

Woody Plants of Six Northern Kentucky Counties

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ABSTRACT

Our field work and herbarium surveys have documented the woody flora of Bracken, Fleming, Harrison, Mason, Nicholas, and Robertson counties, Kentucky. The presently known woody flora consists of 172 taxa; 11% of the woody flora is exotic. We report *Thuja orientalis* L. for the first time as an introduced member of Kentucky's flora. There is a significant discontinuity of distribution between the northern Bluegrass and Knobs regions. *Arundinaria gigantea* is a much rarer plant in northern Kentucky than conventional wisdom indicates. We include an annotated listing of woody plant taxa and a discussion of the state of natural habitats and potential impact of weedy woody species.

INTRODUCTION

Narratives related to the natural features of Kentucky have typically attested to an abundance and variety of natural resources. A recent, statewide assessment of biodiversity in Kentucky (Taylor 1995) convincingly argues that plant diversity in the state is substantial. However, in spite of recent attempts to estimate vascular plant diversity in Kentucky (Browne and Athey 1992; Medley 1993), sufficient information is not yet available for an accurate estimate of which vascular plant taxa actually occur in the state. Contributing reasons for this situation include repeated anecdotal and unvouchered reports of occurrences and a general paucity of vouchered collections in institutional herbaria (Jones et al. 1995).

However, the situation we find ourselves in is beside the point. The point is, too little is known about the flora of Kentucky, land use trends are continually shrinking and modifying native habitats, and we are at risk of losing elements of the flora before we discover the full extent of its diversity and distribution. There is an urgent need for more thorough documentation of the flora of Kentucky.

SCOPE AND JUSTIFICATION OF THIS STUDY

Our study was undertaken to document the occurrence of woody plants that are native, naturalized, or spreading from cultivation in

six counties of northern Kentucky: Bracken, Fleming, Harrison, Mason, Nicholas, and Robertson. Our goal was to document the woody plant diversity in these counties at greater than the 90% level.

One of the reasons this region was selected for study is because it is not well known botanically. Guetig (1993) compiled a summary of all floristic work previously done in Kentucky. His summary indicated that none of the counties included in the present study has ever been the subject of an organized effort to document the flora. Also, we felt that thorough vouchering of the woody plants of these counties would make subsequent field work to voucher the herbaceous vascular plants easier. (The logistics of field collecting are simpler when one is not continually searching for all sizes of plants.) In addition, woody plants were selected as the focus of our study because they are keystone organisms in forest and savanna ecosystems and have considerable economic significance. We felt that documenting the occurrence of this portion of the flora would be a connection to Kentucky's heritage that people would be more likely to appreciate. Finally, most of this area of the state is typified by an advanced state of habitat elimination and modification. Consequently, we concluded that, if efforts to document the flora were delayed much longer, significant elements of the woody flora could possibly be lost entirely.

THE STUDY AREA

All of the counties lie within the drainage of the Licking River, except for the northern portions of Mason and Bracken counties, which are drained by creeks downcutting directly to the Ohio River. The six county study area totals almost 1700 mi² (438,000 ha), which is almost 4.3% of the land area of Kentucky (Anonymous 2000a).

Elevations within the study area range from about 500 ft. (152 m) above mean sea level near Meldahl Dam on the Ohio River in northwestern Bracken County, to about 1200 ft. (370 m) above sea level in extreme eastern Fleming County. The maximal elevation attained in the Bluegrass part of our study area is about 1000 ft. (305 m), in extreme southwestern Harrison, near Leesburg (U.S. Geological Survey 1976, 1978).

All of the study area except eastern Fleming County lies within the Bluegrass Region of Kentucky. The Bluegrass is underlain by Ordovician strata. Main geologic formations include Lexington Limestone where exposed by downcutting of main tributaries of the western and northern Licking River, with Garrard Siltstone and the Clays Ferry Formation comprising most of the rolling uplands of the western part of the study area. Proceeding eastward from the former exposures, one encounters relatively narrow outcropping belts of the (Ordovician) Bull Fork Formation, Drakes Formation, and Crab Orchard Formation (both of these Silurian and marking the transition between Knobs and Bluegrass), and finally, Devonian and Mississippian strata of the extreme western edge of the Mississippian Plateau. (McDowell et al. 1981) Only extreme eastern Fleming County is within the physiographic province known as The Knobs, characterized (sequentially as one goes eastward) by outcropping Silurian, Devonian, and Mississippian rocks. The Knobs are interpreted as the dissected remnant of the Mississippian (Interior Low Plateau) Province, known parochially in Kentucky as the Pennyryle Plateau (Fenneman 1938; Karan and Mather 1977). Except over heavily organic Ohio shale in the Knobs, most upland soils of our study region have an alkaline pH.

Estimates of the original vegetation in this region vary and are still debated, possibly be-

cause originally there was a complex mosaic from which fire has now been systematically excluded for 200 years. It may have included a preponderance of ash-oak-prairie savanna in the Inner Bluegrass and various facies of oak-chestnut and mixed mesophytic on the Knobs (Braun 1950; Bryant 1987; Campbell 1980; Küchler 1964; Martin et al. 1978).

MATERIALS AND METHODS

Prior to field collecting, each county was surveyed to determine areas which might yield more habitat diversity. Because of the relative lack of geologic diversity in most of the study area, this survey relied on physiographic maps and county road maps (Anonymous 1997; Puetz n.d.; U.S. Geological Survey 1976, 1978). By this method, we were able to identify circumstances with a high likelihood of giving us efficient and repeated coverage of major habitats within each county.

About two field collecting days were spent in each county. Field work began on 7 Jun 1999 and ended 20 Jul 1999. Specimens were collected wherever we found them first, from roadsides and ruderal habitats to reasonably intact habitats. Specimens were temporarily held in wet newspaper within large polyethylene bags and later accessioned by collector, pressed, dried, labeled, and determined to taxon. The senior author determined the taxa of most specimens without consulting additional sources, except to verify nomenclatural authorship. The field work required 2441 miles of travel, an average of about 3 miles (4.8 km) for each taxon collected.

Nomenclature in this report is generally according to Gleason and Cronquist (1991), which also was a source consulted for determination of some groups. The International Plant Name Index (Anonymous 2000b) and Rehder (1940) were consulted in a few cases, and we used Fernald (1950) as an aid to the determination specimens of specimens of *Crataegus* and *Rubus*.

Following processing and determination of our field collections, herbarium collections at EKY, UKY, MDKY, and KNK were surveyed to see if additional taxa had been vouchered in these counties by other collectors. These surveys yielded a few (<1%) additional records. Travel to herbaria required 3 additional work days and about 500 miles (800 km) of

Table 1. Comparative woody plant diversity data for six northern Kentucky counties.

