AMERICAN MISTLETOE (*PHORADENDRON LEUCARPUM* SSP. *LEUCARPUM*, VISCACEAE) OCCURRENCE IN HOST TREES WITHIN THE CITY OF CAIRO, ALEXANDER COUNTY, ILLINOIS, AND ITS INCIDENCE IN ILLINOIS, U.S.A.

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ABSTRACT

A comprehensive survey of American mistletoe [*Phoradendron leucarpum* (Raf.) Reveal & M.C. Johnston ssp. *leucarpum*, Viscaceae] occurrence in host trees was conducted within the incorporated city limits of Cairo, Illinois, from 2011–2013. An extensive herbaria search for Illinois mistletoe specimens was completed in 2012, and a mistletoe reconnaissance was also made in 2013 to verify its present occurrence within 14 southern Illinois counties. Cairo, a historic river city and the county seat of Alexander County, is the southernmost city in Illinois, near the confluence of the Ohio and Mississippi Rivers. In Cairo, *Phoradendron leucarpum* ssp. *leucarpum* was observed in 547 host trees among 13 tree species (9 native, 4 introduced exotics). The two predominate host trees documented were *Acer saccharinum* (304 trees) and *Ulmus americana* (111 trees). The mistletoe occurrence value of Cairo is 13.41 host trees per km, the highest incidence of American mistletoe and greatest number of host species for a city of its size in Illinois. A statewide assessment of 19 southern Illinois counties resulted in 225 mistletoe specimens examined: 52 specimens collected in Cairo, 97 annotated from herbarium searches, and 76 additional specimens collected during the 14 county mistletoe host tree survey. Twenty-one host tree species were documented among those herbarium specimens. The top three host tree species by Illinois counties were *Ulmus americana* (16), *Acer saccharinum* (8), and *Nyssa sylvatica* (8). New North American mistletoe host trees documented were *Acer palmatum*, *Betula utilis* ssp. *jacquemontii*, and *Styphnolobium japonicum*. Duration of low winter temperatures has been the determining factor in the northern extension of mistletoe in southern Illinois over time.

Key Words: American mistletoe, distribution, host trees, mistletoe occurrence, *Phoradendron leucarpum* ssp. *leucarpum*, Viscaceae, Cairo, Alexander County, Illinois counties

RESUMEN

Un estudio exhaustivo de la ocurrencia de muérdago americano [*Phoradendron leucarpum* (Raf.) Reveal & MC Johnston ssp. *leucarpum*, Viscaceae] en los árboles hospedadores se llevó a cabo dentro de los límites incorporados de la ciudad de Cairo, Illinois, entre 2011-2013. Se completó una extensa búsqueda para especímenes de herbario de muérdago de Illinois en 2012, y también se hizo un reconocimiento secundario de muérdago en 2013 para verificar su ocurrencia actual en 14 condados del sur de Illinois. Cairo, una ciudad ribereña histórica vieja y el asiento del Condado de Alexander, es la ciudad más meridional de Illinois, cerca de la confluencia de los ríos Ohio y Mississippi. *Phoradendron leucarpum* ssp. *leucarpum* se observó en 547 árboles huéspedes entre 13 especies de árboles (9 nativas, 4 exóticas introducidas). En Cairo, los dos árboles hospedadores predominante documentados eran *Acer saccharinum* (304 árboles) y *Ulmus americana* (111 árboles). El valor ocurrencia de muérdago de Cairo es 13.41 árboles hospedadores por km, la mayor incidencia de muérdago americano y el mayor número de especies huéspedes para un área de su tamaño en Illinois. Una evaluación del estado resultó en 225 especímenes de muérdago examinados: 52 muestras recogidas en Cairo, 97 anotadas en la búsqueda de herbario, y 76 ejemplares adicionales recogidos durante una encuesta de los árboles huéspedes de muérdago en los condados del sur de Illinois. Veintiún especies de árboles de acogida diferentes fueron documentados de esos especímenes de herbario en 19 condados del sur de Illinois. Las tres principales especies de árboles hospedadores por condados de Illinois eran *Ulmus americana* (16), *Acer saccharinum* (8), y *Nyssa sylvatica* (8).

Palabras Clave: muérdago americano, distribución, árboles hospederos, presencia de muérdago, *Phoradendron leucarpum* ssp. *leucarpum,* Viscaceae, Cairo, condado de Alexander, condados de Illinois

INTRODUCTION

A survey of the incidence of *Phoradendron leucarpum* ssp. *leucarpum* (Viscaceae), herein, American mistletoe or mistletoe, in host trees within Cairo was conducted from March–December 2011, June 2012, and March–

April 2013. This Cairo survey is the first comprehensive American mistletoe survey for any Illinois town, city, or county.

Cairo, a famous historic river city in Alexander County, Illinois, was chosen as an excellent survey site for American mistletoe. This decision was made following preliminary reconnaissance in March 14, 2010, which revealed several species of mistletoe-infested host trees within the incorporated city boundary (Fig. 1). A comparable investigation of host trees infested with American mistletoe was recently completed for the historically significant city of Berea, Kentucky (Thompson et al. 2008).

While documenting mistletoe in Cairo, it also became evident little was known regarding the statewide distribution of this taxon. To conduct a complete study of American mistletoe for Cairo and the state of Illinois, a second essential objective of this study was to annotate the incidence of mistletoe documented by Illinois herbarium specimens. Fourteen state, regional, private, and major herbaria were surveyed for Illinois mistletoe specimens. All available mistletoe herbarium specimens from Illinois were examined to gather data on distribution in Illinois counties, collectors, dates, and host tree specificity through time. A third objective was to make a reconnaissance in 14 southern Illinois counties to currently document incidence of mistletoe-infested host trees.

