PART TWO

Notes for a series of four classes on "Natural History and Conservation Planning in the Central Bluegrass Region of Kentucky" initially presented for Osher Lifelong Learning Institute at the University of Kentucky in April of 2016

Julian Campbell: bluegrasswoodland.com

2. Landscapes: outline of the Central Bluegrass region based on geology, topography, soils, native vegetation, flora and fauna, human history plus potential future balance of man and nature.

What is our ‘ecological address’, from immediate locality to region to biome to continent to globe to solar system to universe? Let’s work down from ‘biome’—a zone with relatively homogeneous climate and native vegetation. Our land used to be mostly covered with humid temperate forest, dominated by deciduous trees except where soils are poorer or where disturbances caused openings. It is important to specify ‘mid-temperate’ here, equivalent more or less to Hardiness Zones 6 and 7 of the USDA (annual minimum temperature averaging -10 to +10 degrees F). Varied terminologies have been confusing. Within our biome, there is also much geological variation, with profound influences on the native vegetation. Glaciation has smoothed over the landscape further north, but older geological patterns have caused most of Kentucky to have diverse topography and soils. There are many differences in flora and fauna from more siliceous soils, especially on sandstone, to more calcareous soils, especially on limestone. The Central Ohio Valley can be defined as a complex combination of the true Bluegrass region (on calcareous Ordovician bedrock), plus the surrounding Knobs and other transitional hills (Silurian, Devonian, Mississippian), plus transitional glaciated land and recent alluvial plains (Pliocene to Holocene).

The Central Bluegrass is loosely defined here to include the Inner Bluegrass (Middle Ordovician) plus some surrounding sections of the less fertile Eden Shale Hills (Upper Ordovician). The Eden Shale Hills are less pronounced to the east, with much intermixing of soil types, perhaps due to ancient rivers and estuaries flowing from the original Appalachian Mountains. Watershed boundaries are close to geological boundaries in some areas, and they can help define useful regions. The whole Ohio River watershed embraces the central Ridge & Valley, Appalachian Plateaus, Interior Low Plateaus and some southern glacial till plains. The Central Bluegrass includes several tributaries that flow into the Kentucky River Palisades, especially Elkhorn Creek, plus the whole South Fork of Licking River. Centered on Bourbon, Fayette, Jessamine and Woodford Counties, this is a useful region for developing a community of conservationists.

It is reasonable to focus on conservation of more natural landscape and watersheds in the following three areas. These have different ecological emphases, and to some extent different sets of imperiled species. Various organizations have initiated much work within them.

A. The Kentucky River Palisades, broadly defined, extends from Lower Howard’s Creek to the mouth of Elkhorn Creek. In addition to this central corridor, the much more degraded Elkhorn Creek watershed could become a focus of work. Also, the adjacent Eden Shale Hills in Garrard and Madison Counties contain relatively extensive woods of potential interest. Ravine slopes and bluffs along the Palisades contain diverse habitats, extensive forest and some unusually old trees in places. Moreover, there is a general concentration of globally and regionally rare species. But the river itself is highly degraded due to locks-and-dams. And on adjacent flatter uplands, the woods have been largely cleared off in the past, leaving few significant remnants. Further away from stream corridors, opportunities for restoration of native vegetation are even less frequent.

B. The South Fork of Licking River (mostly Clark, Bourbon and Harrison Counties) has interest for restoring water quality and aquatic life, especially imperiled species of mussels. This watershed also includes some significant remnants of ancient woodland on the uplands, especially Griffith Woods. There is some potential for recovery of the river system, if the effects of farming can be reduced. However, the main stem of Licking River (further north) has much more integrity, due to less intense farming and more forest in that watershed. Over the long term, it may be possible to increase forested corridors along the South Fork and its tributaries. And Griffith Woods should become a regional model for restoration on the uplands.

C. The Bluegrass Army Depot (Madison County) covers 14,500 federal acres on relatively gentle uplands, part of which is transitional to the dolomitic foothills of the Knobs. Although generally degraded, some sections are already managed for restoration of wildlife and native vegetation. This area contains one of the largest known populations of running buffalo clover, a species maintained by grazing of cattle after settlement but now largely dependent on deer. Conservation remains subservient to military interests, but the Depot could eventually become largely decommissioned.

CLIMATE: our mid-temperate, humid, changeable biome

The climate of Kentucky is generally described as temperate, with mean annual temperature of 53-59° F [12-15 ° C], and humid, with mean annual precipitation of 40-52 inches [100-130 cm]. Both parameters generally increase from north to south. The term "mid-temperate" is useful for the Bluegrass region; but distinction of "warm temperate" versus "cool temperate" climate has been defined in various ways. Walter's map of the world's vegetation (Breckle 2002) indicates that our region is indeed near the center of the temperate zone, between subtropical and boreal. But climatic change in recent decades has pushed us to warm temperate transitions, with average annual lows changing from minus 5-0 ° F to plus 0-5 ° F.

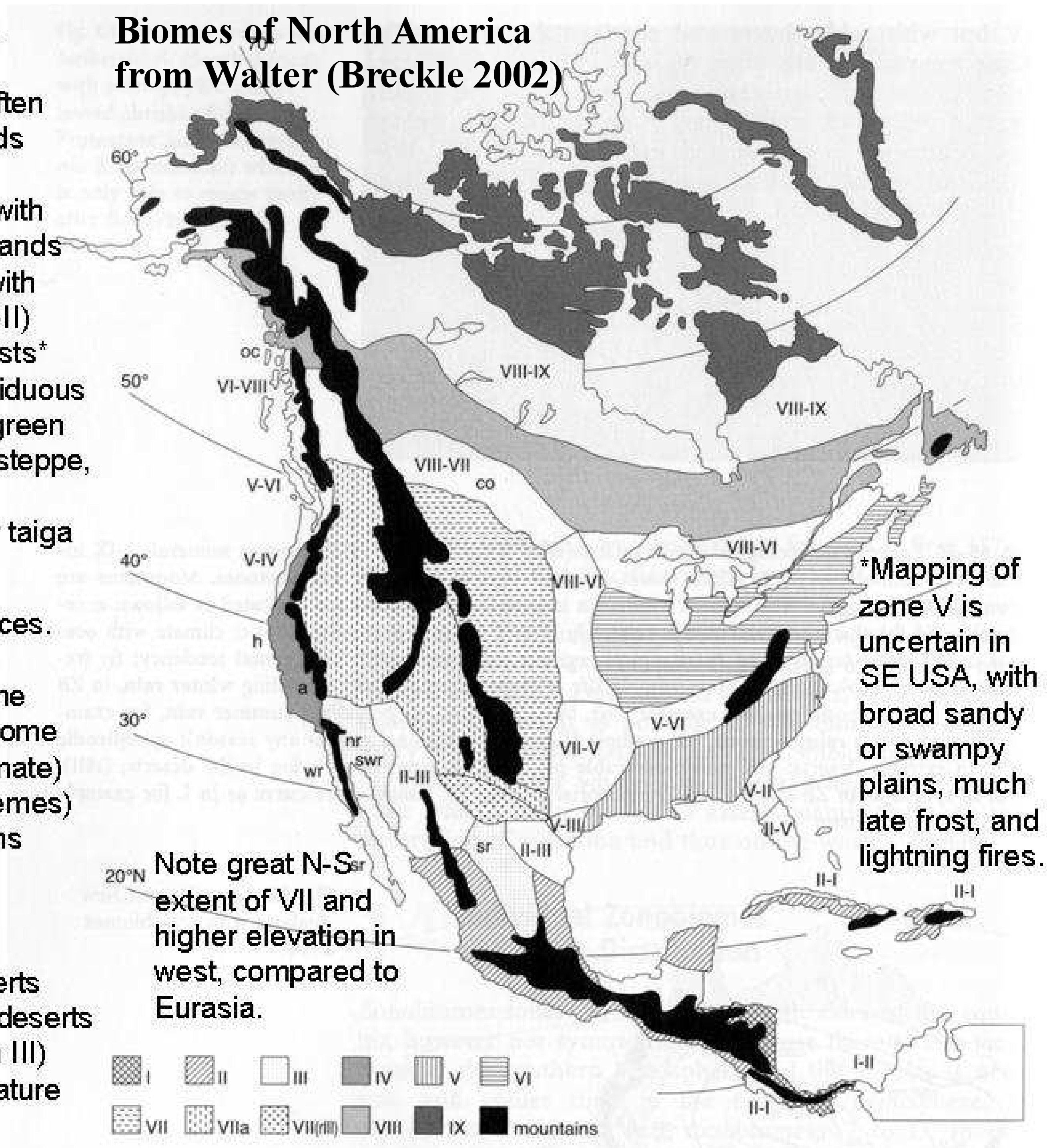
In addition to average temperatures, the year-to-year variation in annual minimum temperature is probably a significant ecological factor. Daly et al. (2012) have shown that there is a remarkable peak in standard deviation within the Central Ohio Valley. The erratic, unpredicatable occurrence of late frosts may have especially important effects on many plant species (e.g. -30 ° F at Gainesway Farm in early 2014). Deeper understanding of this pattern is needed; it may be allowed by the lack of montane barriers to descent of arctic air-masses, and perhaps by cool-air drainage into the many small narrow valleys throughout much of this region. Thus, broadleaved evergreen trees are virtually absent from the native woodland, in contrast to zones of Eastern Asia with similar mean annual temperature.

It is interesting to compare the Central Bluegrass with calcareous regions of southern Kentucky along Green and Cumberland Rivers, where soils are similar but temperatures are slightly higher. Although most of the dominant species are the same, and deciduous forest remains dominant in less disturbed areas, there are many shifts in less common flora and fauna. Yet it is probably reasonable to develop plant material from the south for future plantings here.

More detailed maps of continents.
I = tropical: evergreen rain forests
II = tropical-subtropical: forests (often deciduous), savannas & grasslands
III = subtropical: hot deserts
IV = warm temperate-subtropical with winter rains: sclerophyllous woodlands
V = warm temperate-subtropical with more equitable or (especially in V-II) monsoonal rain: lauriphyllous forests*
VI = temperate humid: mostly deciduous forests; or locally coniferous evergreen
VII = temperate arid: grasslands (steppe, prairie) & cold deserts
VIII = boreal: coniferous forests or taiga
IX = arctic: tundra

Ecotones are shown by white spaces.
Mountains are shown in black.
a = relatively arid for the zonobiome
h = relatively humid for the zonobiome
oc = oceanic tendency (milder climate)
co = continental tendency (w/extremes)
fr = frequent frost in tropical regions
wr = prevailing winter rain
sr = prevailing summer rain
swr = two rainy seasons
ep = episodic rain in extreme deserts
nm = non-measurable dew/fog in deserts
(rIII) = unusually sparse rain (as in III)
(tI) = unusually aseasonal temperature
(as in diurnal climate of I)

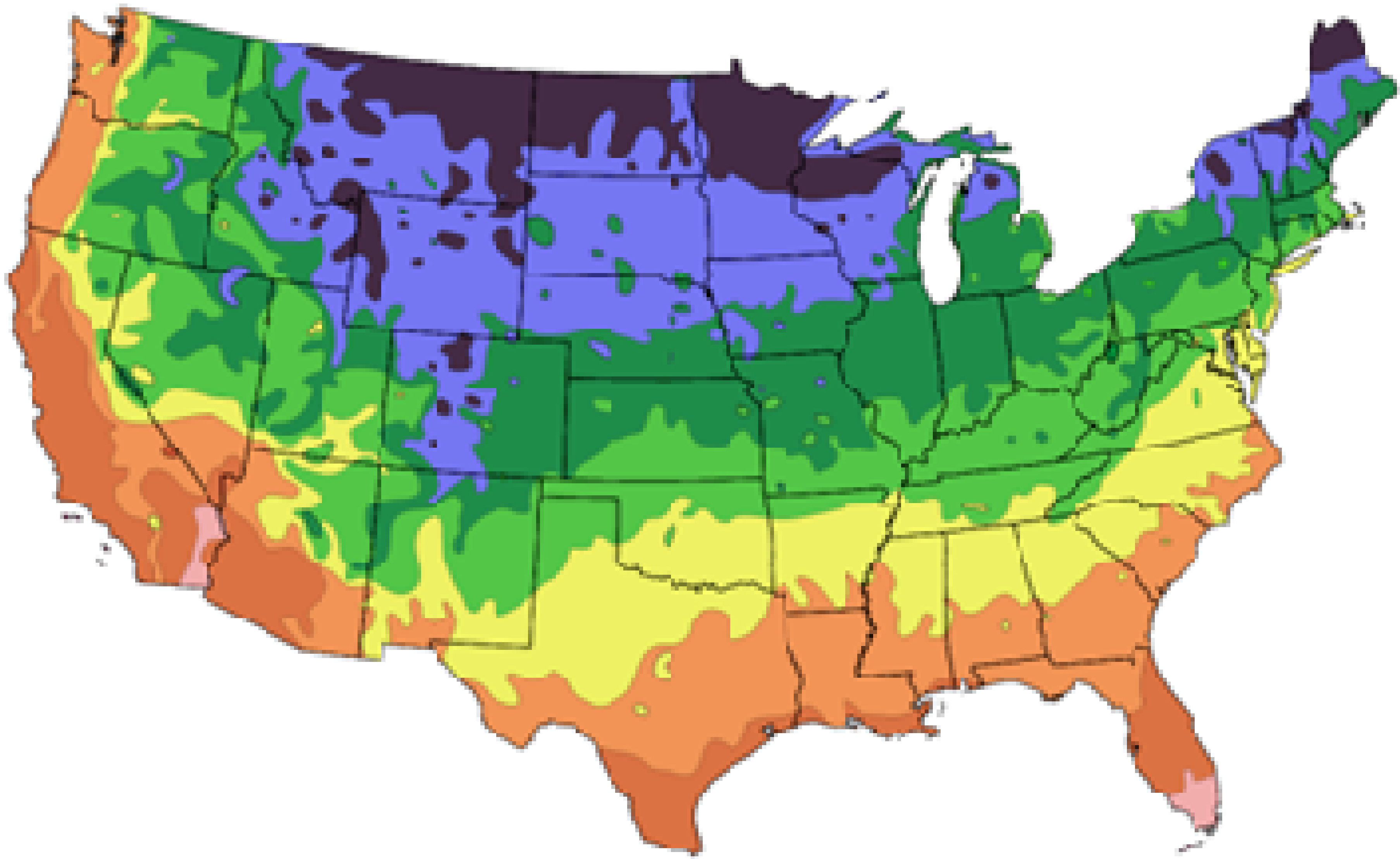
Biomes of North America from Walter (Breckle 2002)



Note great N-S extent of VII and higher elevation in west, compared to Eurasia.

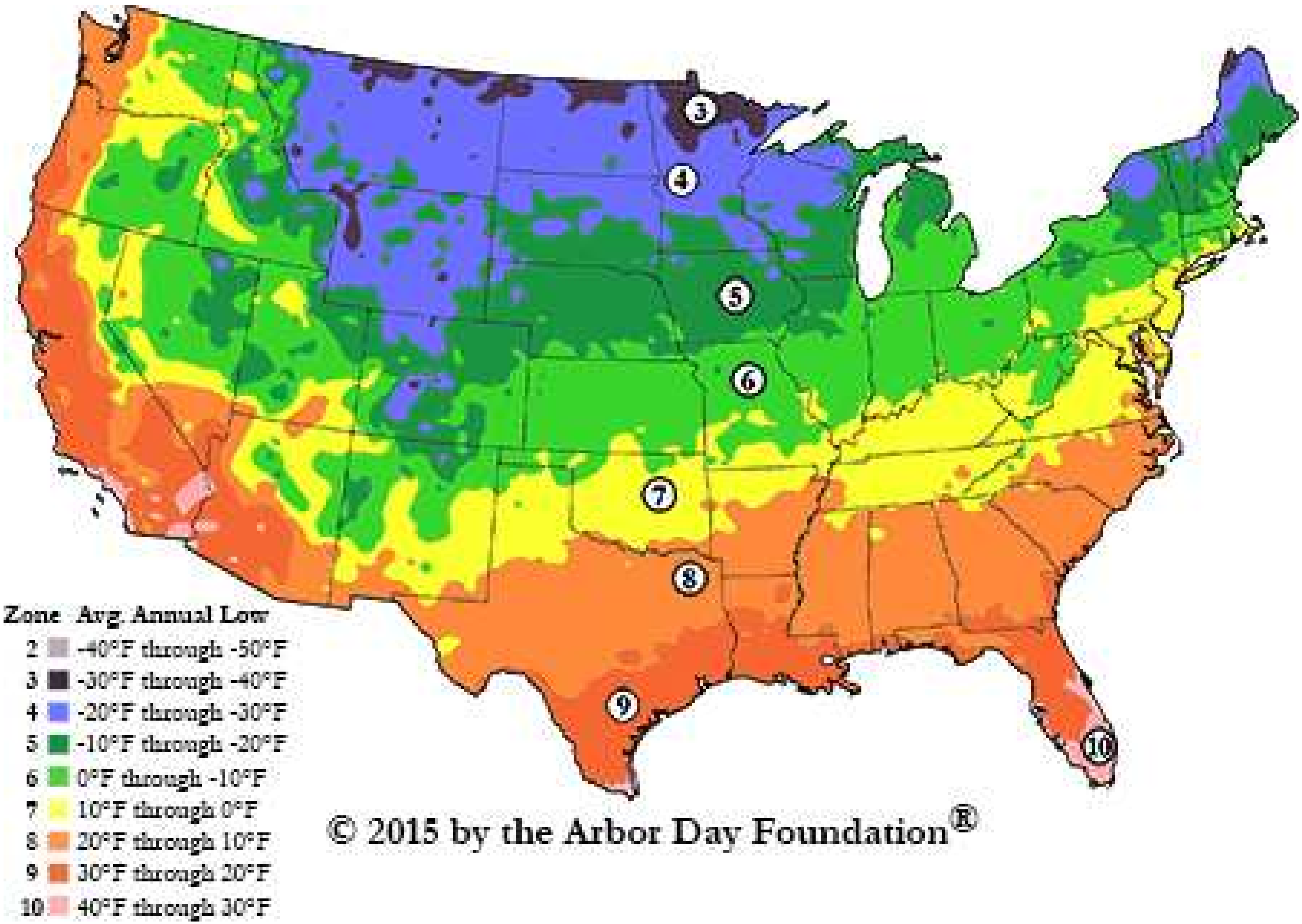
*Mapping of zone V is uncertain in SE USA, with broad sandy or swampy plains, much late frost, and lightning fires.

1990 Map



After USDA Plant Hardiness Zone Map, USDA Miscellaneous
Publication No. 1475, Issued Janusy 1990

2015 Map



3
4
5
6
7
8
9
10
Zone Avg. Annual Low
2 -40°F through -50°F
3 -30°F through -40°F
4 -20°F through -30°F
5 -10°F through -20°F
6 0°F through -10°F
7 10°F through 0°F
8 20°F through 10°F
9 30°F through 20°F
10 40°F through 30°F
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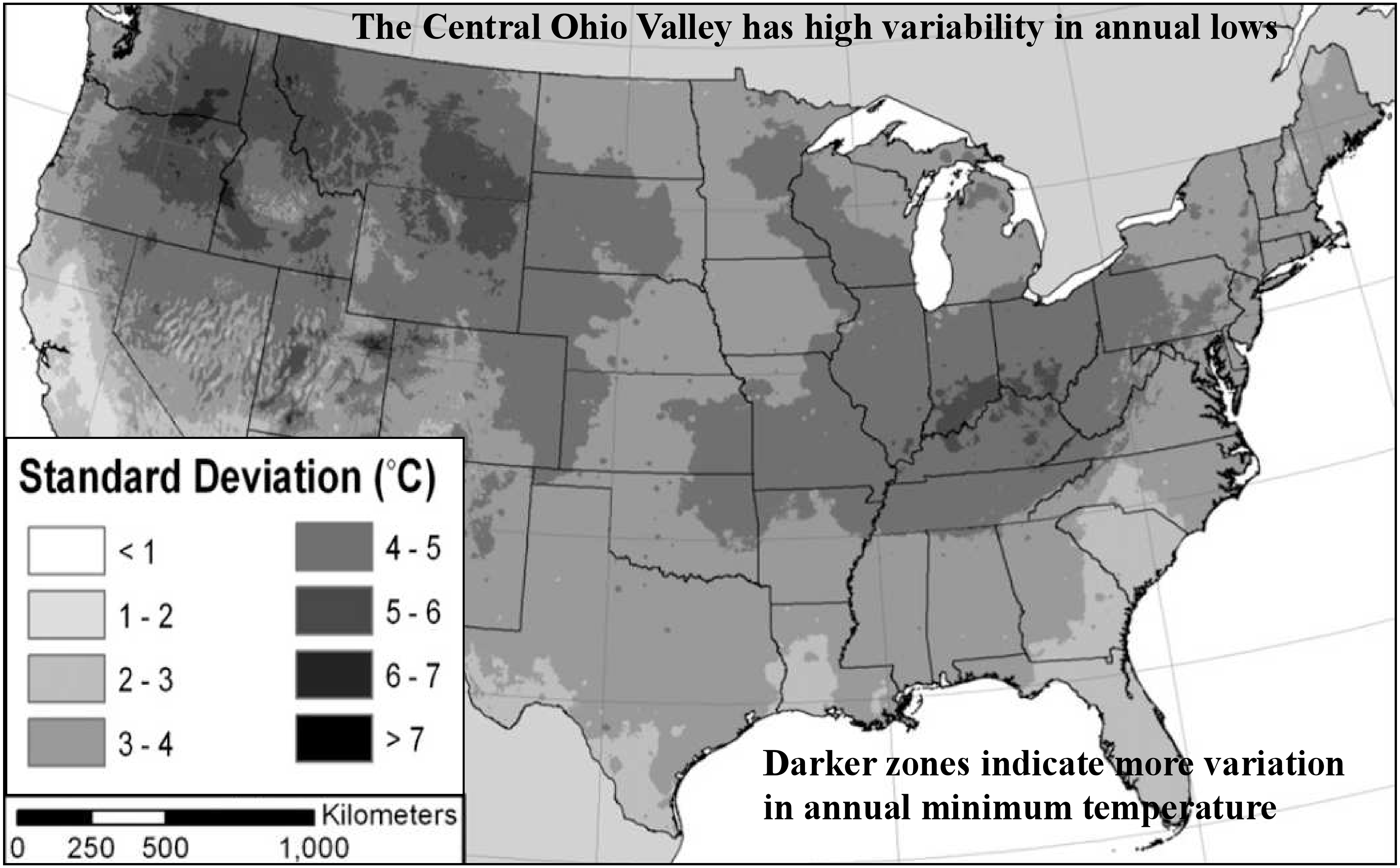
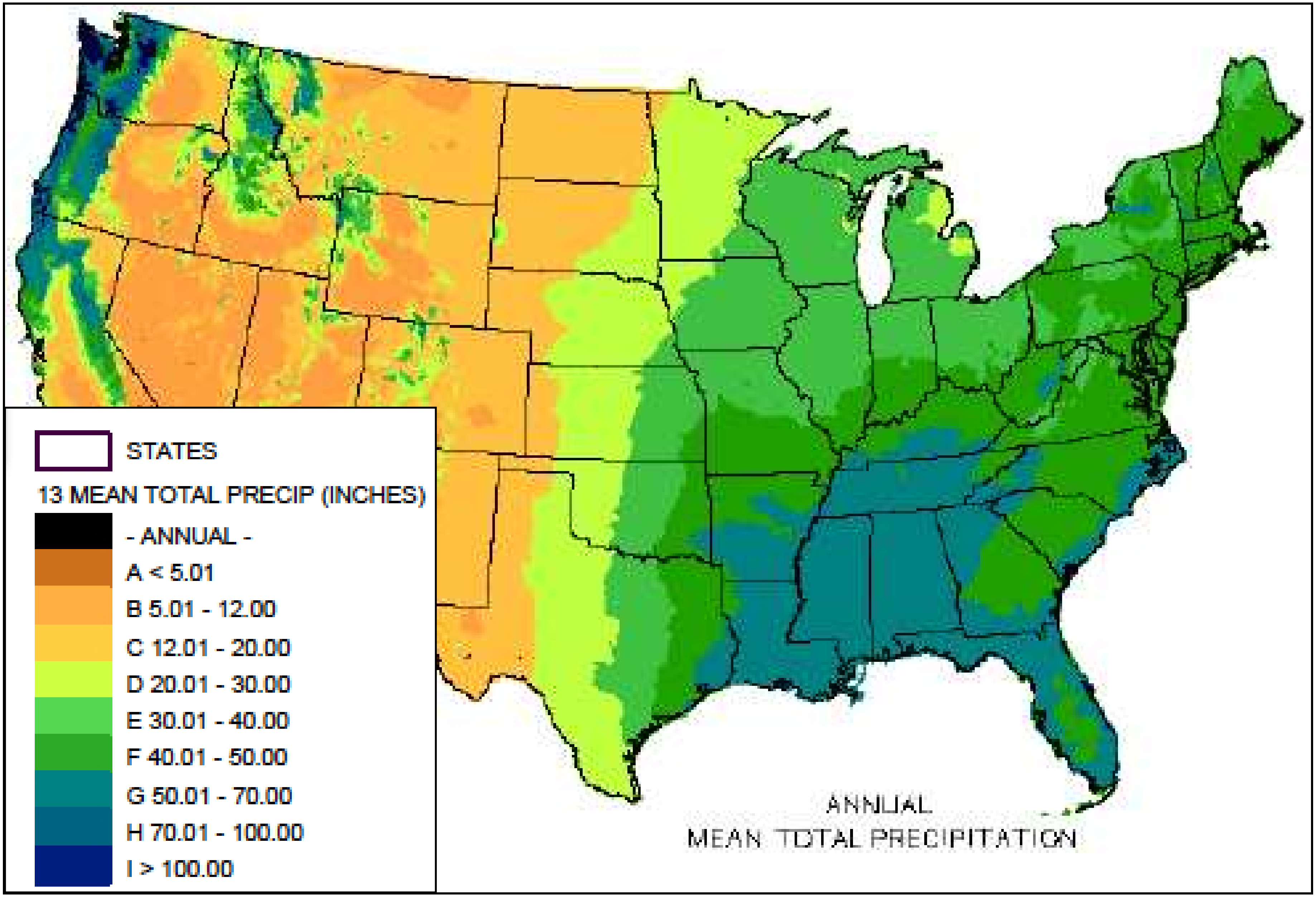


From: Daly et al. (2012). Journal of Applied of Meterology and Climatology 51: 242-264. PRISM [Parameter-Elevation Regressions on Independent Slopes Model] maps of the standard deviation of the 1976-2005 PH statistic [numbered zones with differences of 10° F in annual minimum temperature, allowing fractional transitions between zones].



From: National Climatic Data Center of NOAA
[http://d32ogoqmya1dw8.cloudfront.net/images/eslabs/drought/mean_annual_precip.jpg]

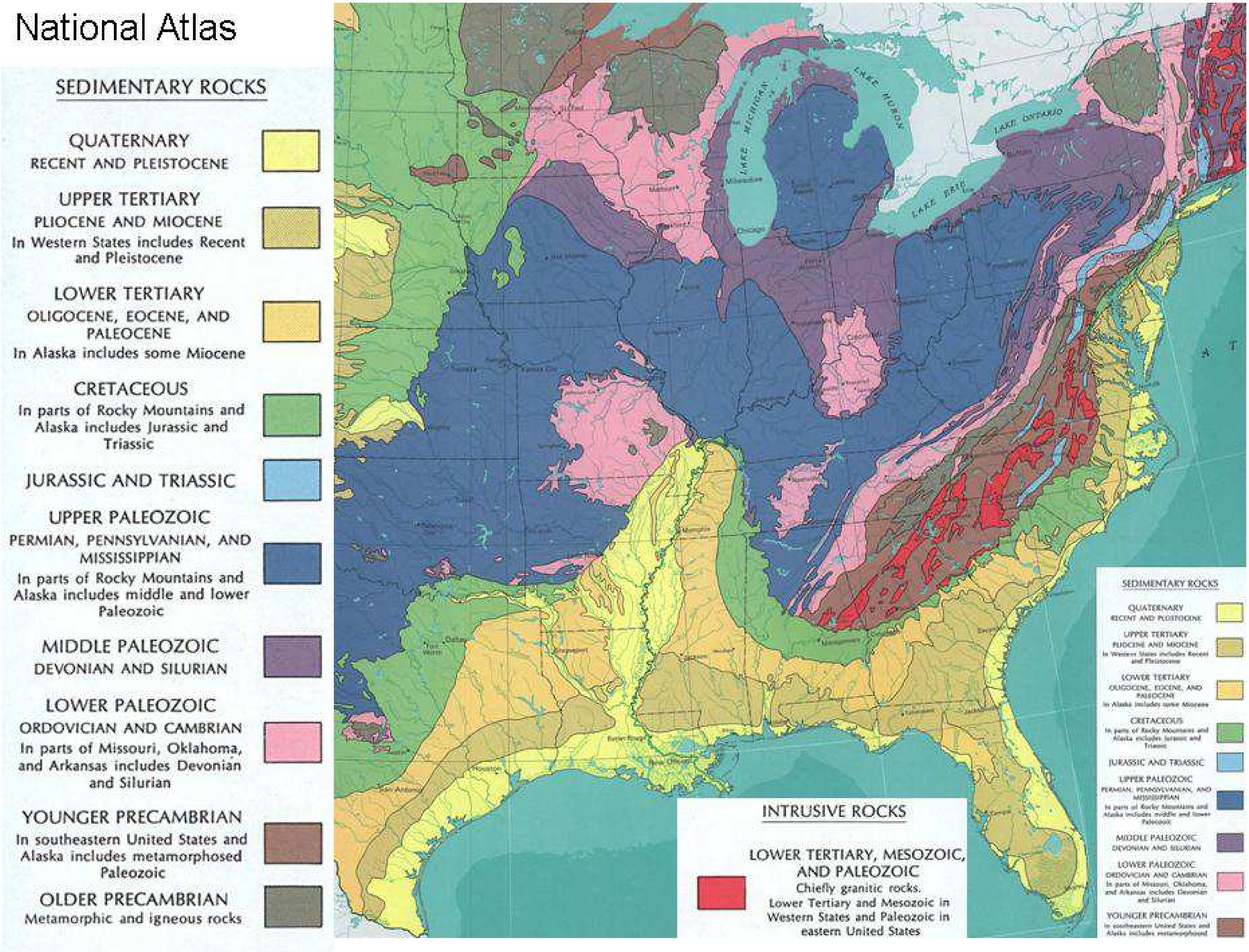
GEOLOGY: concentration of phosphate in ancient limestone

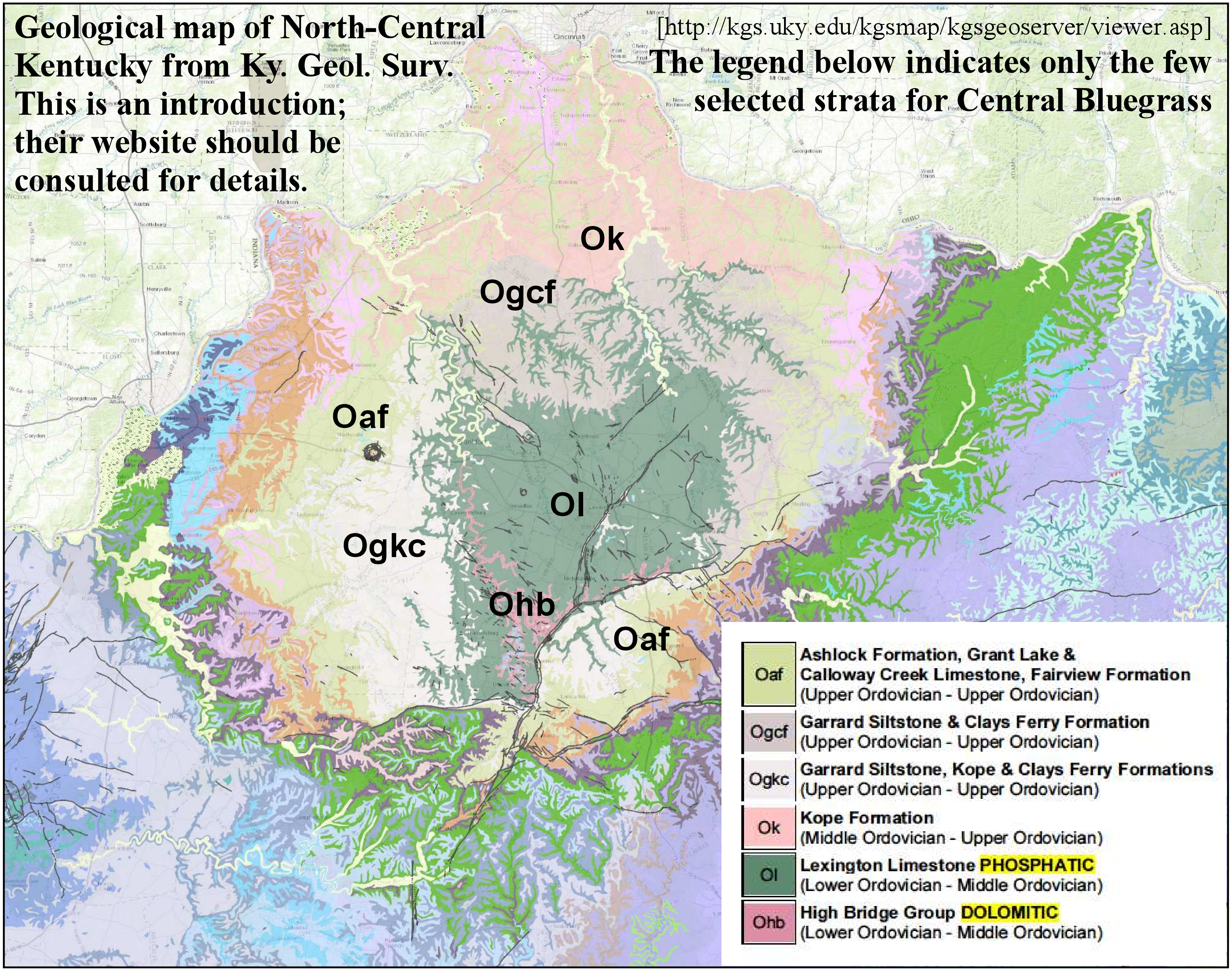
Three major geological features contribute to the distinctive character of our Bluegrass landscape. Firstly, it is largely unglaciated except in northern transitions. Secondly, there is a preponderance of calcareous rocks with Ordovician age (limestones, cherts, shales, siltstones, dolomites). The Central Bluegrass, in particular, is dominated by limestones or calcareous shales. Thirdly, much limestone here is unusually high in phosphate, especially upper parts of the Lexington Limestone (including the "Cynthiana Limestone"). Overlying these central limestones are transitions to the "Eden Shale Hills*" (containing Clay's Ferry Formation and Garrard Siltstone). Except along faults, these transitions are much less abrupt towards the east, possibly due to erosion by ancient courses of the Kentucky River. Underlying the Lexington Limestone is the "High Bridge Group" (Camp Nelson, Oregon and Tyrone Limestones), which are not notably phosphatic; these rocks include dolomites, shales and bentonites. [*Diana]

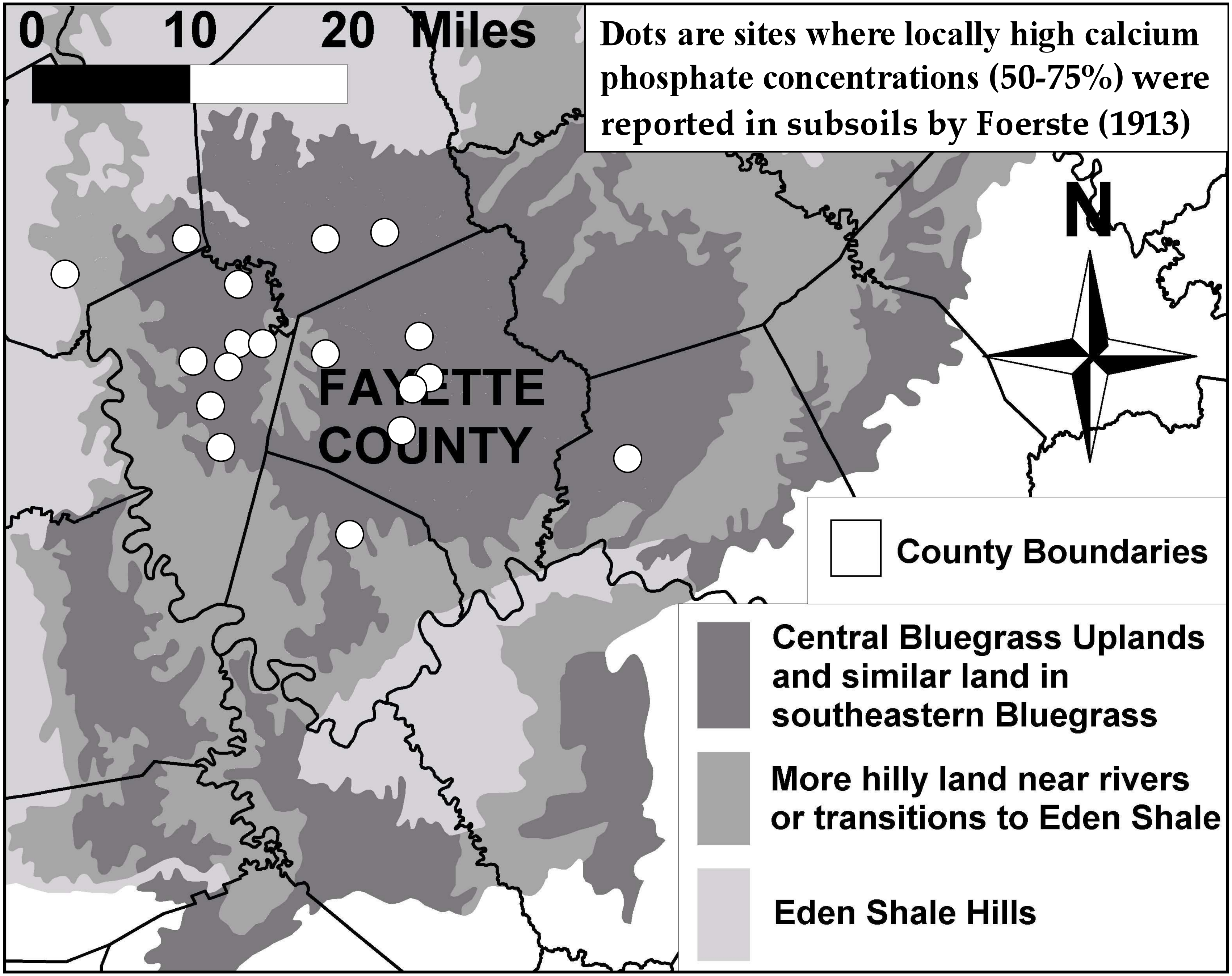
Several sections of the Central Bluegrass have extensive karst, in contrast to the Eden Shale Hills, which have virtually none. Where limestone has more overlying shale, the valleys tend to be filled with more clay, forming regular floodplains. But where there is little alluvial clay, a few creeks have ancient sinking courses, with little above-ground flow. The most extreme development of a sinking creek is Cane Run, north of Lexington. Much of this creek sinks 10-30 feet down for most of the year, to emerge at Royal Spring on North Elkhorn Creek near Georgetown. (The city erroneously has proposed "restoration" of the floodplain here.)

