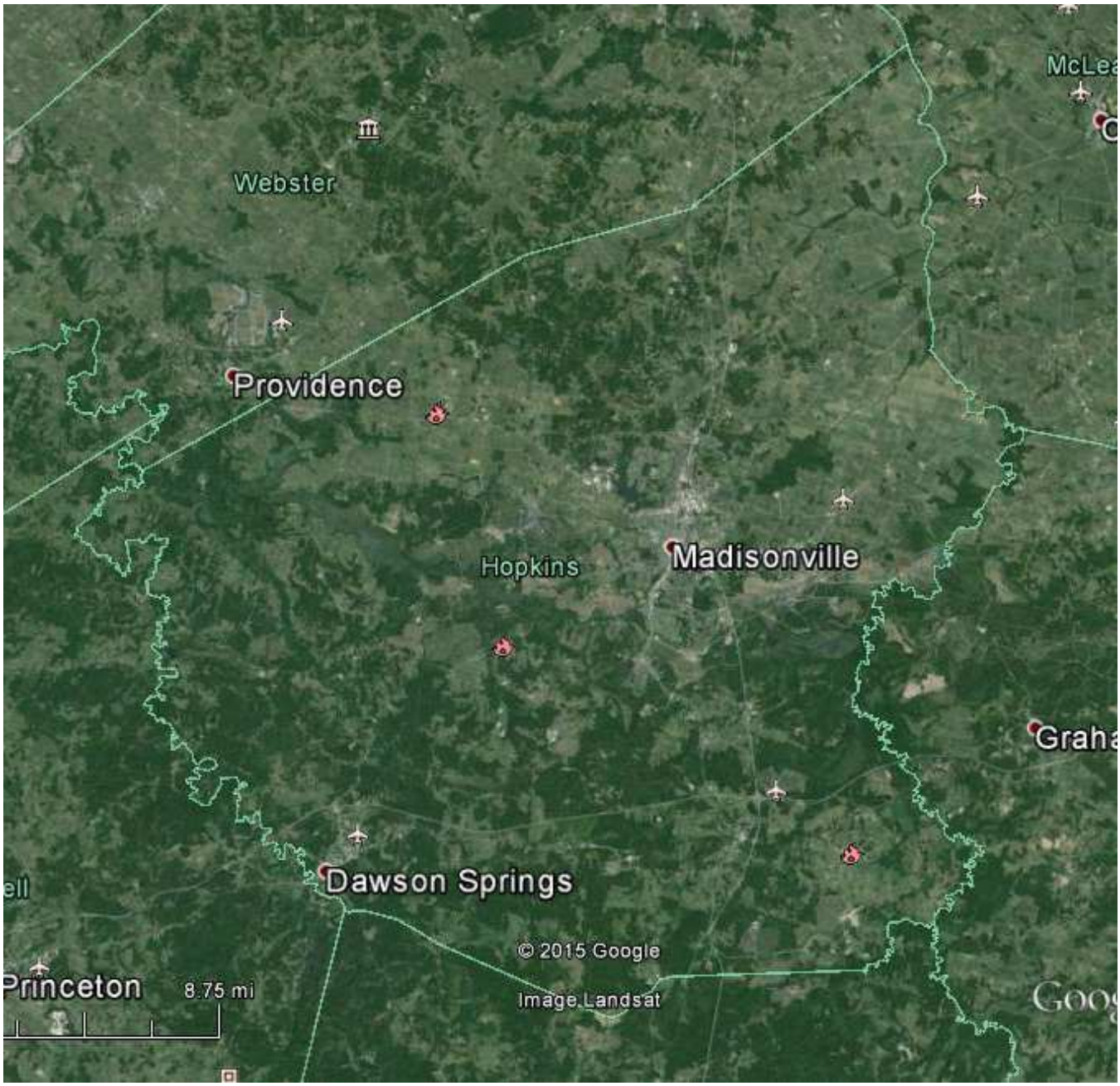
Campbell, J.J.N., & J. Grubbs. 1992. Natural plant communities of Hopkins County, Kentucky. Transactions of the Kentucky Academy of Science 53: 29-38.

Errata

p. 30 & 35: *Carya illinoensis* should be spelled *C. illinoinensis*.
p. 34: *Aureolaria laevigata* was probably *A. flava* var. *macrantha*.
p. 35: *Phlox pilosa* was *P. pilosa* ssp. *deamii*.
p. 35: *Carex gravida* was *C. muehlenbergii*.
p. 35: *Carex projecta* was *C. sangamonensis*.



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Natural Plant Communities of Hopkins County, Kentucky

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ABSTRACT

A survey of Hopkins County was conducted in order to characterize the natural plant communities and to find the best remaining examples. This effort relied on aerial photographs, aerial reconnaissance, and field trips to selected sites. Vegetation patterns are interpreted in relation to Soil Conservation Service data. Species composition is outlined for each community, including reference to rare species. Some classification problems are discussed.

INTRODUCTION

This study is part of the ongoing effort by the Nature Conservancy and Kentucky State Nature Preserves Commission (KSNPC) to identify the best remaining examples of different natural ecosystems in the state. Variation in plant communities is receiving special attention. The inventory is progressing county by county, with the intent of completion in the next 5–10 years. The wetlands of Hopkins County are among the largest in the state; several have been studied previously by Harker et al. (1, 2). In the survey reported below, some of these wetlands were revisited, and uplands were also explored. The results indicate what plant communities exist in the county, and what sites deserve most urgent conservation action.

