre)
E. White pine	85	145
Shortleaf pine	75	136
Virginia pine	75	120
White oak	75	57
N. red oak	80	62
Yellow-poplar	100	107

MANAGEMENT PROBLEMS

Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate to severe	Slight to moderate	Moderate to severe	Moderate to severe	Slight

SPECIES DESIRABILITY

Most desirable	Acceptable	Least desirable
E. white pine	Hickories	E. hemlock
White oak	American beech	Black birch
N. red oak	Cucumbertree	American hornbeam
Black oak	Sugar maple	Serviceberry
Yellow-poplar	Yellow buckeye	Sumac
White ash	White basswood	Red maple
		Blackgum
		Flowering dogwood
		Sourwood

younger base ages are common for fast-growing species grown in short rotations. When site indices were available for one species, estimates for other species were sometimes made using site index comparisons. When necessary, SCS site index values were adjusted for aspect and slope position based on the author's experience and soil-site research. When available, site indices for a specific region or subregion were used instead of averages for the soil series. In a few cases, when no values were available, site indices of important species were estimated. In the tables, these estimated values are enclosed in parentheses.

Average annual cubic growth was calculated from available yield tables. Yield tables represent either normal or fully stocked conditions. Annual growth rates for all naturally occurring species or forest types were averaged over 50 years. Average annual growth for loblolly and shortleaf pine plantations was based on 40 years and for eastern white pine on 35 years, the oldest ages reported in the respective yield tables. Because yields are not expressed in a common merchantability standard, care must be exercised in comparing average annual yields of species, both within and between landtypes.

Management Problems

For the most part, the five management problems --PLANT COMPETITION, SEEDLING MORTALITY, EQUIPMENT LIMITATIONS, EROSION HAZARD, and WINDTHROW HAZARD--and ratings of slight, moderate, and severe follow SCS definitions (Soil Conservation Service 1987).

Species Desirability

Three categories are used to rate species desirability of tree species that commonly occur on each landtype. MOST DESIRABLE species are those that have the potential for fast growth or high value, or both. ACCEPTABLE species are those having moderate growth rate or value. LEAST DESIRABLE species are those having slow growth or low value, or both. These ratings represent the average situation of a region. The presence of local markets could result in a species being assigned to another category.

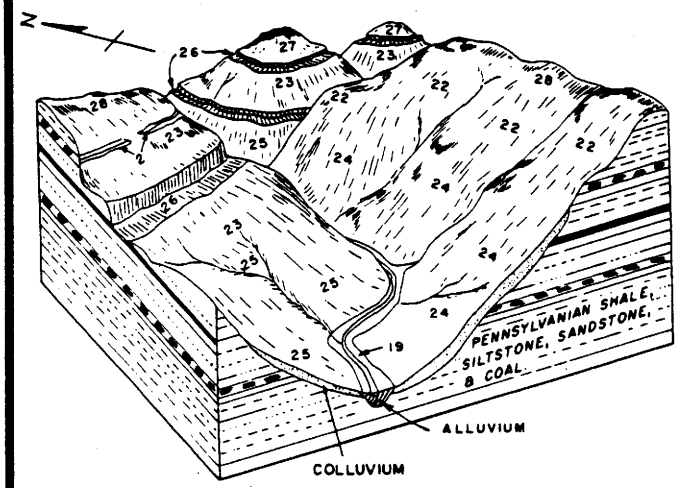
USING THE SYSTEM

The system is designed to allow resource professionals to make on-site determinations of site productivity and provides a site-dependent framework for forest management planning and forest research.

To make on-site determinations on a specific tract of land, users should trace the location of the tract through the classification hierarchy to the level of landtype association, verify the location on the reference map (fig. 2 in each regional guide), (e.g., fig. 2) and ascertain all possible landtypes by referring to the proper table (table 4 in each regional guide, except table 3 in the guide for the Southern Cumberland Plateau). Landscape descriptions (e.g., table 2) and landform drawings (e.g., fig. 3) enable users to identify specific landtypes. Most tracts smaller than 500 acres seldom contain as many as 12 landtypes. Once a landtype has been identified, users should refer to the accompanying table (e.g., table 3) to obtain information about productivity, severity of management problems, and species desirability.

A logical vehicle for converting this site classification system into a valuable forest management tool is a landtype map (fig. 4), which can be used in all phases of management, from day-to-day activities to long-range planning. The number and scale of maps will depend on size of ownership and how intensively one wishes to manage. Landtypes can be mapped at scales of 1:10,000 to 1:60,000, and at these scales, areas as small as 2.5 acres can be recognized on the larger scale maps. Smoothness of the terrain will determine maximum size. In the Interior Uplands, maximum size of landtypes probably will not exceed 50 acres. The U.S. Geological Survey 7.5-minute quadrangle sheets (1:24,000) make excellent base maps on which to delineate landtypes for "regulated" forests. Topographic base maps at a scale of 1:12,000 are more appropriate for "domesticated" forests. Black and white or color aerial photos, particularly stereopairs, can also serve as base maps. A reasonable amount of ground checking should be part of the mapping process. Owners of large tracts should explore the capabilities of mapping, storage, retrieval, and manipulation of this spatial information with a geographic information system.