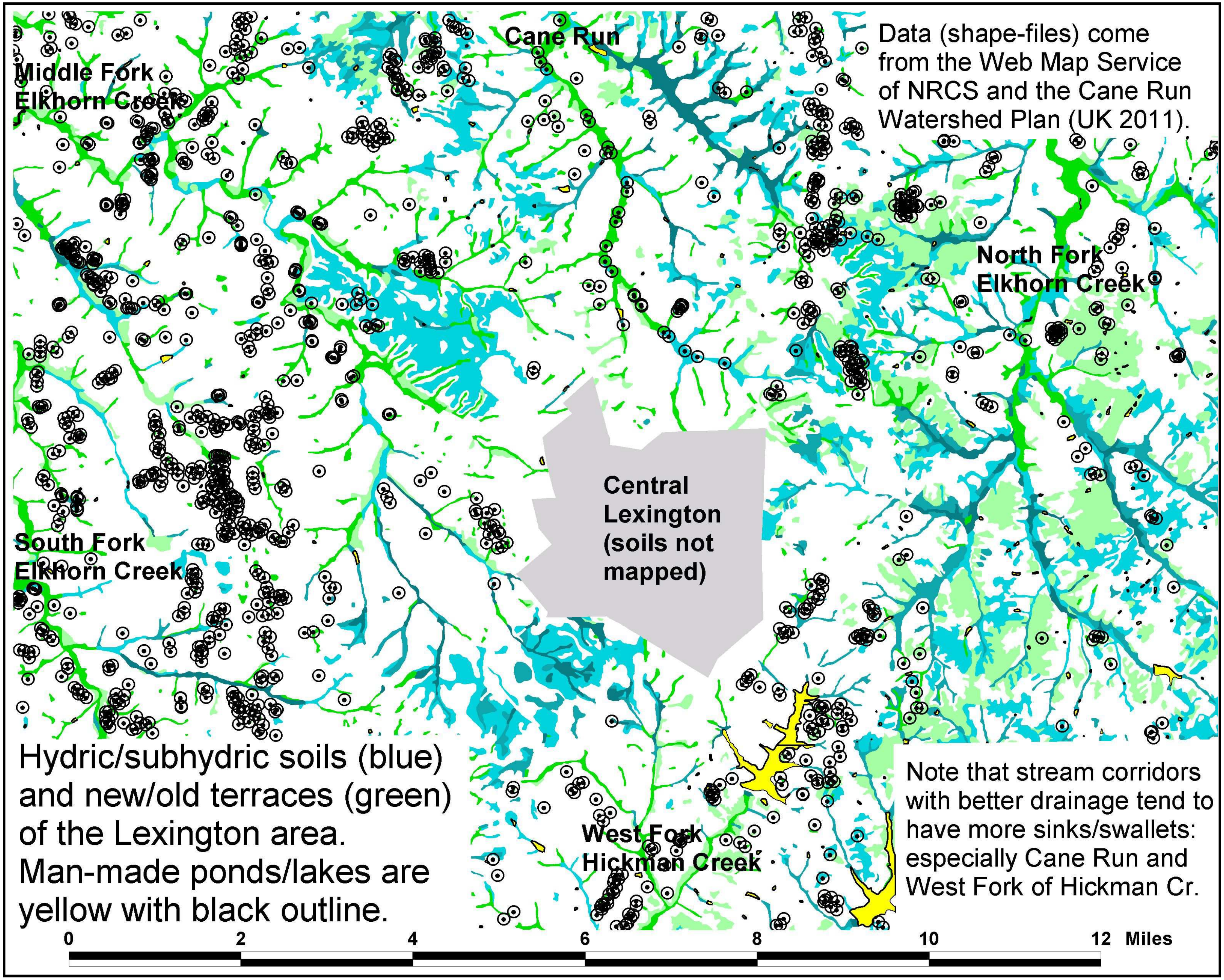
Ancient courses of the Kentucky River have left non-calcareous alluvium from the east, including local sand or gravel. Some of these terraces have distinctly acid soils, especially those dating from the Pliocene or early Pleistocene eras (for example, near Alton). Older courses (perhaps Miocene) were hypothesized by Jillson (1943-1963) to exist on the Elkhorn Plains.

National Atlas




Geological map of North-Central Kentucky from Ky. Geol. Surv. This is an introduction; their website should be consulted for details.
[http://kgs.uky.edu/kgsmap/kgsgeoserver/viewer.asp]
The legend below indicates only the few selected strata for Central Bluegrass
Ok
Ogcf
Oaf
Ol
Ogkc
Ohb
Oaf
Oaf Ashlock Formation, Grant Lake & Calloway Creek Limestone, Fairview Formation (Upper Ordovician - Upper Ordovician)
Ogcf Garrard Siltstone & Clays Ferry Formation (Upper Ordovician - Upper Ordovician)
Ogkc Garrard Siltstone, Kope & Clays Ferry Formations (Upper Ordovician - Upper Ordovician)
Ok Kope Formation (Middle Ordovician - Upper Ordovician)
Ol Lexington Limestone PHOSPHATIC (Lower Ordovician - Middle Ordovician)
Ohb High Bridge Group DOLOMITIC (Lower Ordovician - Middle Ordovician)

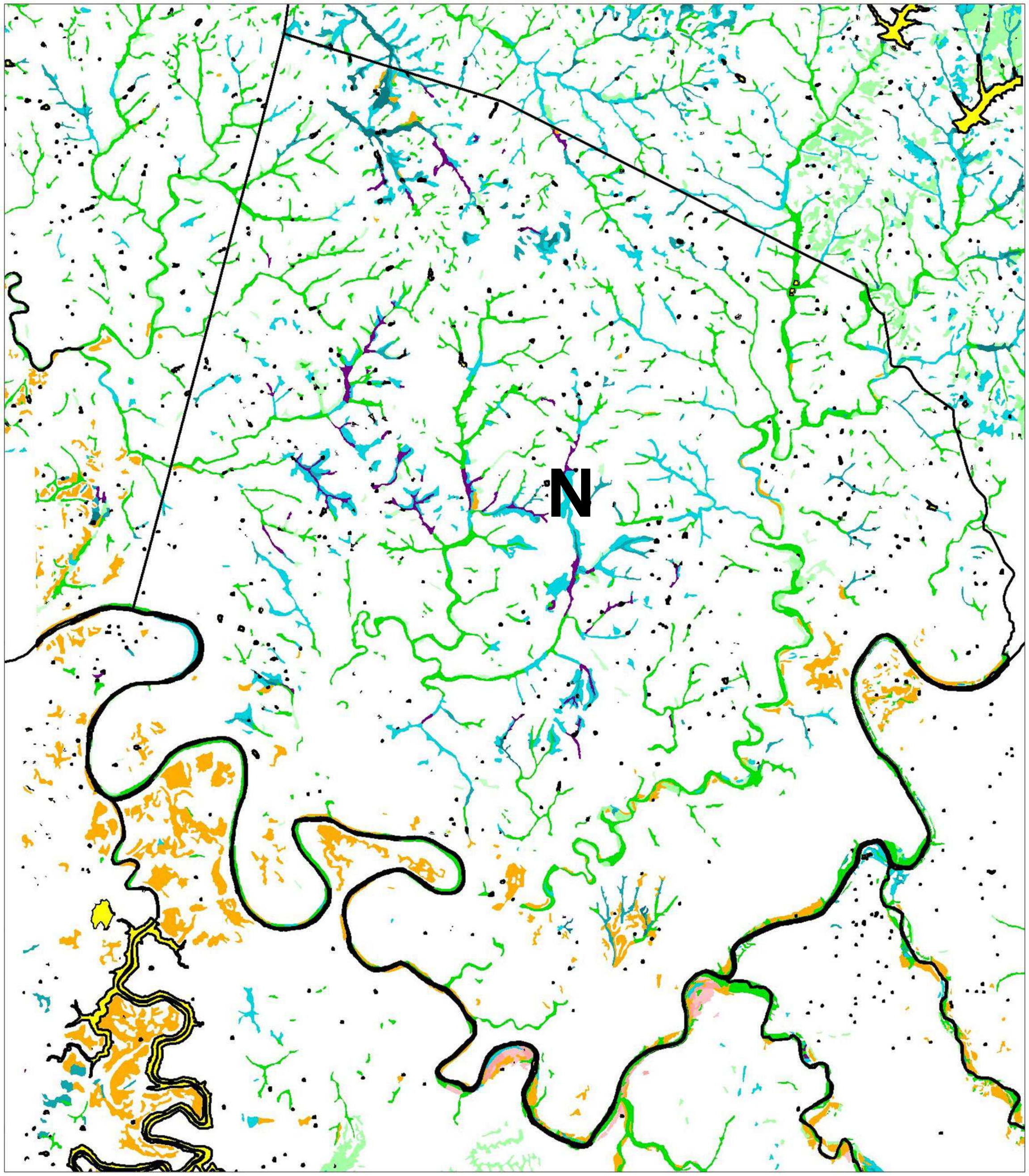

0 10 20 Miles
Dots are sites where locally high calcium phosphate concentrations (50-75%) were reported in subsoils by Foerste (1913)
N
FAYETTE COUNTY
County Boundaries
Central Bluegrass Uplands and similar land in southeastern Bluegrass
More hilly land near rivers or transitions to Eden Shale
Eden Shale Hills


Cane Run
Middle Fork
Elkhorn Creek
Data (shape-files) come from the Web Map Service of NRCS and the Cane Run Watershed Plan (UK 2011).
North Fork
Elkhorn Creek
Central
Lexington
(soils not
mapped)
South Fork
Elkhorn Creek
Hydric/subhydric soils (blue) and new/old terraces (green) of the Lexington area. Man-made ponds/lakes are yellow with black outline.
West Fork
Hickman Creek
Note that stream corridors with better drainage tend to have more sinks/swallets: especially Cane Run and West Fork of Hickman Cr.
0
2
4
6
8
10
12 Miles

The varied alluvial soils of Jessamine County.

All GIS data come from the website of NRCS.

Colors indicate soils typical of wetlands, stream corridors and transitions to uplands.



Blues: true wetlands (darker are saturated for more months)

Greens: well-drained alluvial soils along streams, toe-slopes and other transitions to uplands (darker are more regularly flooded)

Reds: recent river terraces.

Orange: old high river terraces.

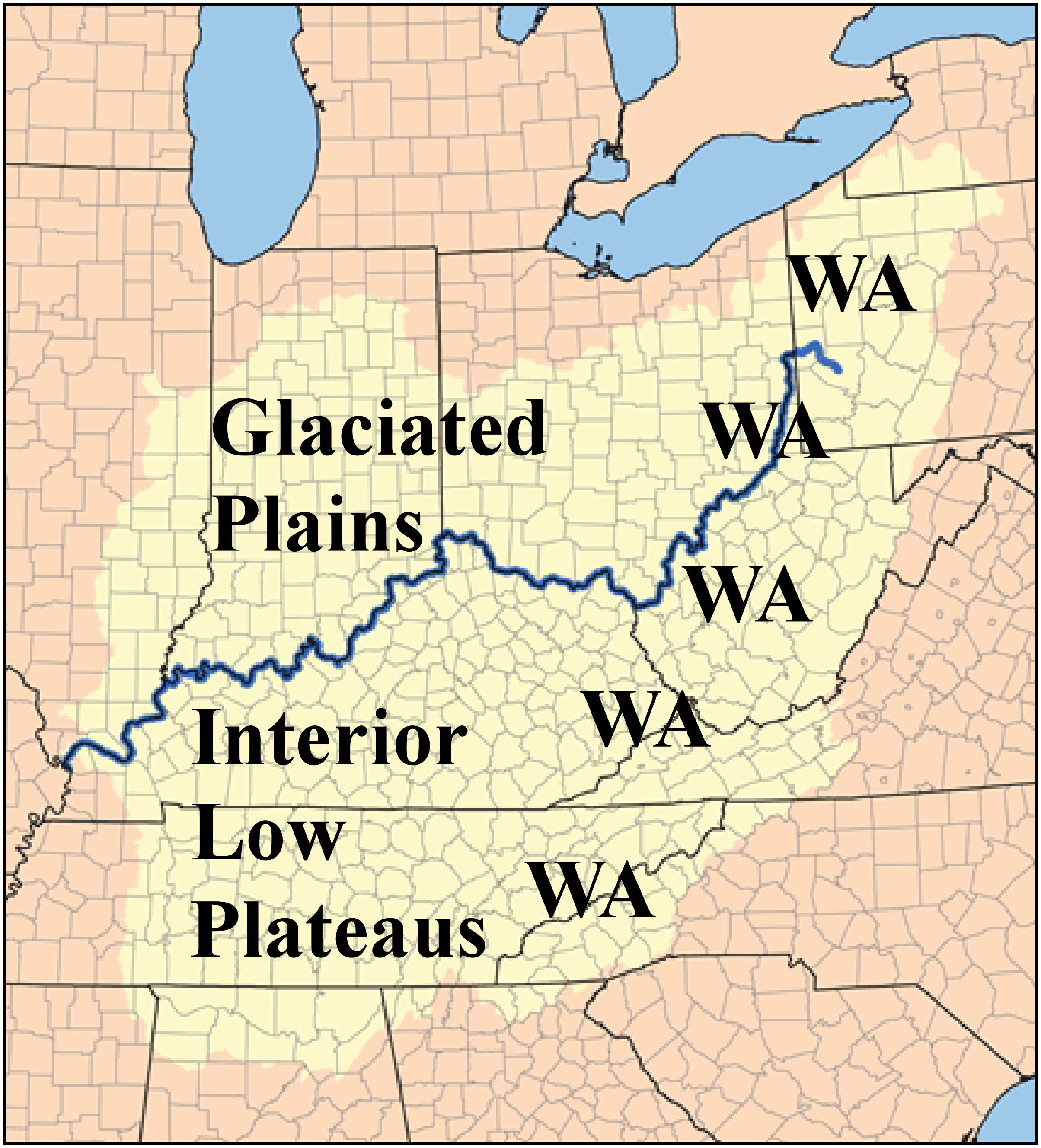
Black & yellow: impoundments.

PHYSIOGRAPHY: ancient western shelf of the Appalachian core

In earlier literature, this term has been used to mean the interpretation of topography based on geological and hydrological factors, i.e., geomorphology. However, much broader definitions have been adopted. Wikipedia states: “Physical geography (also known as geosystems or physiography) is one of the two major sub-fields of geography” [the other is human]; they include geomorphology, hydrology, glaciology, biogeograpy, climatology, metereology, pedology, paleogeography, coastal geography, oceanography, quaternary science, landscape ecology, geomatics, environmental geography.

The Ohio River watershed has developed over 100s of millions of years, with much of it draining from the ancient Appalachian core (about 480-500 million years old), initially forming the Interior Low Plateaus and more northern land that has now been glaciated. The “Cincinnati Arch” has lifted the Ordovician shelf, much of which has eroded to form gently rolling hills and plains that contrast sharply with more rugged topography on younger rocks of the Appalachian Plateaus. The summit of this uplift is name the “Jessamine Dome”, located approximately between Hickman Creek and Marble Creek in southeast Jessamine County. The Central Bluegrass—or “Lexington Plain”—has long been recognized as a distinct physiographic section, formed on relatively uniform limestones and eroded shales. However, the Kentucky River runs through an unusually deep gorge, which is considered to have formed after more recent uplift about 10-20 million years ago.

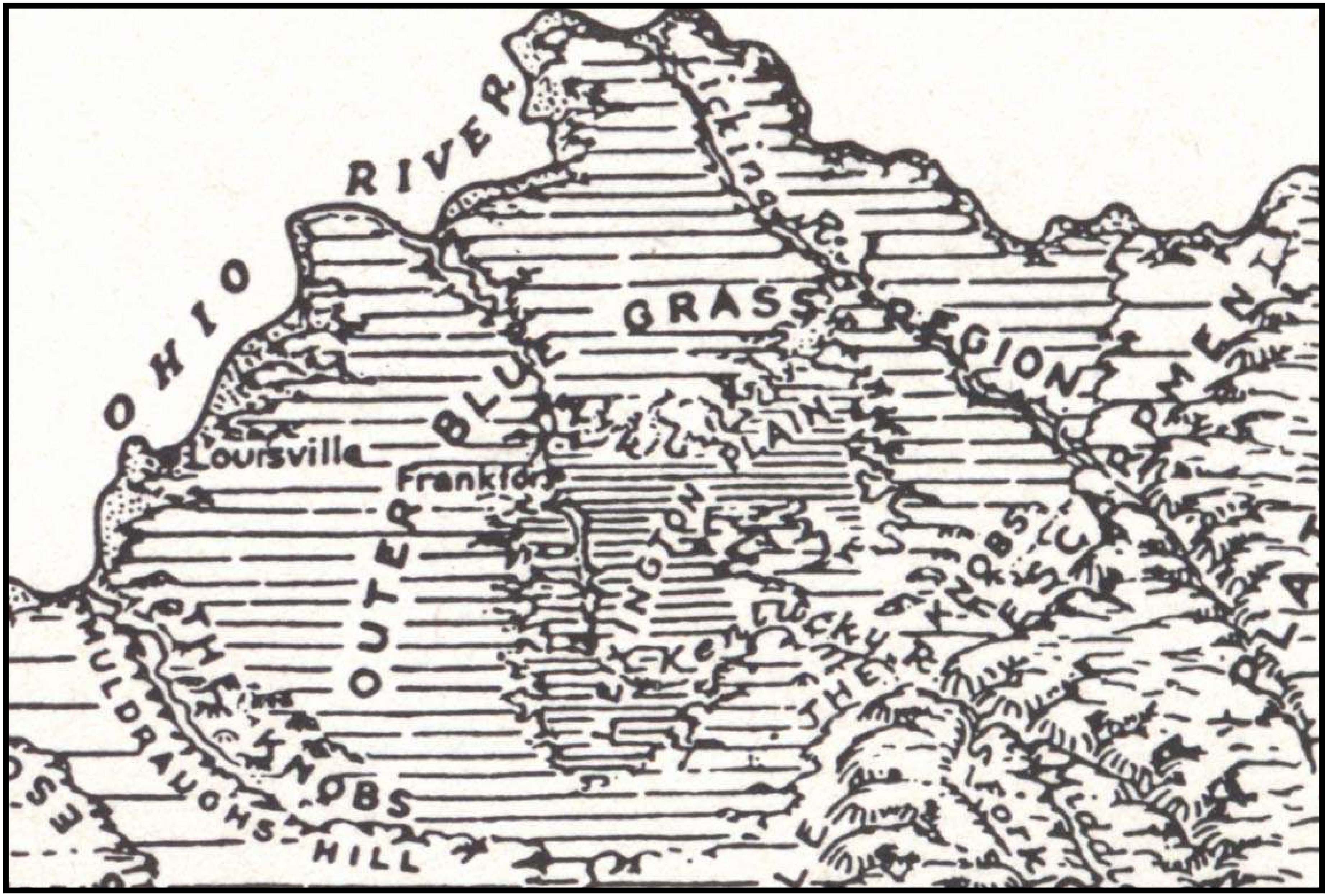
Because phosphates are most common in deep oceanic waters, phosphates in the Lexington Limestone probably formed in deep waters on flanks of the Jessamine Dome. Upwelling caused phosphate to be transported into coarser-grained limestones, which are interpreted to have formed within shoals of relatively shallow water (Cressman 1973).



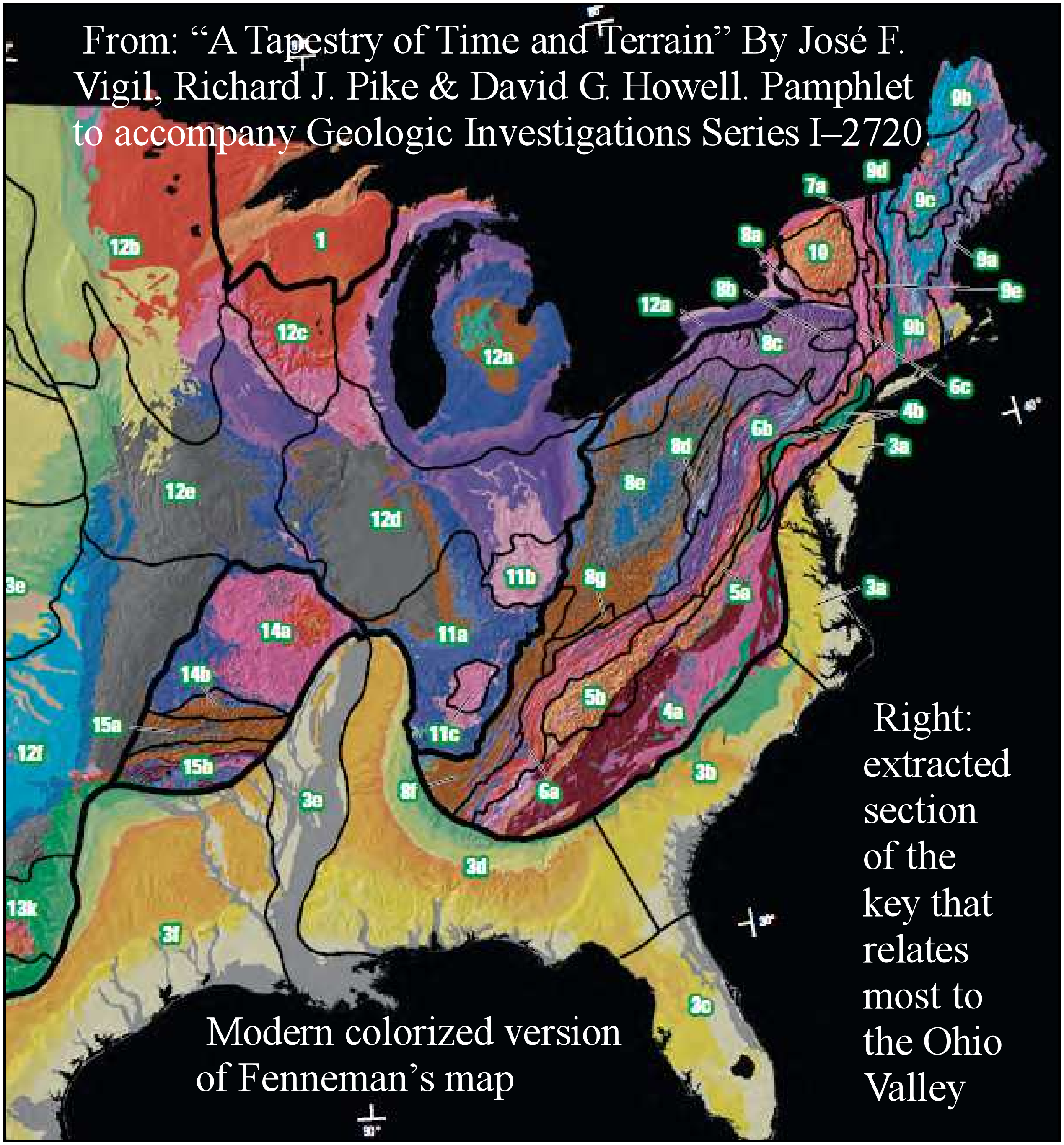
The Ohio River watershed (yellow)

WA = western Appalachian regions (sedimentary rocks of Ridge & Valley region plus Appalachian Plateaus)

https://upload.wikimedia.org/wikipedia/commons/b/b4/Ohiorivermap.png



Lobeck, A. K. 1932. Physiographic diagram of Kentucky. Geographical Press, Columbia Univ.
"Lexington Plain" is Inner Bluegrass; "Outer Bluegrass" includes Eden Shale Hills. See also his 1929 paper: "The geology and physiography of the Mammoth Cave National Park", Kentucky Geological Survey, ser. 6, v. 31, pt. 5, p. 327-399.



From: "A Tapestry of Time and Terrain" By José F. Vigil, Richard J. Pike & David G. Howell. Pamphlet to accompany Geologic Investigations Series I–2720.

Modern colorized version of Fenneman's map

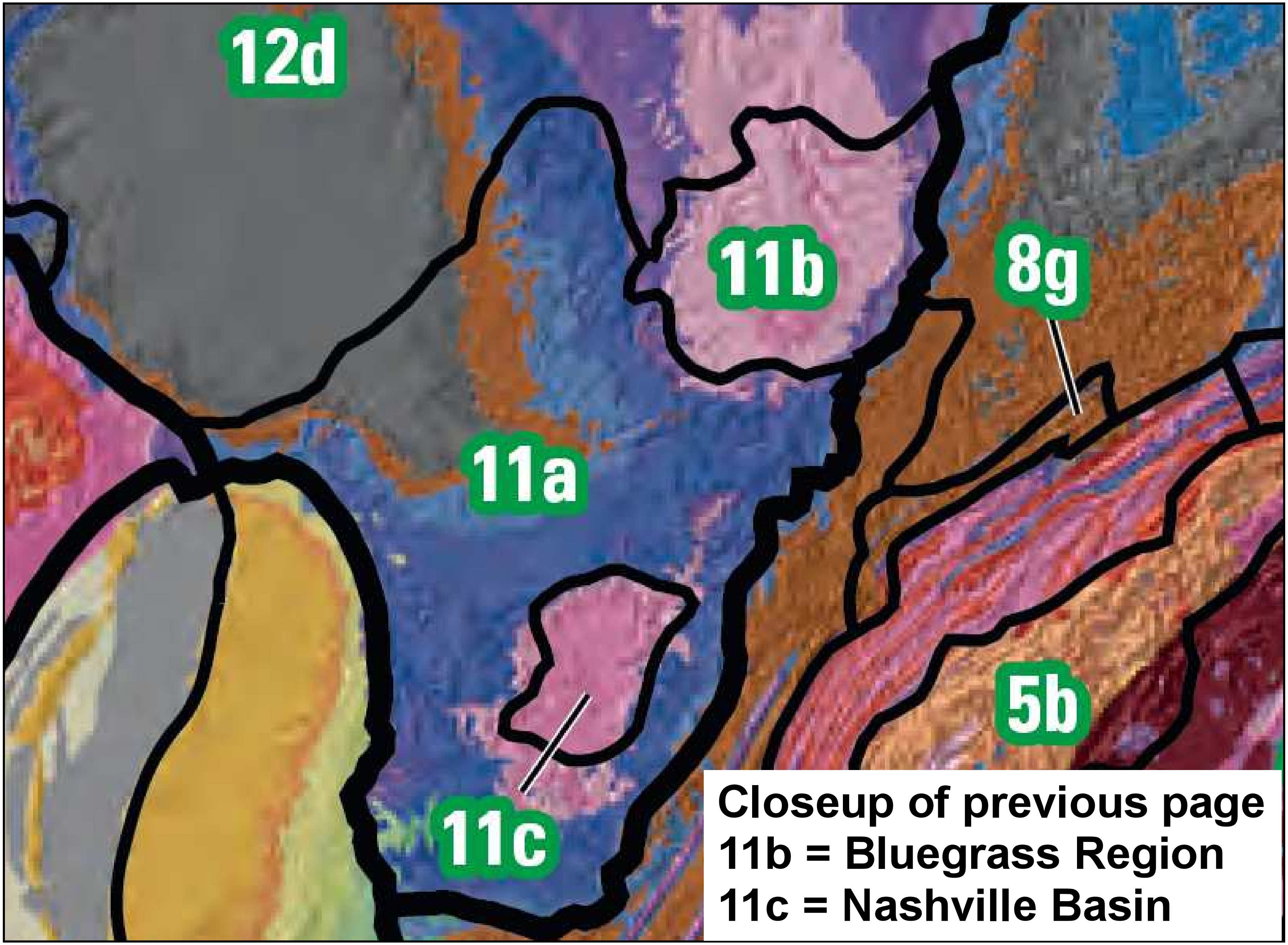
Right: extracted section of the key that relates most to the Ohio Valley

APPALACHIAN HIGHLANDS

- 4. Piedmont province
  - a. Piedmont Upland
  - b. Piedmont Lowlands
- 5. Blue Ridge province
  - a. Northern section
  - b. Southern section
- 6. Valley and Ridge province
  - a. Tennessee section
  - b. Middle section
  - c. Hudson Valley
- 7. St. Lawrence Valley
  - a. Champlain section
  - b. Northern section (not on map)
- 8. Appalachian Plateaus province
  - a. Mohawk section
  - b. Catskill section
  - c. Southern New York section
  - d. Allegheny Mountain section
  - e. Kanawha section
  - f. Cumberland Plateau section
  - g. Cumberland Mountain section
- 9. New England Province
  - a. Seaboard Lowland section
  - b. New England Upland section
  - c. White Mountain section
  - d. Green Mountain section
  - e. Taconic section
- 10. Adirondack province

INTERIOR PLAINS

- 11. Interior Low Plateaus
  - a. Highland Rim section
  - b. Lexington Plain
  - c. Nashville Basin
- 12. Central Lowland
  - a. Eastern Lake section
  - b. Western Lake section
  - c. Wisconsin Driftless section
  - d. Till Plains
  - e. Dissected Till Plains
  - f. Osage Plains


12d
11b
8g
11a
11c
5b
Closeup of previous page
11b = Bluegrass Region
11c = Nashville Basin

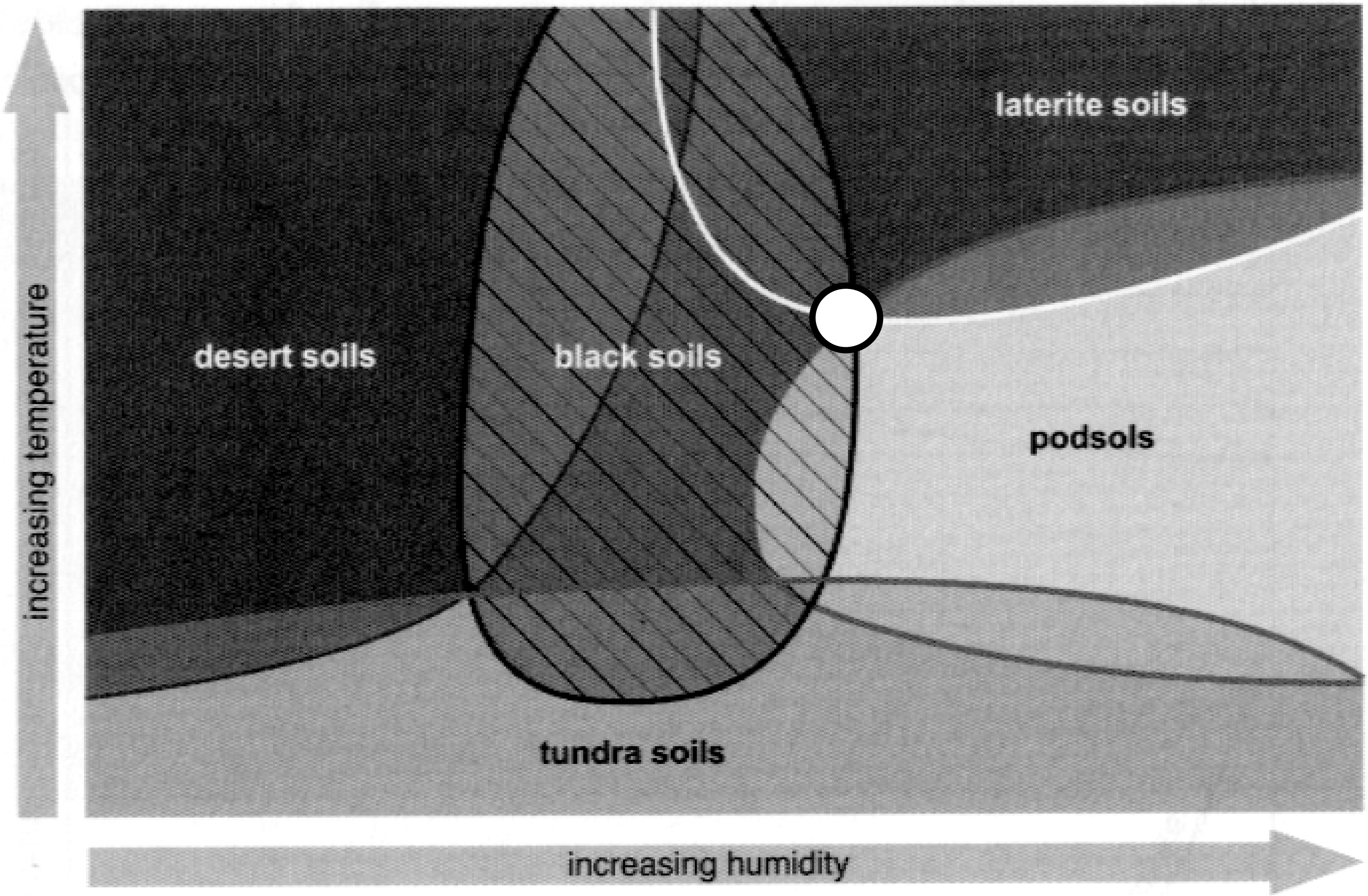
SOILS: from complex taxonomy to functional catenas—all greek!