Human disturbance and destruction of natural vegetation in Hopkins County has increased greatly in the past few decades. Most of the flatter uplands have been farmed for over 100 years, but large bottomland areas remained forested until clearance and drainage accelerated after 1950. On the Pond and Green river bottoms, in particular, more than 10,000 acres (4,000 ha) were forested in the 1950s, but at least 75% has now been converted to cropland (see USGS Topographic Quadrangles and KSNPC aerial photographs). The other major disturbance is strip-mining for coal, which has removed over 10% of the natural soils (3), and has caused much sedimentation and pollution in the wetlands.

In addition to describing some of the best remaining natural areas in the county, this report discusses apparent ecological relationships, with special attention to wet and dry extremes, and possible seasonal fluctuations. Understanding the causes of variation in natural vegetation will help in developing a truly ecological (functional) classification, in selecting the best examples, and in implementing management for conservation.

The Study Area

Hopkins County lies entirely within the Shawnee Hills, in its strictest sense, which has also been called the "Western Coal Field" in Kentucky (4). The bedrock is all of Pennsylvanian age, consisting of shale, siltstone and sandstone with minor amounts of coal and limestone (USGS Geological Quadrangles). Overlying most of these gently rolling hills and broad valleys is a mantle of loess, i.e., calcareous silt blown in during glacial eras from large river valleys to the west. Probably due to this loess (3), most soils are only moderately acid (alfisols), in contrast to the Appalachian Plateau soils on similar bedrock (ultisols). The northern half of the county lies among less rugged hills, where uplands are mostly on Upper Pennsylvanian rocks, with less extensive sandstone. Loess deposits tend to be thicker in the north, and upland soils are mostly somewhat poorly drained (fragiudalfs) as opposed to well-drained (hapludalfs). There is also a

