An Overview of Forest Diversity in the Interior Low Plateaus Physiographic Province

Edward W. Chester [1]

Chester, E W. 1995. An Overview of Forest Diversity in the Interior Low Plateaus: Physiographic Province. In: Landis, T.D.; Cregg, B., tech. coords. National Proceedings, Forest and Conservation Nursery Associations. Gen. Tech. Rep. PNW-GTR-365. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 109-115. Available at: http://www.fcnanet.org/proceedings/1995/chester.pdf

Abstract-The Interior Low Plateaus Physiographic Province includes parts of six states and is centered in the Ohio, Cumberland, and lower Tennessee River drainage systems. Four sections and numerous subsections are included. The diversity of topographic, geological, climatic, and drainage patterns results in innumerable microenvironments and consequently, the botanical diversity also is great. Floristic diversity includes elements of great geological age, disjuncts, endemics, and many groups with great genetic complexity. Also, the province is at a botanical crossroads and receives elements from many migratory pathways and from adjacent provinces, resulting in numerous floristic-vegetation themes. The results of anthropogenic influences, mostly over the past 200 years, also are great. In addition, evidence indicates a flora of diverse origins and interesting relationships.

INTRODUCTION

Biodiversity (biological diversity) has become a widely used term in both popular and scientific literature. Although often used synonymously with species richness, numerous authors (e.g. Wilson 1994), have pointed out that diversity has various components and may be addressed in several ways. McMinn (199 1) notes that biological diversity encompasses the "diversity of life, including the diversity of genes, species, plant and animal communities, ecosystems, and the interaction(s) of these elements."

It is not the purpose of this paper to discuss biodiversity and the all-important need to preserve as much of the remaining biodiversity as possible. Excellent discussions on these topics can be found in various sources (e.g. the authors cited above, and the first issue of Nature Conservancy for 1994

is devoted entirely to biodiversity). Instead, I will discuss here the Interior Low Plateaus Physiographic Province, diversity of forest communities within the Province, and some of the reasons for that diversity.

THE REGION

Physical Features

The Interior Low Plateaus Physiographic Province, as described by Quarterman and Powell (1978), includes central Kentucky and Tennessee and smaller areas in Alabama, Illinois, Indiana, and Ohio (Figure 1). The Province, drained by the Cumberland, Ohio, and Tennessee rivers and some of their tributaries, includes a complex of level to rolling plains, dissected uplands, and hilly outliers of adjacent provinces. Elevations range from about 109-400 meters. Provincial boundaries are the Appalachian Plateaus (east-south), the Gulf Coastal Plain (southwest-west, except for a narrow interface with the Ozark Plateau in southwestern Illinois), and the Central Lowland (north).

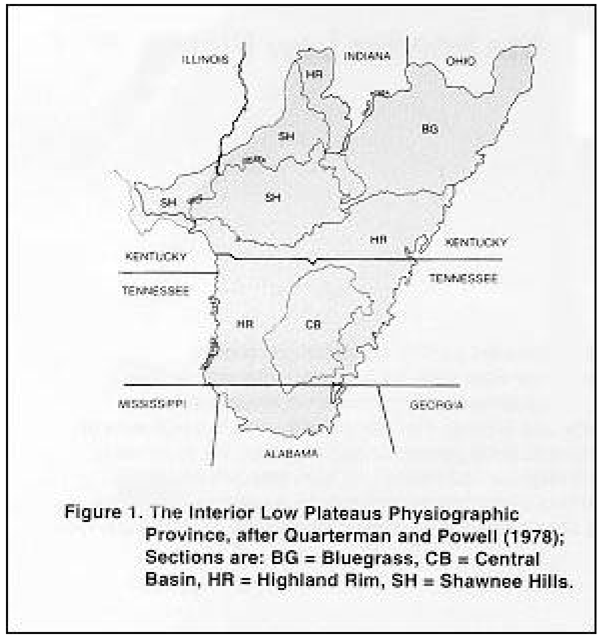

Figure 1. The Interior Low Plateaus Physiographic Province, after Quarterman and Powell (1978); Sections are: BIG = Bluegrass, C13 = Central Basin, HR = Highland Rim, SH = Shawnee Hills.