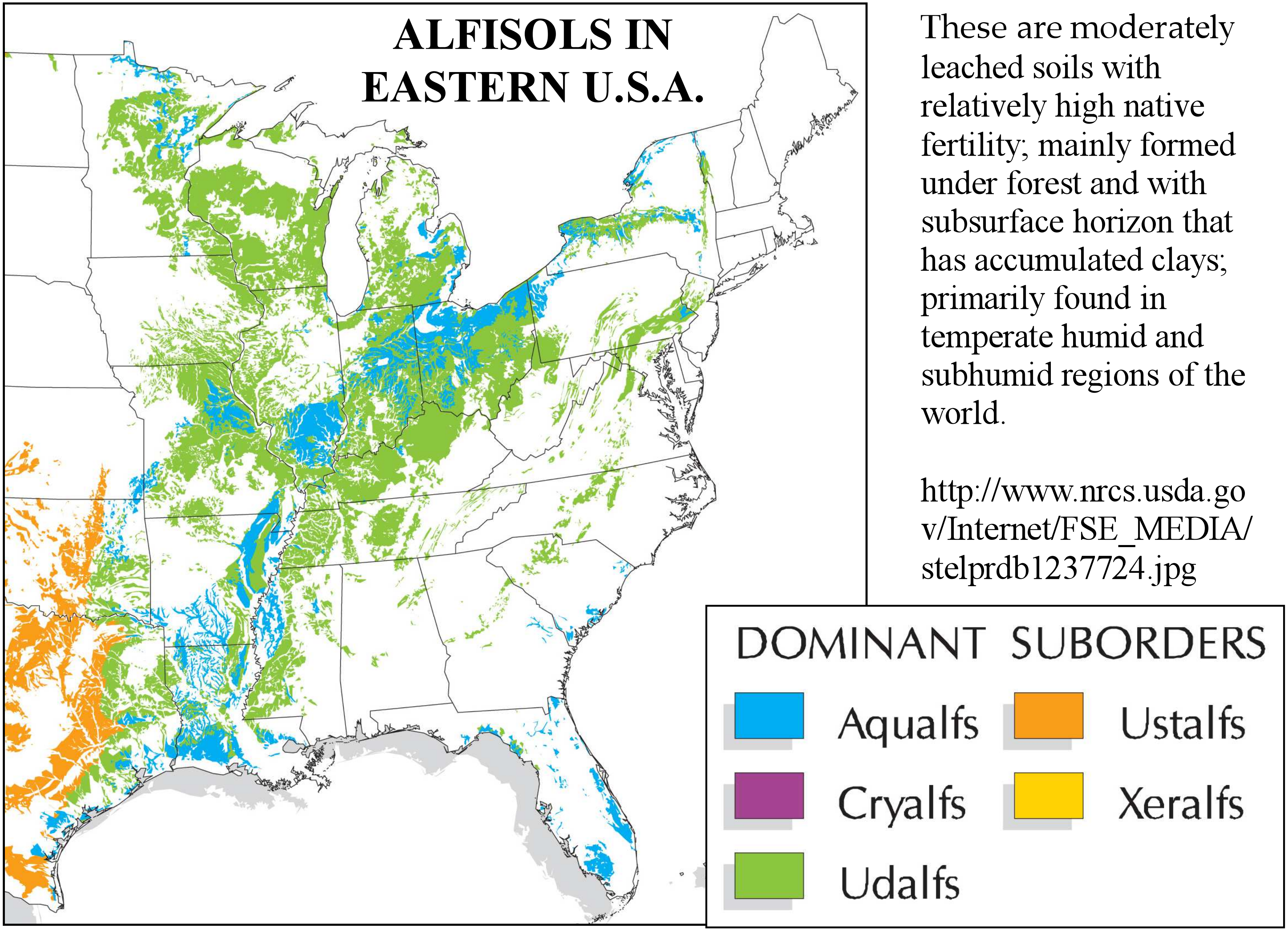
The USDA (NRCS) has provided a global classification of soils, but details often remain confusing, even to professionals. Our Bluegrass region has the most extensive block of "alfisols" east of the Mississippi lowlands and south of the glacial boundary. Alfisols are moderately leached with medium to high native fertility; they have subsurface horizons that are "argillic" with accumulated clays (or kaolonitic "kandic" or salty "natric"); they are mainly formed under forest and primarily found in temperate humid or subhumid regions of the world. Some uplands of the Inner Bluegrass have particularly deep, old altisols known as "paleudalfs" (Maury series), which have phosphatic accumulation at lower levels in the transition to bedrock; in these soils, roots occur as deep as 5-10 feet and bedrock is met at up to 16 feet.

Other soil classes occur in less extensive areas: entisols, especially on swampy ground (immature with no B horizon and often "ochric" with pale thin hard surface); inceptisols, especially on rocky slopes or fresh alluvium (moderately mature with beginning of B horizon); and mollisols, especially on lowland terraces and toeslopes (with thick dark organic surface usually formed from a long history of dense grass or herbs). In most of the Central Bluegrass, there is a notable lack of ultisols: old soils with argillic or kandic horizon and base saturation <35% at 1-2 m. Ultic soils are restricted to minor areas with more chert (silica weathered out of limestone), and to old terraces with non-calcareous alluvium; but even these soils are largely transitional rather than clearly ultisols. (Deeper loess in western Bluegrass may also be ultic.)

The topographic arrangement of soils helps us understand how to define varied biological habitats. On relatively uniform parent material in each regional section, it is useful to think of soils along two gradients ("catenas"): (1) from lowlands to uplands; and (2) from less mature or steep or shallow soils (yet often mesic if NE-facing) to deeper soils on flats (hydric or xeric).

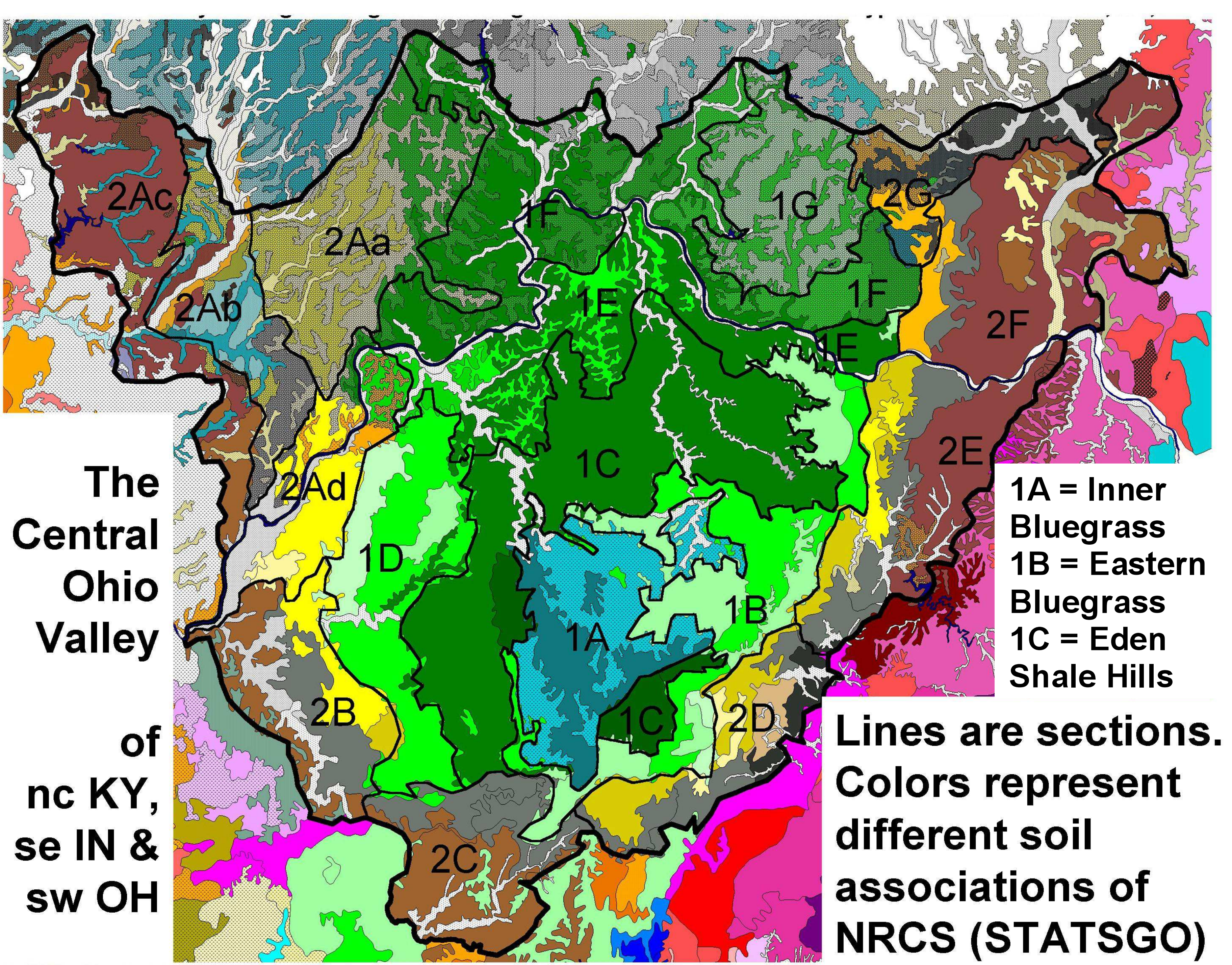
Main groups of soils in an ecogram of humidity and temperature; from Walter's masterful "Vegetation of the Earth" (Breckle 2002). The large dot indicates approximate position of typical alfisols, between mollisols ("black soils") and ultisols (cooler "laterites" or drier "podsols").

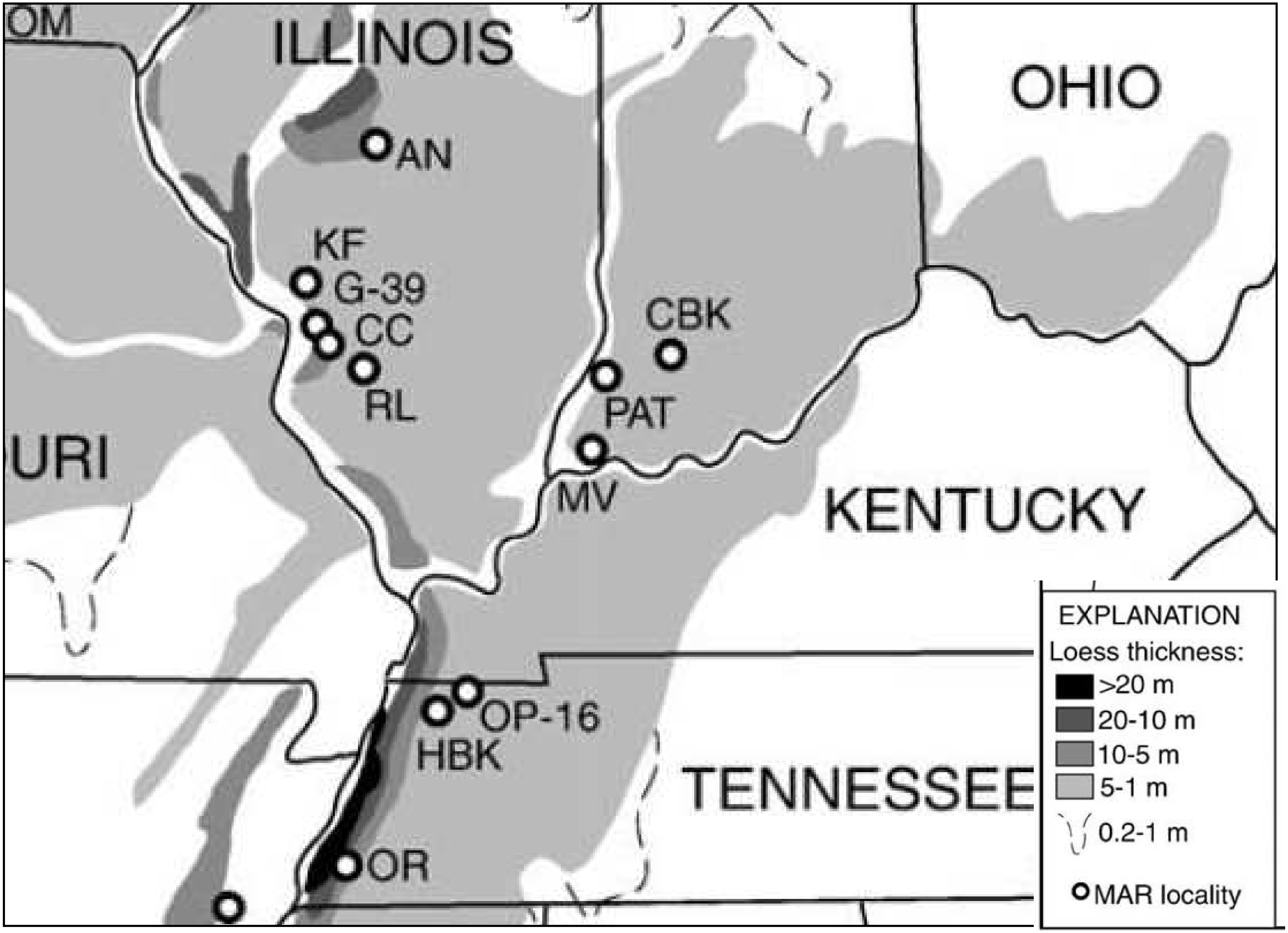




These are moderately leached soils with relatively high native fertility; mainly formed under forest and with subsurface horizon that has accumulated clays; primarily found in temperate humid and subhumid regions of the world.

http://www.nrcs.usda.gov/Internet/FSE_MEDIA/stelprdb1237724.jpg


The Central Ohio Valley of nc KY, se IN & sw OH
1A = Inner Bluegrass
1B = Eastern Bluegrass
1C = Eden Shale Hills
Lines are sections. Colors represent different soil associations of NRCS (STATSGO)
2Ac
2Aa
1F
1G
2G
2Ab
1E
1F
2F
1E
2E
1C
2Ad
1D
1B
1A
2B
1C
2D
2C



Depth of loess: figure extracted from Bettis et al. (2003); see also Barnhisel et al. (1971).

From Soil Survey of Fayette County (Sims et al. 1968)

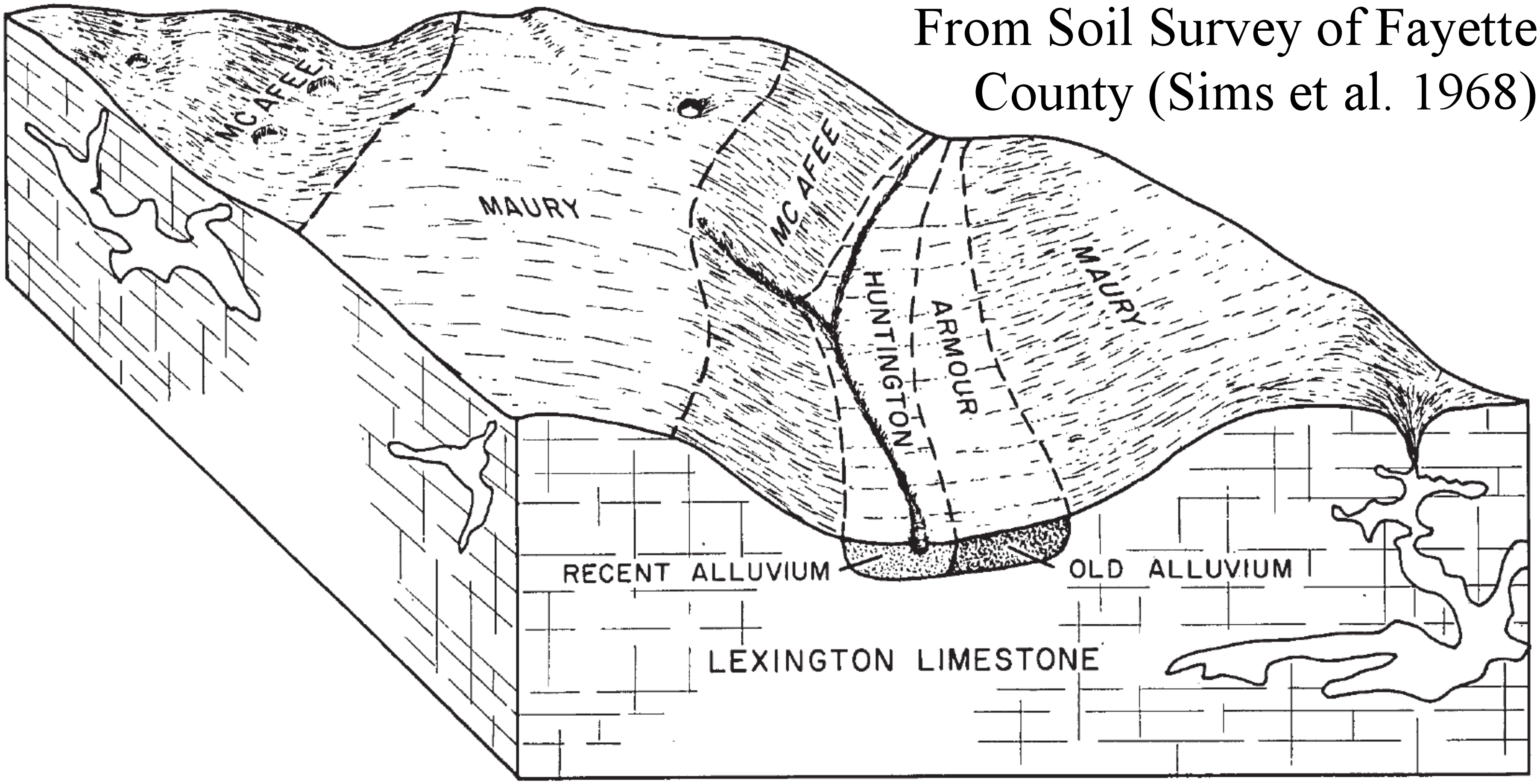


Figure 2.—Relationship of soils to topography and underlying material in association 1. Unshaded areas represent caverns or sinkholes in the limestone bedrock.

1. Maury-McAfee Association

Undulating, deep and moderately deep, well-drained soils high in phosphate; on uplands

From Soil Survey of Fayette County (Sims et al. 1968)

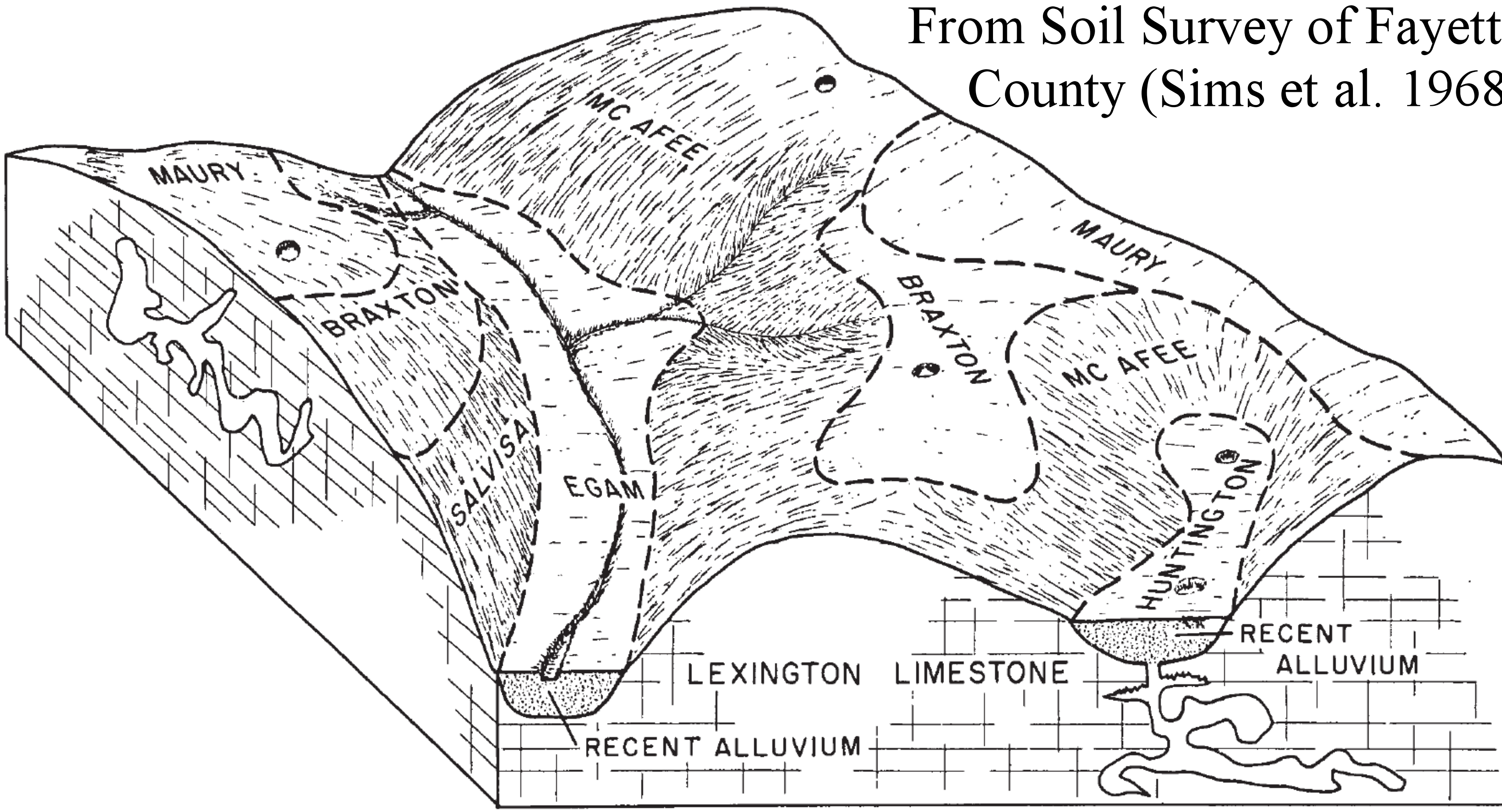


Figure 4.—Relationship of soils to topography and underlying mater ial in association 3. Unshaded areas represent caverns or sinkholes in the limestone bedrock.

3. McAfee-Maury-Braxton Association

Rolling to strongly sloping, moderately deep and deep, well-drained soils high in phosphate; on uplands

From Soil Survey of Fayette County (Sims et al. 1968)

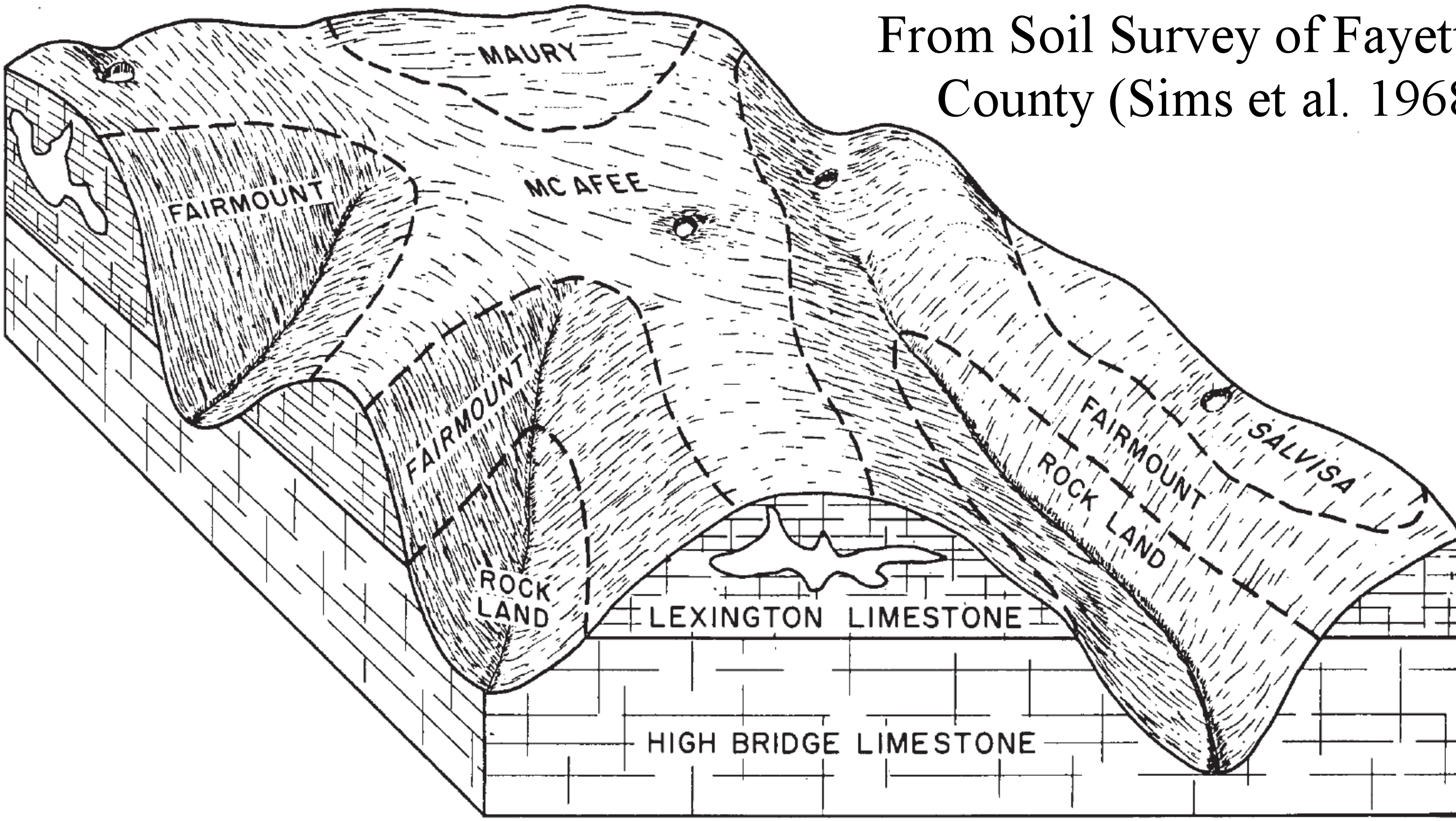
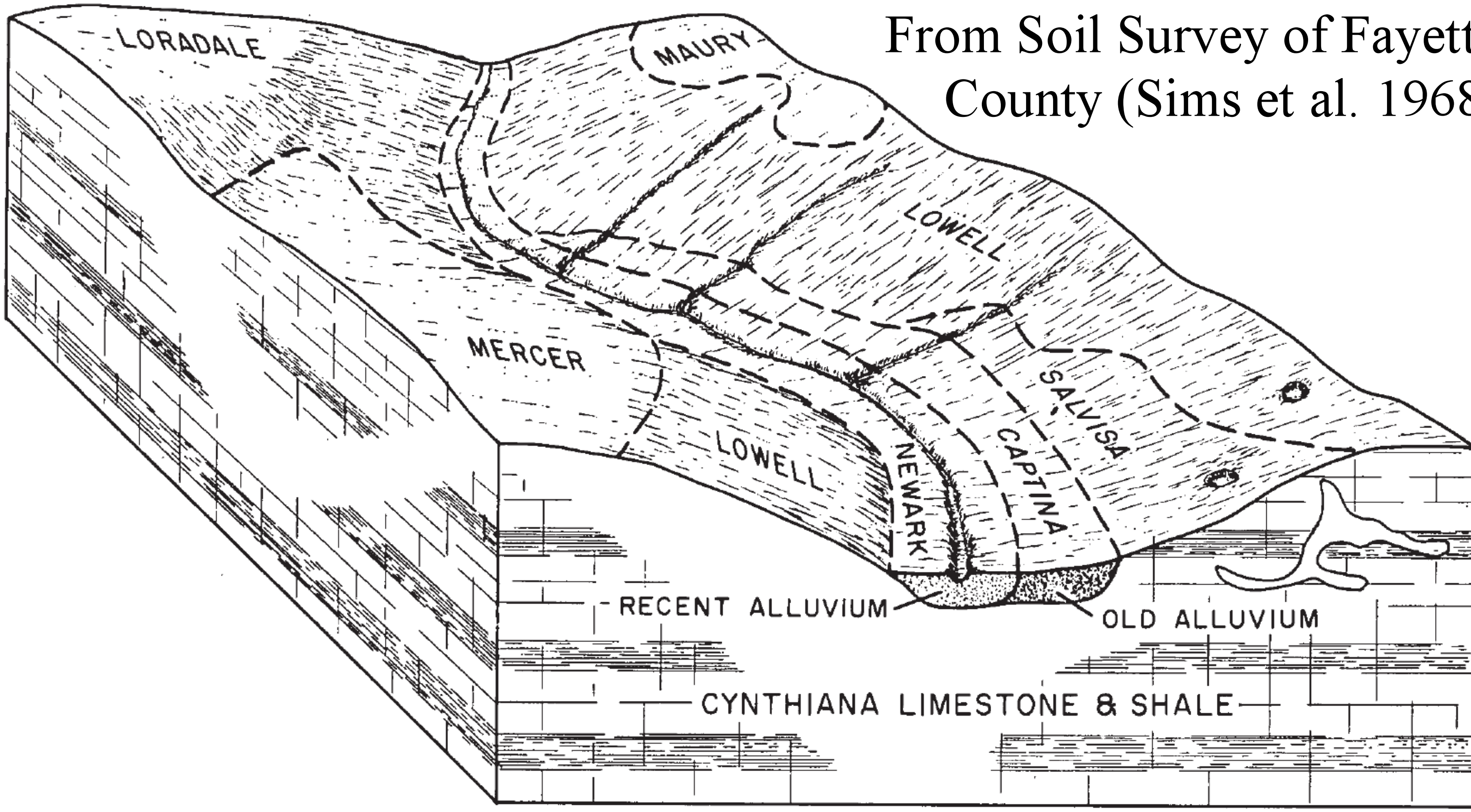


Figure 5.—**Relationship of soils to topography and underlying material in association 4. Unshaded areas represent caverns or sinkholes in the limestone bedrock.**

4. Fairmount-McAfee-Rock Land Association

Sloping to steep, very shallow to moderately deep, clayey, rocky soils on uplands



From Soil Survey of Fayette County (Sims et al. 1968)

Figure 3.—Relationship of soils to topography and underlying material in association 2. Unshaded areas represent caverns or sinkholes in the limestone bedrock.

2. Lowell-Loradale-Mercer Association

Gently sloping, deep and moderately deep, well drained and moderately well drained soils on uplands

From Soil Survey of Fayette County (Sims et al. 1968)

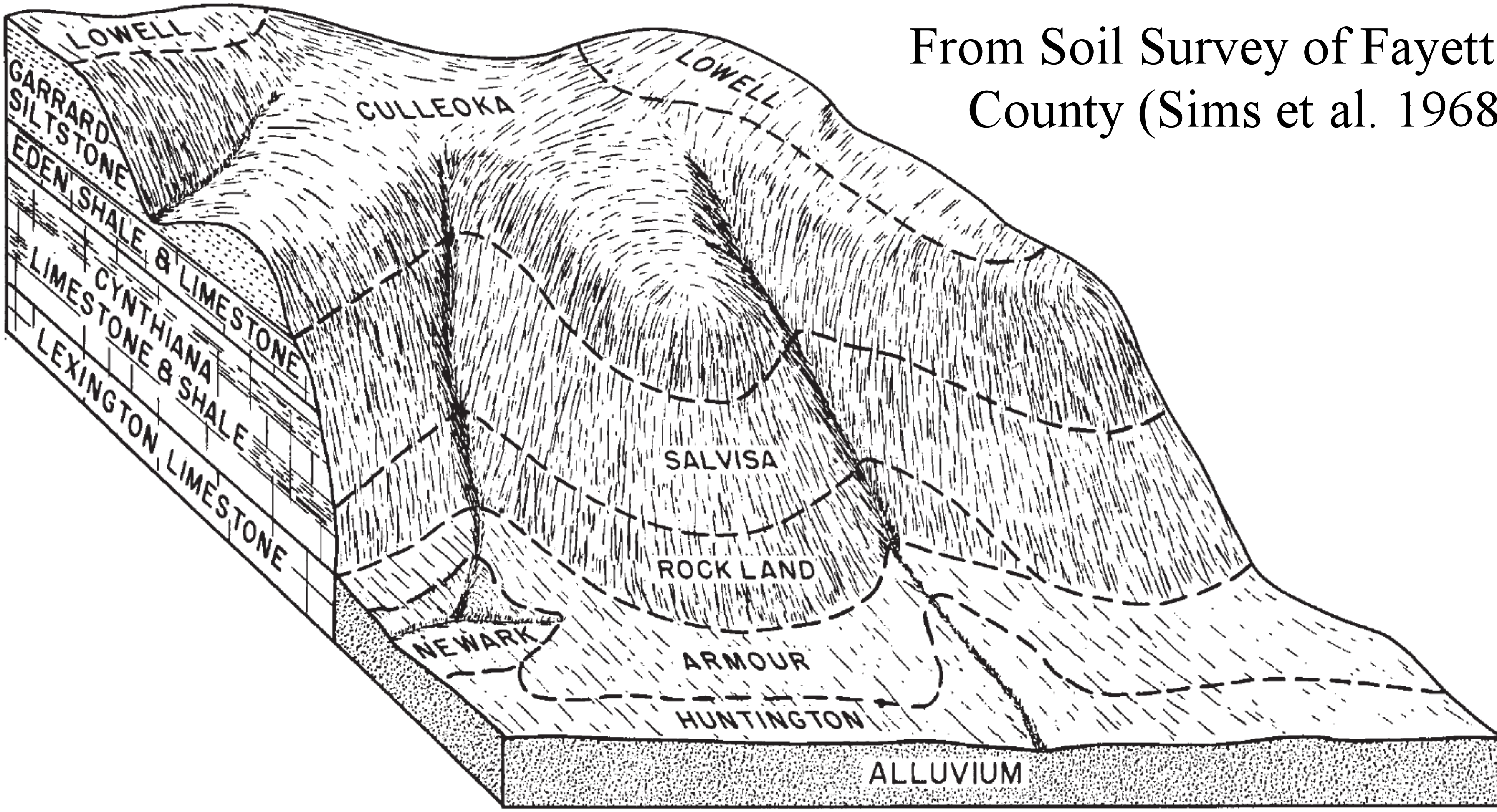


Figure 6.—Relationship of soils to topography and underlying material in association 5.