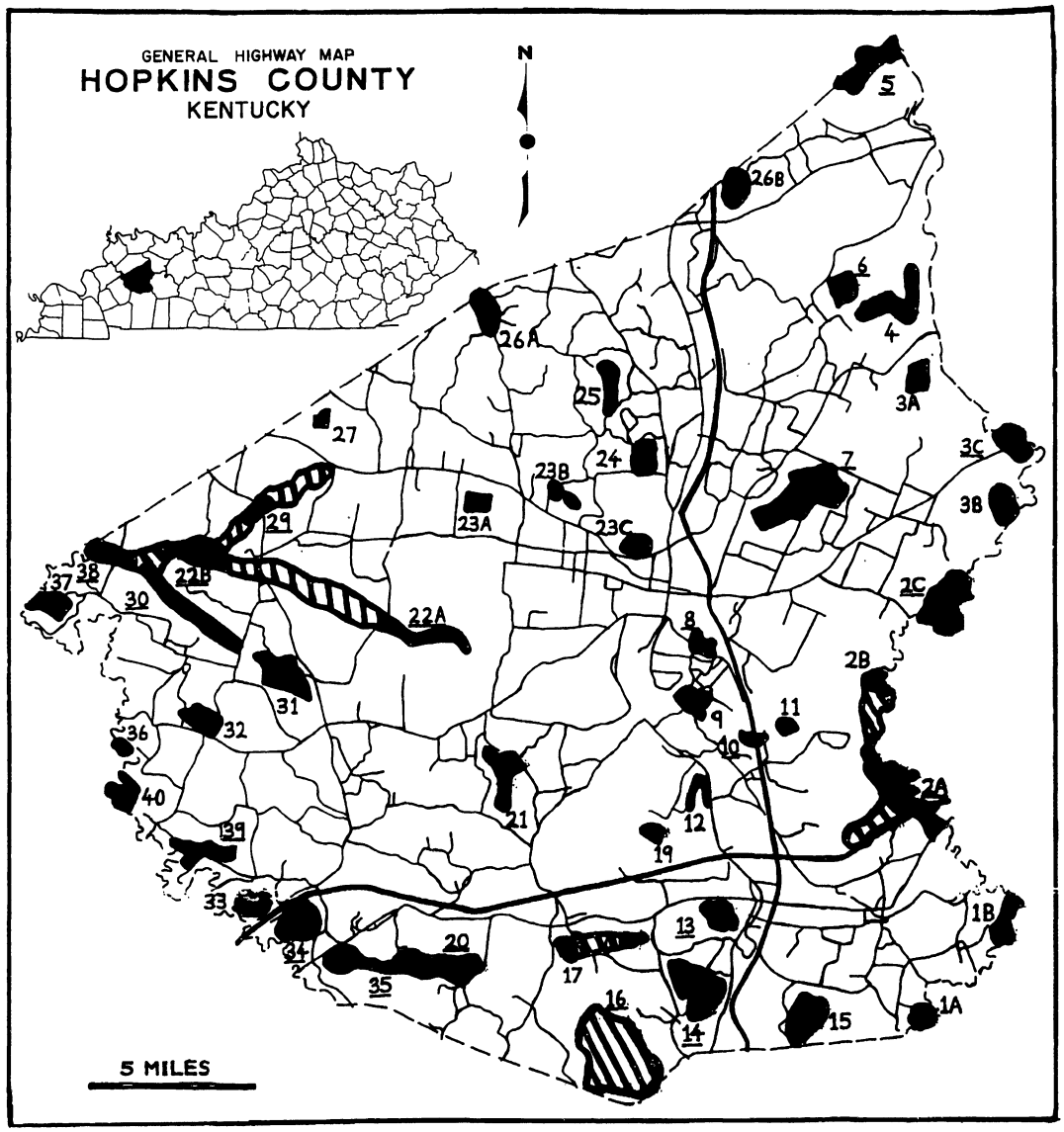

FIG. 1. Map of Hopkins County, Kentucky, showing roads (from 1990 Dept. of Transportation road map) and "potential natural areas" (PNAs) inspected during this study. The underlined numbers indicate PNAs that were checked on the ground in addition to aerial reconnaissance. Hatched areas do not have special natural quality other than their large acreage and potential importance for connecting better sites.

greater extent and variety of bottomland soils, covering huge terraces of the Green and Ohio rivers (3).

Early descriptions, and ecological inference, suggest that almost all of the county was forested before settlement, except, perhaps, the wettest and driest extremes (4, 5, 6, 7). Abundant trees included *Quercus alba, Q. velutina* and *Carya* spp. on drier sites; *Fagus grandifolia* and *Acer saccharum* on moister sites; bottomland *Quercus* spp., *Liquidambar styraciflua* and probably *A. rubrum* on wetter sites. Some trees typical of the Mississippian Embayment approach their northern limits here, e.g., *Q. pagoda, Q. michauxii, Carya illinoensis* and *C. aquatica*. The dominants of deep southern swamps—*Taxodium distichum* and *Nyssa aquatica*—are unknown from the county, though the former still occurs in McClean and Muhlenberg counties to the east. In the

UPLAND SOILS

no loess sewd
LITHIC DYSTROCHREPT
Ramsey lom
30-50 1-2 1-2

no loess wd
TYPIC DYSTROCHREPT
Steinsburg lom
20-30 2-3 1-2

thin loess wd/mwd
TYPIC FRAGIUDALF
Zanesville sil
2-20 5-8 1-2

thin loess mwd
GLOSSIC FRAGIUDALF
Sadler sil
2-6 5-8 1-2

no loess wd
VERTIC HAPLUDALF
Lenberg sil
12-30 2-3 1-2

thin loess wd
ULTIC HAPLUDALF
Wellston sil
6-20 3-5 1-2

thick loess mwd
GLOSSIC FRAGIUDALF
Grenada sil
2-6 5-10 1-2

thin loess wd
ULTIC HAPLUDALF
Frondorf sil
12-30 2-3 1-2

thick loess mwd
TYPIC FRAGIUDALF
Loring sil
2-12 5-10+ 1-2

thick loess spd
GLOSSIC FRAGIUDALF
Calloway sil
0-2 5-10+ 2-3

clay slack wd/mwd
TYPIC HAPLUDALF
Markland sic
6-12 6-12+ 2

mixed all. wd/mwd
TYPIC FRAGIUDALF
Otwell sil
2-6 >10 1-2

mixed all. spd
AERIC FRAGIUQUALF
Weinbach sil
0-2 >10 1-2

mixed all. wd
FLUV. DYSTROCHREPT
Cuba sil
0-2 >10 1-2

loess all. mwd
AQUIC UDIFLUVENT
Collins sil
0-2 >10 1-2

clay slack spd
AERIC OCHRAQUALF
McGary lom/sil
0-2 6-12+ 1-3

mixed all. mwd
FLUV. DYSTROCHREPT
Steff sil
0-2 >12 1-2

loess all. spd
AERIC FLUVAQUENT
Belknap sil
0-2 >12 1-2

clay slack pd
VERTIC HAPLAQUEPT
Karnak sil/sic
0-2 >12 3-4

mixed all. spd
AERIC FLUVAQUENT
Stendal sil
0-2 >12 1-3

loess all. pd
TYPIC FLUVAQUENT
Waverly sil
0-2 >12 1-2

mixed all. pd
TYPIC FLUVAQUENT
Bonnie sil
0-2 >12 1-2

LOWLAND SOILS

FIG. 2. Soil series of Hopkins County arranged according to natural gradients. All data are from Fehr et al. (3), and are condensed here in a way that enables overlays for individual characteristics to be readily generated. The terminology follows standard Soil Conservation Service usage. Terms and symbols in the four-line characterizations of each soil series are as follows: First line: *Left:* parent material; no loess = bedrock alone; thin loess = less than 1.2 m thick; thick loess = over 1.2 m thick; clay slack = clayey slack-water deposits; mixed all. = alluvium from bedrock and loess; loess all. = alluvium derived mostly from loess. *Right:* wd = well drained; sewd = somewhat excessively well drained; mwd = moderately well drained; spd = somewhat poorly drained; pd = poorly drained. Second line: Classification of National Cooperative Soil Survey. Third line: Soil series name, with typical A horizon texture: sil = silt loam; lom = loam; sic = silty clay loam. Fourth line: Left numbers = typical slope percent; Central numbers = typical depth to bedrock in feet; Right numbers = typical A horizon pH (unlimed): 1 = 4.5–5; 2 = 5–5.5; 3 = 5.5–6; 4 = 6–6.5.