	Bracken	Fleming	Harrison	Mason	Nicholas	Robertson	Totals
Area ^{1,2}	495 ¹	351 ¹	309 ¹	241 ¹	196 ¹	100 ¹	1692 ¹
Total number of taxa	109	140	110	100	96	97	172
Number of native taxa	92	124	95	82	78	83	142
Number of non-native taxa	15	16	15	18	18	14	19
% Non-native	12.1	11.4	13.6	18.0	18.9	14.4	11
Human density/mi ² ¹	38.9	350	52.6	40	34.3	22.2	

¹ in sq. mi.² Source: Anonymous 2000.

additional travel. See Table 1 for statistical floristic data.

RESULTS

The field effort resulted in more than 760 collections from the study area. Our subsequent regional herbarium survey yielded a few additional records. Overall, this study resulted in the documentation of 172 woody taxa from the six-county area. Fleming County, with 140 documented taxa, has the most diverse woody flora. Robertson County, with 97 documented taxa, has the least diverse woody flora (Table 1). Information from the Internet is cited here in accordance with the standard proposed by Walker (1995).

ANNOTATED VOUCHERS OF THE WOODY FLORA

Below is a list of vouchers for the woody plants of the six-county study area, followed by citations of voucher specimens and a short comment on the pattern of occurrence. To save space, names of counties of origin of voucher specimens (Bracken, Fleming, Harrison, Mason, Nicholas, Robertson) are abbreviated to first letter in parentheses after voucher numbers. When only a number is listed, it is the accession number of the senior author and the specimen has been deposited in EKY. Vouchers from other Kentucky workers are more completely cited. Nomenclature generally follows Gleason and Cronquist (1991), but in the final analysis reflects the judgment of the senior author. Abbreviations for herbaria are from Holmgren and Holmgren (2000).

Little (1971, 1977) included some additional distributional data for a few taxa within our study area. Presumably, the vouchers on which some of his data are based are in herbaria not consulted during this study. Therefore, his

vouchers are not referenced here. We conservatively estimate that the specimens collected during our study constitute more than 95% of the data now extant for woody plants in this six-county area of Kentucky.

PINOPHYTA

Cupressaceae

Juniperus virginiana L.—24915 (B), 25273 (F), 24657 (H), 24782 (M), 25154 (N), 25038 (R). Common throughout. This is apparently the only gymnosperm native in the Bluegrass.

Thuja orientalis L.—25057 (R). Mature offspring from nearby cultivated plants are established in a fencerow. Introduced; This is apparently the first report of plants of this taxon escaping in Kentucky (Brown and Athey 1992; Medley 1993).

Pinaceae

Pinus echinata Miller—25244 (F). Occasional, Knobs.

Pinus rigida Miller—25227 (F). Frequent, Knobs.

Pinus virginiana Miller—25275 (F). Common, Knobs.

ANTHOPHYTA

Aceraceae

Acer negundo L.—24869 (B), 25282 (F), 24628 (H), 24788 (M), 25147 (N), 25011 (R). Common throughout.

Acer nigrum Michaux f.—24957 (B), 25322 (F), 24611 (H), 24799 (M), 25091 (N), 25024 (R). Mesic woods, usually on north- and east-facing slopes or in alluvium along streams.

Acer rubrum L.—25310 (F). Frequent in various habitats, Knobs.

Acer saccharinum L.—24956 (B), 25342 (F), 24606 (H), 24770 (M), 25136 (N), 24964 (R). Frequent; low ground along streams and terraces.

Acer saccharum Marshall—24901 (B), 25232 (F), 24651 (H), 24796 (M), 25128 (N), 25020 (R). Frequent; various upland habitats.

Anacardiaceae

Rhus aromatica L.—25327 (F), 24613 (H). Xeric bluffs; rare.

Rhus copallina L.—25277 (F), 24648 (H), 25077 (R). Disturbed rights-of-way; rare.

Rhus glabra L.—24912 (B), 25271 (F), 24644 (H), 24831 (M), 25123 (N), 25029 (R). Various habitats, most common in fencerows.

Rhus typhina L.—24832 (B), 24774 (M). Mesic woods and low ground; infrequent; confined to habitats near the Ohio River.

Toxicodendron radicans (L.) Kuntze—24946 (B), 25281 (F), 24597 (H), 24756 (M), 25151 (N), 25079 (R). Various habitats; common.

Toxicodendron pubescens Miller—24874 (B), 24707 (H). Xeric woods; rare.

Annonaceae

Asimina triloba (L.) Dunal—24889 (B), 25313 (F), 24646 (H), 24758 (M), 25139 (N), 24990 (R). Various mesic and alluvial habitats; frequent.

Apocynaceae

Vinca minor L.—25218 (F), 25047 (H), 24802 (M), 25047 (R). Introduced; ruderal habitats and dump sites; infrequent.

Araliaceae

Aralia spinosa L.—25286 (F). Mesic and alluvial habitats; Knobs.

Hedera helix L.—24850 (B). Introduced; dump site; rare.

Berberidaceae

Berberis thunbergii DC.—24867 (B), 25048 (H), 25094 (N), 25048 (R). Introduced. Various disturbed and degraded habitats; infrequent.

Betulaceae

Alnus serrulata (Aiton) Willd.—Thieret s.n., 30 Jan 1983 (KNK) (B), 25235 (F), 24807

(M). Streambanks and low, open ground; infrequent; apparently absent from Bluegrass. *Betula nigra* L.—25338 (F). Alluvial woods, rare; Knobs.

Carpinus caroliniana Walter—24924 (B), 25307 (F), 24701 (H), 24754 (M), 25095 (N), 24991 (R). Various habitats, usually mesic; frequent to occasional.

Corylus americana Walter—24879 (B), 25289 (F), 24694 (H), 25025 (R). Bluffs and mesic habitats; infrequent.

Ostrya virginiana (Miller) K. Koch—24909 (B), 25203 (F), 24617 (H), 24746 (M), 25096 (N); common.

Bignoniaceae

Bignonia capreolata L.—25324 (F), 24619 (H), 25025 (R). South- and west-facing bluffs along major streams; rare, but locally common.

Campsis radicans (L.) Seemann—24897 (B), 25241 (F), 24653 (H), 24798 (M), 25146 (N), 25015 (R). Most habitats; common.

Catalpa bignonioides Walter—24837 (M), 25132 (N). Low woods, rare. In spite of its common name (southern catalpa), this species appears to be native along the Ohio River in the study area. However, both this species and the following one are cultivated and can be expected to produce adventive plants.