AMERICAN MISTLETOE BIOLOGY

Reveal and Johnston (1957) established *Phoradendron leucarpum* (Raf.) Reveal & M.C. Johnston as the nomenclaturally correct name for American mistletoe. Abbott and Thompson (2011) made new combinations for three subspecific taxa within *P. leucarpum*, of which *P. leucarpum* ssp. *leucarpum* is the only infraspecific taxon native to the eastern United States.

American mistletoe is an epiphytic, dioecious, obligate hemiparasite on numerous deciduous host species in the eastern United States. This evergreen shrub is characterized by aerial shoots with opposite, simple, oval to ovate, coriaceous leaves, small spikes of tiny staminate and pistillate flowers on separate plants, and viscid, pearl-white, translucent one-seeded globular berries (Kuijt 1982, 2003; Fig. 2).

The principal dispersal agents of mistletoe fruits and seeds are avian vectors (Kuijt 2003). Birds spread mistletoe by ingesting the berries, defecating on branches, dislodging fruits, and wiping bills and feet during feeding, perching, and roosting (Thompson & Poindexter 2005; Thompson et al. 2008). The availability of host trees and birds are two important variables; moreover, the Mississippi Flyway corridor, which extends from upper Canada through Illinois to the Gulf Coast into South America, constitutes one of the most important flight pathways for bird travel and migration in the eastern United States. Nearly 50 percent of the 700–900 bird species in North America spend at least part of their lives in the Mississippi Flyway (Audubon 2013). Mistletoe has a clumped or aggregated spatial distribution pattern characteristic of ornithophily (Thompson & Noe, Jr. 2003; Thompson & Poindexter 2005).

In his *Monograph of Phoradendron*, Kuijt (2003) mapped the distribution range of American mistletoe [as: *Phoradendron serotinum* (Raf.) M.C. Johnston ssp. *serotinum*]. Its geographical range extends from New Jersey and Maryland southward through all Atlantic and Gulf Coastal States westward to central Texas, northeast Oklahoma, southeastern Kansas, east to Arkansas and Tennessee, southern Missouri, Illinois, Indiana, and Ohio, throughout Kentucky to west-central West Virginia and southern Pennsylvania. The geographical range of *Phoradendron leucarpum* ssp. *leucarpum* in the southeastern United States is southern intraneous (Thompson & Jones 2001) based on the geographical affinity model of Cain (1930). The geographical affinity of American mistletoe in southern Illinois is southern extraneous with its northernmost distribution limits primarily within a 160 km radius of the Mississippi Gulf Coastal Plain Province.

Winter climate is the determining factor of the northernmost extension of American mistletoe. Several botanists have reported the controlling factor on the northern distribution limits of mistletoe as low and prolonged winter freezing temperatures, e.g., Illinois (Schneck 1884a, b), Indiana (Deam 1932), Ohio (Spooner 1983), and Kentucky (Garman 1913; Thompson 2005). Coder (2008) reported climatic limits were the controlling features of the distributional range of American mistletoe and assessed the northern boundary to be

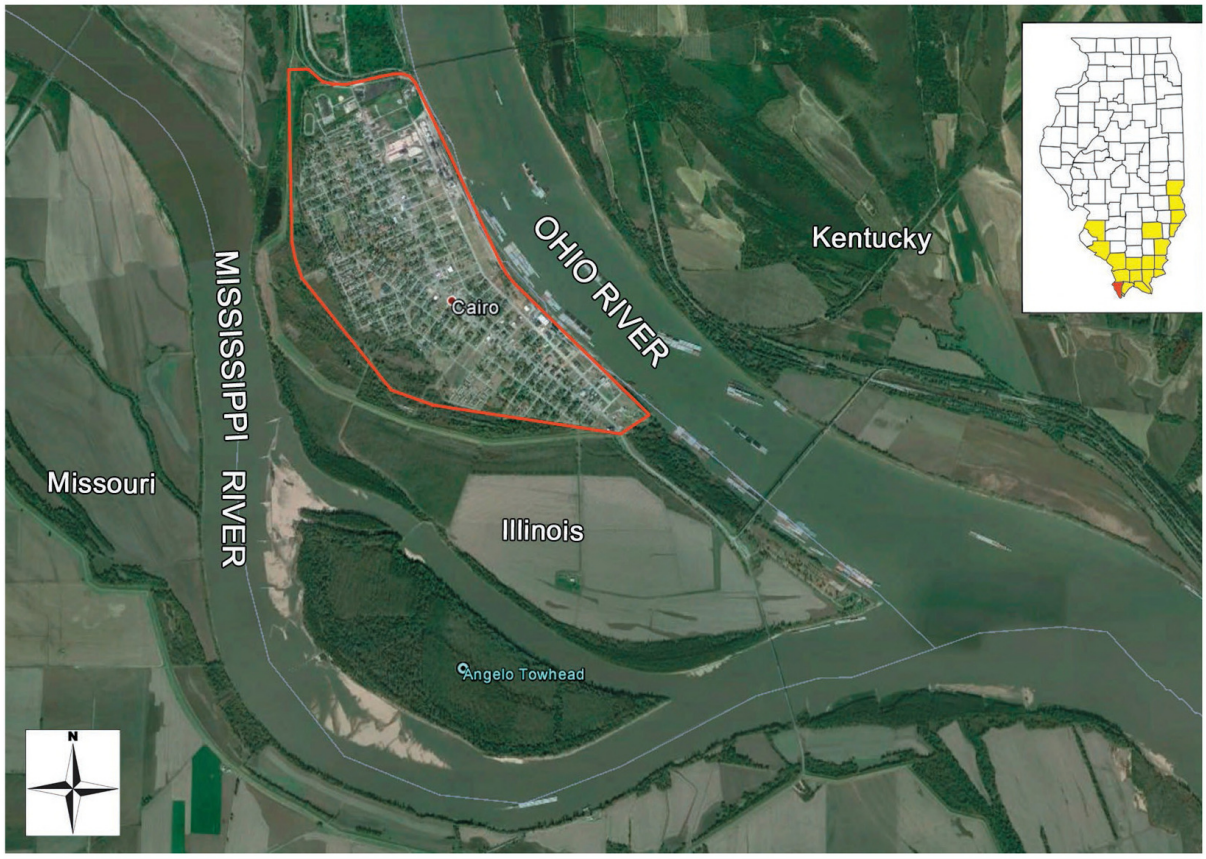

Fig. 1. Cairo incorporated city limits (red-lined boundary) in southern Alexander County near confluence of the Ohio and Mississippi Rivers.