absence of these 2 species, land that is too wet for closed hardwood forest is occupied by more or less open marshes, sloughs and ponds. These areas include some of the most extensive wetlands in the Shawnee Hills. The wetlands and adjacent forests have several rare plants, as detailed below, and these areas are also essential habitat for most rare animals known from the county or its immediate environs (8): fishes (cypress minnow, lake chubsucker, spotted sunfish, stargazing minnow); an amphibian (bird-voiced treefrog); reptiles (copperbelly watersnake, mudsnake—cottonmouth snake is also notable here at its range margin); and birds (American bittern, least bittern, great blue heron, pied-billed grebe). Most of these plants and animals are southern species, here near the northern edge of their Mississippi Valley ranges. No species currently listed or proposed for federal protection are known to reside in the county.

METHODS

About 40 "Potential Natural Areas" (PNAs) were identified by the senior author from aerial photographs taken in the summer of 1980 for the Kentucky State Nature Preserves Commission (Fig. 1). Compared to some other regions of the state, the threshold for "natural quality" was lowered substantially to select these 40 sites. This selection included the few areas that appeared to have forest of uniform commercial maturity, with trees ca. 75–100 years old (PNAs 6/10/29). However, most areas appeared to have younger forests, up to 30–60 years old, with only scattered older trees. Given this general immaturity, other sites were selected simply due to their having relatively large areas free from mining or recent logging. A particular effort was made to cover upland and bottomland about equally, and to include representative areas from all kinds of topography and soils (3).

On 19 June 1991, the 40 PNAs were inspected by the senior author by flying over the country in a small airplane (172 Cesna). This revealed any major disturbance or destruction of sites since 1980, and it allowed better assessment of tree sizes and other natural features in remaining sites. About 15 sites were finally selected for field visits, including sites with particularly mature forest, and maintaining topographic variety. These sites were visited in July 1991. Several of these sites, and some others, had been visited also by the second author during 1989. On the ground, notes were made on forest maturity and the most frequent species. Rare plant species were looked for, and vouched by collections deposited at the University of Kentucky. However, complete floristic lists were not attempted. Field notes of the senior author are deposited at the Kentucky State Nature Preserves office in Frankfort; those of the second author are available at his address. Field notes from KSNPC (1, 2) and other sources (especially Hal Bryan and R. Mohlenbrock, pers. comm., from PNA 2C) are also referred to below.

In order to examine the relationship of vegetation to soils, the USDA Soil Survey of Hopkins County (3) was analyzed in order to display the major gradients in soil conditions. Ecological features of each soil series were used to arrange them in a two-dimensional scheme that places similar soils close to each other (Fig. 2). On this scheme was then overlayed the pattern of forest types most frequently associated with each soil series (Fig. 3). All soil terminology below follows the above reference.

The term "old growth," as used in this report, refers to those few sites where most canopy trees exceed 75–100 years old, i.e., about 50–75 cm dbh (diameter at breast height) on bottomland or 40–60 cm dbh on uplands. "Maturing forest" refers to areas that appear to be in this transitional range of ages and sizes. Botanical nomenclature generally follows Fernald (9), though with a few changes used by Kartesz and Kartesz (10; see also 11).

Results: Notes on Community Types

Each community heading below is followed by the corresponding type code in Allard's (12) regional "Natural Community" classification (codes in parentheses are transitional or mixed types). Species lists in this section are not meant to be complete, but indicate only some of the more common, characteristic and rare species in each community type. Asterisks (*) indicate relatively rare species in Kentucky that have been listed by KSNPC (13), or may warrant consideration.