Geologically, the Province is dominated by Mississippian age limestones and shales; these carbonate rocks result in the most extensive area of karst topography in the United States. The Shawnee Hills Section in the west is a southern extension of the Pennsylvanian- aged sediments of the Illinois Basin. A regional uplift, the Cincinnati Arch, extends from northern Kentucky into Middle Tennessee; erosion of this uplift has exposed limestones and shales of Ordovician age. The region is not generally considered glaciated, but small parts (extreme north) have been, and the entire northern boundary is along the Till Plains Section of the Central Lowlands Province.

Four Sections (Highland Rim, Shawnee Hills, Bluegrass, and Central or Nashville Basin; Figure 1), each with named Subsections, comprise the Province (Quarterman and Powell 1978).

Vegetation

The Interior Low Plateaus is within the extensive Deciduous Forest Formation, first studied in its entirety by Braun (1950), who divided the Formation into nine regions. One of these, the Western Mesophytic Forest Region (WMFR), occupies the Interior Low Plateaus. The WMFR lies between the more mesic Mixed Mesophytic Region to the east and south, the more xeric OakHickory Region to the west, and the glaciated Beech-Maple Region to the north. The WMFR includes vegetational and floristic elements from these surrounding Regions, as well as from the Mississippian Embayment to the south. Thus Braun considered the WMFR to be a transition region and without a combination of characterizing dominants. Within this broad transition zone, local climatic, topographic, and edaphic factors determine vegetational features of a given area within the broad mosaic of types.

Some have mapped the vegetation of the Interior Low Plateaus differently. For example, Kuchler (1964) included the area in his OakHickory Forest, with some Beech-Maple in southern Indiana, with prairie outliers in Kentucky and Tennessee, and with cedar glades in Alabama and Tennessee. Others (e.g., Bailey 1976) included the Plateaus under the broader Central Hardwood Forest Region.

The following brief vegetational summary of the Interior Low Plateaus looks at each of the four major physiographic Sections of Quarterman and Powell. For details, and especially for conditions in the Subsections and/or specific areas, the reader is referred to the following references (from whence my summaries were taken), and the extensive bibliographies cited by these authors: Braun (1950), Baskin et al. (1987), Chester (1989), Martin et al. (1993 - especially the included paper by Bryant et al.), and Quarterman and Powell (1978).

Sections of the Interior Low Plateaus Physiographic Province

1. Bluegrass (BG) Section. There are five Subsections (Quarterman and Powell 1978), with considerable diversity in substrate, topography, and vegetation. The Inner BG (30% of the BG) is a rolling, fertile, mildly karst plain that is ideal for agriculture and was early- settled. Scanty historical records of the plant life and existing remnants indicate savanna- woodlands characterized by bur, chinquapin, Shumard and white oak, blue and white ash, sugar maple, hackberry, Kentucky coffee tree, and several others, including shellbark hickory. Cane occurred in extensive stands, and meadows were prominent. The Outer BG (40% of the BG) is similar, but includes outwash from Pleistocene glaciations in the extreme north, more floodplains, and glades and glade-like habitats. Forests are mixed hardwoods in various combinations depending upon local conditions. The Northeastern BG and Eden Shale Belt Subsections are oak-hickory dominated, especially on drier sites. The same is true for the Knobstone Escarpment and Knobs Subsection, although deep ravines there support more mesophytic forests. Important species of these more mesic sites are American beech, tulip poplar, sugar maple, northern red oak, and white ash..

2. Central Basin (CB) Section. This Section, sometimes referred to as the Nashville Basin, is unique with its cedar glades and endemic or near-endemic taxa and has received much attention elsewhere (e.g. Somers 1986). In regard to forests, only fragments of original conditions remain; most of the area has been cleared for decades. Earlier references refer to the abundance and enormous size of trees growing on deeper soil in the Basin, especially species of ash, cottonwood, walnut, hickories, beech, maple, buckeye, hackberry, Kentucky coffee tree, red cedar, and others. Red cedar, winged elm, and hackberry are most common on shallow soil in glade areas. Knobby Highland Rim outliers include species similar to those of the Rim

3. Highland Rim (HR) Section. Vegetational diversity is great in this Section and I must at least mention the major Subsections. The Eastern Highland Rim, lying east of the Central Basin and adjoining the Cumberland Plateau on the east, provides a rich and diverse group of habitats and elements. Dry slopes and ridges produce oak-hickory forests, although chestnut

was important before its virtual elimination in the first half of this century. White, scarlet, blackjack, southern red, black, post, chestnut, and southern red oak are significant, as are mockernut, pignut, and shagbark hickories. More mesic slopes add sugar maple, American beech, northern red oak, white ash, and tulip poplar. Mixed mesophytic conditions, with American beech, sugar maple, tulip poplar, white oak, and sporadically, yellow buckeye, basswood, and cucumber and umbrella magnolia are found in some mesic sites. Oak swamps occupy some wet sites, with pin, swamp white, willow, and swamp chestnut oaks, and sweet gum, red maple, black gum, and beech. These upland swamps provide habitats for a number of Coastal Plain herbs and shrubs. Some barrens, especially on the southeastern Highland Rim, are grass-dominated and numerous rare species occur there.

