

SECTION II. THE PHYSICAL SETTING OF KENTUCKY

LOCATION AND TOPOGRAPHY

Kentucky was admitted to the union in 1792, and its current boundaries were established in 1818 with the acquisition of the Jackson Purchase from the Chickasaws (Figure 2). These boundaries enclose about 103,000 sq km of land and 1700 sq km of water, totaling 104,700 sq km (40,411 sq miles, or 25.9 million acres). Natural river boundaries (1376 km or 855 miles of river borders) separate Kentucky from Missouri to the west, from Indiana, Illinois, and Ohio to the north, and from West Virginia to the east. Other states with contiguous borders are Virginia to the southeast and Tennessee to the south. The Kentucky boundaries extend north to south from latitude 39° 9' N to 36° 30' N, and east to west from longitude 81° 58' W to 89° 34' W. The state is divided into 120 counties, ranking it 3rd in the United States in number of counties (behind only Georgia and Texas). See McGrain & Currens (1978) for a review of Kentucky topography.

Elevations in the state range from 78 m (257 ft) along the Mississippi River in Fulton County to 1262 m (4139 ft) on Black Mountain in Harlan County. Topography varies from rugged mountain summits, cliffs, deep ravines, and river gorges, to rolling plains and knobby hills, to plateaus, to floodplains and river bottoms. A total of about 49,105 stream miles at the 1:100,000 scale have been mapped in Kentucky (Kentucky Division of Water 2002). Major river systems are the Big Sandy, Cumberland, Green, Kentucky, Licking, Mississippi, Ohio, Salt, Tennessee, and Tradewater. There are over 11,000 named streams, and over 2000 bodies of water (ponds, sloughs, lakes and reservoirs) in Kentucky, and about 20 of these are major reservoirs. Only a few of these bodies of water were naturally formed (natural ponds, sloughs, small lakes), and most are in the Mississippi Embayment.

CLIMATE

Kentucky is located in the continental interior at a mid-latitudinal location. The climate has been classified in the Humid Temperate Domain by Bailey (1995). Kentucky's climate was reviewed by Ulack et al. (1998), and detailed information is available at <http://kyclim.wku.edu/>. In general, Kentuckians experience warm and humid summers and moderately cold winters. Mean maximum July temperatures across the state vary from 28–33° C (83–91° F), and mean minimum July temperatures vary from 16–21° C (61–69° F). In January the mean maximum temperatures range are from 3–7°C (36–44°F), and the mean minimum temperatures range from -8 to -3°C (18–26°F). Temperature means vary considerably in the state with northern and far-eastern regions averaging about 4–5°C cooler in summer and in winter, compared to more southern and western regions of the state. Precipitation varies north to south with the northernmost areas averaging 97–102 cm (38–40 in), and the southernmost areas averaging 127 cm (50 in). The mean growing season length varies from 155–170 days in eastern and northern regions to 200+ days in western and southern portions of the state. Days per year with below freezing temperatures vary from about 60 days in southwestern regions to 100+ days in northern and far-eastern regions.

NATURAL REGIONS OF KENTUCKY

Traditionally the natural regions of Kentucky have been defined by either physiographic provinces, i.e., differences in landform and underlying geology, or by major forest types. In recent years the concept of the ecoregion has become prominent, these ecoregions defined as “areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources” (Woods et al. 2002). Three of these classification systems are presented in Table 4, and compared with the traditional division of the state into forest regions and physiographic provinces.

The following discussion is oriented around the concept of the physiographic province, (Figure 2) with information provided on the topography, geology, and soils of these regions. In this classification, Fenneman (1938) recognized three major natural regions in Kentucky—an eastern highland region (Appalachian Plateaus), a central plateaus region (Interior Low Plateaus), and a western lowland region (Coastal Plain or Mississippi Embayment) (Figure 1).

Basic references for Kentucky’s physiographic provinces are: Bailey & Winsor (1964), Karan (1973), McDowell (1986), McGrain & Currens (1978), McGrain (1983), Ulack et al. (1998), and USDA SCS (1975). The discussion given below is based on a compilation of information from the above references. Burr & Warren (1986), Cranfill (1980), Mengel (1965), and Palmer-Ball, Jr. (1996), provided physiographic reviews related to the fishes, ferns, and birds of Kentucky.

Figure 2. Kentucky and the south-central United States: state borders and physiographic boundaries. (From USDA FS 1969).

APPALACHIAN PLATEAUS

The Appalachian Plateaus Province extends from New York through portions of Pennsylvania, Ohio, West Virginia, Virginia, Kentucky, and Tennessee to northwestern Georgia and northeastern Alabama. This province covers 30% of Kentucky’s land area, a total of about 31,400 sq km (12,000 sq mi). The region in Kentucky, also known as the Eastern Coalfields, includes 35 counties or parts thereof. Major sections, from north to south, are the Allegheny Plateau, the Cumberland Plateau, and the Cumberland Mountains (Figure 3). The topography varies from rolling hills in the north, to flat plateaus in the south, to highly dissected terrain through much of the interior, especially in the southeast and southwest portions of the province, where mountain peaks, steep ridges, and narrow valleys predominate. The most rugged terrain in the Commonwealth is in the Cumberland Mountains, where many ridges and peaks surpass 610 m (1,200 ft), with the highest elevations at over 1,200 m (4,000 ft) in the Cumberland Mountains. Elevations through the remainder of the province typically vary from 366 m (1,200 ft) to 610 m (2,000 ft). The western border of the province is characterized by the highly dissected Pottsville Escarpment.