Catalpa speciosa Warder—24586 (H). An apparent escape from cultivation; Cynthiana.

Caesalpiniaceae

Cercis canadensis L.—24903 (B), 25255 (F), 24681 (H), 24767 (M), 25170 (N), 25039 (R). Various habitats; common throughout.

Gleditsia triacanthos L.—24917 (B), 25207 (F), 24661 (H), 24755 (M), 25145 (N), 25002 (R). Various habitats; common throughout.

Gymnocladus dioica (L.) K. Koch—24836 (B), 24332 (F), 24624 (H), 24721 (M), 25160 (N), 25073 (R). Disturbed habitats and mesic woods; infrequent.

Caprifoliaceae

Lonicera japonica Thunberg—24098 (B), 25314 (F), 25052 (H), 25353 (M), 25155 (N), 25054 (R). Introduced; most habitats; common.

Lonicera maackii (Rupr.) Herder—24940 (B),

25251 (F), 24632 (H), 24772 (M), 25166 (N), 24976 (R). Introduced; most habitats; common in counties bordering the Ohio River. In our opinion, this is one of the potentially most ecologically disastrous terrestrial plants ever introduced into eastern North America. It eliminates or severely inhibits the reproduction of most native Eastern Deciduous Forest plants.

Sambucus canadensis L.—24833 (B), 25252 (F), 24695 (H), 24778 (M), 25174 (N), 24969 (R). Stream corridors, low ground, and mesic woods; common.

Symphoricarpos orbiculatus Moench—24885 (B), 25215 (F), 24664 (H), 24810 (M), 25116 (N), 25033 (R). Various habitats; frequent.

Viburnum acerifolium L.—25309 (F). Deciduous woods; Knobs.

Viburnum prunifolium L.—24937 (B), 25221 (F), 25051 (H), 24747 (M), 25120 (N), 25058 (R). Upland woods, bluffs, fence-rows, and disturbed habitats; frequent.

Viburnum rufidulum Raf.—24894 (B), 25336 (F), 24682 (H), 24764 (M), 25124 (N), 25036 (R). Upland woods and disturbed habitats; frequent.

Celastraceae

Celastrus scandens L.—24914 (B), 25315 (F), 24671 (H), 24829 (M), 25140 (N), 25037 (R). Upland and mesic woods and disturbed habitats; common.

Celastrus orbiculatus Thunberg—25339 (F), 25104 (N). Introduced; ruderal habitats and rights-of-way. Presently uncommon in the study area and often confused with plants of the preceding taxon. In our area, this species may have the potential of eclipsing most other introduced woody plants in its eventual negative ecological impact.

Euonymus alatus (Thunberg) Siebold—25193 (N). Introduced; fencerow; rare, but with the potential of becoming much more common.

Euonymus atropurpureus Jacquin—24873 (B), 25206 (F), 24670 (H), 24750 (M), 25153 (N), 24992 (R). Upland woods and disturbed habitats, common in fencerows; frequent.

Euonymus fortunei (Turcz.) Hand.-Maz.—24852 (B), 25049 (H), 24777 (M), 25109 (N), 25049 (R). Introduced; old dump sites

and also establishing adventively (spread by birds). Not yet common in the study area but soon will be. When fully established, supplants the entire herbaceous stratum of deciduous forest.

Clusiaceae

Hypericum stragulum Adams and Robson (= *Ascyrum hypericoides* var. *multicaule* of some authors)—25276 (F). Other woody hypericums in Kentucky apparently are absent from the study area; Knobs only.

Cornaceae

Cornus amomum Miller var. *schuetzeana* (Meyer) Rickett—24839 (B), 25234 (F), 24809 (M). During this study, located only on the banks of the Ohio River and in Big Run Swamp, Fleming County.

Cornus drummondii C.A. Meyer—24878 (B), 25329 (F), 24643 (H), 25100 (N), 25001 (R). Xeric woods, disturbed habitats, and fence-rows; common.

Cornus florida L.—24890 (B), 25292 (F), 24703 (H), 24739 (M), 25090 (N), 25023 (R). Mesic woods and bluffs; widespread but nowhere common; being decimated by fungal pathogens (Harlow et al. 1996).

Nyssa sylvatica Marshall—25299 (F), 24636 (H), 24830 (M), 25068 (R). Mesic woods; occasional to rare in study area, except for Knobs of Fleming County.

Nyssa sylvatica Marshall var. *biflora* (Walter) Sargent—25226 (F). Rare; Big Run Swamp.

Ebenaceae

Diospyros virginiana L.—24921 (B), 25262 (F), 24600 (H), 24732 (M), 25129 (N), 25006 (R). Frequent in fencerows; also widespread but not common in mesic woods.

Elaeagnaceae

Elaeagnus umbellata Thunberg—25250 (F), 24702 (H), 24791 (M), 25107 (N), 24972 (R). Introduced; disturbed habitats; infrequent.

Ericaceae

Gaylussacia baccata (Wangenh.) K. Koch—Meijer, Setser, and Meade 1150 = MDKY #4630 (F). Xeric woods, infrequent; Knobs.

Kalmia latifolia L.—25345 (F). Upland woods, rare; Knobs.

Oxydendrum arboreum (L.) DC.—25303 (F). Upland woods; Knobs.

Vaccinium corymbosum L.—25344 (F). Upland woods, infrequent; Knobs only.

Vaccinium pallidum Aiton—25270 (F). Same habitats and localities as *Gaylussacia bacata*.

Vaccinium stamineum L.—25266 (F). Upland woods, frequent; Knobs only.

Fabaceae

Amorpha fruticosa L.—24841 (B), 24808 (M). In our study area, apparently confined to the banks of the Ohio River.

Lespedeza bicolor Turcz.—25205 (F), 25186 (N). Introduced; escaping from plantings in state-managed wildlife management areas.

Robinia pseudoacacia L.—24920 (B), 25295 (F), 24633 (H), 24781 (M), 25172 (N), 25080 (R). Very common in varied habitats and disturbed areas.

Fagaceae

Castanea mollissima Blume—W. Meijer, 15 Sep 1974, UKY #35813 (F). Introduced.

Fagus grandifolia Ehrhart—24854 (B), 25230 (F), 25089 (N), 25013 (R). Ravines and mesic slopes; rare in Bluegrass, common only in Knobs.

Quercus alba L.—24899 (B), 25311 (F), 24660 (H), 24713 (M), 25110 (N), 25004 (R). Mesic woods; common throughout.

Quercus bicolor Willd.—25201 (F). Upland swamp, rare; Knobs.