5. Salvisa-Culleoka Association

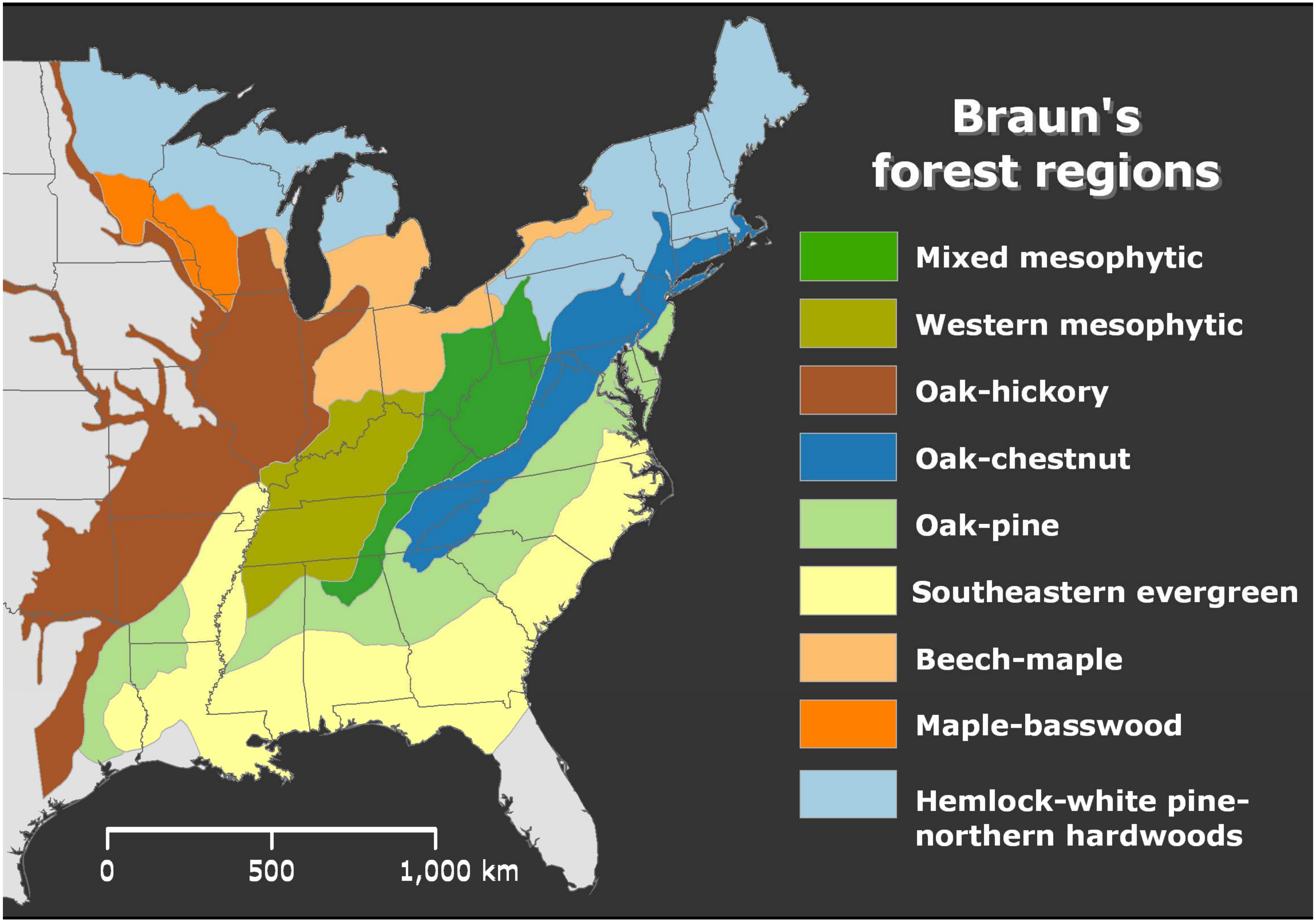
Steep, deep to shallow, droughty soils on uplands

VEGETATION: the pre-settlement "Land of Cane and Clover"

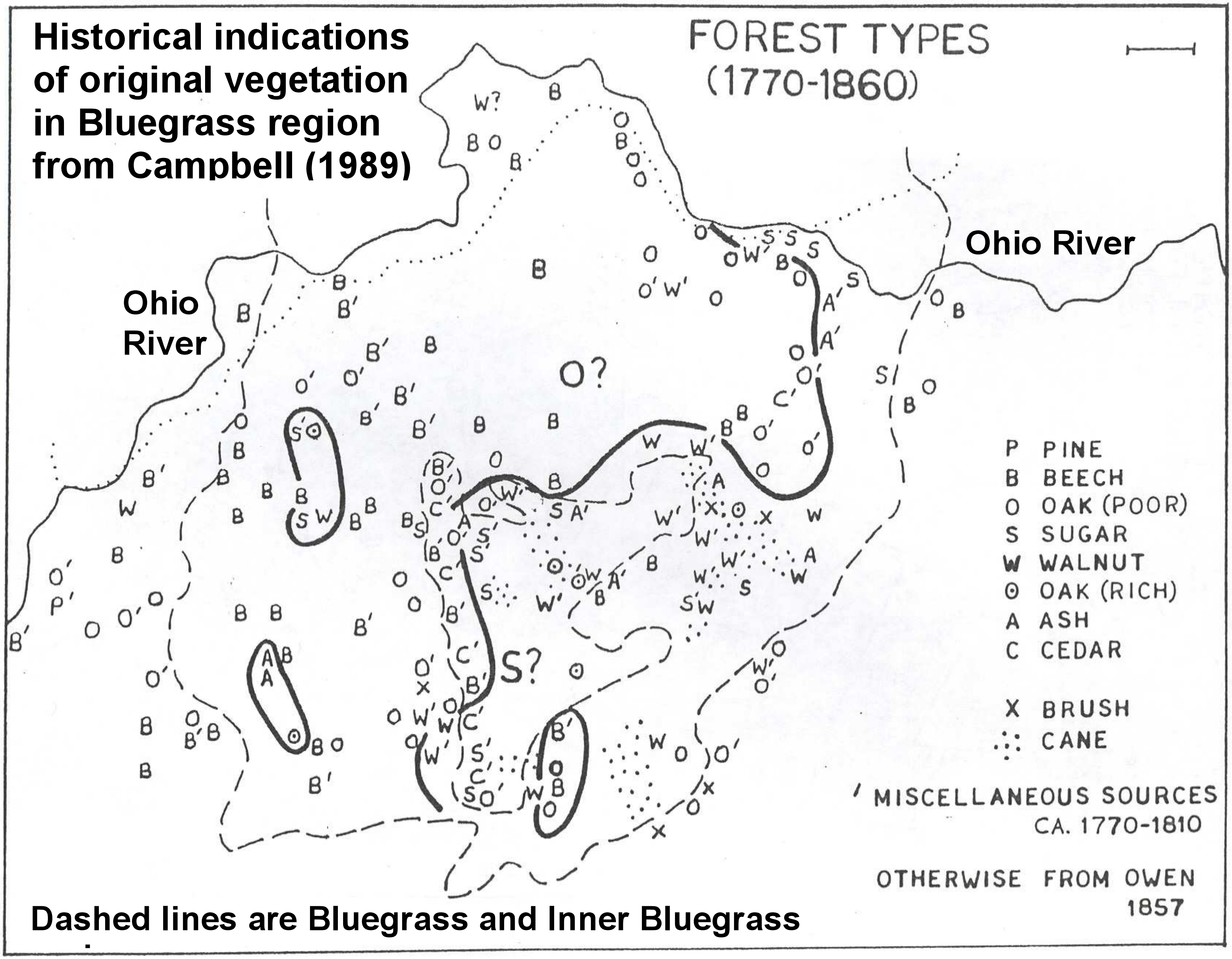
Lucy Braun (1950) described natural vegetation of the Interior Low Plateaus as "Western Mesophytic Forest"—a mixed or transitional forest region, between the "Mixed Mesophytic Forest" of the Appalachian Plateaus and the "Oak-hickory Forest" centered in the Midwest, Ozarks and Ouachitas. However, Kuchler (1964) later merged her Western Mesophytic with the Oak-hickory. The Interior Low Plateaus is actually quite varied in its natural vegetation due to geology, topography and disturbance history. The Central Bluegrass was largely covered by forest when Virginians arrived, with much sugar maple, bitternut, walnut, buckeye, elms, ashes and oaks. In the Eden Shale Hills, forests were generally distinct, with much more white oak, beech, tulip tree and other species associated with less fertile soils.

However, the woods appear to have contained many trails, promoting the clover, and many glades caused by disturbances from larger herbivores or humans. More open areas had locally dominant cane or in places other shrubby species (plums, prickley ash, briars). But pure grassland was virtually absent except for some rocky ridges, river-shores, and licks in the Eden Shale Hills (especially the famous Lower Blue Licks). There is no evidence that typical species of midwestern prairies and savannas were common or even, in many cases, present at all.

Braun called this regional vegetation "anomolous" but it should be viewed as an extreme along the gradient from low to high fertility within east-central states. Because we lack modern functioning examples of the original vegetation, together with its animal populations, it is often difficult to explain the original ecological conditions. But thanks to the first land surveys, journals of pioneers, early botanical work (especially Short, 1828-29), and inventory of modern remnants, we do have a good idea of its overall composition. It was similar in some respects to more mesic groves that dotted the midwest; the term "sumesic" will be applied in Part III.



Adapted from Braun (1950) at http://www.ohio.edu/people/dyer/gifs/braun_for-reg.jpg



Historical indications of original vegetation in Bluegrass region from Campbell (1989)

Dashed lines are Bluegrass and Inner Bluegrass

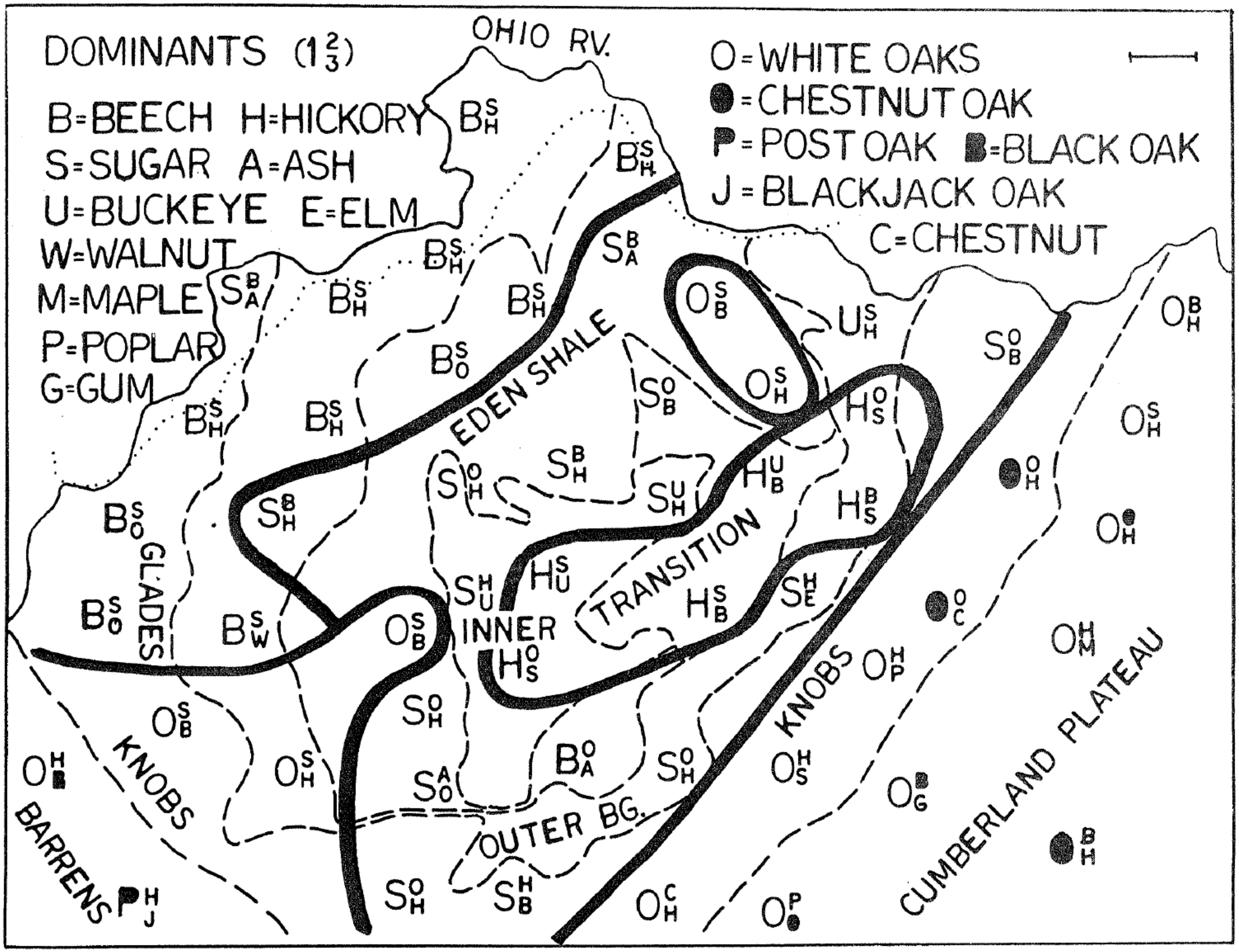


Figure 3.-- Dominant trees in each county (see fig. 1) based on samples from early deed surveys (mostly 1780-1840). Types of tree are indicated by single letter symbols. The second and third most frequent trees in each county are shown by the smaller symbols to the right of the most frequent tree symbol.

From Campbell (1989).

Barton's report on "The amount of standing timber in Kentucky" is a fascinating document that deserves much more attention; the data may come from 1900-1916.

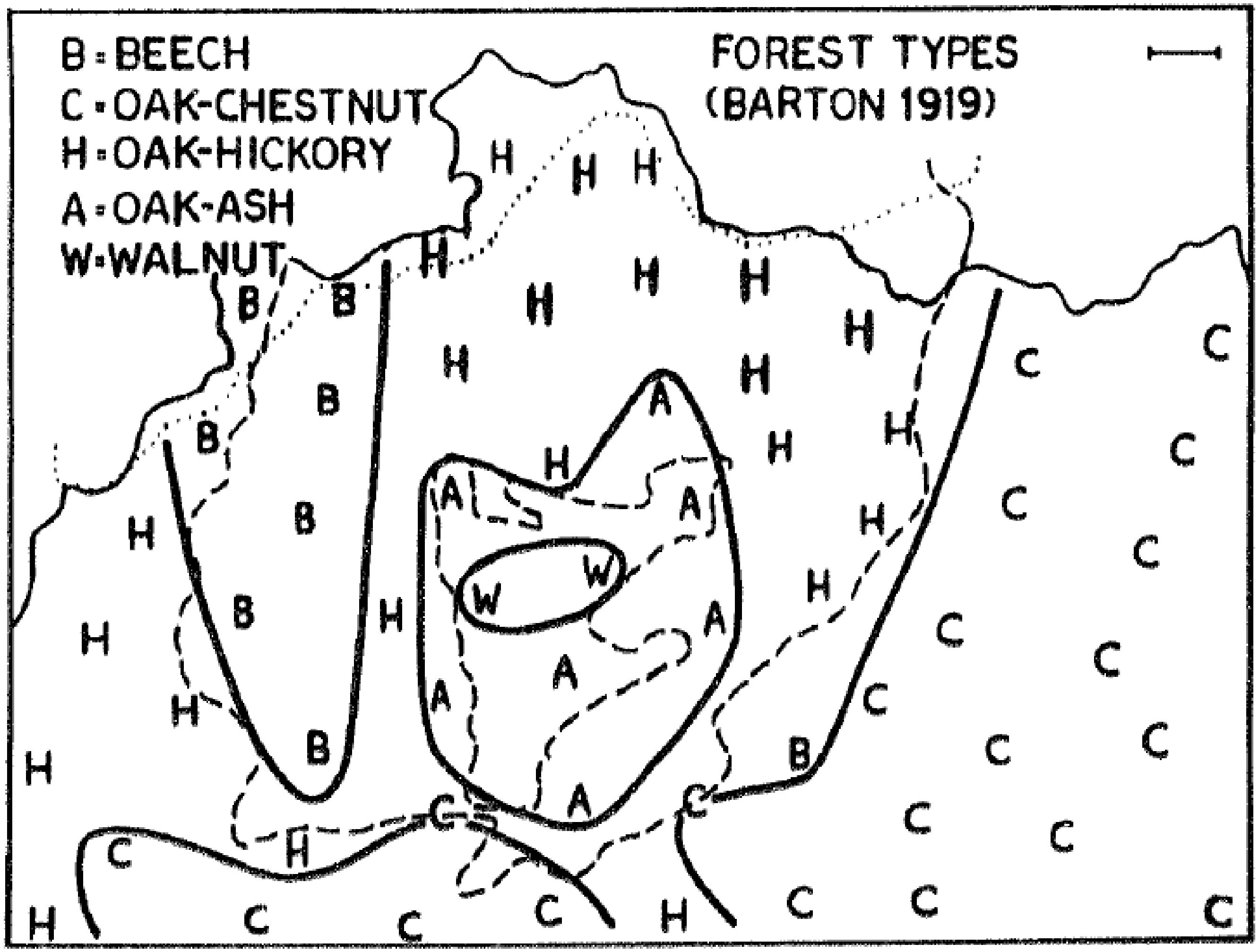
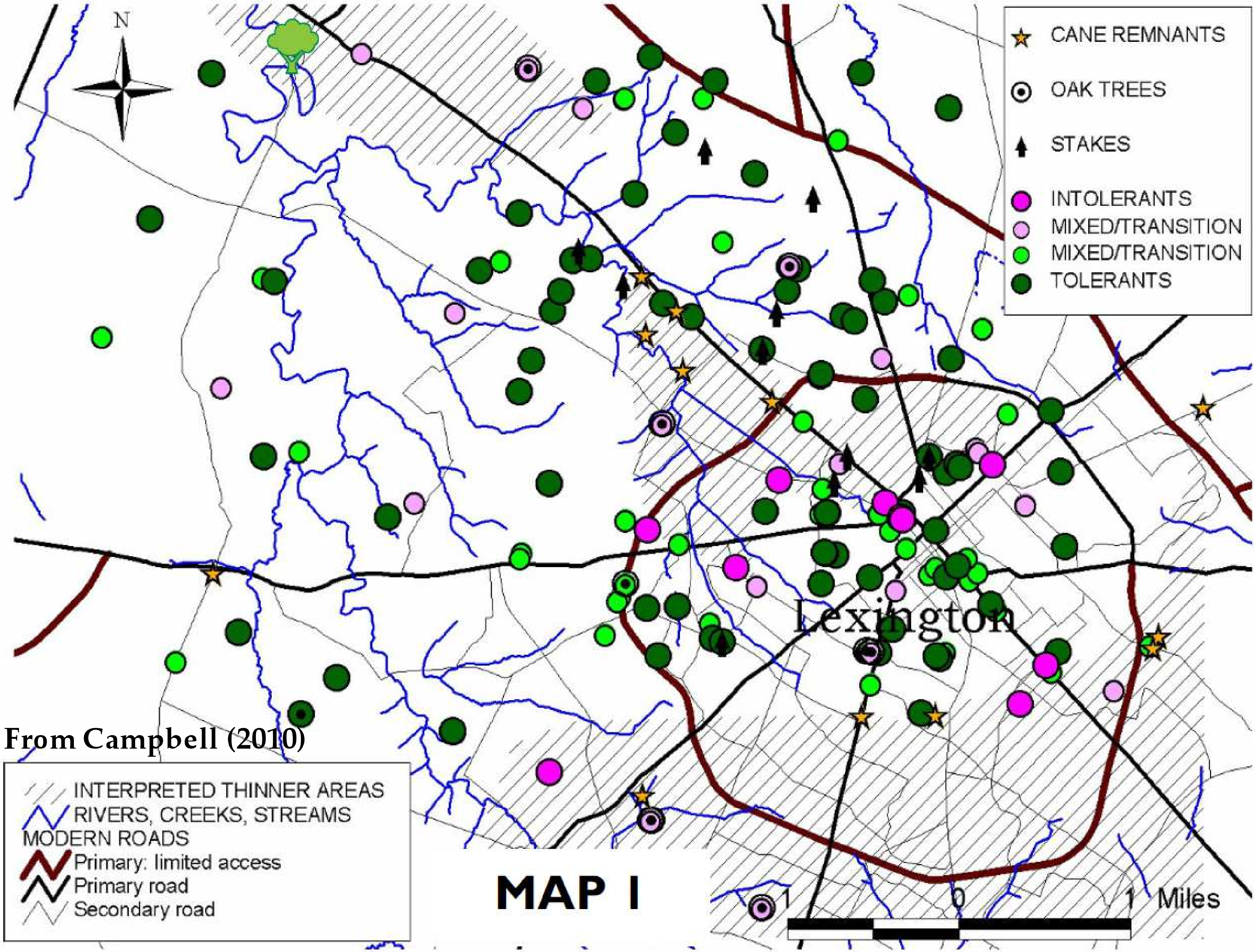
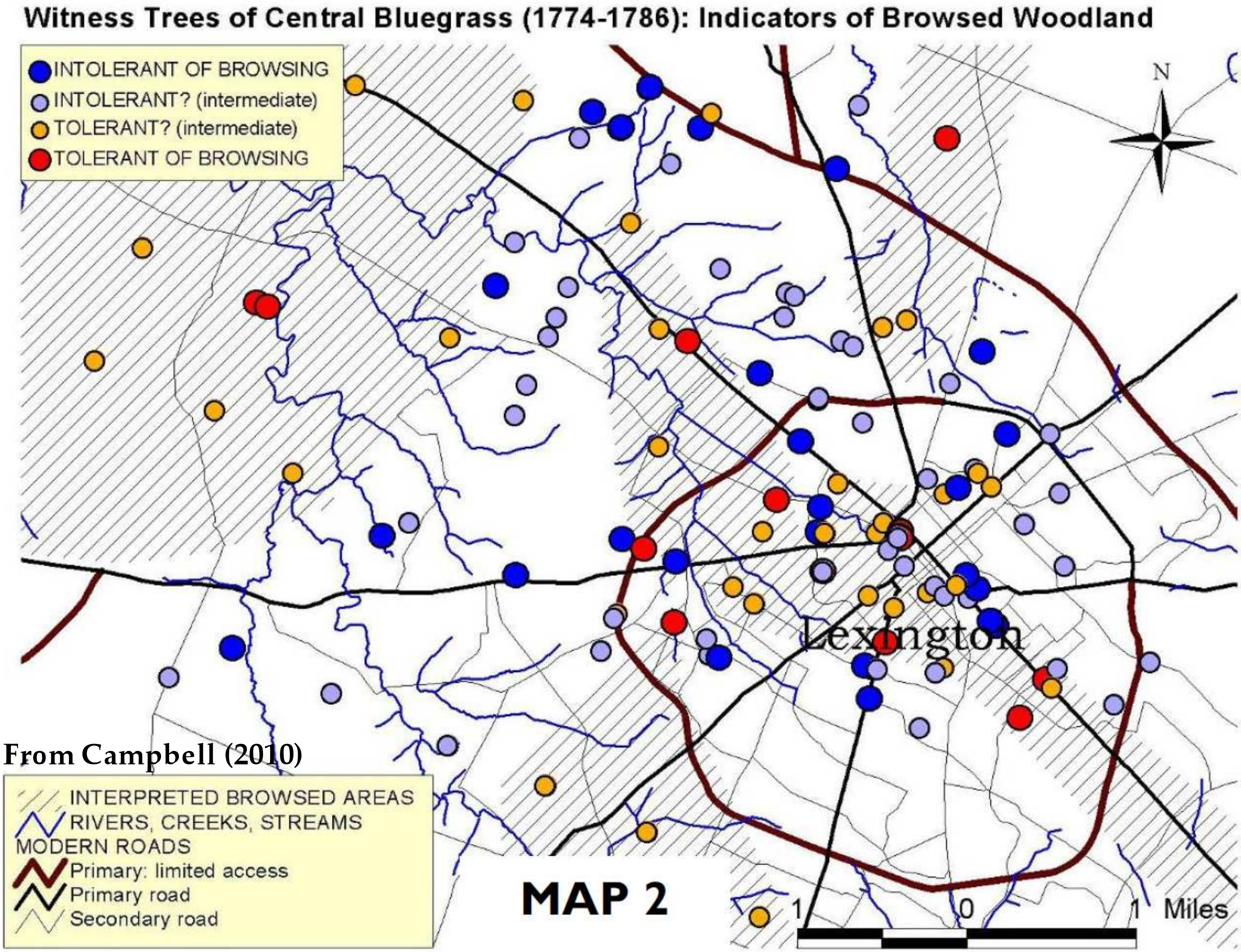


Figure 4.--Dominant trees in each county (see fig. 1) according to Barton (1919). Congeners are combined. One "B" has maple slightly more abundant than beech; one "A" has walnut slightly more abundant than ash.

Witness Trees of Central Bluegrass (1774-1786): Indicators of Thinner Woodland



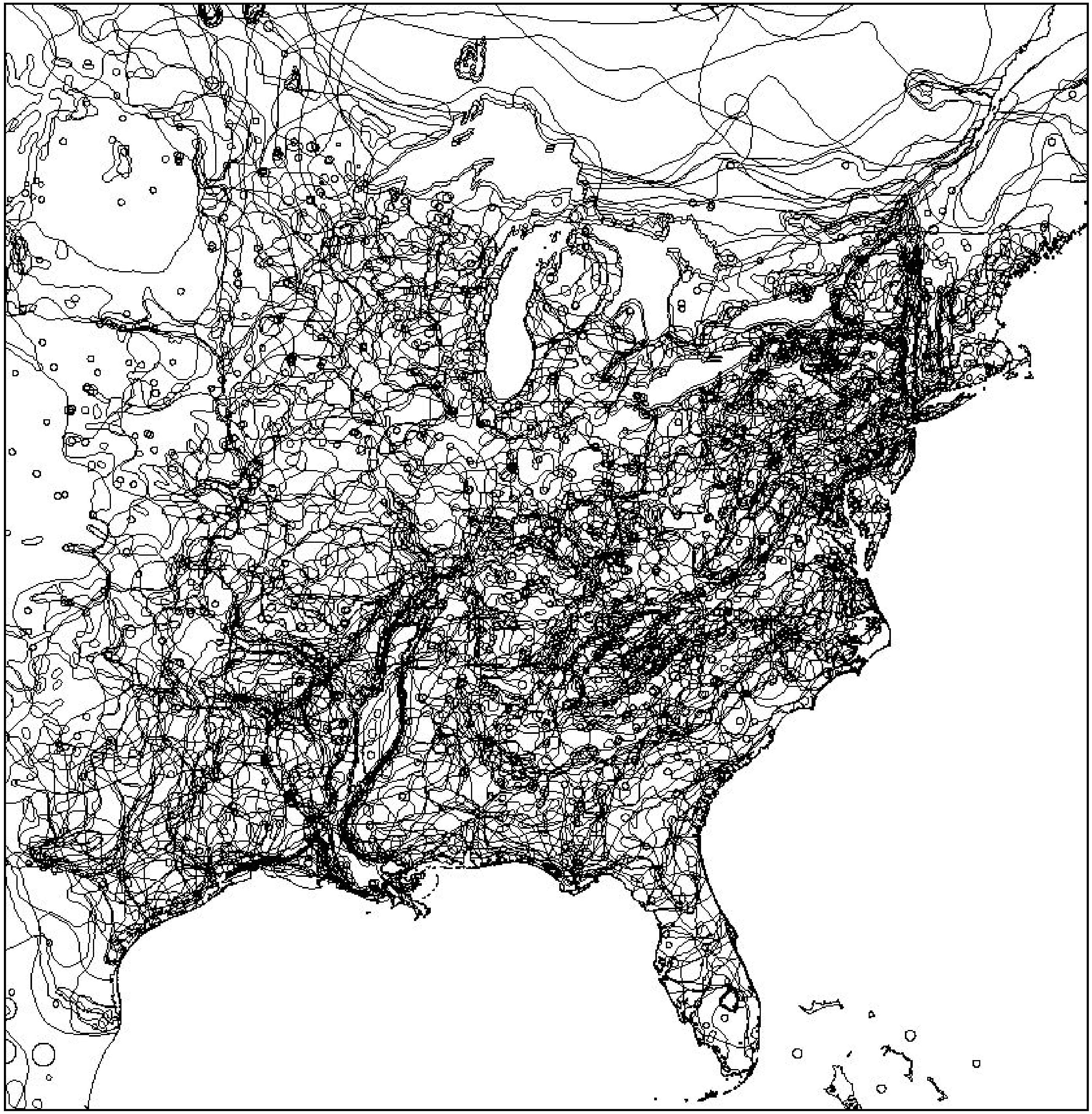

Witness Trees of Central Bluegrass (1774-1786): Indicators of Browsed Woodland
INTOLERANT OF BROWSING
INTOLERANT? (intermediate)
TOLERANT? (intermediate)
TOLERANT OF BROWSING
N
Lexington
From Campbell (2010)
INTERPRETED BROWSED AREAS
RIVERS, CREEKS, STREAMS
MODERN ROADS
Primary: limited access
Primary road
Secondary road
MAP 2
1
0
1
Miles

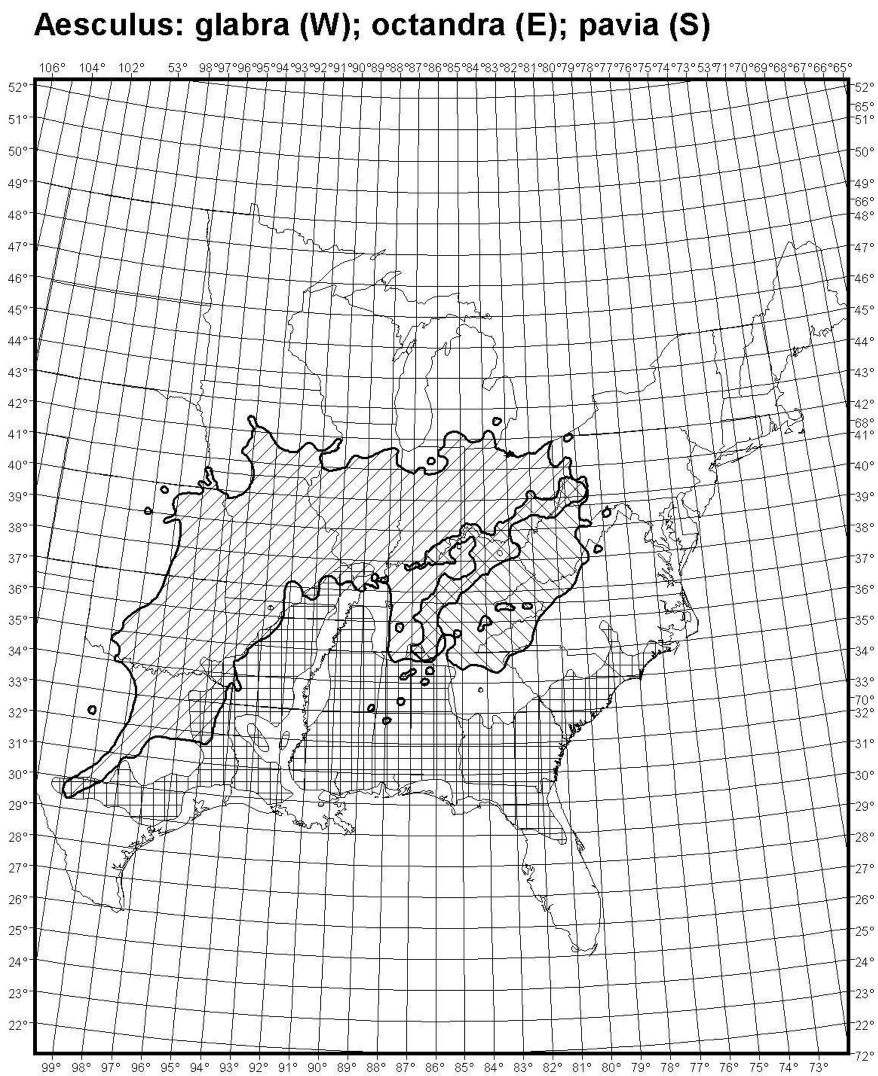
Tree ranges boundaries from Little (1971 etc) overlayed: Q-Z.

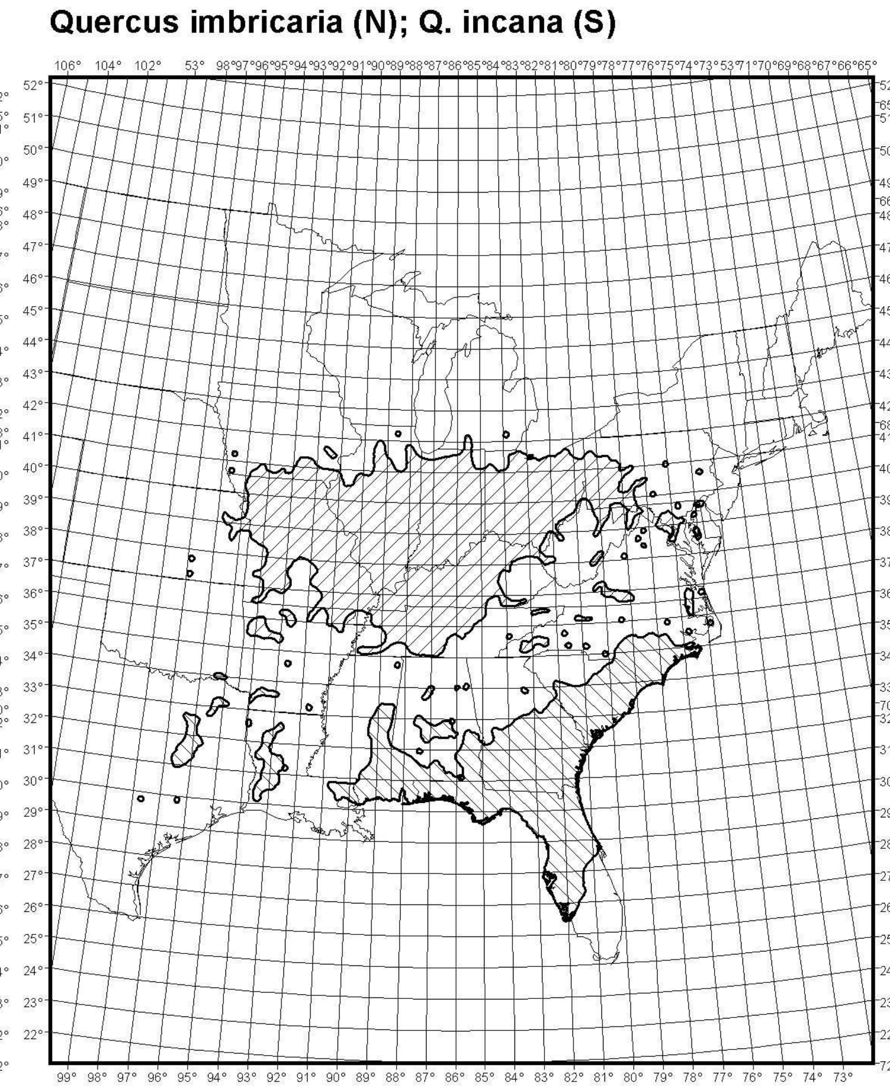
Key questions: How can we quantify clustering of boundaries?