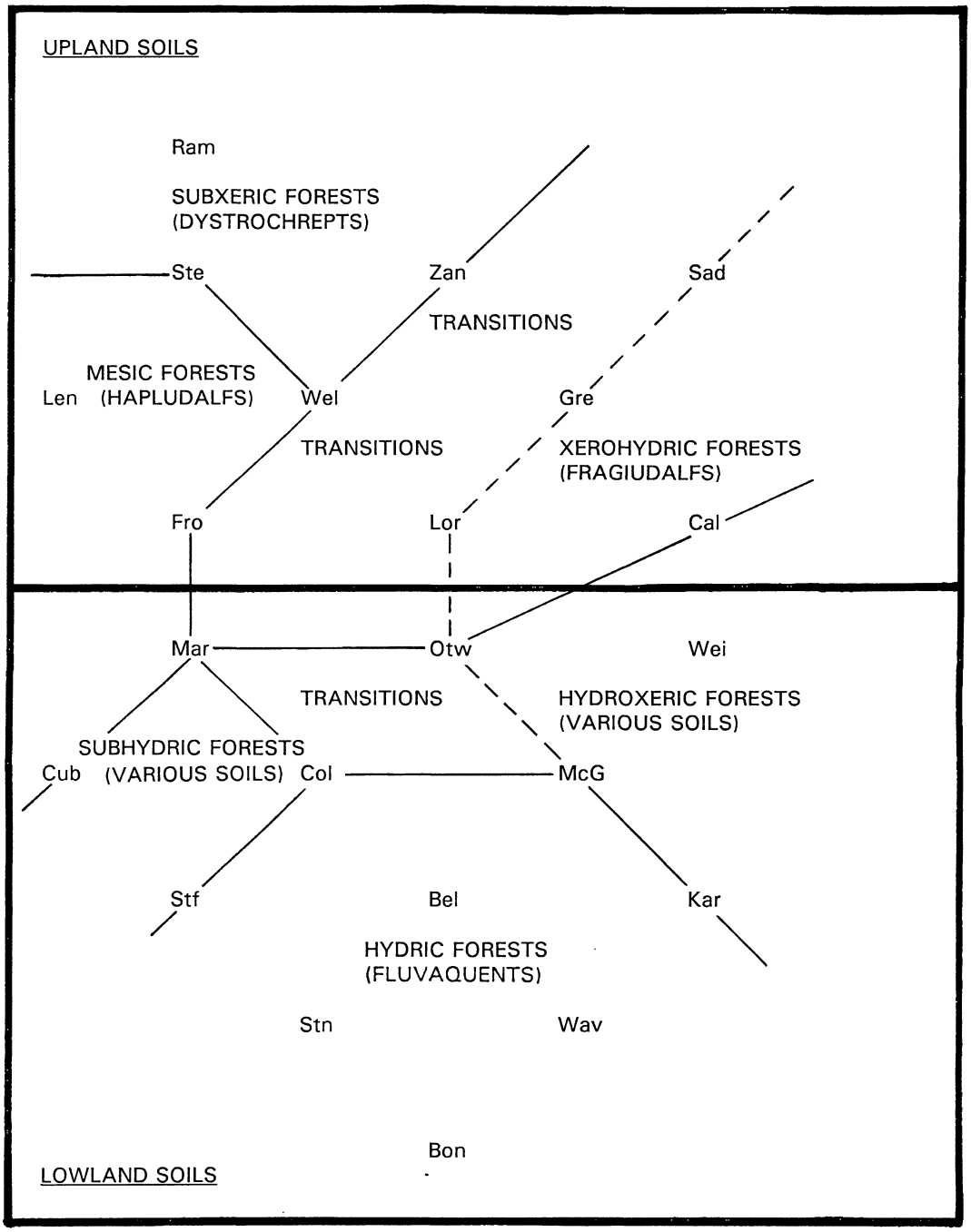

FIG. 3. Major forest types associated with each soil series. This is an overlay for Figure 2, with the same arrangement of soil series, abbreviated by their first three letters. Forest types and typical soil classes are shown in upper case. Forest types are based on data from the ca. 15 sites visited during this study. The most characteristic types are shown for each soil series; contacts and transitions are indicated by more than one type sharing a soil series.

Upland Communities

1. *Moist (mesic) forest:* IA5d(/e). This is typically located on well-drained soils that are relatively base-rich (hapludalfs), especially on lower slopes (6–30%) and on north or east aspects. Bedrock is at 2–5 ft (0.6–1.5 m) depth, and in some areas there is a thin loess cover. Common species include *Fagus grandifolia, Acer saccharum, Liriodendron tulipifera, Carpinus caroliniana, Asimina triloba* and *Lindera benzoin.* Also typical are *Quercus rubra, Juglans nigra, Fraxinus americana, Ulmus rubra* and *Morus rubra.* Ground vegetation includes *Polystichum acrostichoides, Podophyllum peltatum, Asarum canadense, Circaea canadensis, Mitchella repens, Galium triflorum, G. concinnum, Eupatorium rugosum, Polygonatum biflorum, Carex laxiflora* and *Brachyelytrum erectum.* The rare *Cimicifuga rubifolia*, Hydrastis canadensis** and *Panax quinquefolius** have been found at an old-growth site in adjacent Caldwell County (1).

Best examples. No old-growth was found. Small 1–10 acre (0.4–4 ha) remnants of maturing forest occur on moister sites within some larger upland areas (e.g., PNAs 8/1/34/35).

2. *Moderately dry (subxeric) forest:* IA7i(/c/d). This is typically located on well- or somewhat excessively well-drained soils with relatively low base-status (dystrochrepts), especially on steeper slopes (20–50%) and on south or west aspects. Bedrock is at 1–2 ft (0.3–0.6 m) depth, and there is little or no loess. *Quercus alba* is frequent in this forest type, and may have been dominant before logging. In 1884, DeFriese (6) noted this species "all along the streams and the foot-hills and on low grounds generally. In many localities, even the hilltops are covered with it; but, generally speaking, it does not extend high up the hill-sides." Other species include *Q. velutina,* which increased greatly after logging (6), and lesser amounts of *Carya* spp. (especially *C. glabra*), *Acer rubrum, Nyssa sylvatica, Sassafras albidum, Cornus florida, Ostrya virginiana* and *Oxydendron arboreum. Quercus coccinea* and *Vaccinium arboreum* occur on more rocky ground, where the tree canopy is locally open. *Pinus virginiana* is locally abundant in younger stands, but it was apparently rare or absent before settlement (6, 7). In some transitions to moister forests (e.g., PNA 13), *Acer saccharum* dominates the understory, perhaps replacing the *Quercus* spp. in areas without fire or other disturbance. A different kind of transition was noted by DeFriese (6) as a "splendid belt of timbers" on relatively moist soil, corresponding to the Middle Pennsylvanian Carbondale Formation, with *Q. alba, "Q. heterophylla"* [*Q. pagoda*?], *Q. velutina, Carya* spp., *Liriodendron, Juglans nigra, Fraxinus americana* and *F. quadrangulata* [unvouched?]. Ground vegetation is generally sparse, except in disturbed areas with frequent *Rhus radicans* and the exotic *Lonicera japonica.* Typical species include *Porteranthus stipulatus, Desmodium nudiflorum, Ascyrum hypericoides, Aureolaria laevigata, Monarda bradburiana, Cunila origanoides, Houstonia tenuifolia, Galium circaezans, Solidago caesia, S. erecta, Aster undulatus, Helianthus microcephalus, Antennaria plantaginifolia, Carex digitalis, C. wildenovii, C.* Section *Montanae, Bromus purgans, Panicum commutatum* and *P. dichotomum.*