Fig. 2. Pistillate clump of American mistletoe (*Phoradendron leucarpum* ssp. *leucarpum*) in Callery pear (*Pyrus calleryana*).

determined by the December minimum daily temperature being greater than -4.0°C. She also considered that the western edge of mistletoe was bounded by areas with a mean greater than 63.5 cm annual precipitation. Spooner (1983) determined the principal limiting factor of the northern expansion of mistletoe was directly correlated with the -4.5°C January mean minimum isotherm. He specifically mentioned that one of two exceptions to this isotherm was along the Wabash River Valley in southern Illinois. At this location, microclimates exist that are not incorporated into the gross climatological data. In southern Illinois, the northern range of American mistletoe lies within USDA Plant Hardiness Zone 6b (-17.78°C to -20.56°C) temperature range (USDA, ARS 2013).

CAIRO: THE STUDY SITE

History

Cairo, the southernmost city in Illinois and the county seat of Alexander County, served as an important steamboat port for cargo and commerce to New Orleans in the 19th century. The city is situated on a near level peninsula surrounded entirely by levees just north of Fort Defiance Park at the junction of the Ohio and Mississippi Rivers (Fig. 1). The Mississippi River is the largest river in discharge flow at its mouth and the Ohio River is the third largest river in discharge flow at its mouth in the United States (Kammerer 1990). Fort Defiance Park, a Union campsite and fort during the American Civil War, represents the southernmost land border within the Cairo Corporate Boundary and the lowest elevation in Illinois at 84 m above sea level (asl).

The first Europeans to discover the junction of the Ohio and Mississippi Rivers were the French Jesuit Jacques Marquette and explorer Louis Jolliet on their trip to map the Mississippi River in 1653. French Jesuit explorer Louis Hennepin made a campsite on the Cairo peninsula in 1660, and the first fort and tannery were built in 1702 by Pierre Charles Juchereau de St. Denys. By 1703, Native Americans had driven off the French, destroyed the village, and effectively curtailed European settlement for over 110 years (Weiser 2012).

On November 16, 1803, Meriwether Lewis, William Clark, and the Corps of Discovery Expedition "… landed on the point at which the Ohio and Mississippi form there [*sic*] junction…" (now Cairo, Alexander County, Illinois). The exploration party remained until November 21, 1803, to conduct scientific research before continuing up the Mississippi on their historic westward journey (Lewis et al. 2005). In 1818, John Comegys obtained a charter to establish a city on the peninsula by the convergence of the two rivers, but his plans never materialized due to lack of financial support. Nevertheless, Comegys coined "Cairo" as the name for the future city from his deduction that the Ohio River delta resembled the delta of the Nile River in Cairo, Egypt. Thereafter, "Cairo" and the "Little Egypt" area became standard usage throughout southern Illinois (Bradsby 1883; Lansden 1910; Lantz 1972). Cairo was founded in 1837 by the Cairo City and Canal Company, incorporated into a city in March 1858, and designated the county seat of Alexander County in 1860 (Bradsby 1883; Lansden 1910; Lantz 1972).

The 19th century history of Cairo has been well recorded including accounts of its pioneer settlements, major shipping port, building of factories, warehouses, levees, and canals, completion of the Illinois Central Railroad in 1854, occupation by the Union Army and Navy in April 1861 during the Civil War, decline of steamboat river commerce, and the severe effects of great floods (Bradsby 1883; Lansden 1910; Lantz 1972; Beadles 1990). Other past occurrences, such as the turbulent events of the 1967–1973 Civil Rights Movement, general decay of the city, and demographic changes in the mid-20th century, have also been reported (Lantz 1972; Ewing & Roddy 1996; Weiser 2012). According to the 2010 United States Census, the population of Cairo was 2381 individuals (Illinois Demographics 2013). Weiser (2012) described Cairo, Illinois, as a "ghost town," a historical city that left behind evidence of its previous glory.

Historical Mistletoe Literature Near Cairo

White (1997) presented significant references on the flora and vegetation of the nearby Cache River, and some reports directly pertained to American mistletoe along the Ohio River near or at the junction with the Mississippi River in Alexander County, Illinois.

The Journals of the Lewis and Clark Expedition (1803–1806) originally written by Meriwether Lewis were edited by G.E. Moulton two centuries later at the University of Nebraska (Lewis et al. 2005). These documents provide a unique introduction into the past vegetation of this area. Lewis et al. (2005) noted the abundance of large silver maple (*Acer saccharinum* L.), American elm (*Ulmus americana* L.), eastern cottonwood (*Populus deltoides* W. Bartram ex Marshall), and American sycamore (*Platanus occidentalis* L.) floodplain forests, and river cane [*Arundinaria gigantea* (Walter) Muhl.] thickets along the Ohio and Mississippi shorelines. On November 21, 1803, while moored near the confluence of the Ohio and Mississippi Rivers, Lewis et al. (2005) recorded:

…"from this place, I observed a large quantity of Misseltoe [*sic*] on the trees bordering on the river, on the main shore… in descending the Ohio, I furst [*sic*] observed this plant about the mouth of the Muskingum river [joins Ohio River, near Marietta]…it [mistletoe] continued increasing until I arrived at the mouth of the Ohio [junction of the Ohio and Mississippi, Alexander County, Illinois] and still continues in larger quantities on this [Mississippi] river than on the Ohio, in so much that the trees at this place were perfectly loaded with it."