Are clusters related to abrupt shifts in environment, or do they reflect thresholds of biological response?

Are any clusters anomalous in terms of current environment—i.e. do they reflect historical factors?

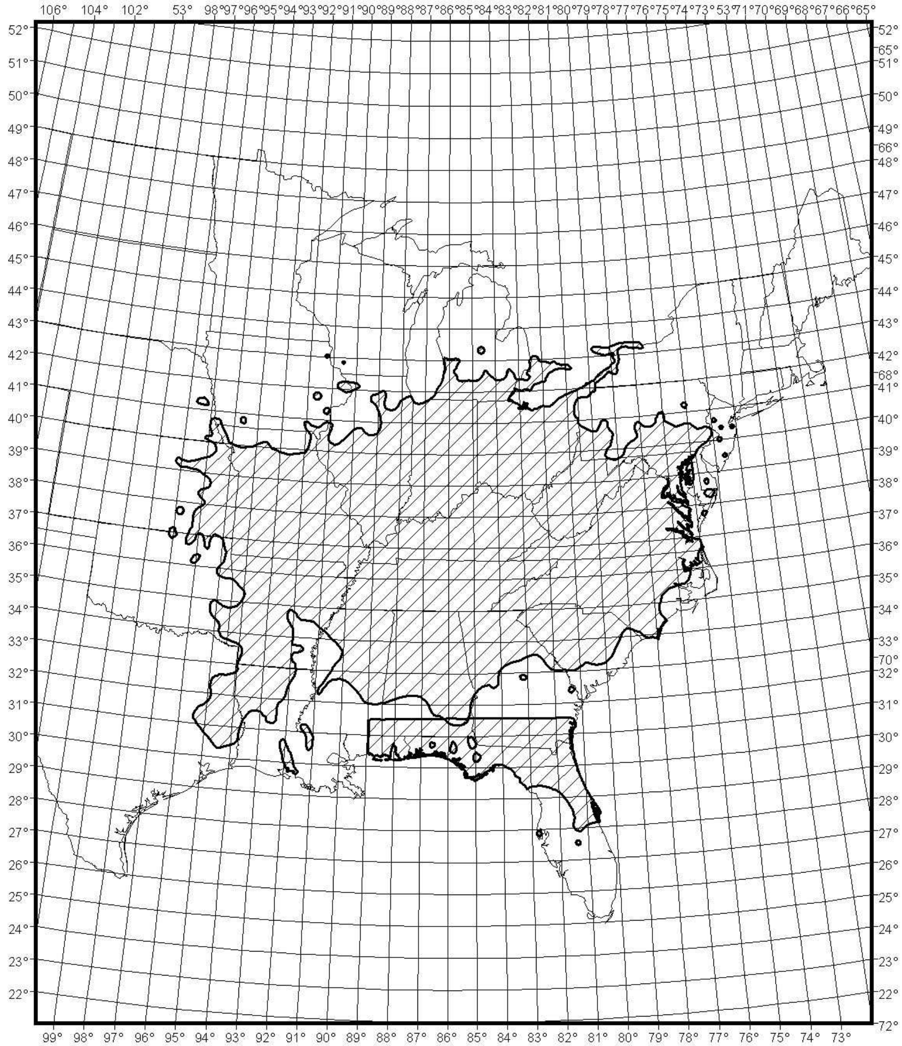




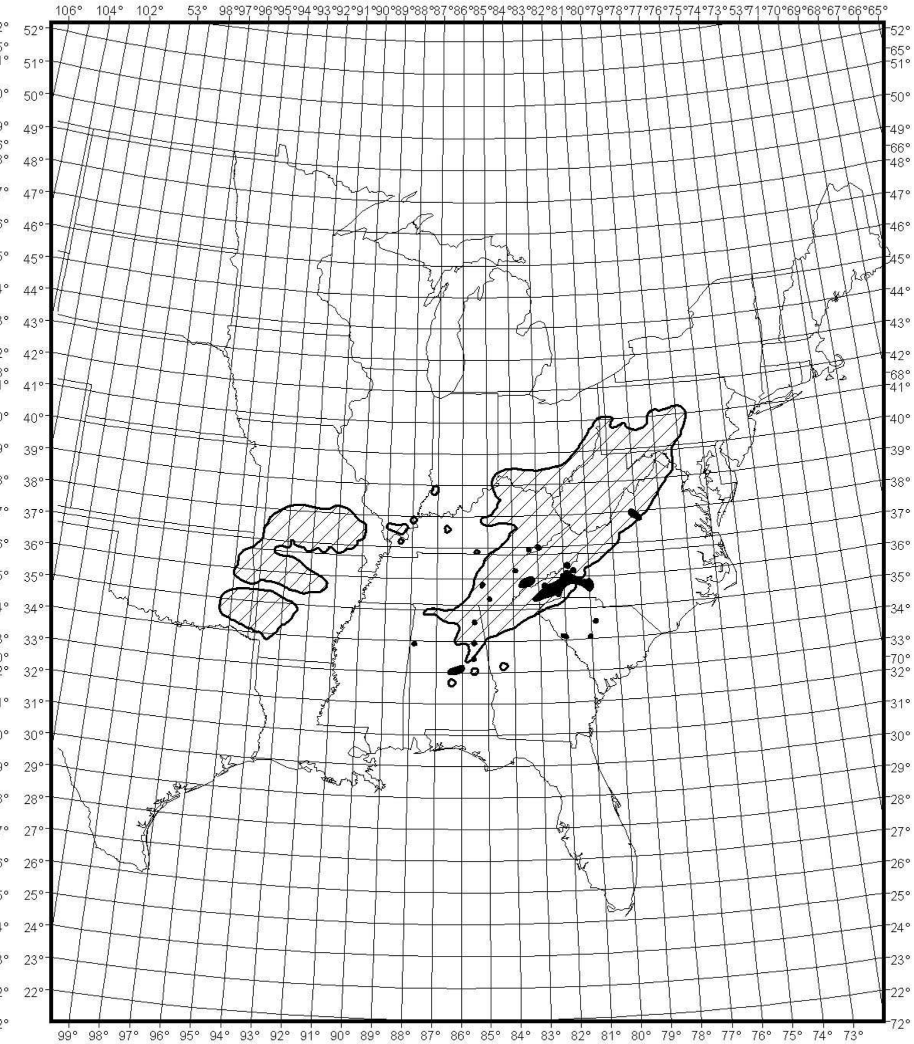


Examples of trees with mid-western or east-central range contrasted with southern relatives.
R: Ohio buckeye (*Aesculus glabra*; versus *A. octandra* = *flava* and *A. pavia*).
L: shingle oak (*Quercus imbricaria* versus *Q. incana*).

Asimina triloba (N); A. parviflora (S)

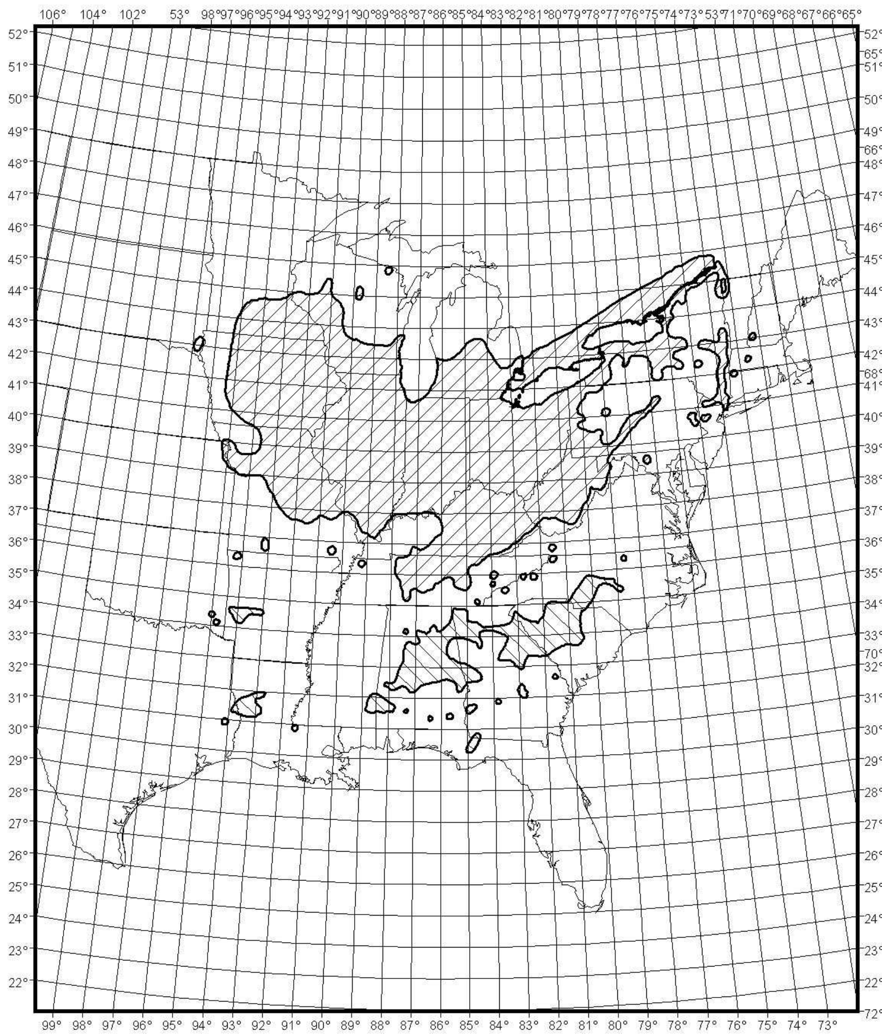


Robinia pseudoacacia (C); R. viscosa-kelseyi (E)

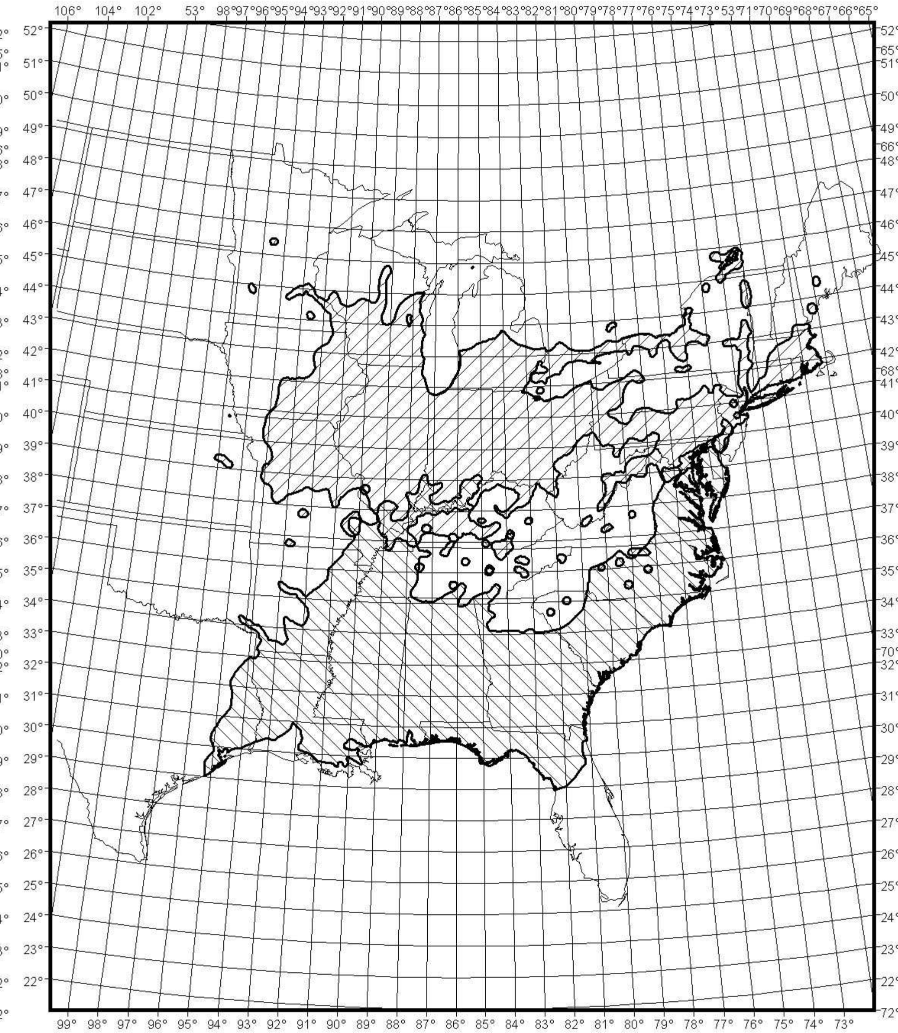


Examples of trees with mid-western or east-central range contrasted with southern relatives.
R: common pawpaw (*Asimina triloba*; versus *A. parviflora*).
L: black locust (*Robinia pseudoacacia* versus *R. viscosa* and *R. kelseyi*).

Acer nigrum (N); A. leucoderme (S)



Quercus bicolor (N); Q. michauxii (S)



Examples of trees with mid-western or east-central range contrasted with southern relatives.
R: black maple (*Acer nigrum*; versus *A. leucoderms*).
L: black locust (*Quercus bicolor* versus *Q. michauxii*).

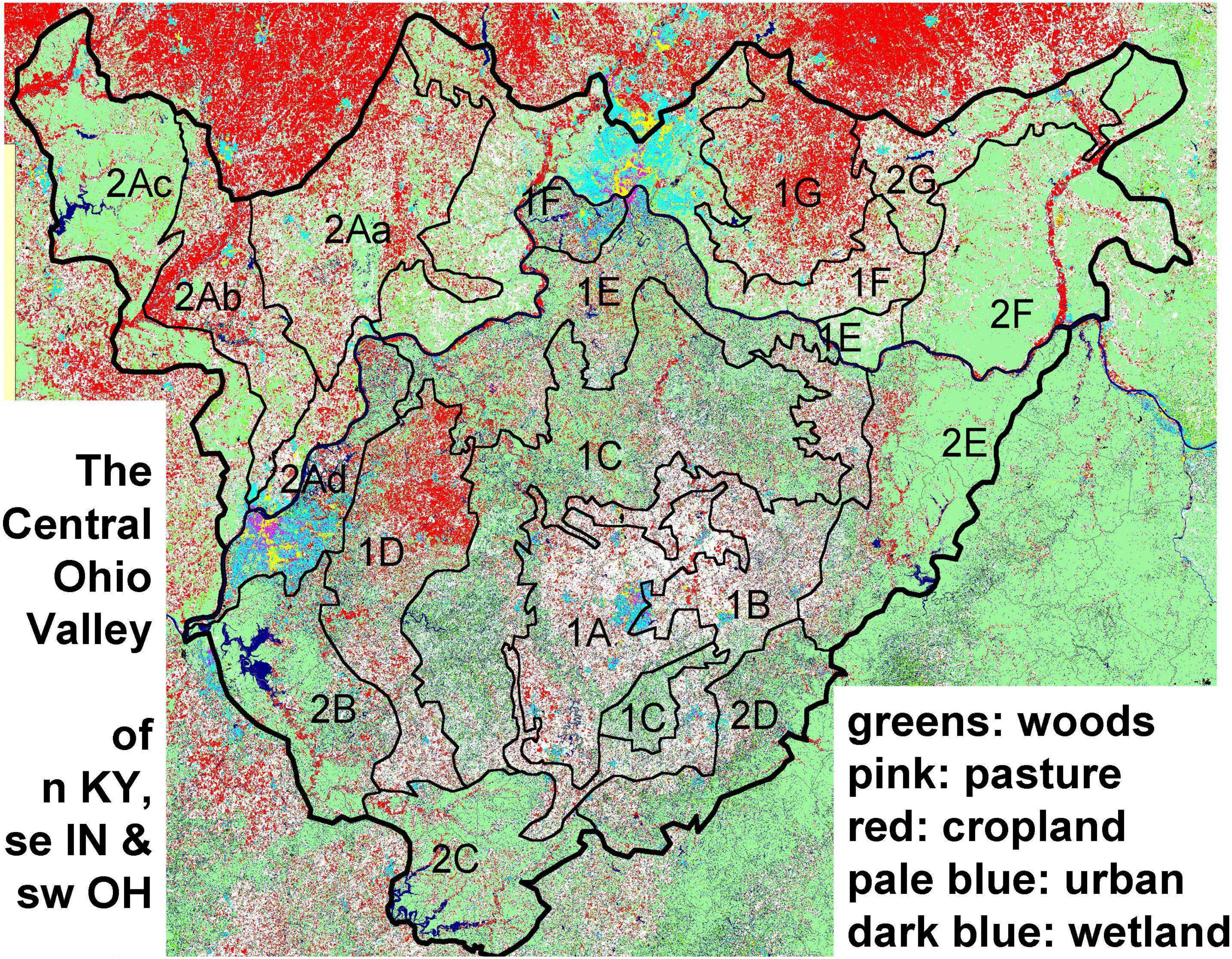
VEGETATION: the post-settlement conversion of "paradise"

After settlement in 1770-90, most uplands were cleared for farmland. Much land was even cleared along moderately steep rocky slopes near the Kentucky River and its tributaries. Within remaining strips and patches of woods, there have been large declines in the proportions of sugar maple, buckeye, hickories, slippery elm, mulberry, hornbeam, spicebush, pawpaw, cane and other species, including many in ground vegetation such as blue cohosh, twinleaf, buffalo clovers, nettles, peavine, hyacinth, showy orchid and midwestern lily. Native species with apparent increases in proportioin include black walnut, hackerry, black cherry, cherry, briars, white snakeroot, wingstems, ironweed, nimble will and many others. The local dominance of black walnut and ashes (mostly white and blue) became especially distinctive about 1860-1900, when the only Kentucky counties dominated by walnut were Fayette and Woodford; and the only ones dominated by ashes were other counties of the Central Bluegrass (Barton 1919).

There has been much erroneous interpretation of the "woodland-pastures" that Mary Wharton and others called "savanna-woodlands". In addition to changes in proportions of tree species, there are historical accounts of how "woodland-pastures" were created out of the wilderness. For example, Hulme (1819) noted: "I approve of Mr. [Henry] Clay's method very much, especially in laying down pasture. He clears away all the brush and underwood, leaving timber enough to afford a sufficiency of shade to the grass, which does not thrive here exposed to the sun as in England and other such climates. By this means, he has as fine grass and clover as can possible grow." Virginians of course recognized the exceptional soil fertility, and the potential for high phosphate content to build bones in livestock. By converting some of the woods to use by livestock, part of the original character was maintained in some locations.

The Central Ohio Valley

of n KY, se IN & sw OH



greens: woods
pink: pasture
red: cropland
pale blue: urban
dark blue: wetland

From Campbell (1989) and unpublished data

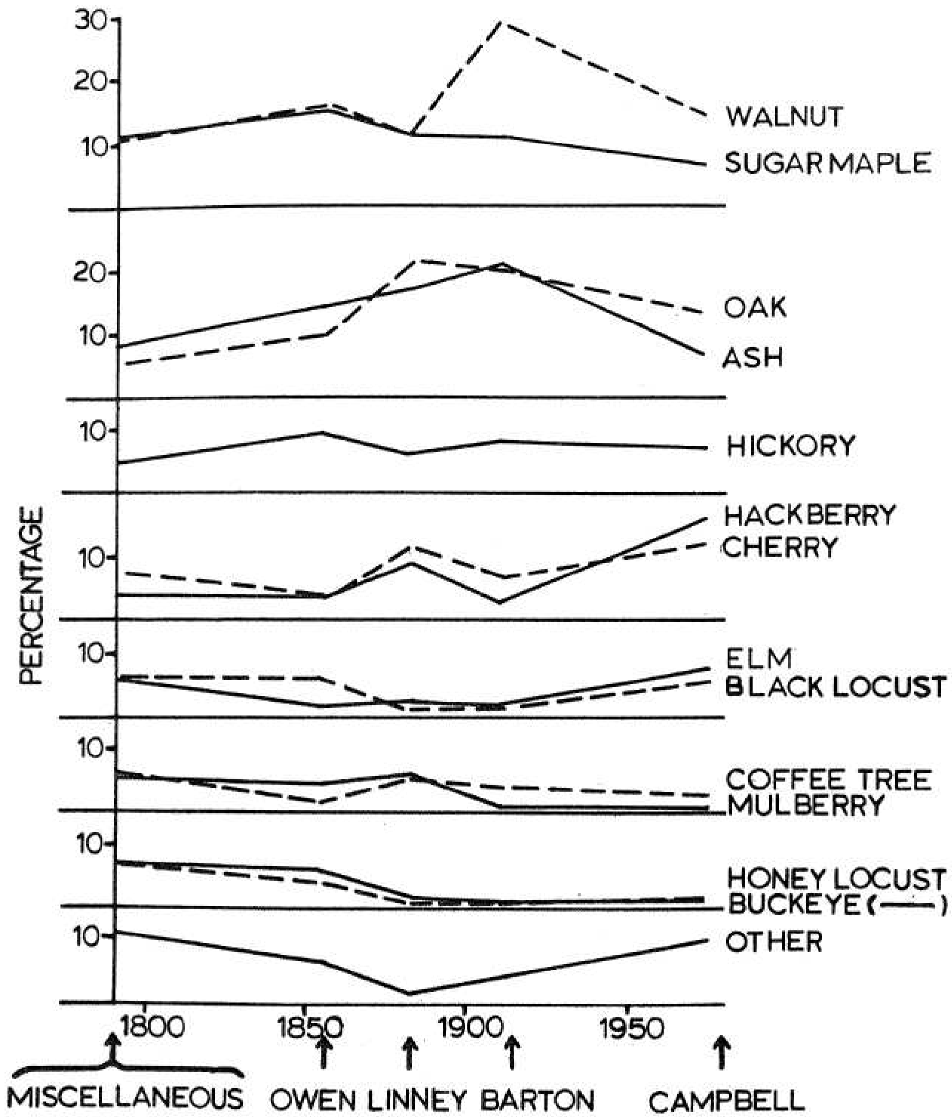
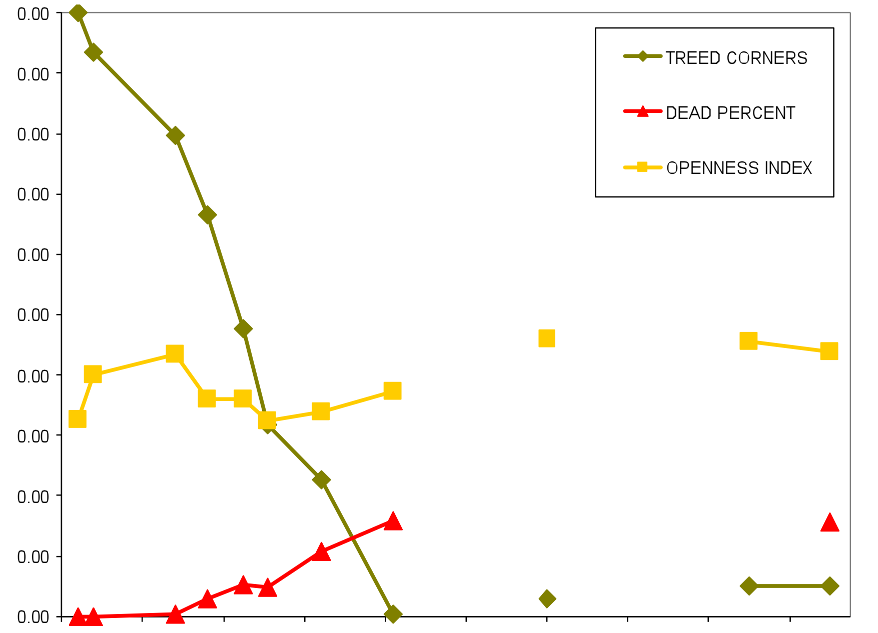
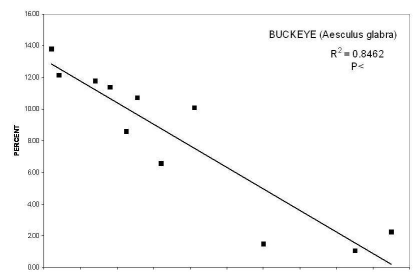
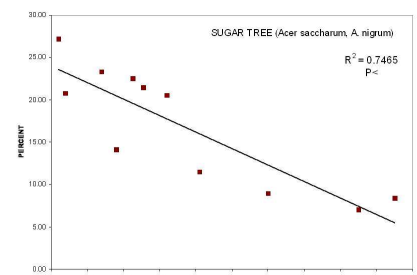


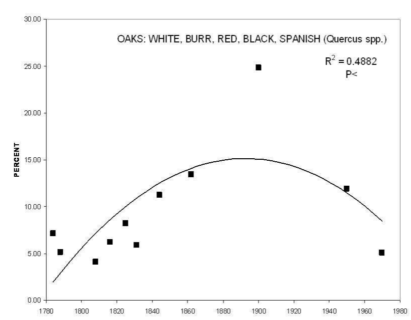
Figure 6.--Temporal shifts in forest composition on more fertile soils (mostly in the Inner Bluegrass), as suggested by miscellaneous early landscape descriptions (Table 1:B), Owen (Table 1:J), Linney (Table 1:N), Barton (Table 1:R) and Campbell (1980, p. 63; mean basal area of successional phases D-G). Small trees like pawpaw, dogwood, redbud, hawthorn, hornbeam and ironwood are excluded from these percentages.

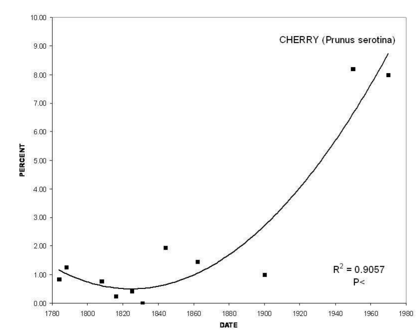
BOURBON COUNTY SURVEY CORNERS: PERCENT WITH TREES; PERCENT DEAD TREES; OPENNESS INDEX (AT TREED CORNERS) = GRADIENT FROM SUGAR TREE TO LOCUSTS

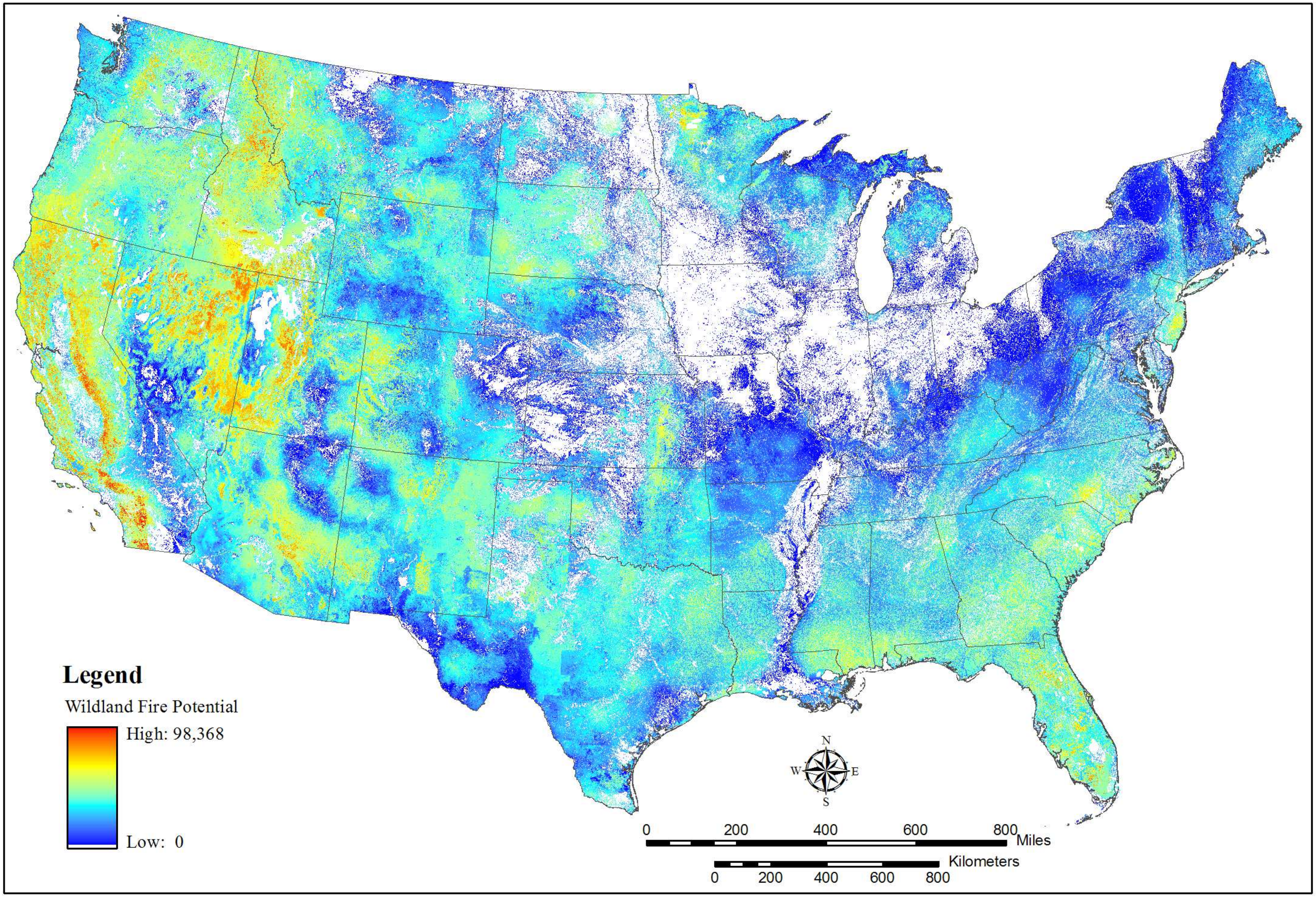












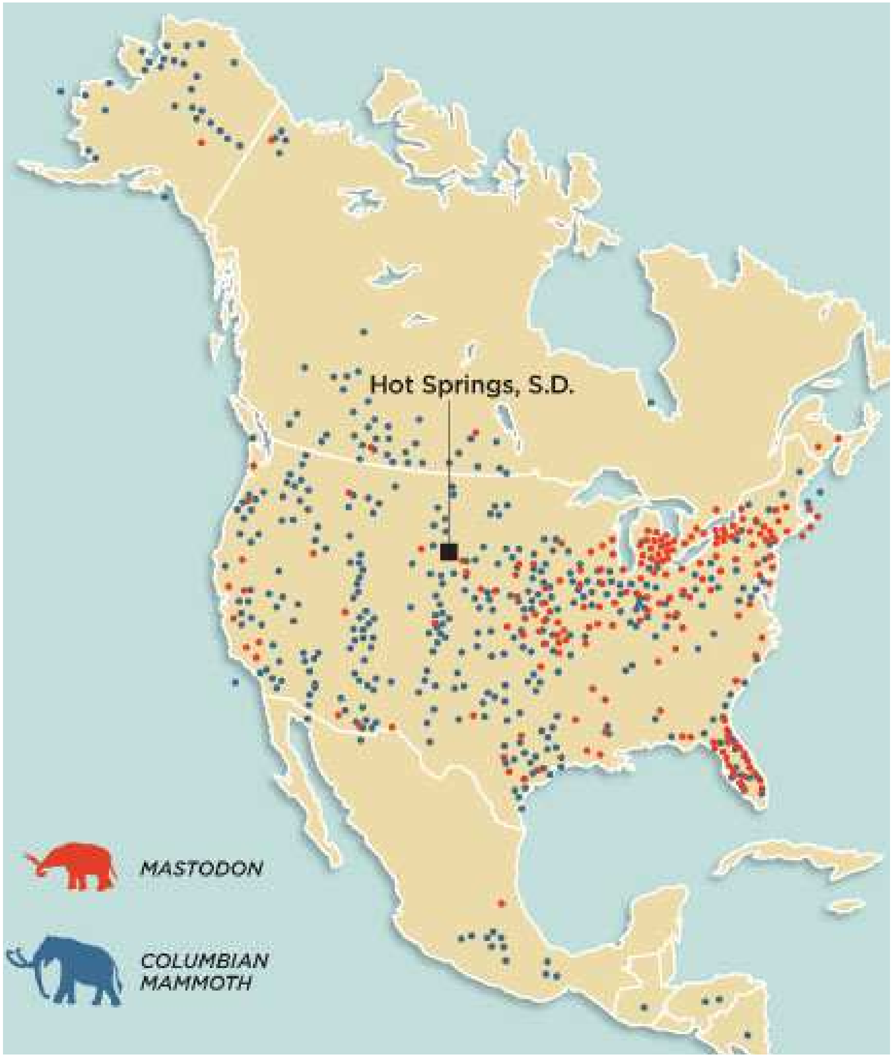
Dillon et al. (2012). Mapping Wildland Fire Potential for the Conterminous United States.

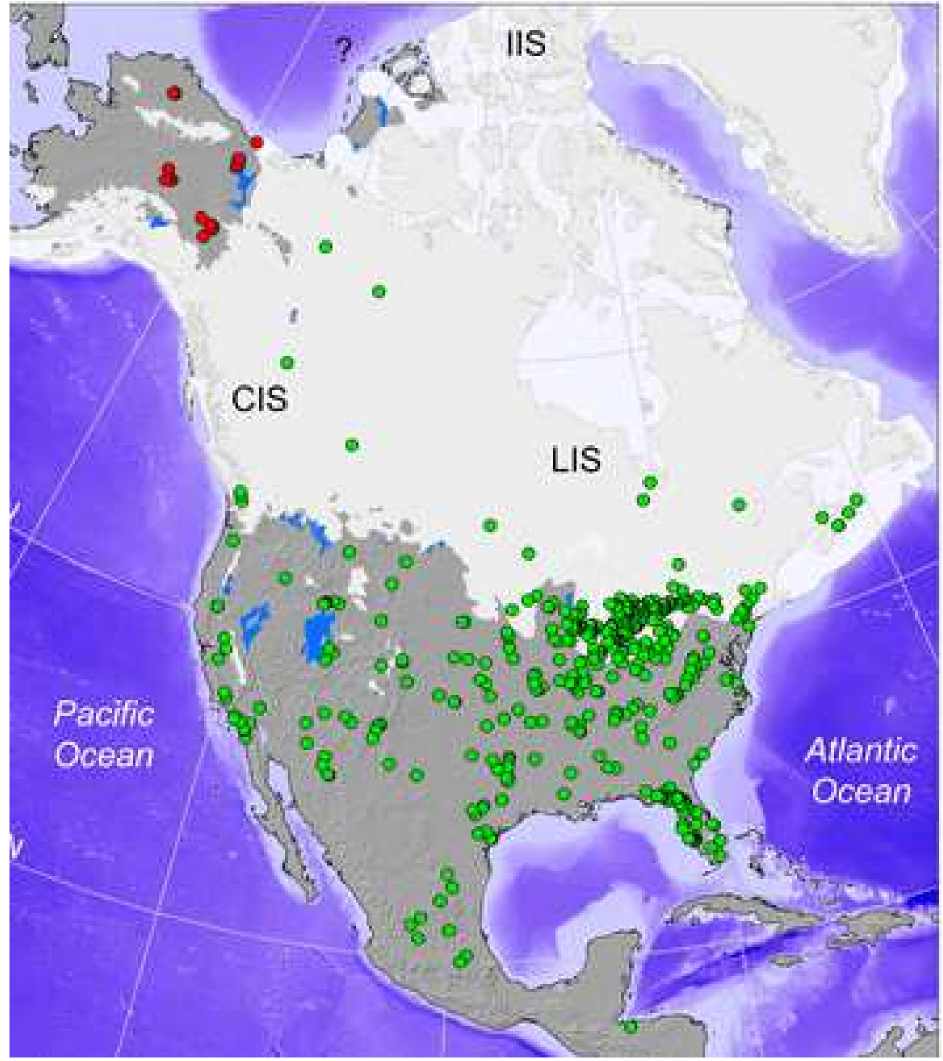
MEGAFAUNA: formerly free-ranging "ecosystem engineers"

Mastodons, mammoths, giant bison, wild horses, sloths, giant beavers and other large herbivores roamed freely over North America until extinction about 10,000 to 11,500 years ago. The largest remaining animal is the modern bison, which resurged into Kentucky after the decline of native american human populations during 1500 to 1800 AD. In the Bluegrass region, there is a strong concentration of Pleistocene fossils from larger herbivores. This pattern is presumably related to the importance of salt licks and soils rich in calcium phosphate. Historical information on bison numbers suggests that there was a seasonal migration between north and south across Kentucky. That migration probably had significant effects on the vegetation. Analogies need to be explored further with other grazing systems around the world. It is likely that larger animals such as masdodons had locally intense effects on the vegetation of eastern North America. Cedar glades of central Tennessee may have been partially created by such animals in their seasonal wallowing, then carrying off soil on their bodies. In the Central Bluegrass, "stamping grounds" of bison were located in or near springs and licks rich in phosphates. Such effects have been documented in modern African elephants (Haynes 2012).