Quercus coccinea Muenchh.—24856 (B), 25265 (F). Extremely rare in Bluegrass; we discovered a population of only two mature trees in a pasture fencerow in Bracken County and noted no reproduction. Very common in xeric and submesic woods in the Knobs.

Quercus imbricaria Michaux—24934 (B); 25229 (F); 24588 (H), 24820 (M), 25177 (N), 24966 (R). Widespread but rare throughout our study area.

Quercus macrocarpa Michaux—25320 (F), 24623 (H), 24823 (M), 25162 (N), 25056 (R). Frequent in the south but progressively more rare northward in the area we studied.

Quercus montana Willd. (= *Q. prinus* L. of some authors)—25287 (F). Xeric south- and

west-facing slopes and ridges; frequent in Knobs. The type of *Q. prinus* in the Linnaean herbarium may be of the lowland chestnut oak (= *Q. michauxii* Nuttall) instead of the upland chestnut oak, and the two names have been confused in the literature for many years (Hardin 1979). Since *Q. michauxii* and *Q. montana*, respectively, are unambiguous names, it is better to use them instead.

Quercus muhlenbergii Engelm.—24880 (B), 25195 (F), 24656 (H), 24757 (M), 25143 (N), 25041 (R). Upland habitats throughout; frequent.

Quercus palustris Muenchh.—24947 (B), 25258 (F), 24698 (H), 24789 (M), 25106 (N). Frequent only along the Ohio River and in Fleming County upland swamps; otherwise sporadic and occasionally escaping from cultivation.

Quercus rubra L.—24906 (B), 25288 (F), 24696 (H), 25102 (N), 24986 (R). Mesic uplands, usually on east- and north-facing slopes; occasional to rare.

Quercus shumardii Buckley—24870 (B), 25224 (F), 24631 (H), 24734 (M), 25138 (N), 25012 (R). Various habitats; common.

Quercus stellata Wangenh.—24871 (B), 25264 (F), 24666 (H), 24825 (M), 24977 (R). Upland woods and fencerows; occasional.

Quercus velutina Lamarck—24910 (B), 25278 (F), 24642 (H), 24716 (M), 25111 (N), 25069 (R). Upland woods; frequent.

Quercus ×willdenowiana Zabel—24692 (H). A hybrid, found in a fencerow, between *Q. velutina* Lam. and *Q. falcata* Michaux. We were unable to find the latter parent in the vicinity; however, considering the advanced state of habitat loss, it easily could have formerly occurred nearby.

Grossulariaceae

Ribes missouriense Nuttall ex Torrey and Gray—25357 (N). Canebrake, rare.

Hamamelidaceae

Hamamelis virginiana L.—25294 (F). Various wooded habitats; Knobs.

Liquidambar styraciflua L.—25259 (F). Various wooded habitats; Knobs. Plants of this taxon we noted along the Ohio River appeared to have been planted.

Hippocastanaceae

Aesculus flava Aiton—24835 (B); 25223 (F); 24814 (M). Confined to ravines and north-facing slopes along the Ohio River and its direct tributaries; also in mesic woods of Knobs.

Aesculus glabra Willd.—24855 (B), 25196 (F), 24614 (H), 24722 (M), 25173 (N), 25021 (R). Wooded slopes, disturbed habitats, and fencerows; common.

Hydrangeaceae

Hydrangea arborescens L.—24927 (B), 25291 (F), 24720 (M), 25176 (N), 25061 (R). Normally confined to mesic east- and north-facing bluffs along major streams; infrequent.

Philadelphus coronarius L.—25243 (F). Introduced; established and spreading on old roadcut; rare. Most other adventive populations of this genus in Kentucky probably should be referred to this taxon.

Juglandaceae

Carya cordiformis (Wangenh.) K. Koch—24887 (B), 25202 (F), 24649 (H), 24763 (M), 25142 (N), 25031 (R). Most wooded habitats; the most common hickory in our study area.

Carya glabra (Miller) Sweet—24891 (B), 25269 (F), 24676 (H), W. Meijer, 13 Jun 1969, UK #33801 (M); 25017 (R). Upland woods; infrequent to rare.

Carya laciniosa (Michaux f.) Loud.—24898 (B), 25328 (F), 24668 (H), 24712 (M), 25125 (N), 25014 (R). Various wooded habitats; frequent.

Carya ovata (Miller) K. Koch—24892 (B), 24635 (H), 25125 (N), Thieret 52747 in KNK (R). Infrequent to rare; most common near the border between Bluegrass and Knobs in Fleming County. Plants of this taxon in our region do not fit well the recent description given by Stone (1997). The apparent reason is that, throughout most of central Kentucky, introgression may be occurring between plants of this taxon and the following one.

Carya tomentosa (Poiret) Nuttall—24883 (B), 25222 (F), 24640 (H), 24824 (M), 25087 (N), 24989 (R). Upland woods and woods remnants; frequent to occasional.

Carya ovata × *Carya tomentosa*—24733 (M). As mentioned above, introgression between

these two taxa is common in our region, producing various degrees of intermediacy. This is a collection that appeared to us to be truly intermediate, so we cite it as an unnamed hybrid.

Carya pallida (Ashe) Engler and Graebner—24860 (B), 25112 (N), 25062 (R). Upland woods and woods margins; infrequent.

Juglans nigra L.—24896 (B), 25280 (F), 24677 (H), 24730 (M), 25148 (N), 24923 (R). Various habitats; common. We did not observe any specimens of *J. cinerea* L., living or dead, in the study area.

Lauraceae

Lindera benzoin (L.) Blume—24876 (B), 25293 (F), 24650 (H), 24762 (M), 25088 (N), 25019 (R). Various disturbed, degraded, and intact habitats; one of the most common shrubs in this area of Kentucky.

Sassafras albidum (Nuttall) Nees—22419 (B), 25285 (F), 24647 (H), 24718 (M), 25114 (N), 25027 (R). Various habitats; common.

Magnoliaceae

Liriodendron tulipifera L.—24853 (B), 25305 (F), 24627 (H), 24717 (M), 25018 (R). Mesic woods; rare in Bluegrass, progressively more common eastward.

Malvaceae

Hibiscus syriaca L.—24761 (M). Introduced; escaped along roadside; rare, but to be expected more commonly in the future.

Menispermaceae

Menispermum canadense L.—24877 (B), 25246 (F), 24592 (H), 24760 (M), 25164 (N), 24998 (R). Various habitats, more frequent in highly disturbed situations, such as fencerows and rights-of-way; common.

Mimosaceae

Albizia julibrissin Durazzini—25216 (F). Introduced; possibly persistent after cultivation, or possibly an escape.