Best examples. There are 1,000s of forested acres that have not yet been mined, but few areas even approach old-growth status. A few areas are slightly more mature than average (PNAs 8/11/13), and a few are notable for their large contiguous acreage (PNAs 14/16).

3. *Dry-wet fluctuating (xerohydric) forest:* IA7c(/?). This appears to have been widespread, typically on gentler slopes (0–20%) with moderately well-drained soils containing a fragipan (fragiudalfs). Bedrock is at 5–10 ft (1.5–3 m) depth, and loess is present, often over 3 ft (1 m) deep. The forest is virtually all converted to farmland today. *Quercus stellata* (post oak) was the most typical tree; in 1884, DeFriese (6) noted that "post oak is plenty, covering all the hills through this part of Kentucky, and extending far down toward the foot-hills." Other characteristic species in modern remnants may include *Q. falcata, Q. marilandica, Carya tomentosa, Ulmus alatus, Corylus americana* and *Symphoricarpos occidentalis.* However, there is much mixture with other forest types. On the better drained land, now most intensively farmed, transitions to moister (mesic or subhydric) forest appear to have had much *Q. pagoda,* since trees up to 3–4 ft dbh (1 m) are frequently seen along roads and in

woodlots. Wetter sites appear to have had more *Acer rubrum, Liquidambar,* some *Q. palustris* and occasional *Q. imbricaria.*

Drier sites may have had sparse tree canopy. On Pennsylvanian shales in nearby Union County, R. Peter (in 5: vol. 2, p. 266; vol. 3, p. 402) noted "remarkable flat post oak glades." Judging from the few wooded remnants, adjacent rights-of-way and old fields, post oak forest in Hopkins County may indeed have been open in places. Some of the species in native grasslands are *Desmodium* spp., *Lespedeza* spp. (including *L. capitata**), *Strophostyles umbellata, Tephrosia virginiana, Crotonopsis elliptica**, *Monarda fistulosa, Hypericum denticulatum* var. *recognitum, Phlox pilosa, Pycnanthemum* spp., *Diodia teres, Galium pilosum, Liatris squarrosa, Helianthus* spp., *Eupatorium* spp., *Solidago nemoralis, Carex hirsutella, C. gravida, Danthonia spicata, Elymus glabriflorus, Panicum* spp. (including *P. longiligulatum**), *Andropogon scoparius, A. gerardii, Erianthus alopecurioides* and *Sorghastrum nutans.* Fires may well have promoted such species before settlement.

Best examples. There is virtually no native vegetation left on flatter ground with deeper loess (Loring-Grenada-Calloway soil association), other than highly disturbed, 1–10 acre (0.4–4 ha) remnants (e.g., uplands of PNAs 8/34 and woodlots SW of PNA 6). However, within more dissected areas, broad ridges capped by thin loess often have the characteristic *Quercus* spp. noted above, intermixed with typical subxeric forest (e.g., PNAs 8/14/16/35).

Bottomland Communities

These are all on alluvial soils with a depth to bedrock of at least 10 ft (4 m), or 6 ft (1.8 m) in slack-water areas. All of these communities can be intimately mixed with aquatic communities (see below).

4. *Moderately wet (subhydric) forest:* IIA8b(/6g). This transitional type occurs on more or less well-drained soils, on either: (a) mixed alluvium sufficiently high above the level of frequent saturation (fluventic dystrochrepts); or (b) more dissected areas near the front or back edges of broad slack-water floodplains (hapludalf and udifluvent soils). Common species include mesophytes like *Fagus* and *Liriodendron,* plus more hydrophytic species such as *Quercus michauxii, Q. pagoda, Liquidambar, Nyssa sylvatica* and *Acer rubrum* var. *trilobum.* Especially on slack-water deposits, other species include *Fraxinus pensylvanica, Ulmus americana, Celtis laevigata, Q. macrocarpa, Carya laciniosa* and occasional *C. illinoensis.* Rare trees that may be expected in the county or nearby include *Gleditsia aquatica** (vegetative collections suggest hybrids with *G. triacanthos*) and *Bumelia lanuginosa** (collected by L.R. Phillippe, pers. comm., from the small old-growth forest in adjacent McLean County). Ground vegetation includes *Boehmeria cylindrica, Polygonum virginianum, Parthenocissus quinquefolia, Rhus radicans, Eupatorium serotinum, Uvularia sessilifolia*, Carex rosea, C. projecta, C. debilis, Poa autumnalis, Elymus virginicus, Panicum clandestinum* and *P. joorii**.