On his trip down the Ohio River to the confluence of the Mississippi, Judge James Hall (1838) recorded in his *Notes on the Western States*:

"The mistletoe is seen hanging from the branches of the trees throughout the whole course of the Ohio. It becomes more abundant after passing Cincinnati, and is seen in the greatest profusion between Louisville and the mouth of the river [at Cairo]. This little plant never grows upon the ground, but with a very poetic taste, takes up its attic residence upon the limbs of the tallest trees. The berry which contains the seed, is so viscous as to adhere to the feet of birds, which carry it from tree to tree, and thus contribute to the propagation of this ornamental parasite."

In a letter to his northern Illinoisan friend J. Danforth, in December 24, 1861, Captain George Dodge (1861) at Camp McClernand wrote on the presence of mistletoe and the living conditions at Cairo:

"We are located about one and a half miles north of this city [Cairo], and almost on the only ground that I have seen which is susceptible of being drained. Standing here and there, thro' our camp is a number of stately sycamore trees, upon whose boughs hang pendant tufts of mistletoe, and which would, in almost any other place look very pretty, but here in this low, flat, muddy sink and hot-bed of diarrheas, ague, and fevers, although a rare thing to us of the north, [mistletoe] is hardly even looked at, and seldom mentioned."

Mistletoe was even commemorated during the Civil War, when a small steamboat tug, built in 1861 under the name *Restless* at St. Louis, was purchased by the Union Army early in the Civil War for service in the Western Naval Flotilla. In 1862, the tugboat was renamed, *USS Mistletoe*, after the "parasitic green shrub" (Mooney 1968). The tugboat then was transferred to the Navy at Cairo, Illinois, where it joined the Mississippi River Squadron toward the 1863 assault upon Vicksburg. After the Civil War in 1864, *USS Mistletoe* was decommissioned and sold at public auction in Mounds City, Illinois. It was renamed *Ella Wood* in 1866 and remained in merchant service until 1871 (Mooney 1968).

Cairo Location and Description

The land area inside the Cairo Corporate Boundary encompasses 1750 ha, and consists of Fort Defiance Park (22 ha), Angelo Towhead (311 ha), agricultural bottomland and floodplain forest (661 ha) southwest of Cairo, the Future City (40 ha), the Cairo Regional Airport (190 ha), and the incorporated city (526 ha) of Cairo (Soil Survey Staff 2013; Fig. 1). The study area for this mistletoe survey was restricted to the incorporated Cairo city limits situated within the Cairo Quadrangle (Fig. 1). The southern boundary lies just south of the Cairo Sewage Disposal Plant and Levee Road between latitude 36°59'38.976"N and longitude 89°9'15.768"W (at 95 m asl), and the northernmost border of the Illinois Central Railroad overpass levee (The Cairo Gate) is located at latitude 37°1'14.998"N and longitude 89°11'17.998"W (96 m asl). The eastern boundary is created by the concrete floodwall adjacent to the Ohio River (100 m asl), while the western boundary is determined by the top of the long earthen Levee Road (105 m asl) of the Mississippi River. The eastern and western levees then adjoin the northern levee of the 1903 Illinois Central Railroad bridge (Fig. 1).

Cairo is broadly bisected into western and eastern portions by US 51N to Washington Avenue then north-northeast on Sycamore Street towards Mounds, Illinois (Fig. 1). The major Cairo population resides in older neighborhoods primarily in the western section beyond Washington Street and Sycamore Street. The eastern half of the city is comprised of many fewer residences, a soybean oilseed processing company, the Bunge Cor-

poration of North America, and numerous abandoned, decaying commercial buildings, vacant lots, houses, and rubble among the dilapidated "Historic Downtown Cairo" district. However, Cairo has some fine examples of historic architecture listed in the National Register of Historic Places; e.g., Riverlore Mansion (1865), Magnolia Manor (1872), the U.S. Custom House Museum (1872), A.B. Safford Memorial Library (1883), at least nine stone churches dating from 1857 to 1964, and the American sculptor, George Grey Barnard's The Hewer (1906) bronze statue (Pilotlight 2005).

Physiography and Geology

Fenneman (1938) mapped extreme southern Illinois within the Southeastern Lowlands of the Mississippi Alluvial Plain of the Gulf Coastal Plain Province. Keys et al. (1995) classified extreme southern Illinois into the North Mississippi River Alluvial Plain Subsection, Mississippi Alluvial Basin Section of the Eastern Broadleaf Forest. Omernik (2007) mapped the southern Illinois area of Alexander County into the Mississippi Alluvial Plain. The Cairo Peninsula lies entirely within the Bottomlands Section of the northern extension of the unglaciated Gulf Coastal Plain Province (Leighton et al. 1993). Specifically, Cairo is situated within the Bottomland Section of the Gulf Coastal Plain Division of Alexander County (Schwegman et al. 1973; White 1997). Although the Bottomland Section of the Coastal Plain Division was not glaciated, the overall effects of outwash and alluvial deposits have largely determined the present physiography, soil development, and vegetation.

Nelson (2008) described the geology of Cairo and environs in detail from the Cairo Quadrangle. The geology of the Cairo Peninsula belongs to the Cahokia Formation with clayey deposits ranging from 8 to 52 m deep from the Holocene Stage of the Quaternary System. The superficial sediments from 5 to 10 m in depth consist of mottled medium to dark gray clay, silty clay, and silt containing very fine to fine sands with quartz and chert among organic matter (Nelson 2008).