Moraceae

Broussonetia papyrifera (L.) Ventenat—24719 (M). Introduced; an escape into highly disturbed habitat.

Maclura pomifera (Raf.) C.K. Schneider—24859 (B), 25337 (F), 24684 (H), 24768

(M), 25156 (N), 25076 (R). Various disturbed habitats; common.

Morus alba L.—24948 (B), 25319 (F), 24669 (H), 24818 (M), 25182 (N), 25078 (R). Introduced; roadsides and other disturbed habitats; occasional.

Morus rubra L.—24904 (B), 25290 (F), 24679 (H), 24779 (M), 25161 (N), 25008 (R). Mesic slopes and alluvial terraces; infrequent, but more common eastward.

Oleaceae

Chionanthus virginica L.—25300 (F). Upland woods; occasional; Knobs.

Fraxinus americana L.—24902 (B), 25296 (F), 24667 (H), 24811 (M), 25171 (N), 25007 (R). Woodlands and woodland remnants; common.

Fraxinus pennsylvanica Marshall—24949 (B), 25204 (F), 24596 (H), 24723 (M), 25137 (N), 25060 (R). Alluvial terraces and stream margins; common.

Fraxinus quadrangulata Michaux—24938 (B), 25325 (F), 24618 (H), 25141 (N), 24983 (R). Various wooded habitats but most common on south- and west-facing xeric woodlands and stream bluffs; frequent.

Ligustrum sinense Louriero—24851 (B), 24602 (H), 24804 (M). Introduced; escaped to waste places, highly disturbed habitats and alluvial woods. Most common near the Ohio River.

Ligustrum vulgare L.—24951 (B), 24785 (M), 25190 (N). Introduced; escaped to highly disturbed habitats. Most common in the Ohio River corridor.

Platanaceae

Platanus occidentalis L.—24941 (B), 25253 (F), 24630 (H), 24787 (M), 25149 (N), 25044 (R). Most common in low ground, but also in other situations; frequent.

Poaceae

Arundinaria gigantea (Walter) Chapman—25355 (N). Wooded ravine; extremely rare.

Ranunculaceae

Clematis virginiana L.—24954 (B), 25257 (F), 24700 (H), 24742 (M), 25175 (N), 25070 (R). Low ground along streams and woodland margins; infrequent.

Rhamnaceae

Rhamnus caroliniana Walter—25197 (F), 24743 (M). Deciduous woods and disturbed rights-of-way. Very rare in Bluegrass, infrequent in Knobs.

Rhamnus lanceolata Pursh—25200 (F), 24693 (H). Only two populations noted: one on a wooded alluvial terrace (Bluegrass), the other in highly disturbed upland habitat (Bluegrass-Knobs border).

Rosaceae

Amelanchier arborea (Michaux f.) Fernald—25297 (F). Deciduous woods, occasional; Knobs.

Crataegus calpodendron (Ehrh.) Medikus—24863 (B), Meijer, Setser, and Meade 1190 = MDKY #1190 (F), 24594 (H), 25097 (N), 25063 (R). Upland roadsides, blufftops, and woodland margins; infrequent.

Crataegus coccinea L.—25211 (F), 24612 (H), 25121 (N). Woodland margins and disturbed habitats; infrequent.

Crataegus crus-galli L.—25238 (B), 24685 (F), 24812 (M), 25126 (N). Upland disturbed sites and woodland margins; infrequent.

Crataegus flabellata (Bosc) K. Koch—25208 (F), 24590 (H), 25113 (M), 25064 (R). Upland disturbed sites and woodland margins; infrequent.

Crataegus mollis (Torrey and Gray) Scheele—24863 (B), 24678 (H), 24817 (M), 25158 (N). Mainly in fencerows and on blufftops; infrequent.

Crataegus pruinosa (Wendland) K. Koch—24862 (B). Disturbed woodland; rare.

Malus angustifolia (Aiton) Michaux—25341 (F), 25118 (N). Only two populations noted: open field (Bluegrass); low woods along creek (Knobs). Rare.

Malus coronaria (L.) Miller—24932 (B), 25247 (F), 24683 (H), 24815 (M). Upland woodland margins and fencerows; rare.

Malus sylvestris (L.) Miller (= *M. pumila* of some authors)—25318 (F), 24765 (M), 25152 (N), 24974 (R). Introduced; fencerows and other ruderal habitats; infrequent.

Physocarpus opulifolius (L.) Maxim.—G.F. Buddell II #2206, in KNK (B).