Best examples. Two areas of 5–20 acres (2–8 ha) approach old-growth (PNAs 10/34A). Another area (PNA 5B) has an unusual abundance of *Q. macrocarpa, Carya laciniosa* and Urticales (see Discussion).

5. *Wet (hydric) forest:* IIA6b(/d). This is extensive on more or less poorly drained soils of floodplains (especially fluvaquents). Common species include *Quercus palustris, Acer rubrum* var. *trilobum* and *Liquidambar,* with *Q. lyrata* on wetter sites and *Q. michauxii* on drier sites. *Quercus bicolor* and *Fraxinus pensylvanica* are frequent on slack-water deposits. Minor species on wetter sites include *F. tomentosa, Carya aquatica** and *Cornus stricta.* Ground vegetation includes *Onoclea sensibilis, Saururus cernuus, Boehmeria cylindrica, Impatiens capensis, Hypericum tubulosum, Cicuta maculata, Scutellaria lateriflorus, Lycopus virginicus, Galium obtusum, Bidens frondosa, Aster* spp. (*ontarionis, simplex, lateriflorus, vimeneus*), *Iris virginica, Commelina virginica, Carex crinita, C. louisianica, C. grayii, Leersia lenticularis, Glyceria striata, Cinna arundinacea* and *Muhlenbergia* cf. *bushii**. More acid soils at seeping slope bases may have had distinct vegetation, including *Stenanthium gramineum,* several ferns (*Osmunda* spp., *Thelypteris palustrus, Woodwardia areolata,* etc.) and mosses (*Sphagnum* spp.). The only good example known in the

region is in adjacent Caldwell County ("Dawson Springs Swamp"; 1), but these species have been found nearby in Hopkins County (Western PNA 35; M. Medley).

Best examples. There are no areas of old-growth. Maturing forest occurs in a few locations (e.g., parts of PNAs 2A/2C/22B/35). Extensive areas of less mature forest occur along the Pond River and the Tradewater River.

6. *Wet-dry fluctuating (hydroxeric) forest:* IIA6a(/5a/?). This is typical of soils that are more or less poorly drained, but which often dry out in the growing season. Extreme examples occur on the clayey slack-water deposits (with relatively base-rich ochraqualf and haplaquept soils). Less distinct examples also occur on these deposits and on old mixed alluvial terraces with fragipans (fragiudalfs). Perhaps the most characteristic tree of extreme hydroxeric conditions is *Quercus phellos*, which can be associated with *Q. lyrata* and other species of wetter forests, or with *Q. stellata, Carya ovata* and other species of drier forests. *Ilex decidua* is often frequent. Less extreme sites are transitional to wetter forest types with *Liquidambar, Q. palustris, Q. pagoda* and others, or to upland forest types with *Q. alba, C. tomentosa, Diospyros virginiana* and others. The highly varied ground vegetation includes *Rhus radicans, Baptisia leucantha** (collected by H. Bryan), *Amsonia tabernaemontanum* var. *gattingeri**, *Lycopus rubellus, Leersia virginica, Carex tribuloides, C. typhina, C. intumescens* and *Panicum longiligulatum**. Species in the *Quercus stellata* woods (PNA 5A) include *Lespedeza intermedia, Crotonopsis elliptica**, *Carex glaucodea, Eleocharis tenuis, Danthonia spicata* and *Panicum acuminatum* var. *fasciculatum*.

Best examples. There are no areas of old-growth. On slack-water deposits, areas with frequent *Quercus phellos* are well-represented along the outer floodplain limits of the lower Clear Creek watershed (especially PNA 38); DeFriese (5, p. 22) noted in 1884 that "On Clear Creek, a great deal of swamp laurel oak [*Q. phellos*] is found, often 26 inches [66 cm] in diameter". There are several less distinct examples, with little or no *Q. phellos* (e.g., PNA 6 and the large PNA 7). The *Q. stellata* forest on Pitman Creek (PNA 5A) is exceptional for its lack of typical hydric species. On the terraces with fragipans, strips of forest remain along Green and Pond rivers (e.g., PNA 3C).

Communities Associated with Bodies of Water

7. *Flowing water (rivers and streams):* IIA7b/f. More or less well-drained soil that, nevertheless, gets frequent flooding with fresh alluvium is typified by *Salix nigra, Platanus occidentalis, Betula nigra* (especially on more acid soil), *Acer negundo* (especially on more base-rich soil) and *A. saccharinum* (especially along larger streams and rivers). This zone generally grades into adjacent subhydric or hydric forest. A shrub zone of *Cornus obliqua* is often present next to the water. Ground vegetation includes *Boehmeria cylindrica, Laportea canadensis, Polygonum* spp., *Cryptotaenia canadensis, Ruellia strepens, Mimulus alatus, Aster ontarionis, Arundinaria gigantea, Chasmanthium latifolium, Leersia oryzoides, Elymus virginicus* and *Muhlenbergia frondosa*. Bars of gravel or sand are generally not well-developed.

Best examples. No particularly mature forest was found along rivers and streams, but these communities remain extensive.