Soils

The topography of incorporated Cairo is nearly level (<1.0–2.0% slope) with an elevation gradient of 94 to 97 m asl from southern to northern boundaries. Much of the soil in Cairo has initially been excavated and redeposited during construction to level roads, streets, and railways, levees, homes, and business enterprises due to its location on the great floodplain of the Mississippi and Ohio Rivers. The soil data are derived from Williams et al. (2007) and Soil Survey Staff (2013). The soils of Cairo (526 ha) are comprised mainly of one artificial earthy fill soil and seven major alluvial soil series on the broad floodplain bottomlands prior to enclosing the corporate city area within levees and flood walls.

Orthents (215 ha/40.9 % of Cairo area) are excavated, earthy fill materials that had been redeposited over the generally level Cairo floodplain and in construction of levees. Orthents are undulating to hilly 15–200 cm deep silty loams, moderately well drained, and strongly acidic in reaction (Williams et al. 2007; Soil Survey Staff 2013). The seven naturally deposited soils are Beaucoup (28 ha/5.4%), Cairo (27 ha/5.2%), Darwin (51 ha/9.6%), Gorham (49 ha/9.2%), Riley (37 ha/7.2%), Tice (89 ha/16.9%), and Ware (30 ha/5.6%). The seven alluvial silty clay to silty clay loam soils are very poorly drained to poorly drained to rarely moderately well-drained with very slow to slow permeability, and strongly acidic to moderately acidic to near neutral in reaction. The depth of these soils varies from 50 to 203 cm. Under natural seasonal bottomland flooding conditions, these alluvial soils are annually flooded and are deposited on existing sediments by the Mississippi and Ohio Rivers outside of the Cairo boundary (Parks & Fehrenbacker 1968).

Climate

The climate of Cairo is of the humid subtropical (Köppen Cfa) type (Rosenberg 2013). Precipitation at this mild mid-latitude tends to be spread relatively evenly throughout the year without a significant dry season. Summers are hot and humid with temperatures frequently nearing 32.2°C. The low elevation and proximity to the Mississippi and Ohio Rivers hold in the summer heat and the high humidity creates hot, muggy conditions. Winters are generally cool with mild periods due to the elevations and proximity to the rivers preventing strong winter lows and plunging temperatures. Winter climate is the major limiting factor to mistletoe distribution along the Ohio River in southern Illinois, Indiana, and Ohio, and the Mississippi River in southeastern Missouri and southern Illinois.

The Cairo area has the mildest climate in Illinois. Climate data for 1971–2000 are from Cairo 3 N Station 111166 (Midwest Regional Climate Center 2013). Mean annual temperature in Cairo is 14.7°C with the coldest month in January (0.7°C) and the warmest month in July (26.9°C). Mean annual precipitation is 121.5 cm and a mean snowfall of 24.4 cm. The least rainfall occurs in September (7.7 cm) and the most rainfall in April and May (each 12.1 cm). The longest growing season is 270 days, based on 0°C, and the median growing season is 228 days. The last freeze approximates April 9 and the first frost occurs around October 22.

Vegetation and Plant Communities

Braun (1950) classified the forest region at the northern extension of the Mississippi Gulf Coastal Plain in southern Illinois as Southeastern Evergreen Forest of Bottomland Hardwood Forest composition, while Küchler (1964) placed vegetation of the region in the Southern Floodplain Forest. Dyer (2006) in a reclassification of Braun's forest regions, subsequently mapped her Southeastern Evergreen Forest of the Mississippi Gulf Coastal Plain as the Mississippi Alluvial Plain Mesophytic Forest. Voigt and Mohlenbrock (1964) classified the lowland plant communities as Bottomland Forest in Alexander, Pulaski, Massac, and Pope Counties of southern Illinois. They recognized five floodplain types of vegetation-moisture classes in the adjacent Lower Wabash Valley that ranged from heavy-wet (littoral), wet (overflow bottom), wet-moist (overflow terrace), very moist (aggraded terrace), to moist floodplain. In the Bottomland Section of southern Alexander County, bottomland forests are mainly mesic floodplain, wet-mesic floodplain, and wet floodplain forest based on natural physical features (topographic elevation and aspect, soil moisture, reaction, and permeability, frequency and duration of flooding, geological substrate and glacial history), and species composition of woody flora and existing vegetation (White & Madany 1978; Taft & Mankowski 1997). The characteristic forest communities of the Bottomland Section at Horseshoe Lake Conservation Area in Alexander County, 27 km northwest of Cairo at 98 m elevation asl, are characterized as swamps, wetland marsh, wet floodplain, and wet-mesic floodplain forest (Basinger et al. 1997). Hosner and Minckler (1963) described tree species composition in a successional study of bottomland hardwood forest in southern Illinois, which included three Alexander County sites, as representative of a mixed soft-hardwoods forest.

Near Cairo and environs, lands disturbed by annual flooding and siltation are composed of wet floodplain forest, while seasonally flooded terraces are primarily wet-mesic floodplain forest. Species composition of wet floodplain forest along the Ohio and Mississippi Rivers is comprised of riparian trees, most of which also inhabit wet-mesic floodplain forest. Wet floodplain indicator trees are American sycamore, black willow (*Salix nigra* Marshall), box elder (*Acer negundo* L.), eastern cottonwood, river birch (*Betula nigra* L.), and sandbar willow (*Salix exigua* Nuttall). Characteristic hardwoods of wet-mesic forests include American elm, green ash (*Fraxinus pennsylvanica* Marshall), hackberry (*Celtis occidentalis* L.), honey locust (*Gleditsia triacanthos* L.), pin oak (*Quercus palustris* Muenchh.), red elm (*Ulmus rubra* Muhl.), sweetgum (*Liquidambar styraciflua* L.), and sugarberry (*Celtis laevigata* Willd.). These taxa are all present inside the levees of Cairo. Woody species richness and species diversity become higher in bottomlands as the moisture gradient progresses from wet floodplain to wet-mesic floodplain to mesic floodplain forest.