Prunus americana Marshall—24857 (B), 25245 (F), 24589 (H), 24714 (M), 25144

- (N), 24984 (R). Forest remnants, disturbed woods, and fencerows; frequent.
- Prunus cerasus* L.—25219 (F). Introduced; adventive, adjacent to road right-of-way.
- Prunus mahaleb* L.—24935 (B), 24690 (H), 24745 (M), 25133 (N), 25034 (R). Introduced; roadcuts and rights-of-way; infrequent.
- Prunus mexicana* S. Watson—24905 (B), 24639 (H), 24715 (M), 25122 (N), 24981 (R). Forest remnants, disturbed woods, and fencerows; frequent.
- Prunus munsoniana* Wight and Hedrick—25214 (F). Ridgetop in deciduous woods, Mississippian Plateau (Knobs); rare.
- Prunus persica* (L.) Batsch—25213 (F), 24687 (H), 24806 (M), 25178 (N), 24963 (R). Introduced; fencerows and other ruderal habitats; infrequent.
- Prunus serotina* Ehrhart—24919 (B); 25304 (F), 24637 (H), 24775 (M), 25169 (N), 25042 (R). Most habitats; common.
- Pyrus calleryana* Decne.—24884 (B), 25209 (F), 24595 (H), 24816 (M), 25117 (N), 25059 (R). Introduced; roadsides, margins of blufftop woods; infrequent.
- Rosa carolina* L.—24858 (B), 25274 (F), 24659 (H), 24735 (M), 25099 (N), 25009 (R). Upland deciduous woods and glades; frequent.
- Rosa multiflora* Thunberg—24916 (B), 25283 (F), 24658 (H), 24786 (M), 25159 (N), 25035 (R). Introduced; most habitats, common. At present, the worst woody weed in our study area.
- Rosa setigera* Michaux—24895 (B), 24591 (H), 24741 (M), 25092 (N), 25075 (R). Fencerows, low rights-of-way; common.
- Rosa virginiana* Miller—24680 (H). This is apparently the first report of this species from the Bluegrass (Browne and Athey 1992). However, because Medley (1993) rejected the notion that the species occurs in Kentucky, this collection actually may represent the first verified occurrence of the species in the state. Fencerow; rare.
- Rosa wichuraiana* Crepin—24953 (B), 24601 (H), 24822 (M). Introduced; roadsides and fencerows; infrequent, but undercollected.
- Rubus allegheniensis* T.C. Porter—25308 (F). Various habitats, Knobs.
- Rubus argutus* Link—24881 (B), 25346 (F), 24675 (H), 24803 (M), 25150 (N), 24993 (R). Various habitats; common.
- Rubus flagellaris* Willd. (incl. *R. enslenii* Tratt.)—24634 (H), 24995 (R). Deciduous woods; infrequent, but undercollected.
- Rubus occidentalis* L.—24866 (B), 25248 (F), 24674 (H), 24784 (M), 25165 (N), 24994 (R). Upland and lowland woods and various disturbed habitats; frequent.
- Rubus trivialis* Michaux—25331 (F), 25083 (R). Fencerows; rare.
- Spiraea tomentosa* L.—Meijer, Setser, and Meade #1223, in MDKY (F). Wooded upland swamp.
- Rubiaceae
- Cephalanthus occidentalis* L.—24944 (B), 25236 (F). Margin of Ohio River backwater; upland swamp; rare.
- Rutaceae
- Ptelea trifoliata* L.—25321 (F), 24607 (H), 25185 (N). Bluffs along major streams; common in habitat but absent elsewhere.
- Zanthoxylum americanum* Miller—24931 (B), 25198 (F), 24641 (H), 24737 (M), 25085 (N), 25000 (R). Xeric bluffs and slopes, usually south- or west-facing; common in habitat, absent elsewhere.
- Salicaceae
- Populus alba* L.—24865 (B), 25194 (F), 24626 (H), 24725 (M), 25098 (N), 25065 (R). Introduced; spreading from cultivation at old home sites, fencerows, and ruderal habitats; occasional.
- Populus deltoides* Bartr. ex Marshall—24840 (B), 25340 (F), 24686 (H), 24795 (M), 24973 (R). Low ground; occasional to rare, nowhere common.
- Populus grandidentata* Michaux—25242 (F). Old roadcut; rare. Apparently absent from Bluegrass area.
- Salix alba* L.—25108 (N). Introduced; established along Brushy Creek.
- Salix caroliniana* Michaux—24848 (B). Backwater of Ohio River, apparently absent from other parts of study area.
- Salix discolor* Muhl.—J. Campbell, 16 May 1992, UKY (F).
- Salix exigua* Nuttall—24846 (B), 25240 (F), 24706 (H), 24797 (M), 25135 (N), 24971 (R). Open stream corridors; common.

Salix nigra Marshall—24942 (B), 25237 (F), 24705 (H), 24821 (M), 25135 (N), 24971 (R). Open stream corridors; occasional.

Salix sericea Marshall—25261 (F). Open, upland swamp; rare.

Simaroubaceae

Ailanthus altissima (Miller) Swingle—24955 (B), 25212 (F), 24604 (H), 24780 (M), 25130 (N), 25082 (R). Introduced; disturbed habitats (mature trees; seedlings are found in almost all habitats). Occasional, but obviously accelerating in its rate of naturalization.

Smilacaceae

Smilax glauca Walter—24861 (B), 25267 (F), 24645 (H), 25101 (N). South-and west-facing wooded slopes, fencerows; infrequent.

Smilax hispida Muhl.—24958 (B), 25279 (F), 24652 (H), 24759 (M), 25119 (N), 25071 (R). Most habitats; common.

Smilax rotundifolia L.—25302 (F). Various habitats; Knobs.

Staphylea trifolia L.—24930 (B), 25323 (F), 24608 (H), 24740 (M), 25086 (N), 25066 (R). Mesic woods; frequent.

Tiliaceae

Tilia americana L. var. *americana*—24888 (B), 25231 (F), 24615 (H), 24749 (M), 25127 (N), 24987 (R). Mesic woods; frequent.

Ulmaceae

Celtis occidentalis L.—24907 (B), 25301 (F), 24672 (H), 24773 (M), 25168 (N), 24999 (R). Various habitats, less frequent in the Knobs; one of the most common trees in this part of Kentucky.

Celtis tenuifolia Nuttall (= *C. occidentalis* var. *georgiana* of some authors)—25330 (F), 24599 (H), 24965 (R). Upland xeric habitats, fencerows; infrequent.

Ulmus americana L.—24960 (B), 25256 (F), 24663 (H), 24805 (M), 25157 (N), 25043 (R). Various upland and low habitats; common.

Ulmus pumila L.—24843 (B), 24792 (M). Introduced; adventive in counties bordering the Ohio River.

Ulmus rubra Muhl.—24900 (B), 25249 (F), 24691 (H), 24766 (M), 25192 (N). Mesic

wooded and disturbed slopes, stream bluffs; frequent.

Ulmus thomasi Sargent—24616 (H). Wooded stream bluff; rare.

Viscaceae

Phoradendron serotinum (Raf.) Johnst.—Thompson and Thompson #89-150, in KNK (B), Thompson and McLaughlin #88-3217, in MDKY (F), 24620 (on *Ulmus thomasi*, see above)(H), Thompson #88-3223, in KNK (M), Thompson and Denton #89-3015, in MDKY (R). Less frequently encountered northward.

Vitaceae

Ampelopsis cordata Michaux—24849 (B), 25046 (H), 24727 (M), 25046 (R). Stream-banks, low open ground, and fencerows; sometimes frequent but rare or absent in Knobs.

Parthenocissus quinquefolius (L.) Planchon—24922 (B), 25316 (F), 24673 (H), 24752 (M), 25163 (N), 25016 (R). Most habitats; common.

Vitis aestivalis Michaux—24911 (B), 25317 (F), 25053 (H), 24997 (R). Roadsides and dry woods; common in Knobs, rare in Bluegrass.

Vitis riparia Michaux—24794 (M). Low ground along Ohio River; rare or absent elsewhere.

DISCUSSION

Habitats

Before embarking on this study, we were aware that most of the study region had a long history of intensive post-settlement land use. However, we were frankly surprised at the present extent of its effects. Most natural habitats in this region have been completely destroyed or degraded beyond recognition. Even though one does not encounter extensive row crops in this part of the Bluegrass, most of the uplands in this rolling country have been completely cleared, or only remnant, highly disturbed, young-aged woodlots remain. Down-slope from uplands, where steeper terrain often militates against row cropping, land is most often relegated to pasture. Cattle (and, we suspect, very high populations of white-tail deer, *Odocoileus virginianus*) range through forested slopes and small creek bottoms,

fenced off only from dwellings and roadways. As a result, most of the native herbaceous forest flora has been eliminated, woody plants do not regenerate naturally, and exotic species (such as *Lonicera maackii* and *Rosa multiflora*) are favored over natives. Oak regeneration has practically been eliminated in most of this part of the northern Bluegrass; scarlet oak (*Quercus coccinea*) probably will disappear from this part of the Bluegrass within the near future.