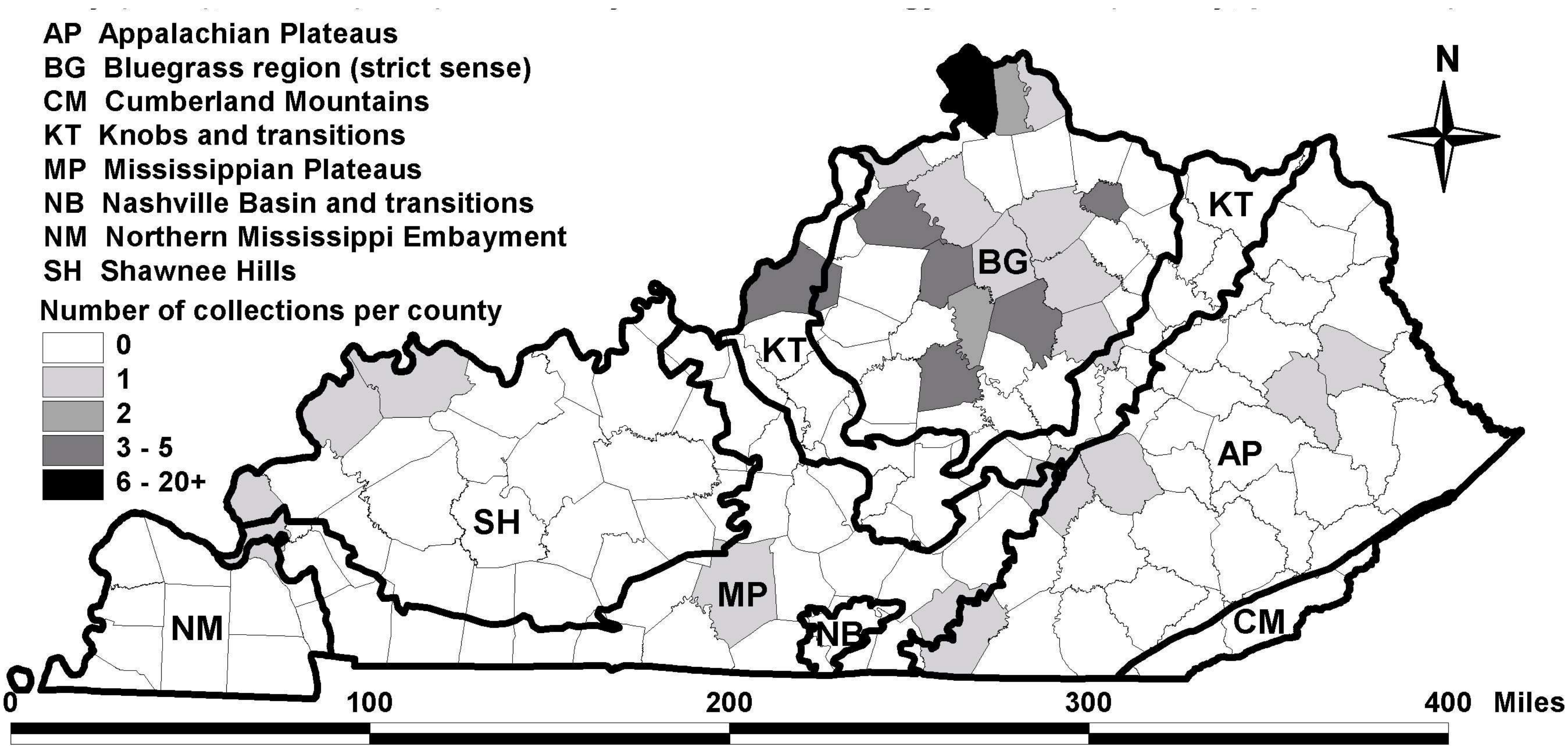
As Frank et al. (1998) have stated: "A continuum exists among grazing ecosystems, from relatively less productive and moderately grazed temperate grassland (e.g., Yellowstone) to highly productive and heavily grazed tropical grassland (e.g., the Serengeti). Because of feedback mechanisms in which herbivores promote plant growth, grazers are important regulators of ecosystem processes in grazing ecosystems. Stronger feedbacks in the Serengeti, including larger ungulate effects on grazing efficiency and aboveground primary production, suggest that herbivores and other ecosystem components are more tightly linked in tropical grazing ecosystems than in temperate grazing ecosystems."

American Mastodon, a species of spruce woodlands and cool temperate lowlands that fed a lot on woody plants (including bark and fruit), rather than mostly grass as in the mammoths. Once common in the Bluegrass region, it survived on Earth until 4000-5000 years ago.
[From painting by Charles R. Knight at the Field Museum (Chicago), via Wikipedia.]

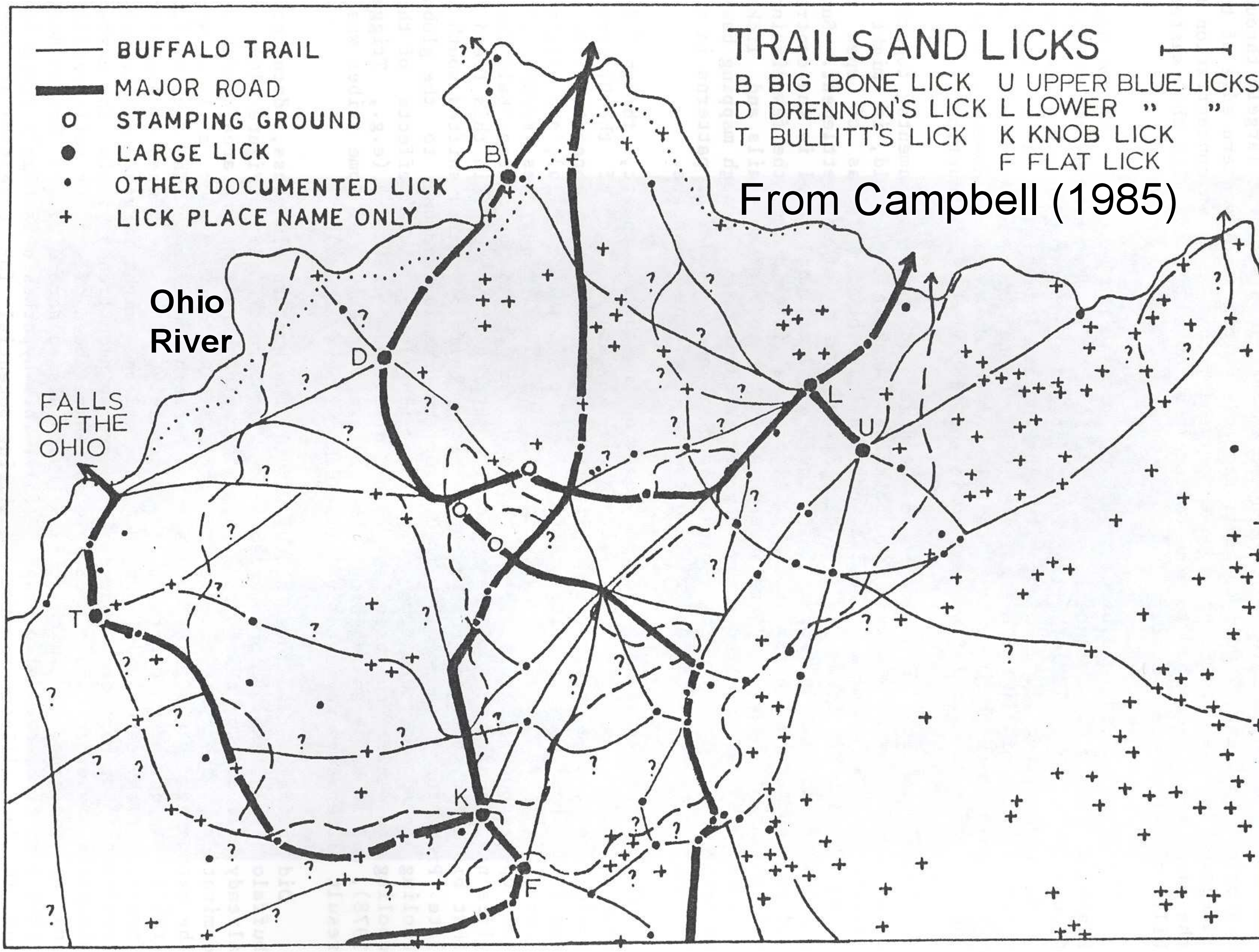




Some maps of former distributions for mastodons (plus mammoths in left), based on fossils up to 5 million years old. Hoppe et al. (1999) indicated that mastodons in Florida did migrate north into the Appalachians during the late glacial era, 10,000-25,000 years ago.
Left from https://craterhunter.wordpress.com/2014/05/
Right http://www.pnas.org/content/111/52/18460.figures-only



Collection sites for larger Pleistocene herbivores fossils from Kentucky. These data were compiled by Campbell (1985) from Hays (1923), Jillson (1968) and the Kentucky State Archaeology database (B. Clay, pers. comm.). The animals are mastodons, mammoths, elephants, sloths, horses, tapirs, peccaries, bison (extinct forms), musk ox, reindeer, moose, elk and deer. By far the most productive site has been Big Bone Lick (Boone Co.). The few records from southern (MP) or eastern (AP) regions are single finds of mastodons or peccaries. [Figure initially developed for: "Prairie Gromwell in Kentucky: the ecology of *Onosmodium* (Boraginaceae)"; posted 2012 at http://bluegrasswoodland.com/Notes_on_Species.html.]


BUFFALO TRAIL
MAJOR ROAD
STAMPING GROUND
LARGE LICK
OTHER DOCUMENTED LICK
LICK PLACE NAME ONLY
TRAILS AND LICKS
B BIG BONE LICK
D DRENNON'S LICK
T BULLITT'S LICK
U UPPER BLUE LICKS
L LOWER " "
K KNOB LICK
F FLAT LICK
From Campbell (1985)
Ohio River
FALLS OF THE OHIO
B
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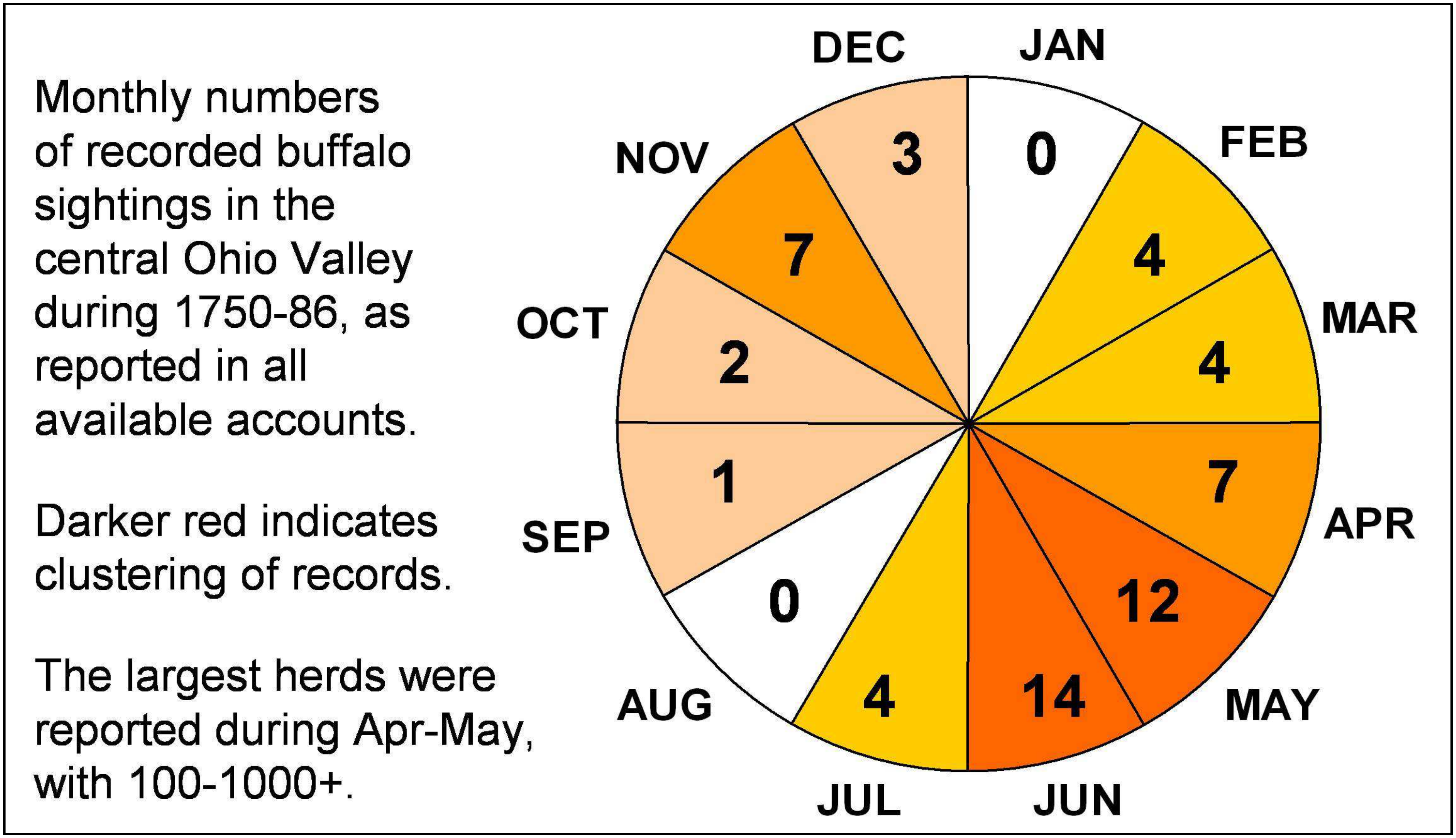


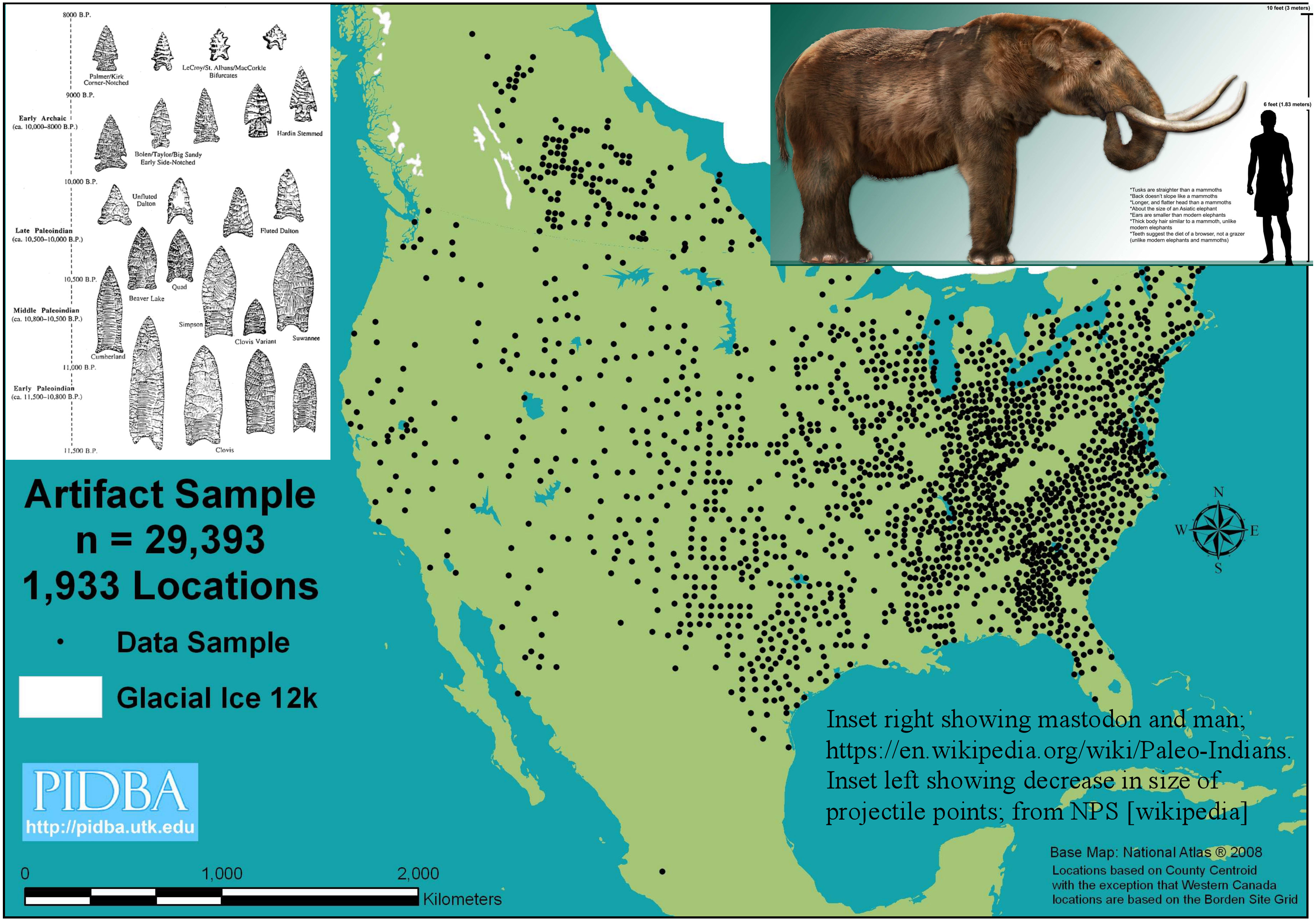
Can some return to the original browsing-regime reduce alien plants? Most of the common aliens during Oct-Dec do provide good forage!

From: Campbell's (2012) "The Herbivore Hypothesis for Bluegrass Woodland".

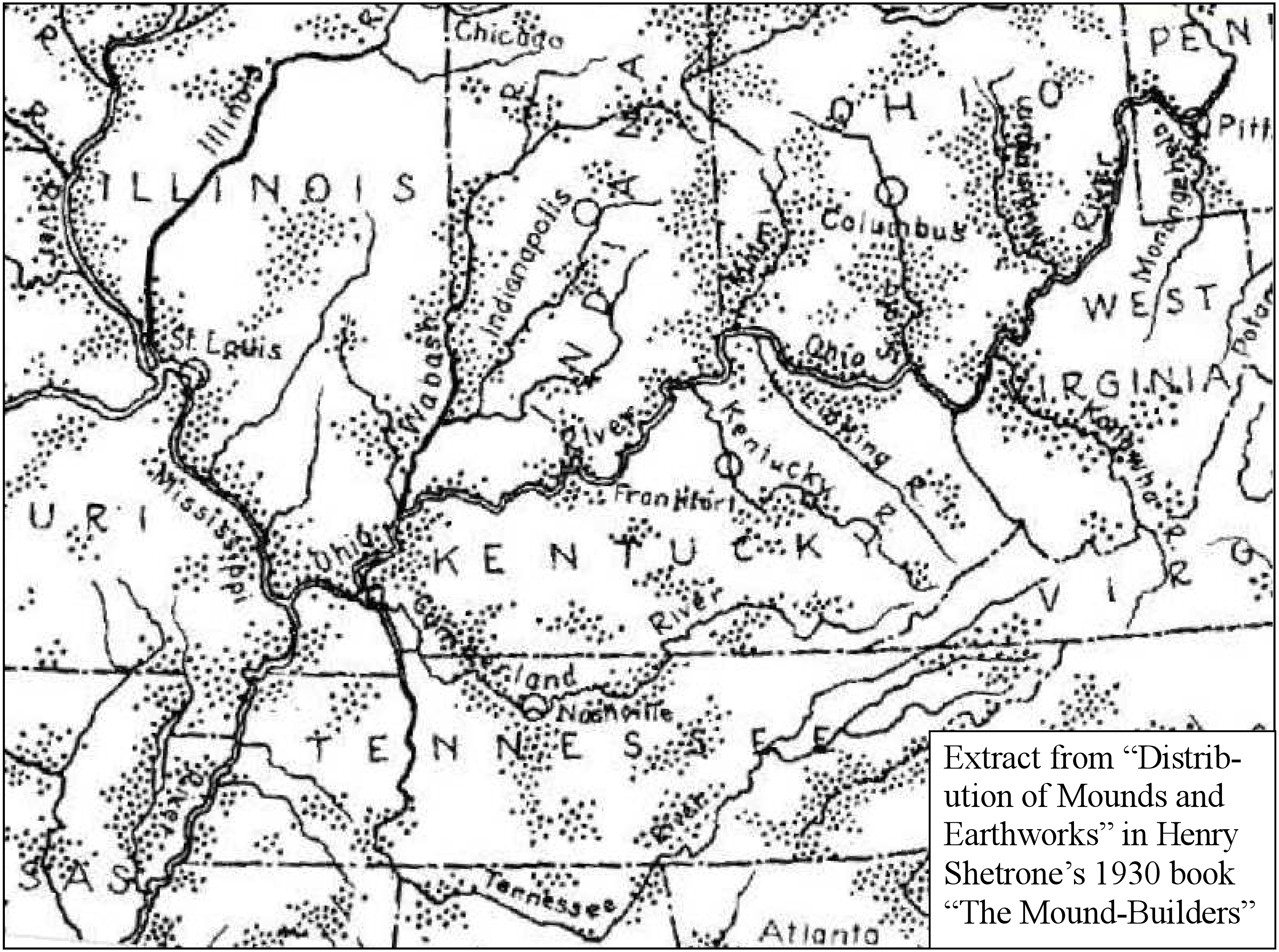
HUMANS: the pre-DeSotan development of tribes and villages

Due to the wealth of archaeological research, we now know that human populations were extensive across eastern North America before the raids of DeSoto and his Spanish explorers. Populations were concentrated on more fertile plains, especially terraces and cuestas near larger streams and rivers. Within the Ohio Valley, the mound-building Fort Ancient (1000-1700 AD), Hopewell (200 BC to 500 AD) and Adena cultures (1000 to 200 BC) were concentrated in the Central Ohio Valley, generally centered on the northern Bluegrass region. Details of Fort Ancient villages and campsites suggest concentrations along the Ohio River, and also around the Central Bluegrass. Fort Ancient records are especially dense in the Stamping Ground area of Scott County, where large congregations of bison were reported by Virginian explorers. Gwynn Henderson (1998-2001) has compiled much information on the Fort Ancient.

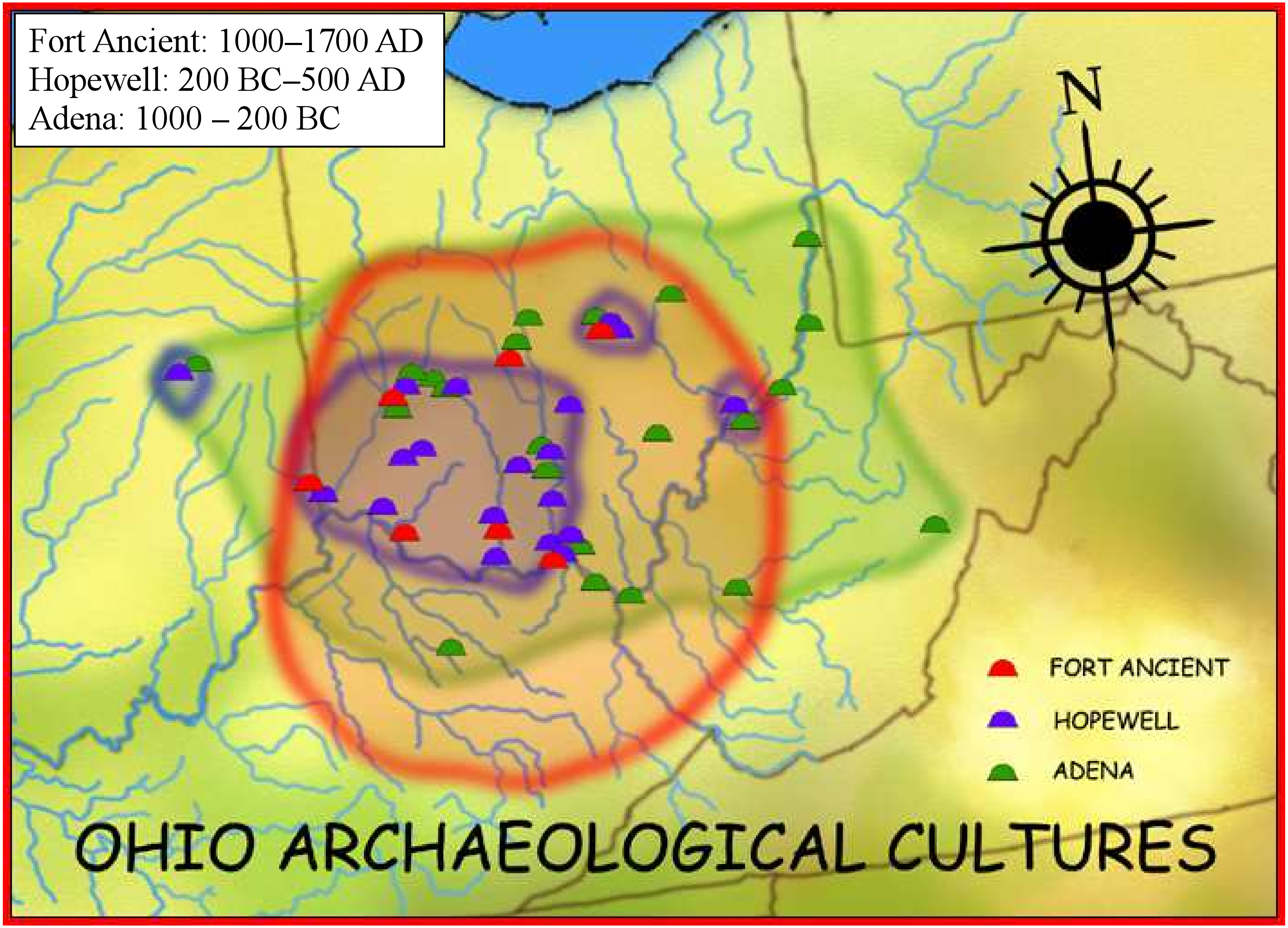
Due to disruptions in relationships of different tribal groups after DeSoto, we do not have a clear picture of tribal ranges during the period 1500 to 1800. Although the Shawnee were associated with the Bluegrass region during 1700 to 1800, they may have been previously concentrated further west, in the "Shawnee Hills". There appears to have been an earlier group in the Bluegrass region, named "Mosopelea" or "Ofo" in some records. According to the 1684 French map of Jean-Baptiste-Louis Franquelin, the Mosopelea had eight villages just north of the Ohio River, between the Muskingum and Scioto rivers, corresponding with the heart of mound-builder country. Franquelin noted the villages on the map as "detruit" [destroyed]. La Salle recorded that the Mosopelea were conquered by the Seneca and other nations of the Iroquois Confederacy during the early 1670s. In 1673, Marquette, Joliet, and other French explorers found that the Mosopelea had fled to the lower Mississippi. Today their descendants are enrolled in the federally recognized Tunica-Biloxi Indian Tribe and have a reservation in Avoyelles Parish, Louisiana. They speak English or French as their first language [Wikipedia].



"Paleoindian database of the Americas: artifact database sample locations." [https://feet2thefire.files.wordpress.com/2014/05/pidba-figure-01.jpg]



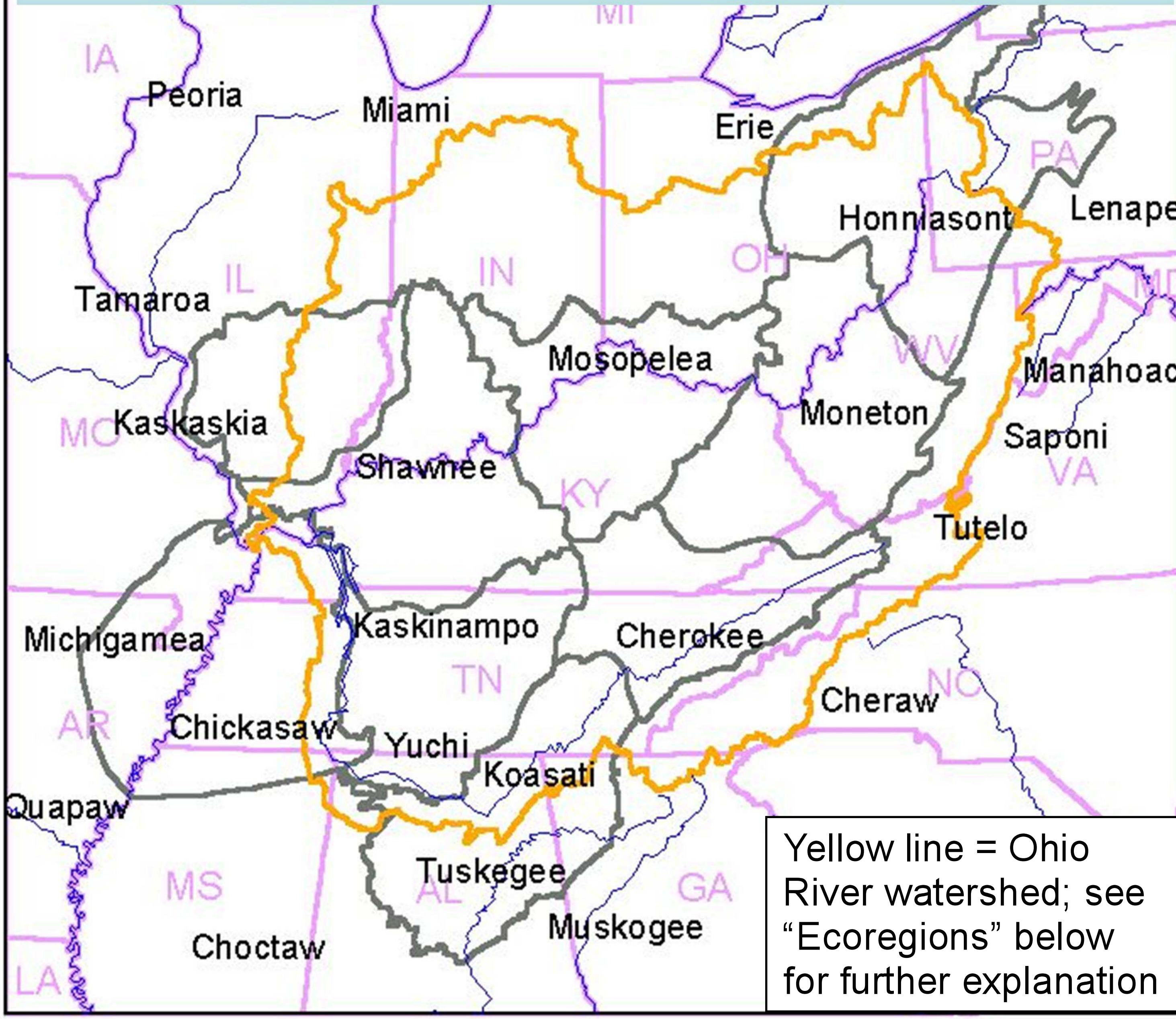
Extract from “Distribution of Mounds and Earthworks” in Henry Shetrone’s 1930 book “The Mound-Builders”



[https://upload.wikimedia.org/wikipedia/commons/f/f0/Ohio_Arch_Cultures_map_HRoe_2008.jpg]

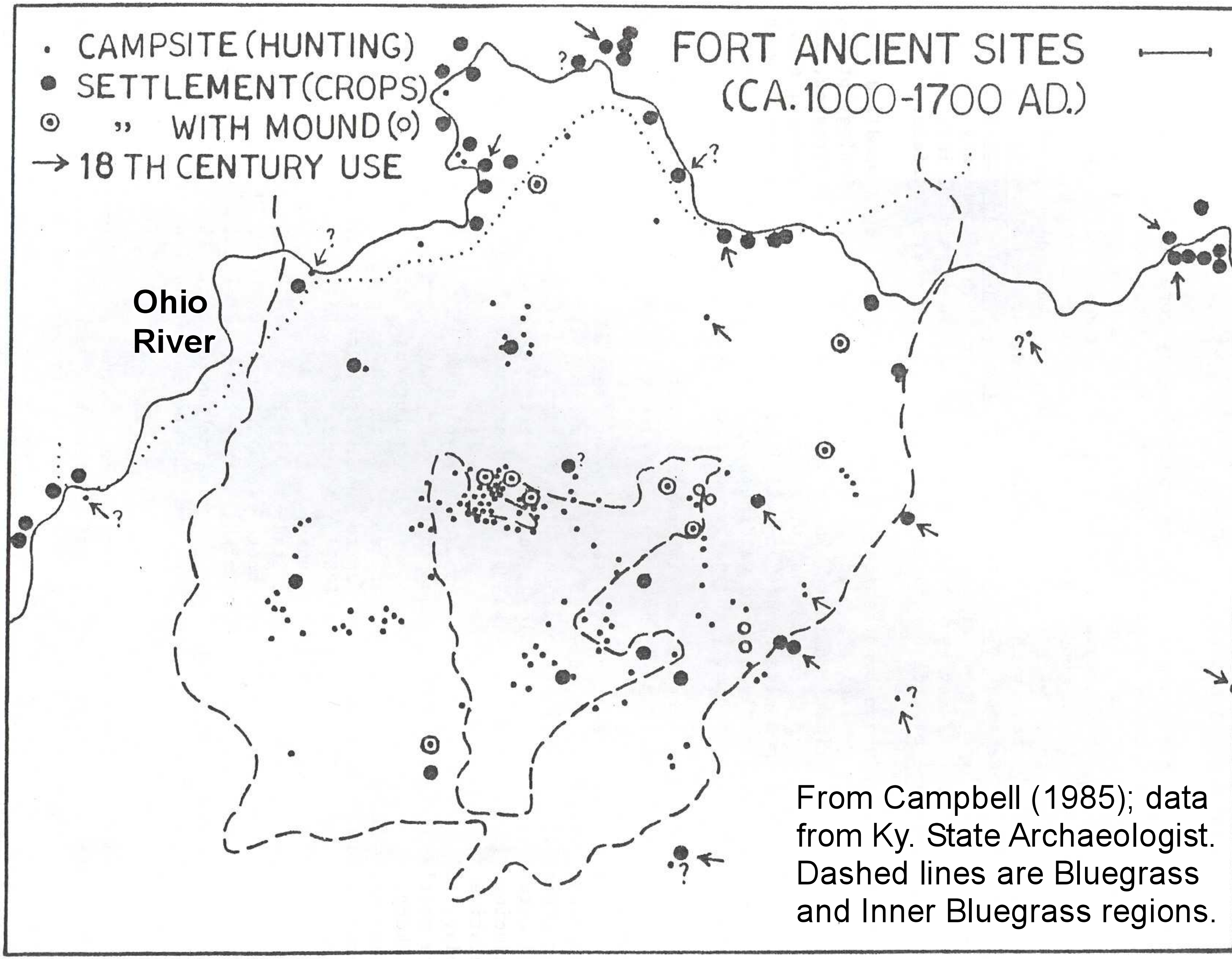
"Mosopelea" villages: closeup in Franquelin's 1684 map of Louisiana [Library of Congress at https://www.loc.gov/resource/g3300.ct000656/]. See Hanna (1911) for interpretation of upper "Chuc Agoa" as Tennessee River; but "Skipakicipi ou la Rivere bleue" may be Kentucky River.