Nevertheless, the predominate plant community within the incorporated boundaries of Cairo consists of woody vegetation including natural remnants and cultivated taxa interspersed among the open graminoid Culturally Derived Community. This major community has been maintained throughout the past to present by anthropogenic disturbances (e.g., lawns, yards, streets borders and medians, parks, vacant lots, woodlots, and numerous other ruderal disturbed habitats).

The woody plant species growing and populating the Culturally Derived Community are mainly native species characteristic of wet floodplain and wet-mesic floodplain forests. Mesic floodplain forest of drier habitats includes those trees of wet and wet-mesic forest with the addition of black cherry (*Prunus serotina* Ehrh.), black walnut (*Juglans nigra* L.), pecan [*Carya illinoensis* (Wang.) K. Koch], red maple (*Acer rubrum* L.), and sugar maple (*A. saccharum* Marshall), among other species. Trees differ significantly in species composition in the open habitats through selective planting of ornamental native and exotic trees. Some natural wet-mesic floodplain woodlots and groves are established in Cairo through volunteering of natives and naturalization

of some exotic trees, e.g., Callery pear (*Pyrus calleryana* Decne.), paper mulberry [*Broussonetia papyrifera* (L.) L'Hér. ex Vent.], and tree-of-heaven [*Ailanthus altissima* (P. Mill.) Swingle]. The more abundant mistletoe-infested trees of floodplain habitats in the Culturally Derived Community tended to be characteristically mature, taller, open-canopied, and located in insolated areas.

METHODS AND MATERIALS

An intensive American mistletoe field survey was conducted within the incorporated city limits of Cairo during March–December 2011, June 2012, and March–April 2013. A vehicle odometer was utilized to record mileage traveled on all paved streets and unpaved gravel roads. Other terrain was traversed through walking reconnaissance. Cairo street maps from City Hall and enhanced Cairo topographic maps (Google Earth 2013) were extensively utilized as street, terrain, and GPS guides.

Nikon Monarch 5 ATB™ 8 × 42 binoculars were used to identify each specific host tree with visible aerial signs of mistletoe infestation or malformation (i.e., sprigs, clumps, clusters, cankerous swellings, leafless brooms, limb dieback). Each host was recorded by tree species, degree of mistletoe infestation, and precise Cairo location. Mohlenbrock (2002) was followed for native tree nomenclature, and USDA, NRCS (2013) was used for selected non-native trees.

The Mistletoe Infestation Index (MIS), a scale of infestation categories (Thompson et al. 2008), was followed and an inclusive index was given for host tree species: light infestation (1–10 clusters), moderate infestation (11–30), heavy infestation (31–100), and extensive infestation (101+). Hemmerly (1989) was used to derive a Mistletoe Occurrence Value (MOV), a spatial distribution pattern and relative abundance value of host trees per kilometer. This density factor is calculated by the total number of host trees divided by the total number of kilometers travelled.

Documentation of selected host trees was by collecting representative voucher specimens with a 12 m extendible fiberglass linesman pole. Each mistletoe voucher specimen was collected with a winter twig or leafy branchlet to substantiate the host tree species. Vouchers were mounted, labeled, and deposited in the Berea College Herbarium (BEREA). A duplicate set of representative mistletoe specimens will be distributed to ILLS (Appendix 1, 2), and other selected duplicate specimens will be sent to BRIT, EIU, MO, MU, and NCU. Acronyms for all herbaria follow Thiers (2014).

In 2012, to document Illinois distribution data of *Phoradendron leucarpum* ssp. *leucarpum*, all available Illinois mistletoe herbarium specimens were annotated from BEREA, EIU, F, ILL, ILLS, IND, ISM, KY, MO, MU, NCU, NY, OSU, and SIU. Descriptive data gathered from each American mistletoe specimen were Illinois county, location, habitat, host tree identification (when listed), collector(s), collector number [or *sino numero* (*s.n.*)], collection date, and herbarium depository.

During March 30–31 and April 1–2, 2013, a extensive mistletoe reconnaissance was made from 14 southern Illinois counties. The field search for mistletoe trees was focused in towns and cities and along terrain bordered by major rivers. In previous Kentucky mistletoe surveys [e.g., Thompson & Noe (2003), Thompson & Poindexter (2005), Thompson et al. (2008), Thompson & Evans (2010)], a high number of host trees were typically associated with urban areas. Wooded terrain along Illinois rivers and streams tend to provide more protected microclimates. Mohlenbrock (1990) reported American mistletoe as occasional from low woods in the southern 19 Illinois counties (Fig. 3). He noted 15 counties were contiguous to the river borders of the Mississippi, Ohio, Wabash, Cache, Saline, and other southern Illinois river tributaries.

The 2013 reconnaissance of 14 counties included the Mississippi River counties (Alexander, Union, Jackson, Randolph) eastward to Williamson and Saline counties, the Wabash River counties (Wabash, White, Gallatin), down the Ohio River counties (Gallatin, Hardin, Pope, Massac, Pulaski, Alexander), and the Cache River counties (Johnson, Pulaski, Alexander). This collecting trip covered portions of the Coastal Plain Province, Salem Plateau Section (Ozark Plateau Province), Mt. Vernon Hill Country, the Till Plains Section (Central Lowland Province), and Shawnee Hills Section (Interior Low Plateau Province) as delineated from the Illinois physiographic provinces map of Leighton et al. (1993).