The province is underlain with Paleozoi sandstones, conglomerates, coals, siltstones, and shales of Pennsylvanian age may be exposed in entrenched stream beds, especially along the Pottsville Escarpment. The characteristic soils of ridges and slopes are typically loamy to clayey, excessively drained, low in fertility, highly acidic, and often very rocky. Soils of higher

organic and moisture content occur less frequently, typically on lower slopes, terraces, and floodplains. The predominant soils of the Appalachian Plateaus belong in the Inceptisol order, Ochrept suborder, and Dystrichrept great group (USDA SCS 1975). Bailey & Winsor (1964) list the major soil series as Dekalb and Muskingum on the steeper land, Jefferson on the top slopes, and Stendal on the bottomlands.

Several major rivers originate in this part of Kentucky, including the Cumberland, Kentucky, Licking, and Big Sandy and hundreds of smaller streams dissect the region. Spectacular geological formations can be found throughout the region, including the Red River Gorge, Cumberland Gap, Carter Caves, Cumberland Falls, the rugged mountain vistas of Black Mountain and Pine Mountain, as well as numerous waterfalls, natural bridges, and arches.

INTERIOR LOW PLATEAUS

The Interior Low Plateaus extend from southern Ohio, Indiana, and Illinois, through central Kentucky and Tennessee, into northern Alabama. In Kentucky this region, extending from the western edge of the Appalachian Plateaus to the Tennessee River, includes about 68,100 sq km (26,300 sq mi). About 65% of Kentucky occurs in the Interior Low Plateaus, involving all or parts of 77 counties. This province includes three major sections: the Bluegrass and Knobs, the Highland Rim, and the Shawnee Hills, and has been divided into a number of subsections (see Table 4). The topography of this region varies from level plateaus to rolling plains to highly dissected uplands, with elevations varying from 92 m along the Ohio River to about 330 m in portions of the Bluegrass and the southern Shawnee Hills. Over 50% of the region is underlain with carbonate rocks, mostly limestones, which form the most extensive karst region in the United States. This region is characterized by numerous caves and springs and is best exemplified by the vast underground formations associated with Mammoth Cave.

Geology of the province varies by major section. The oldest rocks (Ordovician limestones) occur in the central Bluegrass and date to about 450 mya, and the youngest strata (Pennsylvanian sandstones) occur in the Shawnee Hills and date to about 300 mya. The outer regions of the Bluegrass are characterized by limestones, shales, and shaly limestones of Ordovician, Silurian, and Devonian ages; the Knobs by shales, limestones, and sandstones of Silurian, Devonian and Mississippian ages; the Highland Rim by Mississippian limestones; and the Shawnee Hills by limestones, sandstones, and shales of Mississippian and Pennsylvanian ages.

Soils of the region also vary greatly, with basic or near-neutral limestone soils of moderate to high fertility predominating through much of the region. The Bluegrass soils, considered among the most fertile soils of the U.S., are given much credit for the success of the horse industry in central Kentucky. These soils are predominantly deep, well-drained silt loams with high calcium and phosphate content. Alluvial soils occur along the rivers, with the Kentucky River depositing some Appalachian-derived sandstone and shale soils along its floodplain. In the Knobs the soils are thin, excessively drained, acidic, and low in fertility, both on the slopes and in the valleys where the soils often have fragipans and are poorly drained. The flatter regions of the Highland Rim region have soils that are moderately fertile and well-drained. Poorly drained soils with fragipans occur in some areas, especially in south-central Kentucky. The more dissected areas of the Highland Rim have well drained soils of low to moderate fertility and are more acidic. Fertile, deep soils do occur on the extensive floodplains and lower terraces of the major stream systems of the region. Sandstone, shale, and loess-derived soils are more common in the Shawnee Hills, and these soils are more acidic and less fertile, sometimes with a fragipan. Major soil orders (USDA SCS 1975) and soil series (Bailey & Winsor 1964) are as follows:

- 1) Bluegrass—Alfisols, Udalf suborder; Maury, Hampshire, and Loradale in the Inner Bluegrass; Lowell, Shelbyville, and Fairmont in the Outer Bluegrass; Eden, Nicholson, and Lowell in the Hills of the Bluegrass;
- 2) Highland Rim—Ultisols, Udults suborder; Baxter, Crider, Decatur, Dickson, Pembroke, Russellville, Westmoreland;
- 3) Shawnee Hills—Ultisols, Udults suborder; uplands with Christian, Loring, Muskingum, Tilsit, Zanesville; bottomlands Collins, Philo, and Stendal;
- 3) Knobs—Inseptisols, suborder Ochrepts; knobs uplands with Colyer, Rockcastle, Otway; valleys with Tilsit on the uplands, Monongahela on the terraces, Leadvale on the toe slopes, and Philo, Stendal, and Atkins in the bottoms.