8. *Stagnant water (marshes, sloughs, oxbows and ponds):* IIC1e/IID1d/IID6a/IID8a. In these situations, subhydric or hydric forest generally borders the water directly. Dead trees are frequent along the larger sloughs, as discussed further below. A zone of *Cephalanthus occidentalis* is generally present. Along the larger sloughs, this shrub is often mixed with *Populus heterophylla, Salix nigra, Forestiera acuminata* and *Styrax americana*. In deeper water, *Hibiscus militaris* is abundant. The herb layer includes *Polygonum hydropiperoides, Ludwigia* spp., *Diodia virginiana, Alisma subcordatum, Typha* spp., *Sparganium* spp., *Juncus effusus, Rhynchospora corniculata, Carex lupulina, Eleocharis quadrangulata, Phragmites australis, Panicum agrostoides* and *Echinochloa crus-gallii*. True aquatics include *Nuphar luteum, Nymphaea odorata, Ranunculus flabellaris, Ceratophyllum demersum, Didiplis diandra**, *Peltandra virginica**, *Limnobium spongia** and the liverwort, *Riccia fluitans* (sensu lato). Around one shallow pond polluted by red deposits from mine run-off,

*Decodon verticillatus** is dominant, with frequent *Cephalanthus, Itea virginica, Juncus acuminatus* and *Eleocharis obtusa.*

Best examples. There are several extensive marshy bottoms in the county, notably along Clear Creek (PNA 22) and its tributaries—Weir Creek (PNA 29) and Lick Creek (PNA 30). Relatively undisturbed examples of oxbows are Long Pond (in PNA 2A) and the oxbow just south of the mouth of Clear Creek (in PNA 38). Smaller ponds of various types occur in many areas, but their natural or artificial status is often uncertain. Though polluted, the Maple Swamp pond (in PNA 35) may have a natural origin and is notable for the *Decodon.*

DISCUSSION

The Nature Conservancy is currently developing a "Natural Community" classification for the southeastern United States (12), including Kentucky (M. Evans, unpublished). The general correspondence of Hopkins County plant communities to this system is referenced above. However, some forest types on sites with much wet-dry fluctuation are not clearly matched in the regional classification, especially types on less well-drained uplands with fragipans, and on bottoms with high potential for seasonal drought. Also, there needs to be more analysis of soil chemical differences between communities at local and regional levels, which would help refine the correspondence.

A major component in the relationship between soil and vegetation indicated above (Figs. 1, 2) is that soils with potential for much moisture fluctuation have vegetation that is distinct from more constant dry, moist or wet conditions. This local pattern illustrates the independent gradients of dryness and wetness evident in the whole Central Hardwood Region (14). Such independence may be more pronounced on the Coastal Plain and Piedmont, though requiring deeper analysis than sometimes performed (15, 16, 17, 18). Expression of these trends is often limited by the almost complete agricultural conversion of flatter lands, where the most typical "xerohydric" vegetation is hypothesized to have existed before settlement. The search for good examples of natural vegetation on fragipan soils in these landscapes should become a priority. It is intriguing that upland areas most prone to a natural shift from forest to fire-prone, grassy, open woodland or barrens may have occurred on such sites. Despite the historical reference to "post oak glades" (4; see above), no definite remnants of such vegetation have been found within the Shawnee Hills, apart from some peripheral sites on Mississippian bedrock.

The natural condition of the Clear Creek wetland and other large marshy areas in Hopkins County remains uncertain. The frequent dead trees may indicate an increase in water levels during the past 10–30 years, caused by the concurrent increase in dam-building of the recovering beaver population (E. Young, Hopkins Co. Conservation Office, pers. comm.), and by sedimentation and pollution from strip-mines. Studies of "greentree reservoirs" indicate that flooding in the growing season results in a shift from bottomland hardwoods to more water-tolerant plants (19), especially when the trees are less than 3 inches (7.5 cm) dbh (20). After such flooding, trees are stressed and killed by oxygen depletion, whereas flooding in the dormant season has little effect on tree growth (21).

The Hopkins County marshes have not been considered particularly good examples of natural communities (1, 2), though there are several rare plant and animal species. Their enigmatic treeless aspect could simply be due to a lack of natural migration from the Ohio River valley by the extremely flood-tolerant *Taxodium distichum* and *Nyssa aquatica.* However, *Taxodium* is said to have occurred formerly in several parts of the county, as evidenced by old stumps and knees, and may have been eliminated by logging (E. Young, pers. comm.). No relevant historical description has yet been found.

Differences in vegetation related to soil pH and fertility, as evident in regional comparisons (14), are less easily demonstrated within ares of relatively uniform soil parent material. Within Hopkins County, field notes suggest that some areas on the clayey slack-water deposits have forest composition typical of higher pH or fertility. These soils have an A horizon pH of up to 5.5–6.5, whereas all other soils in the county have a typical pH of 4.5–5.5. Trees of Hopkins County that are generally indicative of higher base-status (14), and which appear characteristic of these particular soils in-

clude *Carya laciniosa, Quercus macrocarpa, Q. bicolor, Q. shumardii, Gleditsia* spp., *Fraxinus* spp. and Ulmaceae. In composition, a few of these areas (e.g., PNA 5A) resemble the "savanna-woodlands" and swamps of the highly fertile Bluegrass stream bottoms, which often have a long grazing history (22, 23; and J. Campbell, unpublished data). More detailed study of soils will be needed to examine these relationships at the local level.

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