Fig. 3. Nineteen Southern Illinois counties ranked by total identified mistletoe host tree species plus unidentified hosts (Note: Table 2): **1)** Alexander, **2)** Pulaski, **3)** Hardin,**4)** Union, **5)** Massac, **6)** Pope, **7)** Jackson, **8)** Johnson, **9)** Gallatin, **10)** Randolph, **11)** Wayne,**12)** Wabash, **13)** St. Clair, **14)** Crawford, **15)** Williamson, **16)** Saline, **17)** White, **18)** Lawrence, **19)** Clark.

RESULTS AND DISCUSSION

Mistletoe Survey in the city of Cairo, Alexander County

Phoradendron leucarpum ssp. *leucarpum* was recorded in 547 hosts among 13 tree species (9 native, 4 introduced exotics) within Cairo (Table 1). Predominate mistletoe-infested tree species were silver maple (304 trees) followed by American elm (111 trees). Other significant host trees in order of abundance were sugarberry (29), red maple (22), paper mulberry (17), Callery pear and green ash (16 each), sugar maple (14), and black walnut with 13 (Table 1).

From this Cairo inventory, nine host trees were documented for the first time in Illinois and are indicated by an asterisk (*). Five of these new host trees, green ash, red maple, river birch, sugarberry, and sugar maple, are native volunteers and/or planted. The remaining four hosts, Bradford pear, Himalayan white birch [*Betula utilis* D. Don. ssp. *jacquemontii* (Spach.) Winkl.], Japanese pagoda tree [*Styphnolobium japonicum* (L.) Schott], and paper mulberry, are planted and/or escaped exotics. Himalayan white birch and Japanese pagoda tree with a double asterisk (**), are new host tree records for North America (Table 1).

Seven of the eight host trees listed by Overlease and Overlease (2005) were documented in the Cairo survey (Table 1): American elm, black walnut, red maple, river birch, silver maple, sugarberry, and sugar maple. Although not found in Cairo specifically, the remaining taxon, white ash, listed by Overlease and Overlease (2005), was later documented in two counties. Silver maple and American elm were the highest two documented hosts in the Cairo study as recorded in the Illinois survey by Overlease and Overlease (2005).

Mistletoe occurrence often varied from one to over 100 clusters among hosts of the same species, and the MIS was highly correlated with number of overall host trees (Table 1). The host trees with MIS of only light infestation (1–10 clusters) were honey locust, Himalayan white birch, Japanese pagoda tree, and river birch. Host trees with moderate infestation (11–30 clusters) were black walnut, green ash, paper mulberry, red maple, and sugarberry. Host trees with heavy infestation (31–100 clusters) included American elm and silver maple, and a few older American elm and silver maple had extensive infestation (101+), which could lead to host mortality.

The majority of mistletoe-infested host trees were found in the Culturally Derived Community occupying older populated areas interspersed among open street shoulder margins, paved and unpaved gravel roadsides and medians, yards, city park lawns, church and school yards, and vacant city lots in Cairo proper. The 6.2 ha lawn of St. Mary's Park, established in 1872, had nine native or exotic planted tree species infested with mistletoe. Some host trees were present in wet floodplain forest along the shoreline and levees of the Mississippi and Ohio Rivers. Several other hosts inhabited small open-canopied groves or woodlot remnants of wet-mesic floodplain and mesic floodplain forests throughout non-residential areas within Cairo. More concisely, Cairo lacks any significant natural vegetated areas. Rather, the city is mainly comprised of land subjected to long-term anthropogenic disturbance or altered by bottomland flooding regimes.

As expected, few host trees with mistletoe were observed in the environs outside of the incorporated Cairo city limits. The most common mistletoe-infested host trees were typically also the most numerous canopy trees (i.e., silver maple and American elm). Those host trees in close proximity to each other generally appeared to facilitate greater mistletoe seed dispersal, which likely contributed to the increased aggregated (clumped) mistletoe distribution pattern observed within Cairo. Older and taller mature host trees characteristically formed open canopy crowns with better insolation for mistletoe success and provided greater infestation opportunities from avian vectors over time.

The Mistletoe Occurrence Value (MOV) from 547 mistletoe-infested trees per 40.8 km (25.2 mi) of roads was 13.41 in Cairo. This high density value is a result of the city focus, whereas countywide surveys include much larger expanses of non-urbanized land; e.g., Thompson and Noe (2003) recorded 3502 host trees from 15 tree species in traversing 805 km for a MOV of 4.35 host trees/km in Rockcastle County, and in Garrard County, Thompson and Poindexter (2005) documented 1740 host trees from 12 tree species in traveling 523 km for a MOV of 3.33 host trees/km.

Fifty-two specimens (26 vouchers and 26 duplicates) collected in the Cairo survey are presented with complete label information (Appendix 1). The determination of Illinois state host tree records from Cairo was based on the initial herbarium searches. Six incidental mistletoe specimens (American elm, an oak, black gum (*Nyssa sylvatica* Marshall), silver maple, and two unidentified tree hosts) from other herbaria were examined from Alexander County (Appendix 2). The additions of American elm, black gum, and silver maple specimens added to the nine new tree species of the Cairo study (Table 1) accounted for 14 host trees among the 21 overall hosts for Illinois (Table 2).

Previous Relevant Illinois Mistletoe Collections and Surveys

Schneck (1884a) collected seven *Ulmus americana* specimens in different phenological stages and wrote his

Table 1. Host specificity of *Phoradendron leucarpum* within city limits of Cairo, Illinois.

Host Tree Species	No. Trees	Percent
Acer saccharinum L.	304	55.58
Ulmus americana L.	111	20.29
**Celtis laevigata* Willd.	29	5.30
**Acer rubrum* L.	22	4.02
**Broussonetia papyrifera* (L.) L'Hér. ex Vent.	17	3.11
**Fraxinus pennsylvanica* Marshall	16	2.93
**Pyrus calleryana* Decne.	16	2.93
**Acer saccharum* Marshall	14	2.56
Juglans nigra L.	13	2.38
**Betula nigra* L.	2	0.36
Gleditsia triacanthos L.	1	0.18
***Betula utilis* D. Don ssp. *jacquemontii* (Spach) Winkl.	1	0.18
***Styphnolobium japonicum* (L.) Schott	1	0.18
Total Species: 13	547	100.00

(*) New Illinois host trees vouchered for American mistletoe.
(**) New United States host species vouchered for American mistletoe.