This site classification system provides a sound ecological basis for forest management planning because it recognizes inherent site differences and soil-related hazards. When the system is



LEGEND

2. Shallow soils and sandstone outcrops
19. Mountain footslopes, fans, terraces, and streambottoms with good drainage.
22. Upper mountain slopes--north aspect.
23. Upper mountain slopes--south aspect.
24. Colluvial mountain slopes, benches, and coves-north aspect.
25. Colluvial mountain slopes, benches, and coves-south aspect.
26. Surface mines.
27. Narrow shale ridges, points, and convex upper slopes.
28. Broad shale ridges and convex upper slopes.

Figure 3.--Landtypes characteristic of Landtype Associations E (Middlesboro syncline) and G (Wartburg Basin-Jellico Mountains) in Subregion 2 of the Cumberland Mountains. From Smalley 1984b

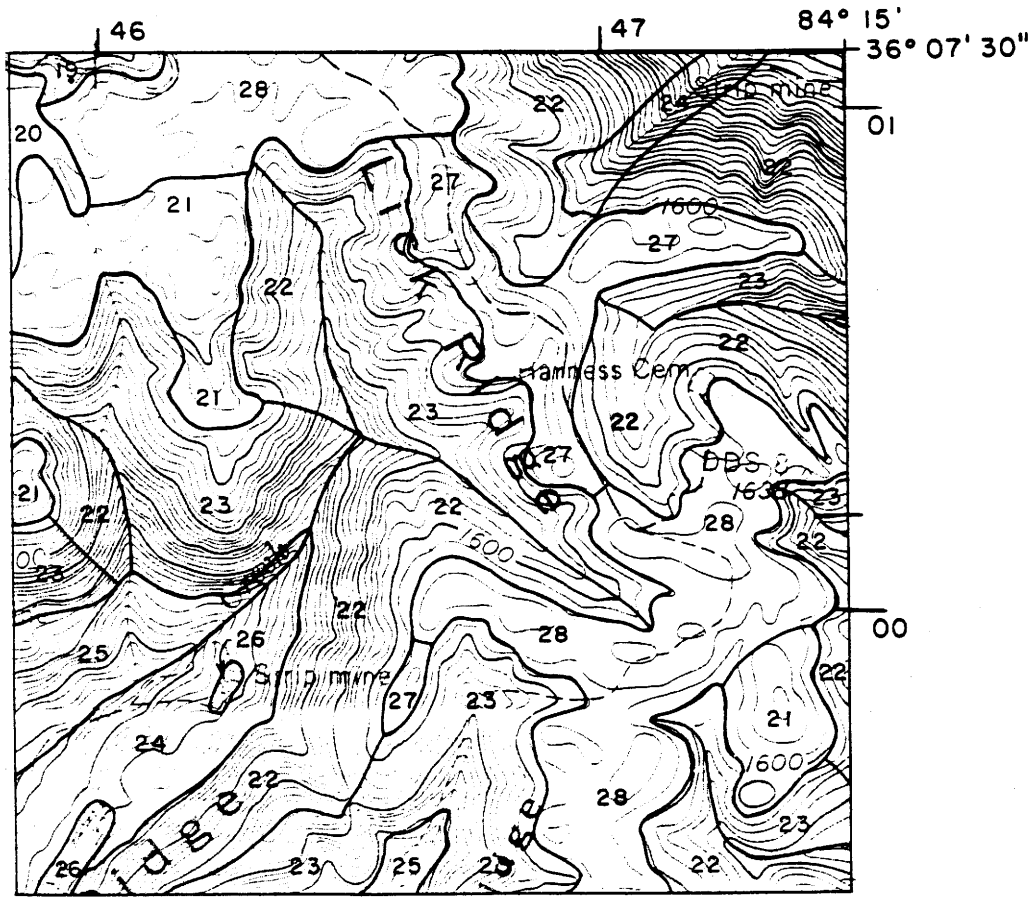


Figure 4.--A sample landtype map showing Landtype Association G (Wartburg Basin and Jellico Mountains) in Subregion 2 of the Cumberland Mountains. Map covers a tract of about 700 acres in the northeast corner of the northwest quarter of the Windrock Quadrangle, Anderson County, TN. The contour interval is 20 feet. Numbers refer to specific landtypes described in Smalley 1984b.

adopted, landtypes become the basic unit of land management rather than existing forest stands whose boundaries are, most likely, artifacts of past land use. Landtypes are landscape units having reasonable homogeneous site potential and a particular set of management constraints and problems. Once landtypes are defined and mapped, existing forest type and inventory information can be merged with the landtypes and forest planning begun. The actual conversion to a landtype system of management can be made gradual as each management unit (e.g., compartment) is entered in the normal sequence of forest operations.

Detailed descriptions of the physical characteristics of each unit of land aid land managers in divising management scenarios that will protect the soil and water, form the basis of silvicultural practices, and promote the maintenance of site productivity.