The Western Highland Rim, lying between the Central Basin and the Tennessee River, is slightly lower in elevation than the Eastern Rim, and mixed mesophytic conditions are much more circumscribed and rare. Ridge and slope forests are oak-dominated (white oak is most frequently seen), but composition varies with aspect and elevation. American beech, sugar maple, white ash, wild black cherry, and tulip poplar are important on more mesic sites and in ravines. Forests are mostly hardwood but white and yellow pine occur sporadically and Virginia pine communities occur on dry promontories about the Tennessee River and along breaks to the Central Basin. Most rivers are impounded by Tennessee Valley Authority and U.S. Army Corps of Engineers dams. Flooding and dewatering regimes result in several kinds of wetland communities, ranging from dewatered flats to marshes and swamps. Bottomland forests are limited (most removed early or now flooded by impoundments). Several site studies are available, especially from the northwestern section (Montgomery Bell State Park, Cross Creeks National Wildlife Refuge, Land Between The Lakes).

The Pennyroyal Plain and Elizabethtown Subsections include areas historically referred to as the Big Barrens (Baskin et al. 1994). A wide variety of landtype associations occurs on these limestone karst plains of Kentucky (mostly) and Tennessee. Although now mostly agricultural, plant communities include limestone cedar glades, prairies dominated by native perennial grasses and forbs, and forests of dry, mesic, and wetland sites which are not unlike those of the adjacent Rim. Forests of upland depressions and karst fens are of interest, and are now the subject of some study.

The Southwestern and Southern Subsections are primarily upland hardwood types, but yellow and loblolly pine types are locally abundant. Ravines and moist slopes support types not unlike that of the adjacent Rim. Several other smaller Subsections of the Highland Rim are addressed by the cited authors, especially by Quarterman and Powell (1978).

4. Shawnee Hills (SH) Section. This Section, also known as the Western Coalfields in Kentucky, in general is a rolling upland plateau with broad, alluvial plains bordering the major rivers. The Dripping Springs Escarpment lies to the south and east, forming an area of bluffs, cliffs, and generally rugged terrain. Agriculture, and especially surface mining for coal, has had devastating effects on much of the natural vegetation. Remaining forests are secondary (apparently) and scattered. Slopes, ridges, and ravines are dominated by mixtures of mostly hardwood species. Slopes are oak-dominated (black, white, red) but hickories (pignut, shagbark, mockernut) are common. More mesic slopes and ravines will have American beech,

sugar maple, tulip tree, white ash, and wild black cherry, while more xeric sites (upper slopes, ridges) will have more typical dry-land oaks (black, blackjack, post), red cedar, even some Virginia pine. Floodplains of major rivers include such southern species as bald cypress, water locust, and water tupelo, along with typical bottomland hardwood species of birch, cottonwood, elm, hickory (shagbark, shellbark, pecan), maple, oak (cherrybark, overcup, pin, swamp chestnut, willow), sycamore, and sweetgum. In the deep gorges of the escarpments may be found several species with Appalachian affinities, e.g., American holly, eastern hemlock, magnolia (bigleaf and umbrella), mountain laurel, white pine, and yellow birch. A few barrens, glades, and relict hill prairies also occur.

FLORISTIC AND VEGETATIONAL SIGNIFICANCE OF THE PROVINCE

The flora of the Province is relatively large, e.g., more than 3000 taxa in Kentucky (Browne and Athey 1992) and 2900 in Tennessee (Wofford and Kral 1993). This floristic richness may be accounted for in a number of ways. Most importantly, the Province is at a botanical crossroads and receives elements from many migratory pathways, as well as various spill-over elements from adjacent provinces. For example, the Tennessee River has provided a migratory pathway for a small but significant Appalachian element, and the Cumberland River, originating in highlands of the Cumberland Plateau to the east, contributes elements from there. Likewise, prairie elements from the north and west, and Coastal Plain elements from the south and southwest, are significant. Massive reservoirs, destructive mining, and other major anthropogenic perturbations have destroyed significant habitats and community types, but also have resulted in new habitats and as a consequence, allowed for the introduction of new species and the expansion of old ones.