Neo-Tribal Agglomeration? (sensible ecoregions)



These are approximate central locations of named tribes from DeSoto’s expedition in “Florida” to Boone’s explorations of Kentucky.

There is, however, considerable uncertainty about some tribes, especially where migrations occurred.



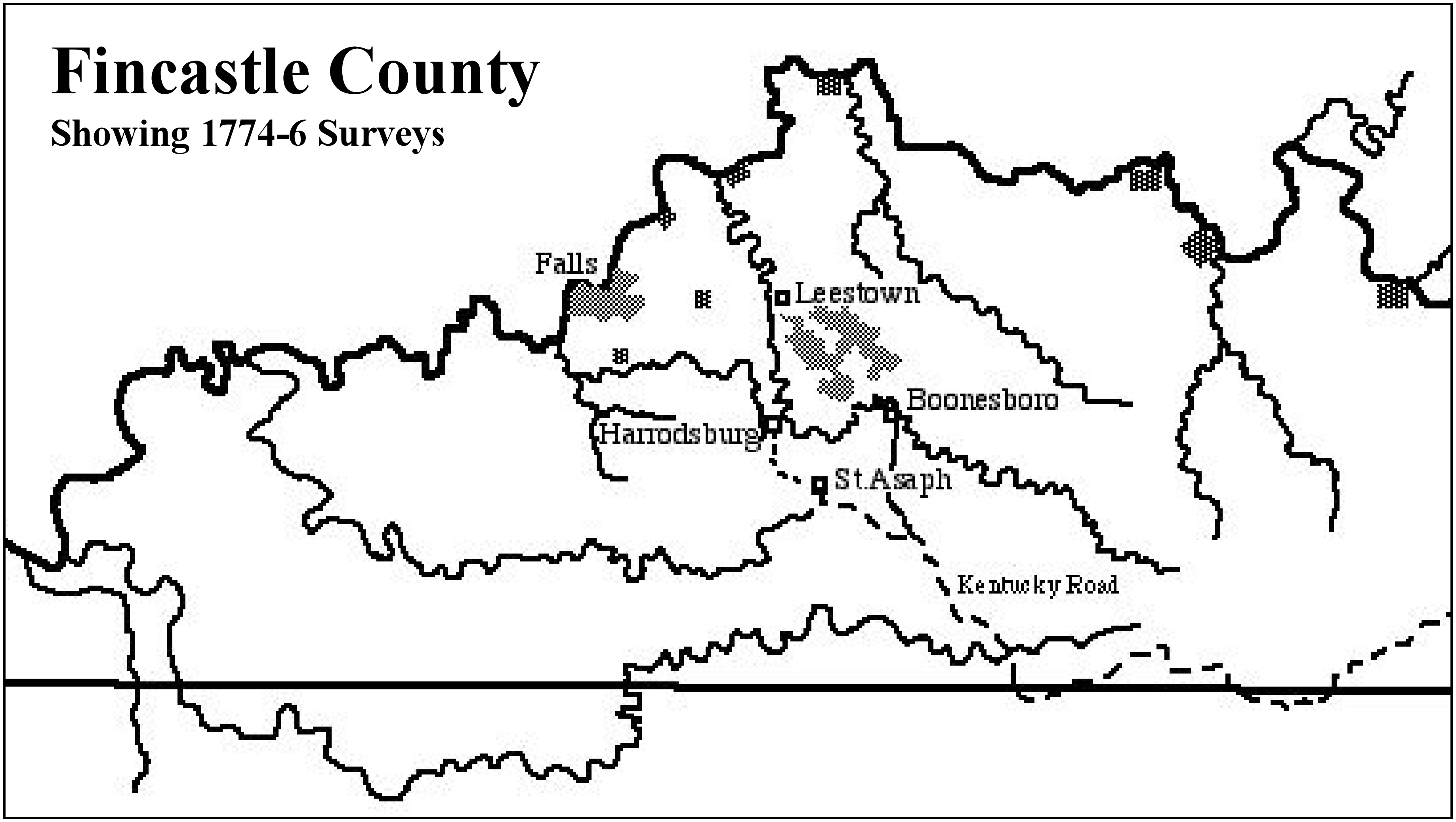
· CAMPSITE (HUNTING)
● SETTLEMENT (CROPS)
⊙ " WITH MOUND (○)
→ 18 TH CENTURY USE
FORT ANCIENT SITES
(CA. 1000-1700 AD.)
Ohio River
From Campbell (1985); data from Ky. State Archaeologist. Dashed lines are Bluegrass and Inner Bluegrass regions.

HUMANS: the post-Boonean rush to grab our best land in region

The first surveys of Virginians in Kentucky—then "Fincastle County" of Virginia—were made in 1774 to 1776. These were almost completely restricted to the "Falls of Ohio" area (later Louisville) and the "Plains of Elkhorn" (Inner Bluegrass), plus isolated settlements at Boonesborough, Harrodsburg and St. Asaph's (later Stanford). Based on estimates of Neal Hammon, early settlement during 1776 to 1796 continued to be strongly concentrated within the Central Bluegrass region, then subdivided into the counties of Fayette (Lexington), Lincoln (St. Asaph's), Madison (Boonesborough) and Mercer (Harrodsburg). Although Jefferson County was also settled very early, it retained a relatively small population—only about 3000 in 1789. Patterns of settlement and early surveys provide invaluable information about the original woods, due to records of "witness trees" marked at corners.

During the 19th Century, the state's counties became more subdivided, especially within the Bluegrass region. Kentucky is now the most subdivided state in the Union, with a mean area of only 337 square miles for its 120 counties. The second most countified state is Georgia, with a mean area of 374 square miles for its 159 counties; next come Indiana, Maryland, New Jersey, Virginia (not counting the independant cities as distinct counties), West Virginia, Tennessee, North Carolina and Ohio, with mean county areas of 390-510 square miles.

Although most of central Kentucky was cleared for farmland after settlement, much has grown back to woods, especially more hilly sections. Today, farmland and, increasingly, urban land, is strongly concentrated within the Central Bluegrass and less rugged sections of the eastern, western and northern Bluegrass. The Eden Shale Hills have become distinctly more wooded, as have the Knobs around the Bluegrass. Agriculture within the Central Bluegrass has become dominated by cattle and, on the best land, horses. Cultivation of grains and legumes has dwindled in this region since 1950, but it remains a major feature of the western Bluegrass.

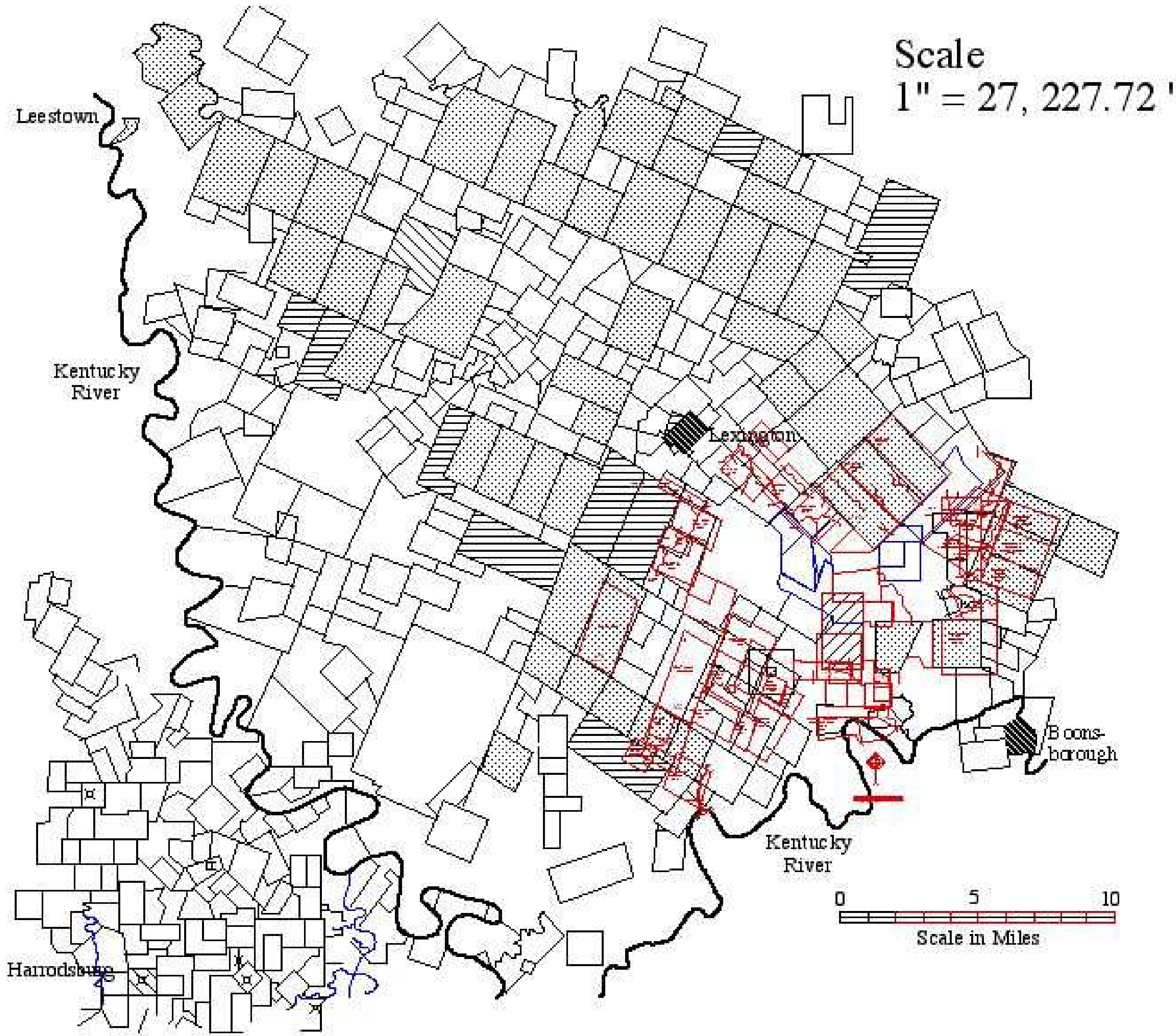


Map by Neal Hammon, posted at Kentucky Secretary of State website (with his other material) [http://www.sos.ky.gov/admin/land/resources/PublishingImages/HammonFincastleCounty.jpg]. Hammon (1972; and later papers) has documented many details of the initial settlement in Kentucky. Fincastle County of Virginia included all of what became Kentucky, except for the Jackson Purchase. In 1774 alone, over 150,000 acres were registered in plats. There were several attacks on the surveyors by Indians, mostly associated with the Shawnee tribe.

Virginia land surveys ca. 1774-88 in the central Bluegrass, plotted by Neal O. Hammon of Shelbyville, Kentucky.

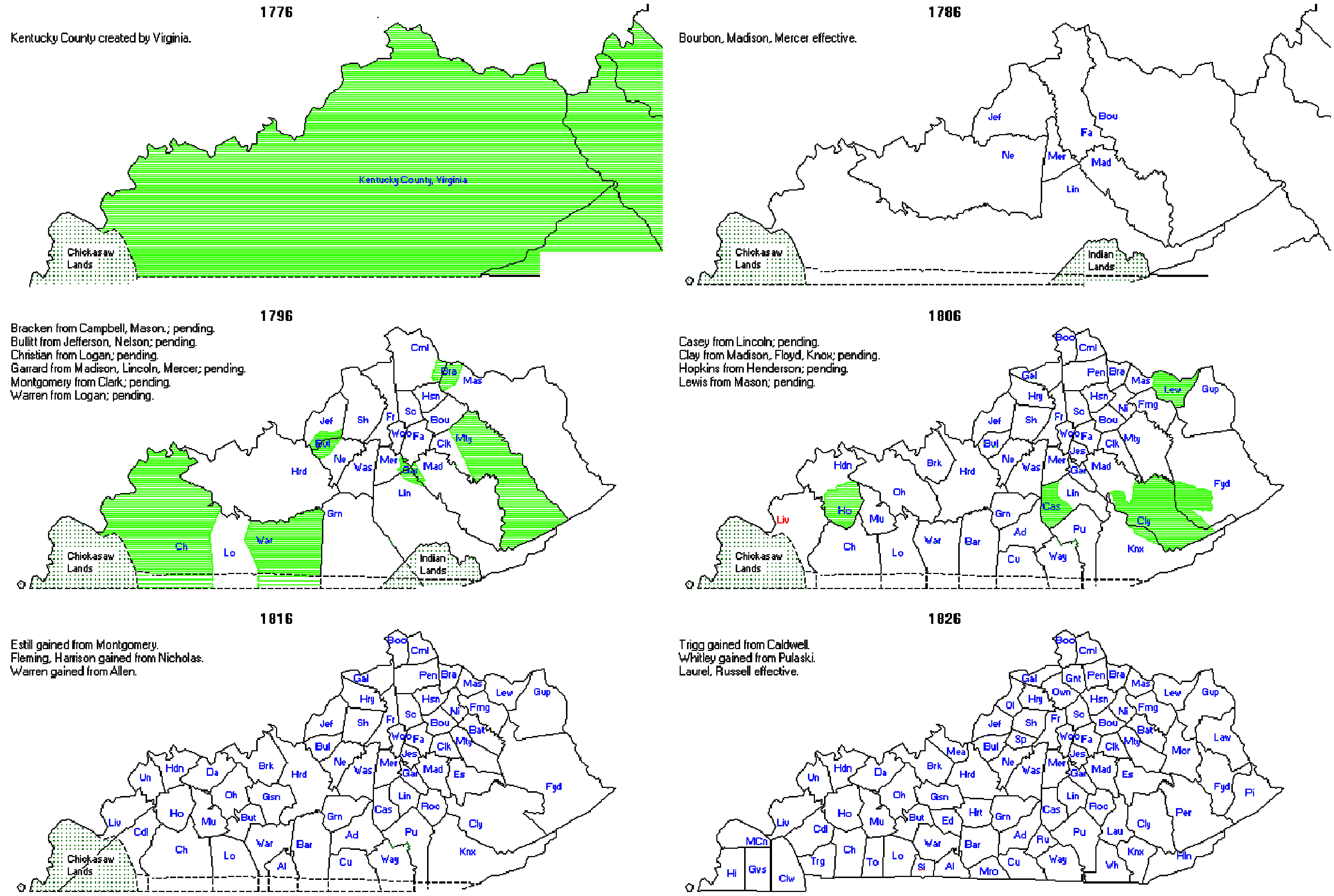
Tree data are available for each corner, and can be used to estimate the types of forest at different localities.

This is a goldmine for future work!



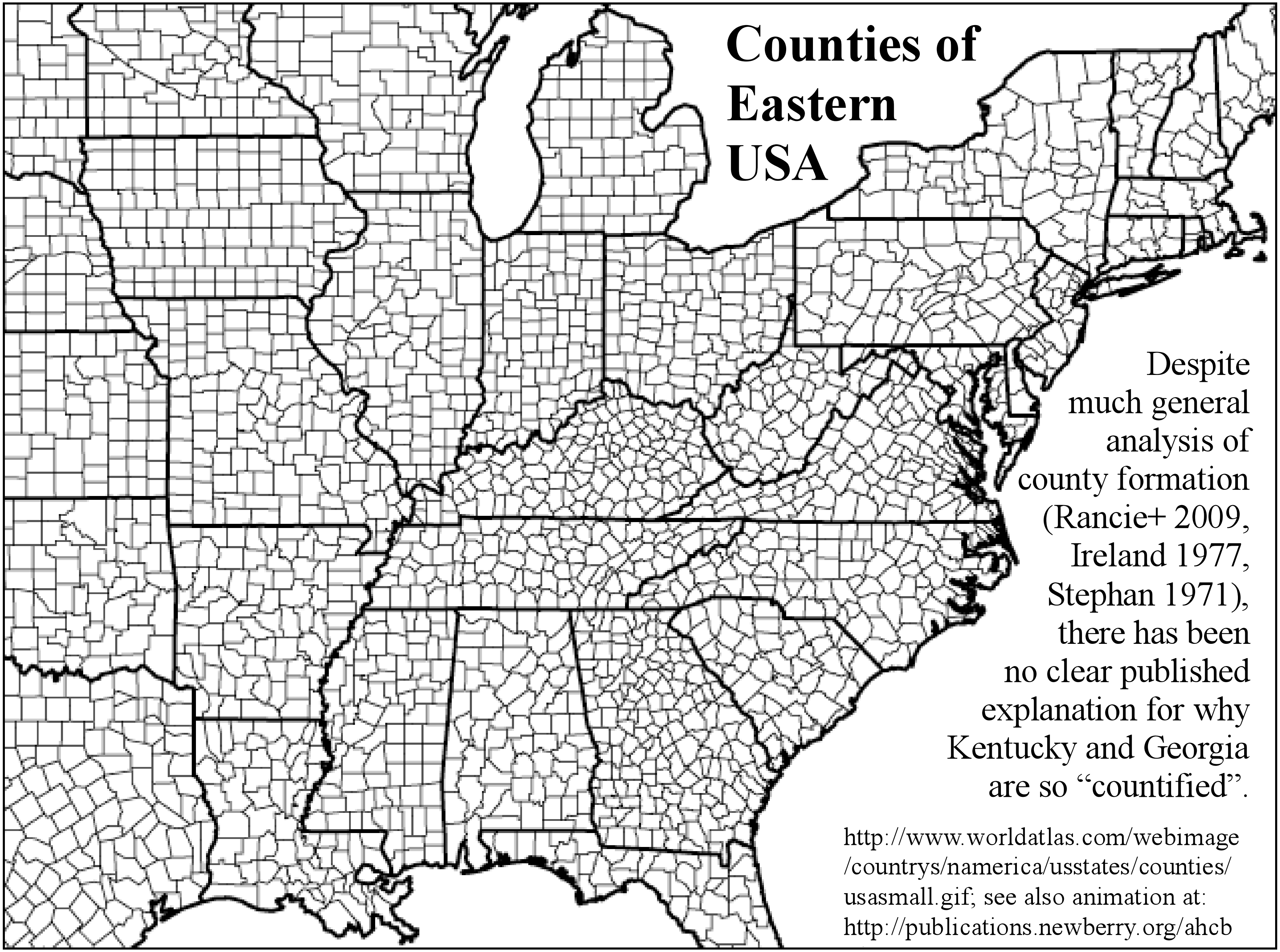
Estimated population of settlers in Kentucky; from manuscript by Neal Hammon (personal communication)

COUNTY	year	names	not taxed	plus w&c	blacks	total	% black
Fayette	1788	1424	284	6832	224	7056	3.28
Madison	1788	231	46	1108	81	1189	7.31
Jefferson	1789	560	112	2688	359	3047	13.36
Lincoln	1789	871	174	4180	502	4682	12.01
Mercer	1789	153	31	736	176	912	23.91
Madison	1792	1175	235	5640	499	6139	8.85
Wayne	1792	344	69	1652	121	1773	7.32
Campbell	1795	414	83	1988	115	2103	5.78
Franklin	1795	419	84	2012	707	2719	35.14
Logan	1795	684	136	3280	291	3571	8.87
Mercer	1795	1542	308	7400	1817	9217	24.55
Shelby	1795	698	140	3352	283	3635	8.44
Washington	1795	480	96	2304	382	2686	16.58
Mongomery	1797	282	56	1352	222	1574	16.42
Christian	1800	509	102	2444	262	2706	10.72
Knox	1800	180	36	864	53	917	6.13



Kentucky counties in 1776, 1786, 1796, 1806, 1816 & 1826; green = splits pending in year.
[http://homepages.rootsweb.ancestry.com/~george/countyformations/kentuckyformationmaps.html]

Counties of Eastern USA

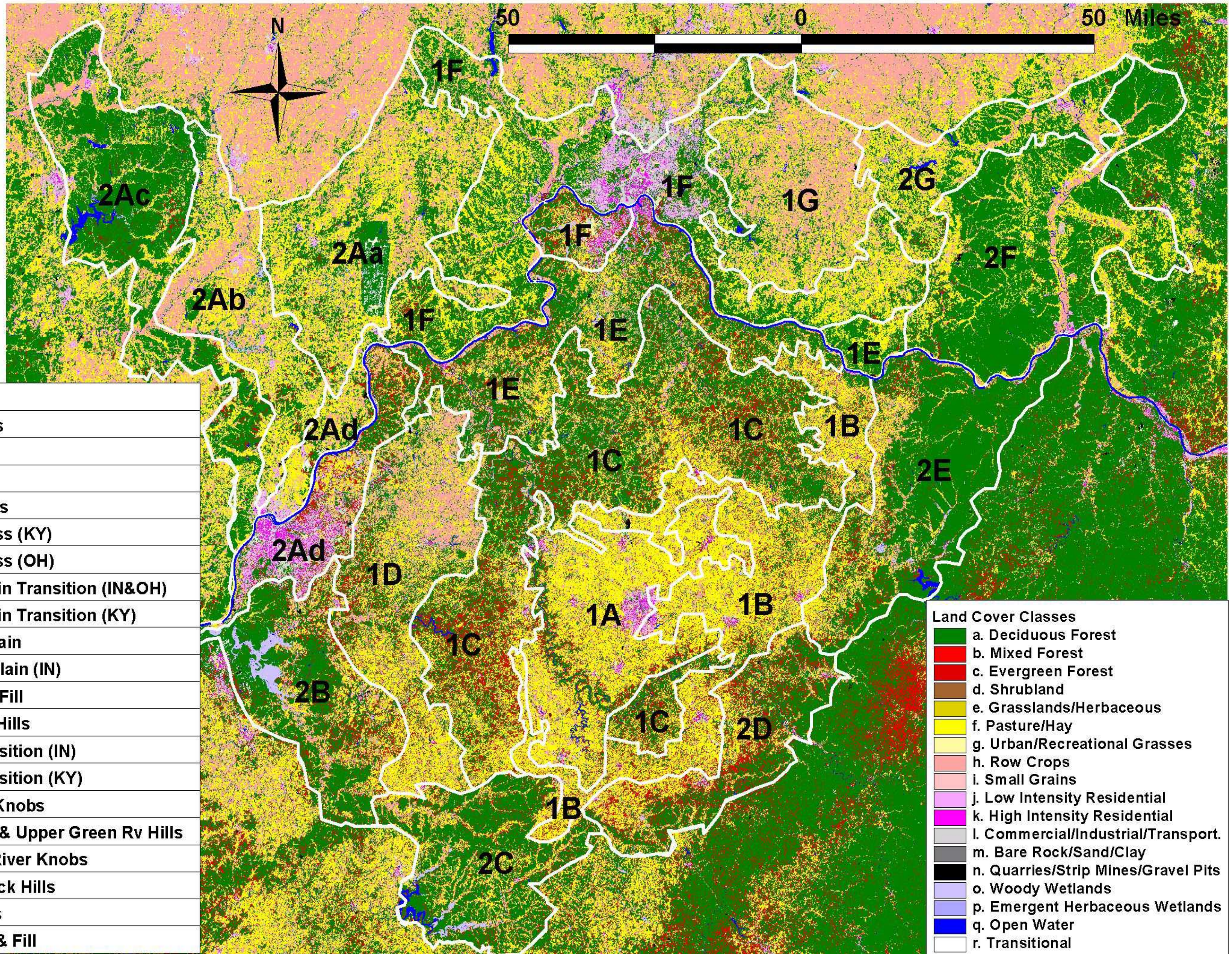


Despite much general analysis of county formation (Rancie+ 2009, Ireland 1977, Stephan 1971), there has been no clear published explanation for why Kentucky and Georgia are so “countified”.

http://www.worldatlas.com/webimage/countrys/namerica/usstates/counties/usasmall.gif; see also animation at: http://publications.newberry.org/ahcb

Central Ohio Valley subsections overlayed on land cover

Thanks to D. Zourarakis for preparing coverage from the 1992 NLCD data of USGS



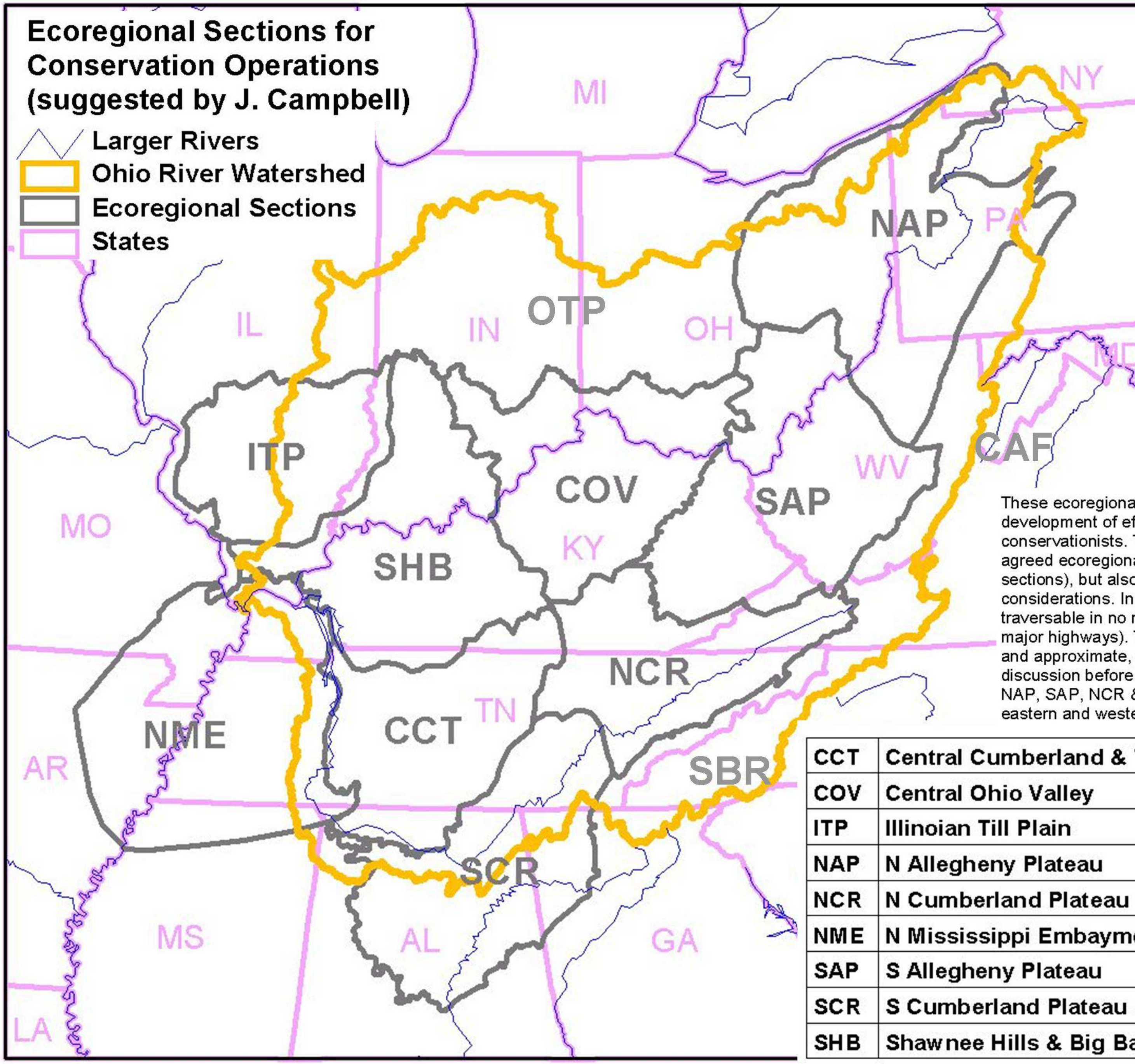
1A	Inner Bluegrass
1B	Eastern Bluegrass
1C	Eden Shale Hills
1C	Eden Shale Hills
1D	Western Bluegrass
1E	Northern Bluegrass (KY)
1E	Northern Bluegrass (OH)
1F	Bluegrass-Till Plain Transition (IN&OH)
1F	Bluegrass-Till Plain Transition (KY)
1G	Little Miami Till Plain
2Aa	White-Miami Till Plain (IN)
2Ab	White River Till & Fill
2Ac	Indiana Siltstone Hills
2Ad	Falls of Ohio Transition (IN)
2Ad	Falls of Ohio Transition (KY)
2B	Lower Salt River Knobs
2C	Rolling Fk Knobs & Upper Green Rv Hills
2D	Kentucky & Red River Knobs
2E	Licking-Kinniconick Hills
2F	Lower Scioto Hills
2G	Lower Scioto Till & Fill

Ecoregional subsections (as suggested by this author), overlaid on 1992 land cover classes. These subsections are based on diverse data plus practical convenience for planning.

ECOREGIONS: towards convenient coalescence of communities?

"Ecoregions"—or "natural regions" or subsections of "biomes"—have been defined in various ways to provide relatively uniform areas for planning conservation and other management of natural resources. Since they are essentially subjective summaries that take many distinct layers of information into account, there is no one right way to map them. During recent decades, The Nature Conservancy (2002) has included the Bluegrass region within the whole Interior Low Plateaus for planning. However, the ILP is too large for regular meetings and coordination among conservationists; annual meetings have never developed and there has been no update to the Conservancy's initial assessment. I suggest that the ILP can be usefully divided into three broadly defrined sections: Bluegrass, Shawnee Hills and Nashville Basin.

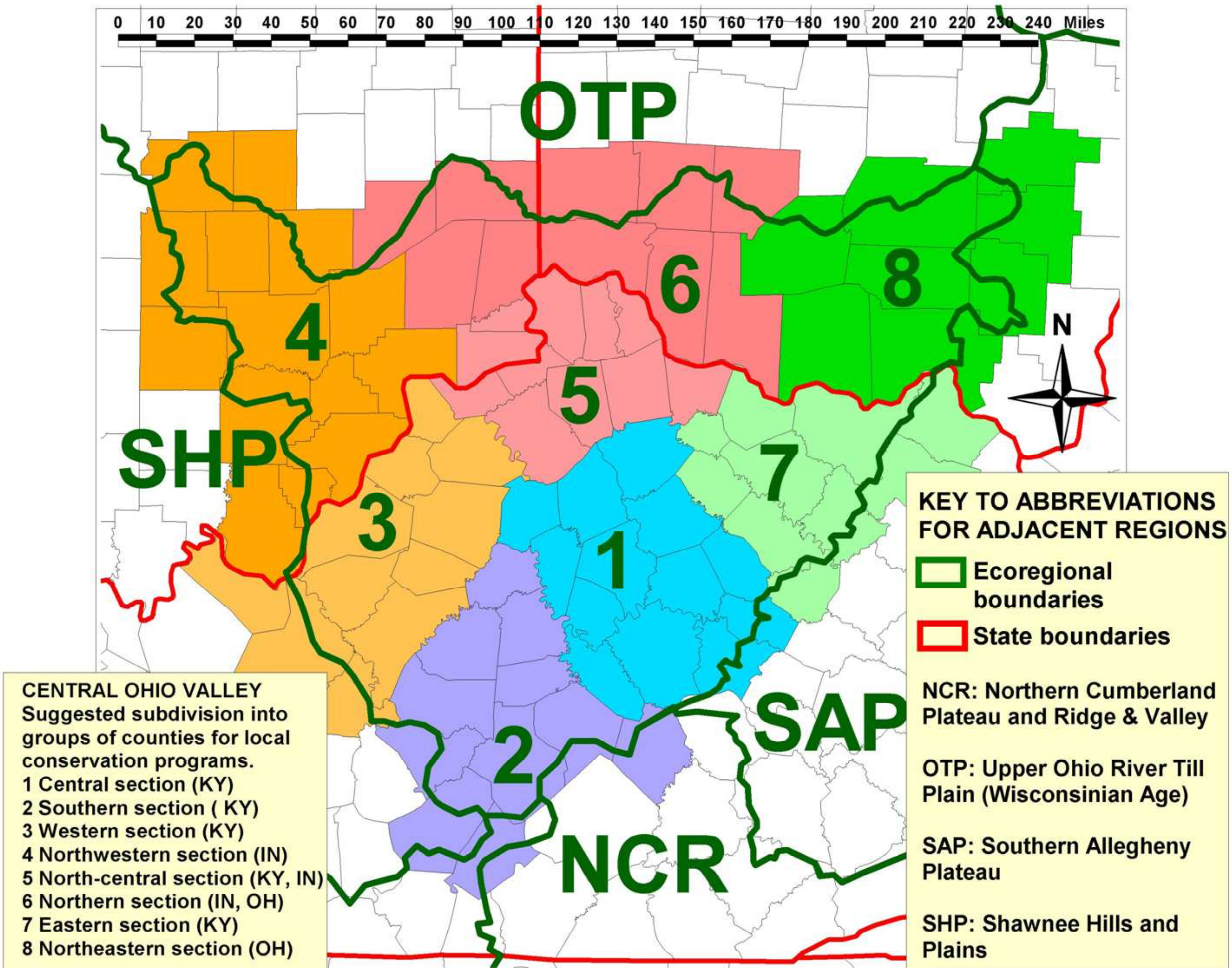
Due to inadequate data for many features, TNC (2002) stated, under "Future Plan Iterations...The Core Team will have the responsibility for ensuring that future iterations of the plan are completed on a periodic basis. It is reasonable at this point to expect that, given the gaps in data identified above, the next iteration of the portfolio should be done within 5-6 years. This proposed schedule would allow for the state offices to incorporate newly acquired data and revised priorities into their strategic planning as soon as possible. Following the next revision, future revisions may not need to be as frequent." No "core team" remains and no "next iteration" has occurred 15 years after initial assembly. But the plan did at least list some "Portfolio Sites" as priorities for the central Bluegrass. The largest were corridors along the Ky. River Palisades and the Licking River, including major concentrations of rare species. Smaller sites were mostly at least transitional to the Eden Shale Hills or Knobs: Blue Lick Glade*, Bluegrass Army Depot, Griffith Woods*, Mercer County Savannah, and a few scattered caves [*included in whole Licking River project area]. Since 2005, another important local effort has begun with the "Woods and Waters Land Trust" along the Kentucky River below Frankfort.