For forest researchers, this site classification system provides a basis for stratifying study areas (e.g., Cremeans and Kalisz 1988). The system also aids in identifying and isolating problems that need to be researched. Finally, the system provides researchers with a vehicle for quick transfer of research results to the practitioner. Results can be reported on the basis of their applicability to specific landtypes.

Development of the system is a continuing process. Additional research, experience in application, and feedback from users will result in revision of productivity data, refined landtype descriptions, improved interpretations for timber management, and extension of interpretations to other forest resources.

The next step is to study the relationships between plant communities and the landscape units on selected, minimally disturbed areas. The goal of such research is the capability of predicting which community(s) grow on each unit and to ascertain the successional pathways resulting from various disturbances.

APPLICATIONS AND PERIPHERAL STUDIES

This land classification system is gradually being accepted and applied as a basis for the management of timber and wildlife. Several studies have been completed that confirm the efficacy of the system as a sound ecological basis for forest management. Extension of the system to other physiographic provinces is contemplated.

The Tennessee Division of Forestry (TDF) uses the regional guides as a comprehensive training manual to orient new employees and is gradually adopting the system as a basis for the management of the State forests on the Plateau and Rim. The regional guides also provide important baseline information for use in advising and preparing management plans for nonindustrial private landowners. Over 150 public and industrial foresters have had on-the-ground training in the system.

For over a decade, the Tennessee Wildlife Resources Agency (TWRA), in cooperation with Tennessee Valley Authority and Forest Service, has been developing a land classification system for 150,000 acres of wildlife management areas (WMA) as part of a long-term wildlife-forest management program (Hughes 1987). If valid relationships between plant communities and landscape units can be found, TWRA can use the units as a faster, cheaper method to define and map habitat for many wildlife species. The alternative is costly inventories of vegetation on every acre.

Several studies have been conducted to determine these relationships. On the 20,000-acre Cheatham WMA on the Western Highland Rim west of Nashville, vegetation on each of six landtypes was significantly different from that on all other landtypes.[3/] The forest communities (landtypes) can be used in a geographic information system to model wildlife habitat, assess site productivity, and extrapolate from one location to another with similar landtypes and history.

Wheat and Dimmick (1987) studied plant community-landform relationships on two other Western Highland Rim tracts. Three ridge landtypes supported similar communities, and distinctive communities existed on cherty north slopes, cherty south slopes, and in streambottoms having good drainage.

Plant community-landform relationships have also been studied on the 26,000-acre Prentis Cooper State Forest and Wildlife Management Area on the south end of Walden Ridge (Mid-Cumberland Plateau) west of Chattanooga (Arnold 1990). Discriminant analysis of 138 plots located on four extensive landtypes revealed that landtypes had relatively distinct forest cover. Contrariwise, cluster analysis revealed common communities on most landtypes.

During the last periodic survey of forest land in Tennessee by Forest Service's Southern Forest Experiment Station, each survey point on the Mid-Cumberland Plateau was classified as to landtype. Forest type, stand volume, site index, and other stand data were analyzed by landtype in an effort to substantiate the productivity values and description of overstory vegetation on Mid-Plateau landtypes (Rennie 1991).

An intensive study of the soils and vegetation on three major landtypes on the Mid-Cumberland Plateau near Crossville, TN, has been completed (Hammer 1986). Landtypes significantly affected magnitudes of temporal and spatial soil variability (Hammer, O'Brien, and Lewis 1987). The morphological features of soils, when precisely described and interpreted with respect to landtypes, are indicators of patterns of movement and relative amounts of available soil moisture and can be a valuable aid in predicting potential site productivity for Mid-Plateau forest soils. The forest land classification system is apparently a valuable method of grouping Mid-Plateau forest soils into landform units having relatively homogeneous chemical and physical properties.

In Kentucky and Tennessee, WESTVACO is in the process of adapting the land classification system to their Highland Rim lands and expanding the concept to lands in the Upper Coastal Plain. In West Virginia, WESTVACO researchers are developing a similar land classification system for their

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[3/]Clatterbuck, W.K. 1988. Classification and analysis of forest plant communities on Cheatham Wildlife Management Area in north-central Tennessee. Report submitted to Tennessee Wildlife Resources Agency. Nashville, TN; 110 pp.

Allegheny Plateau and Ridge and Valley woodlands. Evaluations will incorporate existing forest inventory data plus ratings for logging and other intensive forest management activities.

Smalley [4/] has recently completed a land classification of the 45,000-acre Natchez Trace State Forest, State Resort Park, and Wildlife Management Area (NTSF) on the Upper Coastal Plain in west Tennessee for TDF and TWRA. The forest plan for NTSF was roundly criticized by a wide variety of publics. The land classification was developed to form a sound ecological basis on which to revise the plan and eventually to manage the resources of NTSF. Landtype mapping was completed in 1990. The Laurel Hill WMA on the Western Highland Rim in south-central Tennessee is currently being mapped.

For too many years, forest land management decisions have been made without knowledge of the productive capacity and management restrictions of the land. One does not have to look far to see mistakes resulting from this lack of information. With the application of this system, sounder management decisions can be made for forests of the Cumberland Plateau and Highland Rim/Pennyroyal.

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