In situations such as this, highway rights-of-way and fencerows sometimes act as refugia for elements of the flora. However, in this part of Kentucky, this limited habitat is under frequent assault from the heavy application of herbicides along public roadways. Typically, this results in the elimination of most herbaceous and seedling woody dicots, not only along the roadway but as far as the sprayer can reach into the forest, and the invasion and herbaceous stratum dominance of species such as *Festuca* spp. and *Phalaris arundinacea* are encouraged. In other words, herbicide spraying is eliminating one of the very few habitats remaining in the Bluegrass for native plants. It is a purposeful, all-out assault by the State on its native plants.

As a result of these land-use patterns and prolonged exclusion of fire as an environmental factor, habitats of high quality in our study area were few and far between. In our opinion, the remnant site we encountered (other than Quiet Trails Nature Preserve [Harrison Co.], within which we did not collect) with highest natural value was within Clay Wildlife Management Area in Nicholas County. In our opinion, portions of Clay Wildlife Management Area should be managed as a natural area to protect what has been lost elsewhere in the region. In addition, we recommend that all remaining forested steep bluffs encountered along the Licking River and its major tributaries should receive protection. Without these remnant habitats, a significant percentage of the native woody species in this region would vanish entirely.

Distribution Patterns

We feel our study area is large enough to indicate some possible geographic distributional patterns of woody plant occurrence but too small to produce definitive evidence.

However, four distributional patterns pertinent to the woody flora have emerged within the study area as a result of the evidence we compiled. These distributional categories are (1) an apparent distributional discontinuity between the northern Bluegrass and northern Knobs; (2) plants whose distribution seems related to the Ohio River corridor; (3) noteworthy rarities; and (4) significant weeds.

Category 1. Within the area we studied, it is apparent that there is a sharp distributional divide between the Bluegrass and Knobs. The following species occur in the Knobs but appear to be entirely missing from the Bluegrass. Plants present in the Knobs and absent from the Bluegrass (during this study) include all species of *Ericaceae* (six species), *Acer rubrum*, *Amelanchier arborea*, *Aralia spinosa*, *Betula nigra*, *Chionanthus virginica*, *Hamelis virginiana*, *Liquidambar styraciflua*, *Hypericum stragulum*, *Nyssa sylvatica* var. *biflora*, *Pinus* (three species), *Populus grandidentata*, *Prunus munsoniana*, *Quercus montana*, *Rosa palustris*, *Rubus allegheniensis*, *Salix sericea*, *Smilax rotundifolia*, and *Viburnum acerifolium*. This means that more than 19% of native woody plant taxa occurring in the Knobs apparently do not occur in the adjacent northern Bluegrass. This is a significant discontinuity; reasons for it are hypothetical. One possible explanation could relate to edaphic factors, which affect mycorrhizae; the latter are known to be favored by acid soil. Members of *Ericaceae* and *Pinaceae* will grow if planted in the northern Bluegrass, but perhaps germination and establishment are selected against in Bluegrass soils. Also, it is well known to nurserymen that some species undergo mineral deficiency stress in dry alkaline soils; *Acer rubrum* is one of those species. We hypothesize that the combination of periodic drought, conditions unfavorable to mycorrhizae, and fire may have been major factors that prevented the establishment of seed sources in the Bluegrass, without which sustaining populations of some plants could not persist. One additional word about this distributional discontinuity is that, if one were to include the Cumberland Plateau (not far to the east of the study area), the floristic discontinuity becomes much more striking (includes *Ilex* spp., *Magnolia* spp., etc.). This issue might be a fruitful possibility for autecological investigations.

Category 2. A second recognizable group of woody plants is composed of those that are either confined to the Ohio River corridor or are found only in the Knobs and Ohio River corridor. As we define it here, the Ohio River corridor includes the Ohio River bottomlands, adjacent bluffs, and small streams draining directly into the Ohio River. Plants apparently confined closely to the Ohio River in our study area include *Amorpha fruticosa*, *Physocarpus opulifolius*, *Rhus typhina*, and *Salix caroliniana*. Those associated with the Ohio River and the Knobs but not found in the Bluegrass interior include *Aesculus flava*, *Alnus serrulata*, and *Cornus amomum* var. *schuetzeana*. This physiographic feature (i.e., the river corridor) may actually serve as a migration pathway for some species around the apparent barrier of the northern Kentucky Bluegrass region.

Category 3. Plants that are rare in the study area include those that are confined to particular habitats, as well as those that are in an attenuated portion of their ranges. Plants we would single out in this category include several plants confined to steep or gladelike bluffs (*Bignonia capreolata*, *Rhus aromatica*, *Ulmus thomasi*); those near the edges of their ranges (*Malus angustifolia*, *Nyssa sylvatica* var. *biflora*, *Prunus munsoniana*, *Quercus coccinea*, *Rhamnus lanceolata*, *Rosa virginiana*, and *Ulmus thomasi*).

Perhaps the most surprising rare taxon we encountered is *Arundinaria gigantea*. A few early informal accounts waxed eloquent on the extensive canebrakes in Kentucky, and these accounts seem to have been repeated endlessly by later writers. Perhaps it was true at one time. However, at the present time in our study area, *Arundinaria* is among the rarest of woody plants. We extensively but fruitlessly searched for it and even offered rewards for its discovery. Eventually, Dr. Wendell Kingsolver of Nicholas County took the senior author to a single population on his land. According to him, cane in the northern Bluegrass was once widespread but now has been reduced to a few small, isolated populations along main stem of the Licking River by a combination of grazing by cattle and long-time use of the stems for "jig poles," or throw-away, temporary fishing poles. Kingsolver (pers. comm.) stated that protection of the small (<2

ha) canebrake on his land from cattle grazing and pole collecting has allowed it to increase considerably in area, and ramets have been used to re-establish cane in another location where an extensive canebrake was completely extirpated.

Category 4. On the whole, we determined that 11% of the woody plant taxa of this region is not native. (See Table 1.) Many of these plants are not especially noticeable weeds at the present time. One of them (*Thuja orientalis*) is reported herein for the first time as an escape in Kentucky. Others (not included in our statistics) are plants whose native ranges are becoming obscured because they are both native and escaped from cultivation (e.g., *Juglans nigra*, *Liriodendron tulipifera*, *Maclura pomifera*, and *Quercus palustris*).