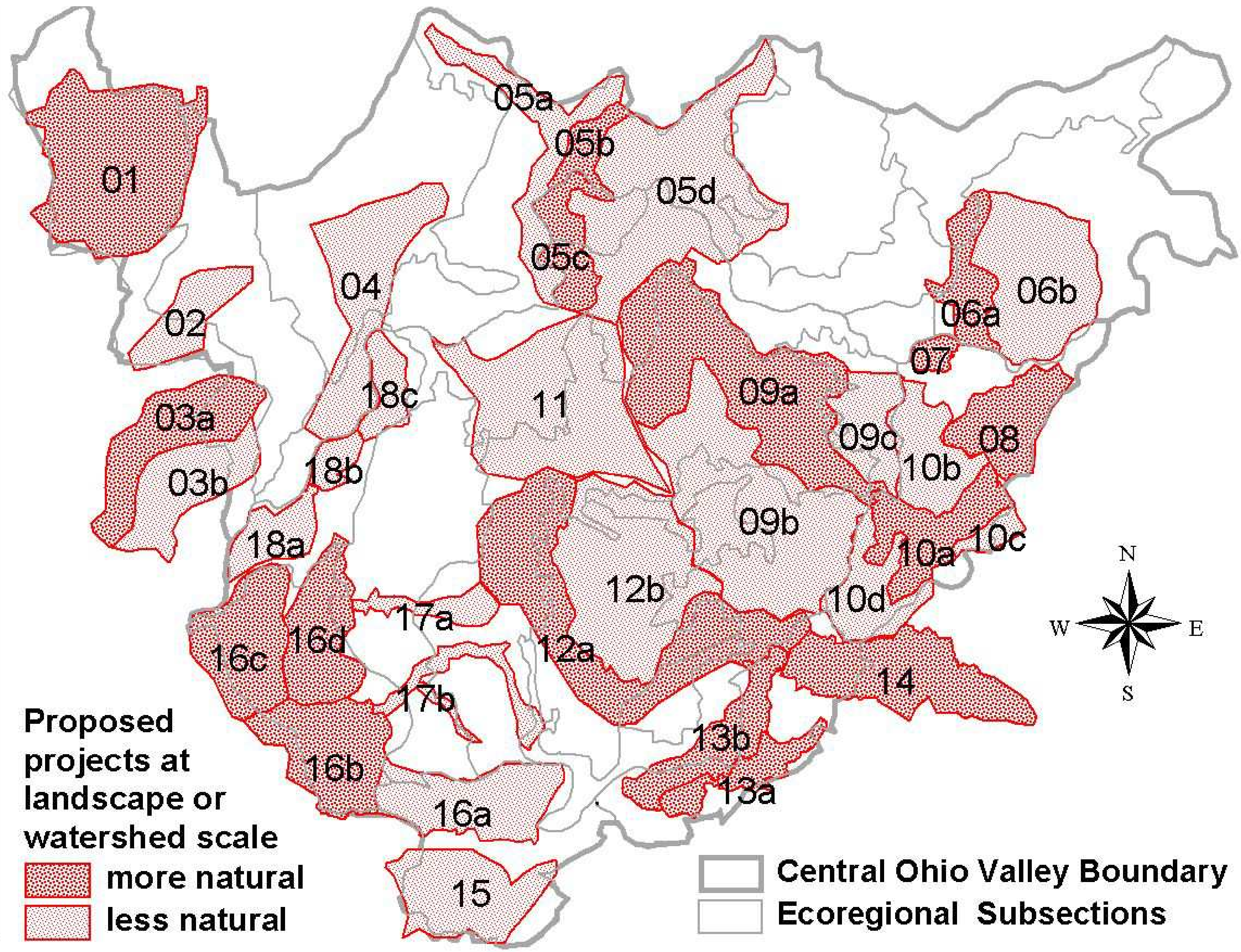
Peripheral Sections
CAF = Central Appalachian Forest (from TNC).
OTP = Ohio Till Plain; this is a provisional definition, excluding land north of the Ohio River watershed that can be reasonably included with regions around the Great Lakes.
SBR = Southern Blue Ridge (from TNC).

These ecoregional sections are proposed for development of efficient networks of cooperating conservationists. They are generally close to agreed ecoregional sections (or groups of sections), but also incorporate some practical considerations. In general, these should be traversable in no more than two hours drive (on major highways). The boundaries are provisional and approximate, and they deserve thorough discussion before implementation. For example, NAP, SAP, NCR & SCR might be subdivided into eastern and western sections for some purposes.

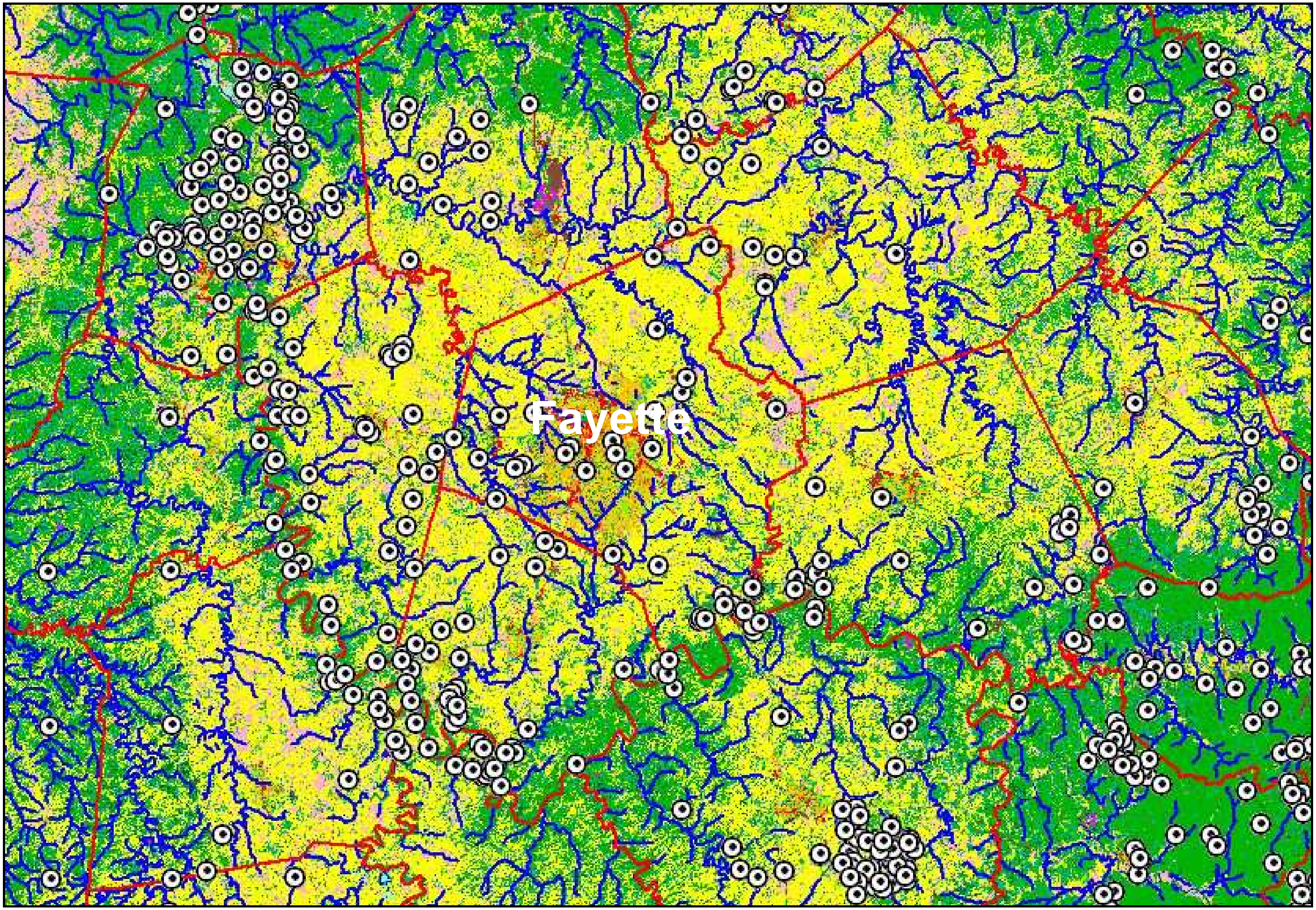
CCT	Central Cumberland & Tennessee Valleys
COV	Central Ohio Valley
ITP	Illinoian Till Plain
NAP	N Allegheny Plateau
NCR	N Cumberland Plateau & Ridge-and-Valley
NME	N Mississippi Embayment & Alluvial Plain
SAP	S Allegheny Plateau
SCR	S Cumberland Plateau & Ridge-and-Valley
SHB	Shawnee Hills & Big Barrens



0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 Miles
OTP
SHP
SAP
NCR
1
2
3
4
5
6
7
8
N
CENTRAL OHIO VALLEY
Suggested subdivision into groups of counties for local conservation programs.
1 Central section (KY)
2 Southern section (KY)
3 Western section (KY)
4 Northwestern section (IN)
5 North-central section (KY, IN)
6 Northern section (IN, OH)
7 Eastern section (KY)
8 Northeastern section (OH)
KEY TO ABBREVIATIONS FOR ADJACENT REGIONS
Ecoregional boundaries
State boundaries
NCR: Northern Cumberland Plateau and Ridge & Valley
OTP: Upper Ohio River Till Plain (Wisconsinian Age)
SAP: Southern Allegheny Plateau
SHP: Shawnee Hills and Plains



Larger focal areas proposed for conservation projects; part of a broader regional summary.
12b = Ky. Rv. Palisades; 09b = South Fk. Licking Rv.; 13b includes Bluegrass Army Depot



Central Bluegrass: dots are rare species locations in Natural Heritage Database; blue = streams; green = woods; yellow = pasture; orange = urban land; red = county boundaries [ky4001sp.bil]

PALISADES: hope or illusion of conservation along these bluffs?

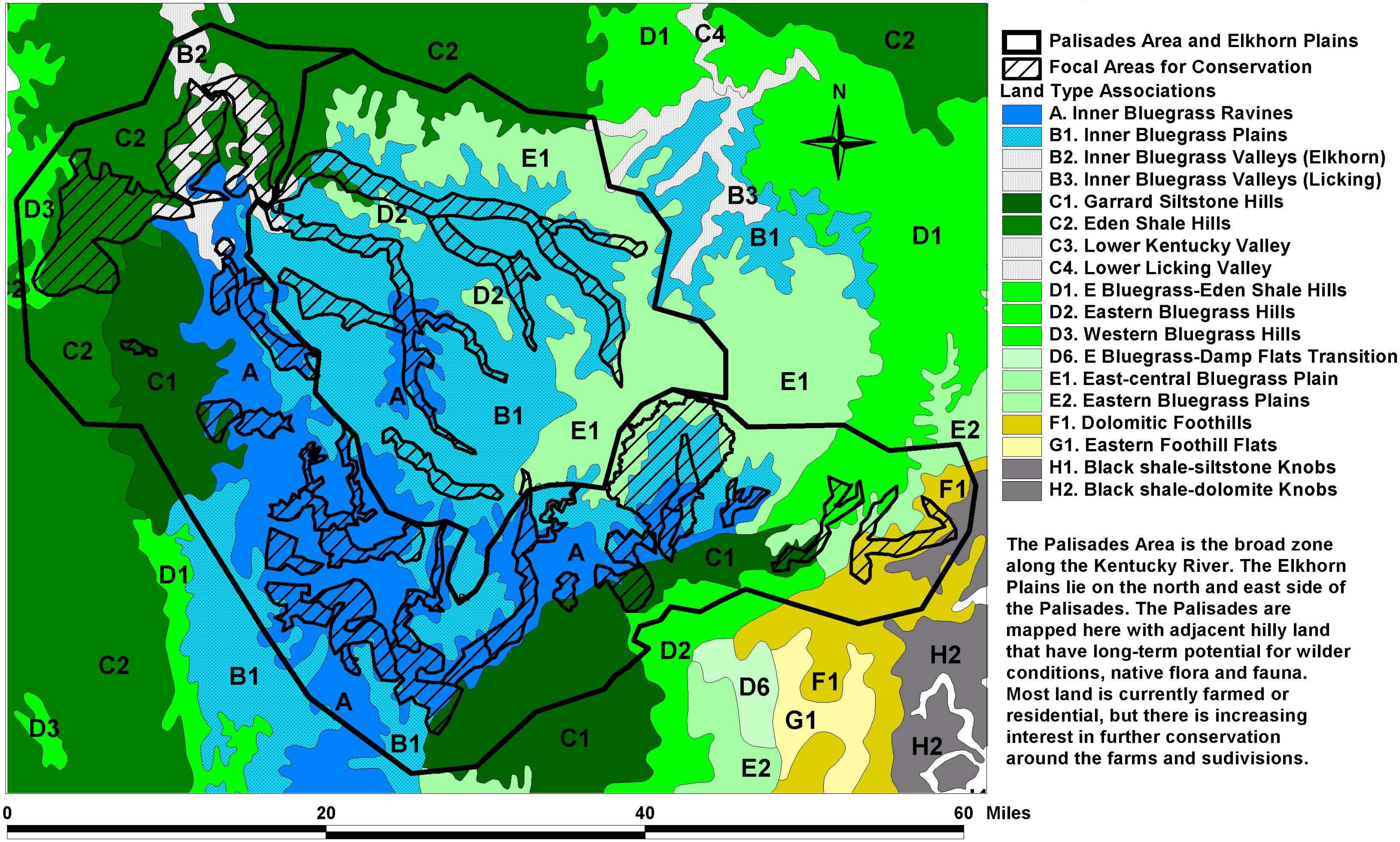
Jillson (1924) first suggested that conservation should be implemented here. This area is defined to include all rugged corridors along the Kentucky River and its tributaries within the region. Diverse tracts are owned or managed with conservation in mind, but the current status of any cooperative effort is unclear. Although there have been scattered efforts, more teamwork and shared goals would be useful. Major problems for management are: (1) how to reduce invasion of alien plants into woodland (especially bush honeysuckle, winter-creeper, garlic mustard); and (2) how to restore adjacent fields towards some reasonably natural condition.

Simple protection of land at large scales ensures much conservation for common habitats in this area—the most significant calcareous ravine system within the Interior Low Plateaus. But some habitats need special attention since they are much less common or have more critical threats: especially remnants of white oak woods on adjacent uplands; also, woodland types that used to be kept open by browsing or other disturbance; caves; and sections of rivers or streams with more natural flooding regime. Also, even after protection of land and restoration of habitat, many species deserve micromanagment for recovery (to be discussed in Part IV): especially rare plants of dry or disturbed phases in the woodland, bats, and some aquatic species.

Optimal management of vegetation is still not generally agreed. Further synthesis of historical data would greatly improve our collective picture of the original landscape, and further comparison of experiences from different managers would improve our ideas about what is best for the community. Effective conservation may, paradoxically, depend on productive working relationships with neighbors in farms and residential areas. Due to their proximity, knowledge and appreciation of the area, these people could ultimately form the core of support for conservation. And their interests should be central to resolving hard tradeoffs in planning any new infrastructure along the river, or perhaps even taken some out—one dam?

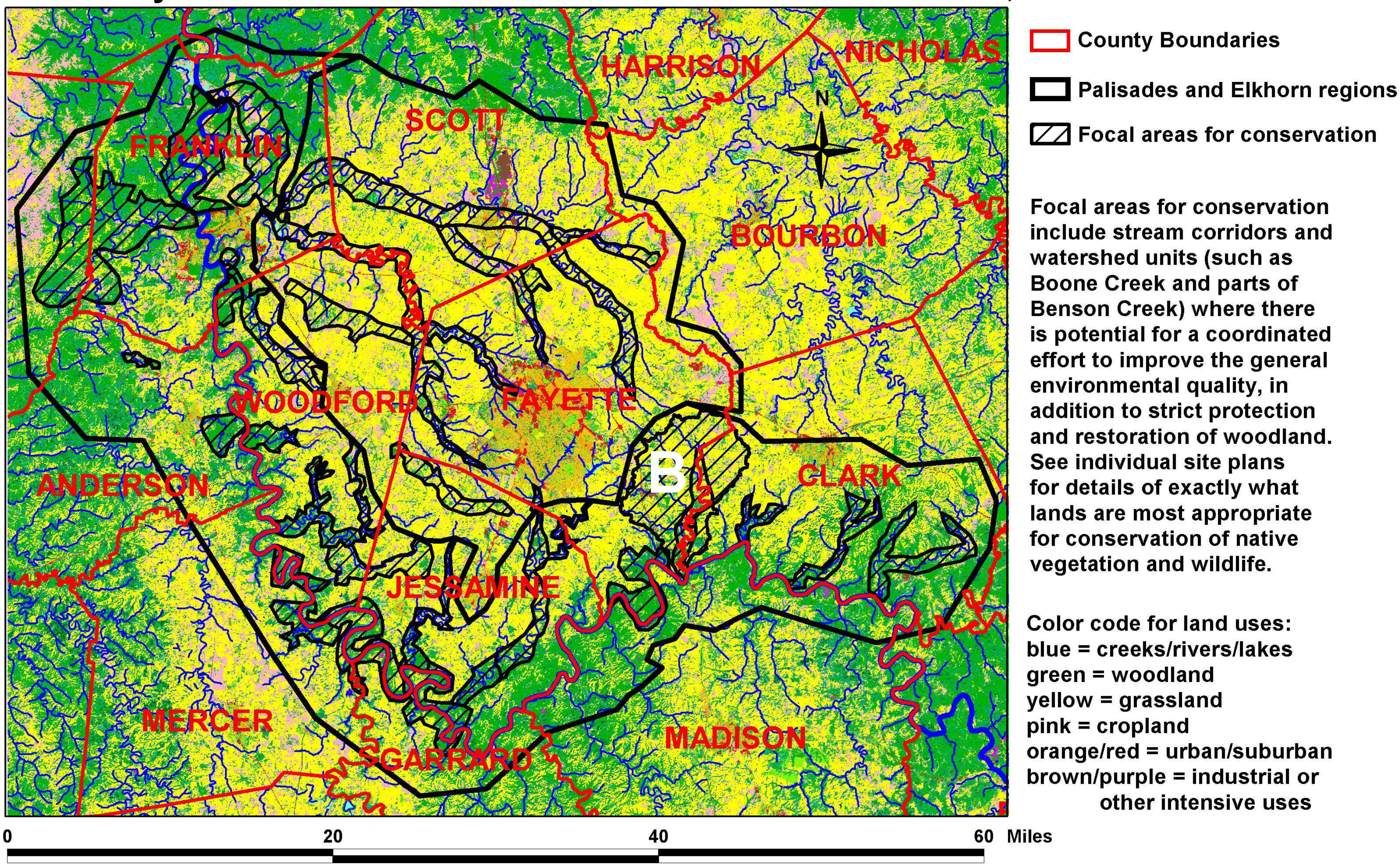
The Palisades offer hope for conservation but looks can be deceiving—problems here are great [cover of booklet posted at http://www.bluegrasswoodland.com/uploads/Palisades_Notes.pdf].

Kentucky River Palisades and adjacent Elkhorn Plains: Land Type Associations



Focal areas for conservation (cross-hatched) along Kentucky River Palisades and on the Plains of Elkhorn. On the Plains, natural systems are highly degraded or essentially gone, but there is much interest in restoring water quality and native vegetation.

Kentucky River Palisades and Elkhorn Plains: Land Uses, Counties and Streams



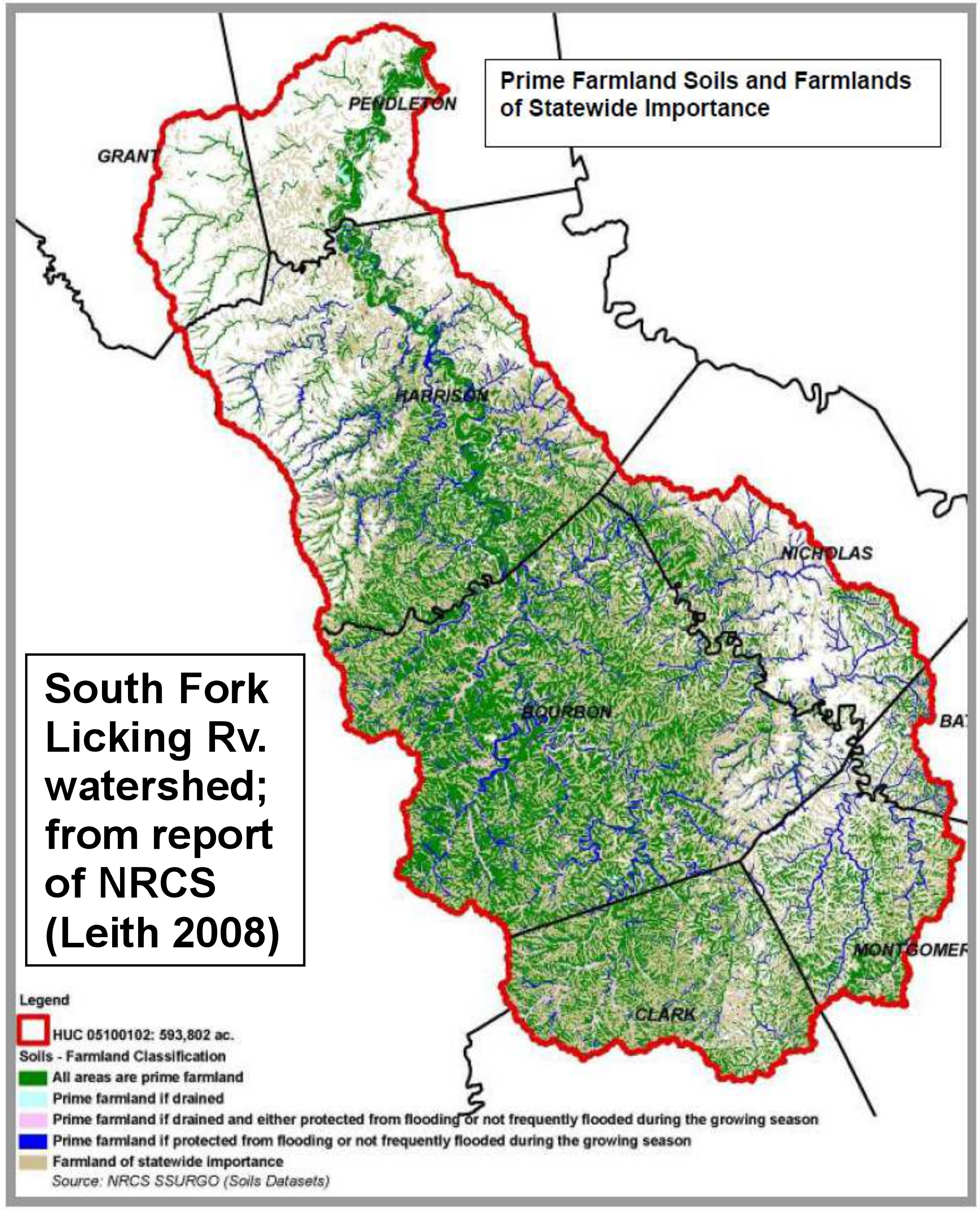
The Palisades area includes connected forest along the river between Boonesborough and Frankfort, but these corridors that are mostly just 0.5-1 mile wide.. The whole Boone Creek watershed (B) is outlined here since it has superior water quality and much historic interest

SOUTH FORK LICKING RIVER: not dammed but polluted!

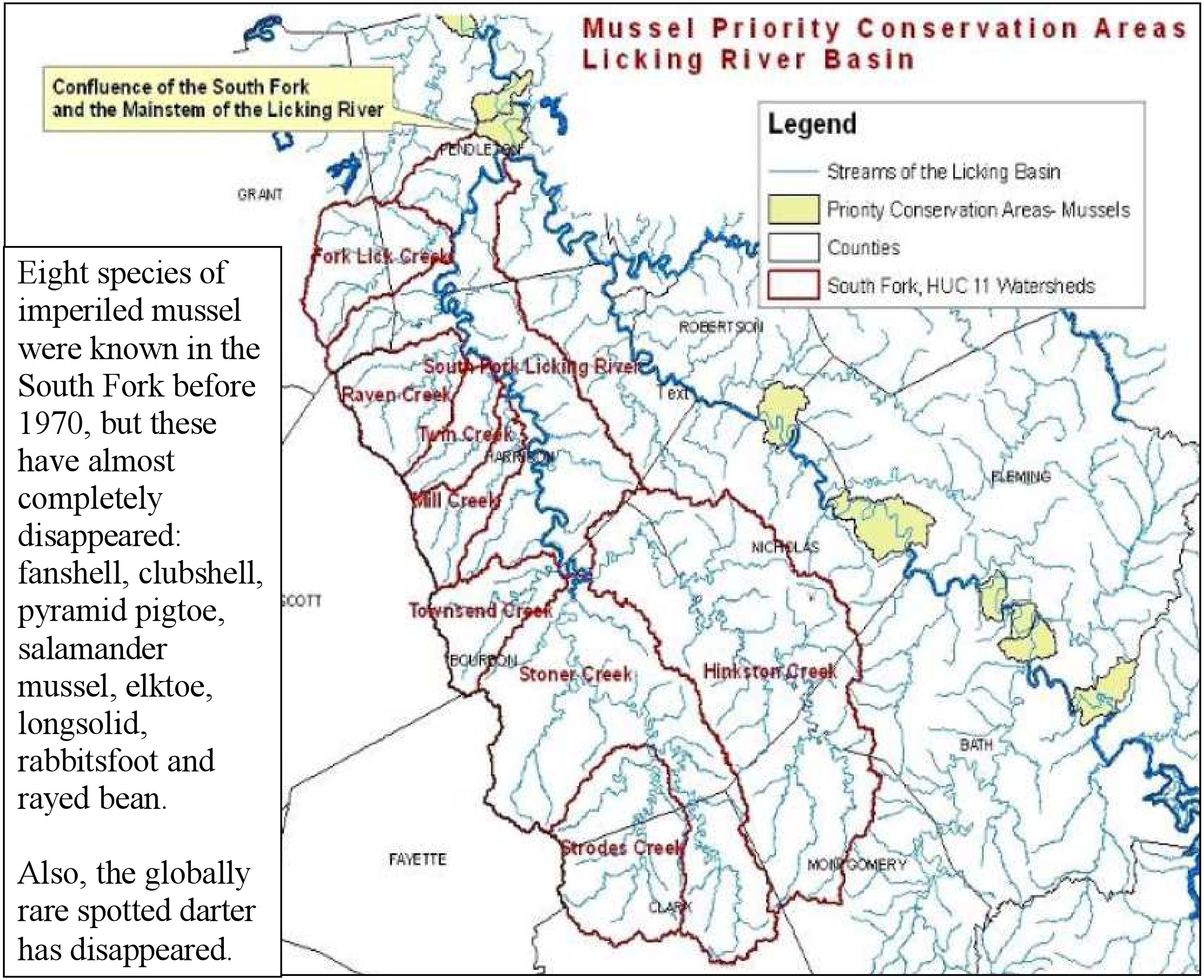
The whole Licking River system still has some significant features, including many fish species (with the rare muskellunge in lower sections), and more than 50 species of freshwater mussels, 11 of which are endangered. However, the South Fork drains from the Central Bluegrass where pollution from intensive farming is a major problem, and rare species have been generally eliminated. Government agencies and non-profits (especially TNC) are working with landowners to improve conditions. For example, TNC's most recent effort in the watershed involved working with Harrison County to secure a State and Tribal Wildlife Grant from the Ky. Dept. of Fish & Wildlife for replacing a low head dam with a bridge on one of the river's tributaries. The project returned a portion of the stream to its natural flow, aiding species migration and benefiting a downstream mussel bed harboring the endangered Fanshell mussel. Replacing the dam provides conservation benefits, a safer crossing for motorists and eliminates the need for removing debris after flood events. The Conservancy has also focussed on the 11,000-acre Townsend Creek watershed, fencing several riparian areas and planting forest buffers in order to reduce heavy sedimentation, pathogens in the water and nutrient overload.

A few tracts of land along the river have been acquired for conservation or protected with easements. In addition, the old-growth at Griffith Woods was partly protected by TNC but then resold to Ky. Dept. of Fish & Wildlife. Unfortunately, we still do not have a good cooperative basis for using this 745 acre site to experiment with different methods of restoration, to demonstrate results for the public, and to propagate the native species we need across the region. It would be useful to realize initial plans for a nursery at the farm. Griffith Woods provides our best opportunity to restore something like the original woodland of the Central Bluegrass, and it deserves more support from interested people. It is especially important to revive regular field trips for the public to appreciate and understand this fascinating site.

The State of Kentucky (Wood et al. 1998) and USDA-NRCS (Leith 2008) have produced good summaries of problems for conservation in the South Fork of Licking River watershed. Relevant data on water quality are collected by state employees and some volunteers (especially Ky. Watershed Watch). There is no regular comprehensive published analysis of monitoring in this watershed. However, 2.9 miles of Townsend Creek (Bourbon Co.) was removed from Kentucky's list of "impaired waters" in 2012. This improvement is attributed to a 2003-2005 grant of $1.5 million from the EPA (section 319); The Nature Conservancy was the primary coordinator for implementation.



South Fork Licking Rv. watershed; from report of NRCS (Leith 2008)



Eight species of imperiled mussel were known in the South Fork before 1970, but these have almost completely disappeared: fanshell, clubshell, pyramid pigtoe, salamander mussel, elktoe, longsolid, rabbitsfoot and rayed bean.

Also, the globally rare spotted darter has disappeared.

Griffith Woods is part of the 745-acre farm now growing up at center of this 2014 view.

BLUEGRASS ARMY DEPOT: a curious military accident

This is a U.S. Army storage facility established in 1941 for conventional munitions and chemical weapons, located in Madison County southeast of Richmond. The 14,500-acre site is composed mostly of open fields and wooded areas, but with scattered structures used for munitions storage, repair of general supplies, and the disposal of munitions. Much of the area has been used for intensive pasturing of cattle until the 1990s, when animals were reduced due to effects on water quality. It was discovered then that the site supports a relatively large population of the imperiled plant species, running buffalo clover, and further biological surveys have revealed several other rare to uncommon plants (*Carex vesicaria, Dryopteris carthusiana, Orbexilum onobrychis*, etc.) and birds. The woodland is fairly diverse; also, there are some patches of cane and, on less fertile soils transitional to foothills of the Knobs, there are some remnants of native grassland.

The site could become a base for restoration of native vegetation in the region, and Eastern Kentucky University has conducted several useful studies here during recent decades. However, its military uses and the degradation of its more natural remnants present challenges. Security has to be strict, and no photography is generally allowed. Perhaps for such reasons, the Army has not encouraged much open discussion about future plans for the site, except as forced to, politically, by the highly controversial issues around chemical munitions. Yet careful long-term research could be established here to examine some critical questions. For example, we could learn much more about how the clover responds to deer versus cattle. The clover declined greatly after cattle were reduced, and it survives mostly where impacts of deer or cattle are most intense. In contrast, prescribed fire has been used for maintaining the remnants of native grassland, which occur on generally drier or poorer soils to the south or east, above the stream corridors with clover. TNC has also proposed that programs here could be linked to those in adjacent foothills of the Knobs.

Bluegrass Army Depot covers 14,500 acres at center of this 2013 view; Richmond to NW.

The most extensive woods at BGAD.

Typical view from outside the fence at Bluegrass Army Depot. For this picture and some good local commentary by Rachel Alexander, see her “Bricks + Mortar” notes from Aug 28, 2012 [posted at https://bricksandmortarpreservation.wordpress.com/tag/kentucky/page/11/].

CONCLUSION: For where is cooperative planning best made?

As summarized above, there are three obvious large focal areas for restoration of more native vegetation within the Central Bluegrass: Palisades Corridor, South Fork of Licking Watershed, and Bluegrass Army Depot. However, many other degraded stream corridors and woodlots can become favorite places for restoration by devoted citizens. For example, at the heart of urban problems in Lexington, we have a highly successful non-profit, “Friends of Wolf Run”, that is implementing much slow small-scale work in this challenging watershed.

Although there are common problems in conservation across this relatively homogeneous region, we lack effective dialog, shared goals, and resolution of differences. The segmentation of varied human interests—into engineering, water, woodland, grassland, hunting, recreation and other subjects—is often hard to overcome, as alluded to by Wendell Berry in his 2000 book, “Life is a Miracle”. There are indeed occasional meetings called for selected “stake-holders” in projects, but it is rare to have relevant public meetings about general goals for conservation across the region. Serious differences in approach do exist, as in how to manage old fields along the Palisades, how to restore old growth at Griffith Woods, how to spend money along Cane Run (see bluegrasswoodland.com), or what plants are to be promoted as “Native” It is important to address these differences, not just for deeper professional understanding, but also to educate the public.

A most fundamental human process for progress here is still not realized—an annual meeting to compare experiences and promote cooperative work across the region. The Land and Nature Trust of the Bluegrass used to offer such vision, but it was retired after other organizations adopted selected aspects of conservation-related work in the region. The next page presents a potential format for setting goals in cooperative planning. Such an approach is essential for developing shared goals and transparent accountability among partners.

Potential format for goals in cooperative conservation planning in the Palisades area. This is merely a suggestion for how meaningful goals could be established and followed. TNC initiated planning of this type in the 1990s, but it has not led to a 'big tent' for partners. No written report is available to measure success versus failure, and costs versus benefits.

Suggested Targets	Condition ► Goal	Primary Problems	Primary Solutions	Progress to 2012
1. 100,000+ acres of protected woods within protected farmland	Fair ► good with 100+ years of more development	Lack of public funds; Lack of local support? Lack of coordination?	Persist in coordinated effort with clear public goals, resolving conflicts	A few 1000 acres now protected, but long-term unclear
2. Extension of oak-hickory woods onto uplands beyond cliffs	Poor ► fair with 100+ years of further work	Lack of understanding? Value of farmland and conversion to housing	Conversion of fields to woods; propagation and planting of native trees	Little or none; some initial experience in Camp Nelson area
3. Management of selected areas with browsing or burning	Poor ► fair (?) with decades of applied research	Lack of understanding! Lack of interest in browsing woodland	Initiate long-term research on effects of browsing and burning	Little or none; but much could be learned from TNC
4. Sensitive sections of karst or stream systems (caves, ponds, riffles)	Poor ► fair (?) with a few decades of focussed effort	Lack of site-control; Past disturbances from vandalism, pollution etc.	Use governmental funds and regulations to protect site	Some success in caves; little or none in ponds, riffles
5. Regionally imperiled plants of dry or disturbed woodland phases	Poor ► good with a few decades of recovery	Lack of understanding! Lack of inventory Lack of propagation	More detailed inventory, research, propagation and trials in recovery	Little or none except for small-scale or private efforts
6. Bats	Poor ► fair (?) with decades of applied research	White-nose syndrome; Disturbances of wintering or maternity colonies	Develop plan in coordination with national efforts	Some protection and recovery of populations but WNS...
7. Selected aquatic species that have disappeared from streams	Poor ► fair (?) with decades of applied research	Past/continuing damage to habitats; lack of research, in vitro growth	If suitable habitat can be restored, conduct in vitro trials, reintroduction etc.	None; but potential for in vitro is well established

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