Other factors explaining the floristic richness include the diversity of substrates and soils, the various slope aspects (direction and degree of slopes), the temperature, wind currents, precipitation, and the drainage systems. These highly variable factors have produced innumerable microenvironments which provide for the ecological requirements of many species. Also of significance is the great age of the Province, or time that the area has been available for plant occupancy; most of the Province has not been under marine waters for millions of years, nor acted upon by glacial ice during the geologically-recent ice ages. Collectively, and along with numerous other (many yet unknown) factors, an interesting flora has developed, one with (1) geologically old elements, (2) disjuncts (with other Provinces and even other continents), (3) numerous endemics, (4) groups with great genetic complexity, and (5) a highly significant, but not always desirable element that is the result of anthropogenic activity.

The factors given above not only help to explain floristic richness, but also offer some explanations for the intricate mosaic of vegetation types present in this Province. Foremost, this region is transitional in a vegetative as well as a floristic sense, with major influences from the more xeric OakHickory Region to the west and the more mesic Mixed Mesophytic Region to the east. It is no surprise that the Province includes numerous floristic-vegetational themes. For example, forests types include mixed mesophytic, mixed hardwoods, oak and oak-hickory, pine, cedar, bottomland hardwoods, and swamp forests. Also, upland swamps, karst fens, cedar glades, barrens, prairie relicts, and several dozen other minor community-habitat types occur.

Ideas on the origins and relationships of this diversity also might be mentioned. Nearly 30 years ago evidence was summarized for origins and relations of the southern highlands floras that include at least part of the Interior Low Plateaus [i.e., by A. J. Sharp, first heard by me in a 1966 lecture - see literature cited, and later (1970) became available in print], and by Alan Graham (1965) for Southeastern North America. They found the uniqueness and diversity of eastern North American Cretaceous floras to be primarily due to diverse origins, including:

1. A portion of the species comprising the modern flora evolved more or less in place from older Mesozoic vegetation. Examples include species of genera known, from the fossil record, to have been present in eastern North America during the early period of angiosperm evolution, including species of maple, birch, walnut, oak, cottonwood, willow, and others.

2. During the Eocene and Early Oligocene, land connections and climates were favorable for the introduction of tropical vegetation (early Tertiary). Once these species were introduced, later Tertiary trends toward colder times produced one of two responses in this area: (A) the tropical species were eliminated and are no longer represented in the flora, except as fossils; (B) some species evolved into types capable of existing under temperate conditions. These species exist today, usually represented only by one or a few species, although there may be numerous relatives in the tropics. Examples are persimmon and pawpaw.

3. A second interchange occurred between our biota and that of Europe and Asia during the Tertiary, via migration across land bridges. These are remnants of the well-documented Arcto-Tertiary Geoflora and probably include species of such genera as yellow-wood, sweetshrub, sycamore, oak, maple, walnut, elm, and others.

4. During the Pleistocene Period many boreal elements were introduced. Most of these were eliminated by warming conditions but some notable northern disjuncts (e.g., arbor vitae and a type of yellow birch, among others) still occur.

5. The last and perhaps most significant modification has occurred during the last 200 years as a result of anthropogenic activity. These include the accidental introduction of weedy species (many grasses and forbs), escape of planted species (fescue, kudzu), the elimination of taxa due to human activity (American chestnut), and perhaps most importantly, elimination of entire landtypes due to urban sprawl, reservoirs, strip mining, and other major land-changing activities.

SUMMARY

The Interior Low Plateaus Province is a place of topographic, floristic, and vegetational transition, and therein lies its beauty, and in many cases its worth. From the blue grass to the hill country, from river bottomlands to glades and barrens, floristic diversity is great, and the number of plant community types and combinations almost innumerable (and in many cases undocumented). For those of us who seek truths of and about the biota of an area its origins, composition, distribution, community types, interactions, and relationships, this is a great place to be. For those of us who seek to preserve and conserve the biota and natural beauty of an area, our work is at hand.

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[1]*Austin Peay State University Clarksville, TN 37044.*

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