However, there are some significant exotic weeds and, based on the senior author's personal experience, few of these have reached their zeniths. The impact of most of these will increase with time, but some are more aggressive invaders than others. Non-native exotics escaped in our study area include the following (those marked with an asterisk were vouchered from a minimum of five counties): *Ailanthus altissima*,* *Albizia julibrissin*, *Berberis thunbergii*, *Broussonetia papyrifera*, *Celastrus orbiculatus*, *Elaeagnus umbellata*,* *Euonymus alatus*, *Euonymus fortunei*,* *Hedera helix*, *Hibiscus syriaca*, *Lespedeza bicolor*, *Ligustrum sinense*, *Ligustrum vulgare*, *Lonicera japonica*,* *Lonicera maackii*,* *Malus sylvestris*, *Morus alba*,* *Philadelphus coronarius*, *Populus alba*,* *Prunus cerasus*, *Prunus mahaleb*,* *Prunus persica*,* *Pyrus calleryana*,* *Rosa multiflora*,* *Rosa wichuraiana*, *Salix alba*, *Ulmus pumila*, and *Vinca minor*. From our field observations, *Lonicera japonica* and *Rosa multiflora* have the greatest negative ecological impact at present. However, *Ailanthus altissima*, *Celastrus orbiculatus*, *Euonymus fortunei*, and *Lonicera maackii* are showing signs of rapid establishment and have the potential for very significant negative impacts within a few years. One omission readers may note is *Paulownia tomentosa* (Thunb.) Steudel; though it appears not to be established in the study area yet, doubtless that will happen soon.

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LITERATURE CITED

- Anonymous. 1997. Kentucky atlas & gazetteer. Delorme, Yarmouth, ME.
- Anonymous. 2000a. "Kentucky Atlas & Gazetteer: Kentucky Counties." <http://www.uky.edu/KentuckyAtlas/kentucky-counties.html> (25 May 2000).
- Anonymous. 2000b. "International Plant Name Index." <http://www.ipni.org/> (28 Dec 2000).
- Braun, E. L. 1950. Deciduous forests of eastern North America. Hafner Publishing Company, New York, NY.
- Browne, E. T., and R. Athey. 1992. Vascular plants of Kentucky: An annotated checklist. Univ. Press Kentucky, Lexington, KY.
- Bryant, W. S. 1987. Actual and potential vegetation of the bluegrass region. Pages 17–19 in J. M. Baskin, C. C. Baskin, and R. L. Jones (eds). The vegetation and flora of Kentucky. Kentucky Native Plant Society, Richmond, KY.
- Campbell, J. J. N. 1980. Present and presettlement forest conditions in the inner Bluegrass of Kentucky. Ph.D. Dissertation. Univ. Kentucky, Lexington, KY.
- Fenneman, N. M. 1938. Physiography of eastern United States. McGraw-Hill, New York, NY.
- Gleason, H. A., and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada, 2nd ed. New York Botanical Garden, Bronx, NY.
- Guetig, R. G. 1993. The vascular flora of Estill County, Kentucky. M.S. thesis, Eastern Kentucky Univ., Richmond, KY.
- Hardin, J. W. 1979. *Quercus prinus* L.—nomen ambiguum. *Taxon* 28:355–357.
- Harlow, W. M., E. S. Harrar, J. W. Hardin, and F. M. White. 1996. Textbook of dendrology. 8th ed. McGraw Hill, New York, NY.
- Holmgren, P. K., and N. H. Holmgren. 2000. "Index herbariorum." [8th edition, updated 28 Mar 2000] <http://www.nybg.org/bsci/ih/ih.html> (25 Dec 2000).
- Jones, R. L., D. A. Eakin, and R. C. Clark. 1995. Index herbariorum kentuckiensis III. *Trans. Kentucky Acad. Sci.* 56:138–140.
- Karan, P. P., and C. Mather (eds). 1977. Atlas of Kentucky. Univ. Press Kentucky, Lexington, KY.
- Küchler, A. W. 1964. Potential natural vegetation of the conterminous United States. *Am. Geogr. Soc. Spec. Publ.* 36. [includes map]
- Little, E. L., Jr. 1971. Atlas of United States trees, Vol. 1. Conifers and important hardwoods. U.S.D.A. Misc. Publ. 1146. U.S. Gov. Printing Office, Washington, DC.
- Little, E. L., Jr. 1977. Atlas of United States trees, vol. 4, minor eastern hardwoods. U.S.D.A. Misc. Publ. 1342. U.S. Gov. Printing Office, Washington, DC.
- McDowell, R. C., G. J. Grabowski, Jr., and S. L. Moore. 1981. Geologic map of Kentucky. U.S. Geological Survey, in cooperation with Kentucky Geological Survey. Publisher not listed (presumably U.S.G.S.), Reston, VA.
- Martin, W. H., W. S. Bryant, M. E. Wharton, and J. B. Varner. 1979. The blue ash-oak savanna-woodland, a remnant of presettlement vegetation in the Inner Bluegrass of Kentucky. *Castanea* 45:149–165.
- Medley, M. E. 1993. An annotated catalog of the known or reported vascular flora of Kentucky. Ph.D. Dissertation. Univ. Louisville, Louisville, KY.
- Puetz, C. J. Kentucky County Maps. Thomas Publications, Lyndon Station, WI. In press.
- Rehder, A. 1940. Manual of cultivated trees and shrubs. Macmillan Co., New York, NY.
- Stone, D. E. 1997. Juglandaceae. Pages 416–428 in Flora of North America Editorial Committee (ed). Flora of North America north of Mexico, Vol. 3. Oxford Univ. Press, New York, NY.
- Taylor, D. J. (ed). 1995. Kentucky Alive! A report of the Kentucky Biodiversity Task Force. Commonwealth of Kentucky, Frankfort, KY.
- U.S. Geological Survey (ed). 1976. Louisville, Ky.; Ind.; Ohio 1:250,000 quadrangle, revised 1969. U.S. Geological Survey, Reston, VA.
- U.S. Geological Survey (ed). 1978. Huntington, W.Va.; Ky.; Ohio 1:250,000 quadrangle, revised 1977. U.S. Geological Survey, Reston, VA.
- Walker, J. R. 1995. "The Columbia guide to online style." Version 1.3. <http://www.cas.usf.edu/english/walker/mla.html> (25 May 2000).
- Wunderlin, R. P. 1997. Moraceae, *Morus*. Pages 390–392 in Flora of North America Editorial Committee (ed). Flora of North America north of Mexico, Vol. 3. Oxford Univ. Press, New York, NY.



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