Major river systems of the Interior Low Plateaus are the Cumberland, Tradewater, Ohio, Green, Barren, Salt, Kentucky, and Licking, along with their numerous tributaries. Many scenic and interesting geologic features occur in the Interior Low Plateaus, including the Kentucky River Gorge and Palisades, Mammoth Cave and many other limestone caves, the Dripping Springs Escarpment, Falls of the Ohio, Blue Lick, and Big Bone Lick.

MISSISSIPPI EMBAYMENT

The Mississippi Embayment is part of the extreme northern end of the Coastal Plain Physiographic Province of the southeastern United States. In Kentucky it encompasses 8 counties, only 5% of the Kentucky land area, a total of about 5,300 sq km (2000 sq mi). The province is bordered on the east by the Tennessee River/Kentucky Lake drainage, to the north by the Ohio River, and on the west by the Mississippi River (Figure 3). The region can be divided into two major sections based on topography: the East Gulf Coastal Plain in the uplands and the Mississippi Alluvial Plain along the Mississippi River. The province is characterized by gently rolling plains and flat, gravelly ridges.

Surface rocks in this region are loosely consolidated or unconsolidated sediments of sands, gravels, and clays, deposited during the late Cretaceous and Tertiary Periods. These deposits are underlain by cherty rocks of Mississippian age. Loess deposits of Pleistocene age cap much of the area and have contributed to the formation of the Mississippi River bluffs. Gravels, sands, and clays are characteristic of the uplands. Elevations vary from 79 m (260 ft) along the Mississippi River in Fulton County (the lowest point in Kentucky) to 195 m (640 ft) in the hilly sections to the east. Soil orders (USDA SCS 1975) and soil series (Bailey & Winsor 1964) are as follows:

- 1) Mississippi River floodplains—Mollisols, suborder Aquolls, being fine-textured, slowly draining silt, clay, or sandy loams; soil series include Sharkey, Dundee, and Commerce;
- 2) Uplands of Mississippi River loess bluffs—Alfisols, suborder Udalfs; soil series Grenada, Calloway, and Collins;
- 3) Uplands of Tennessee and Cumberland River region—Alfisols, suborder Udalfs; soil series Brandon, Guin, and Bodine, being well to poorly drained silt and gravelly soils.

A number of smaller streams cross this province, including Clarks and Blood rivers, Terrapin and Mayfield and Obion creeks, and the Bayou du Chien, but significant portions of these streams have now been channelized. Major geologic features of the region are the New Madrid Fault, Reelfoot Lake, and the Mississippi River bluffs.

Table 4. A comparison of Kentucky's physiographic provinces, ecoregions, and forest regions. Sources: Physiographic provinces (Fenneman 1938; Quarterman & Powell 1978); ecoregions (Woods et al. 2002); forest regions (Braun 1950; Küchler 1964).

**Physiographic
Provinces**

(alternate names)

Sections, Subsections

**Appalachian
Plateaus**

(Eastern Coalfields)

**Cumberland
Mountains**

Cumberland Plateau

Allegheny Plateau

**Interior Low
Plateaus**

Bluegrass

Knobs, Northeastern
Bluegrass, Outer Bluegrass
Eden Shale Belt, Inner
Bluegrass

Highland Rim

(Mississippian Plateau,
Pennyrile)
Eastern Highland Rim
Western Highland Rim
Pennyroyal Plain
Elizabethtown Plain
Greensburg Upland
Cumberland Enclave

Shawnee Hills

(Western Coalfields)
Mammoth Cave Plateau
Marion, Ohio River Hills and
Lowlands, Brush Creek Hills

Mississippi

Embayment

(Jackson
Purchase, Coastal Plain)

**Eastern Gulf
Coastal Plain**

**Mississippi
Alluvial Plain**

Ecoregions

**Central
Appalachians**

**Southwestern
Appalachians**

**Western Allegheny
Plateau**

**Interior Low
Plateau**

**Interior Low
Plateau**

**Interior River
Valleys and Hills**

**Interior Low
Plateau/
Mississippi
Valley Loess
Plains**

**Mississippi
Alluvial Plain**

Forest Regions

**Mixed Mesophytic
Forest** (all of
Appalachian
Plateaus)

**Western Mesophytic
Forest/Oak-Hickory
Forest** (all of
Interior Low
Plateaus)

**Western
Mesophytic
Forest/Oak-
Hickory Forest**
(Eastern Gulf
Coastal Plain)

**Southeastern
Evergreen Forest
/Southern
Floodplain Forest**
(Mississippi
Alluvial Plain)