Table 2. Nineteen southern Illinois counties ranked according to identified mistletoe host tree species plus unknown hosts, collectors, specimens, and year(s) of collection from 225 herbarium specimens (Note: Fig. 3, Appendix 1, 2).

County	Host Species + Unknowns	Collectors	Number of Specimens	Collection Years
1 Alexander	14 + 3	7	65	1939, 1947, 1970, 1985, 1992, 2011, 2012, 2013
2 Pulaski	13 + 5	9	36	1860, 1869, 1919, 1939, 1949, 1950, 1985, 1989, 2013
3 Hardin	7 + 1	4	19	1947, 1949, 2013
4 Union	6	4	14	1948, 1949, 1955, 2013
5 Massac	4	4	12	1902, 1948, 1949, 2013
6 Pope	4	4	8	1931, 1948, 1949, 2013
7 Jackson	3 + 1	5	12	1948, 1949, 1956, 1985, 2013
8 Johnson	3 + 1	4	9	1948, 1949, 1989, 2013
9 Gallatin	3	4	6	1948, 1949, 2013
10 Randolph	2 + 2	5	8	1949, 1955, 1961, 1977, 2013
11 Wayne	2	2	3	1949, 1958
12 Wabash	1 + 1	5	12	1882, 1883, 1912, 1949, 2013
13 St. Clair	1 + 1	2	2	1861, 1955
14 Crawford	1	3	5	1949, 1973
15 Williamson	1	3	3	1949
16 Saline	1	3	3	1949
17 White	1	3	3	1949
18 Lawrence	1	3	4	1949
19 Clark	1	1	1	1949

T = 225 specimens

descriptive notes on each label, which was a source for his article describing the life cycle of mistletoe. Schneck (1884b) observed mistletoe on 28 honey locust trees, a pin oak, one red elm, 11 silver maples, and "*Ulmus americana*, many thousand" over an 18 month period in 1882–1883 at Mt. Carmel, Illinois, in Wabash County. Trelease (1916) excluded Champaign County, *J. Perriam s.n.* (ILL), no date, as "doubtless error of locality" and no other Champaign County specimens were found. Thompson and Bennett (1938) reported [American] elm and [silver] maple as the major trees infested by mistletoe at Horseshoe Lake in Alexander County near Cairo. Tehon (1942) discovered that mistletoe prefers American elm and black gum in southern Illinois along the Ohio and Wabash River bottomlands northward to Wabash County, and the Mississippi River bottomlands

north to Union County. Jones (1945) reported mistletoe as parasitic on American elm, black gum, oak, and other deciduous trees in southern Illinois northward to Union and Lawrence counties. Jones (1963) later added Randolph, Saline, and Crawford counties as containing mistletoe. Carter (1964) listed mistletoe occurrence in 18 Illinois counties and hosts as mainly [American] elm and occasionally black gum, black walnut, honey locust, oak, [silver] maple, and sycamore. Mohlenbrock (1990) listed American elm and sweetgum as host trees. American elm was the predominant host named on herbarium specimens; sweetgum was not verified as a host tree by any representative vouchers from either the herbaria search or this study.

Overlease and Overlease (2005) conducted a reconnaissance survey of American mistletoe (under synonym, *Phoradendron serotinum* (Raf.) M.C. Johnston), with a focus on the distribution, host species, and abundance across its geographical range in the eastern United States. Although they did not collect herbarium vouchers, their identification of host trees in Illinois is accepted from their extensive study. Overlease and Overlease (2005) listed eight host trees for Illinois with the two major hosts in tree numbers and clumps of mistletoe as silver maple (93 trees/2334 mistletoe clusters) and American elm (39 trees/3339 mistletoe clusters). The remaining host trees listed were sugar maple (9/343), red maple (7/282), sugarberry (4/58), black walnut (4/47), white ash [*Fraxinus americana* L. (1/6)], and river birch (1/1). All eight taxa were documented with representative voucher specimens during this study.

Kuijt (2003) cited 23 Illinois voucher specimens (counting six duplicates) from five host trees in 14 Illinois counties from A, GH, ILL, K, MO, NY, US, and WIS. Host trees were a black gum, a black locust (*Robinia pseudoacacia* L.), an oak, a winged elm (*Ulmus alata* Muhl.), 13 American elms, and three unidentified trees. Eighteen vouchers cited by Kuijt (2003), which represented all 14 counties from ILL, MO, and NY, were examined in this study. These 18 specimens are denoted by a dagger (†) in Appendix 2.

All 19 Illinois counties mapped for American mistletoe by Mohlenbrock (1990) were documented in the herbarium searches. Ninety-seven voucher specimens were annotated from holdings at EIU (4), F (0), ILL (33), ILLS (31), IND (0), ISM (16), KY (0), MO (2), MU (1), NCU (2), NY (3), OSU (0), and SIU (5). Twenty-six collection years of these voucher specimens ranged from 1860 to 1992 (Table 3). These 97 specimens (84 vouchers and 13 duplicates) are comprised of 77 identified hosts (10 duplicates) from eight host tree species, and 20 unidentified hosts (three duplicates) from 18 specimens without trees listed plus two unknown *Quercus* sp. Mistletoe specimens with documentation of identified host tree on herbarium labels were counted as host tree records. Similarly, specimens with a host tree identified on the labels while listing other mistletoe-infested trees observed, were not counted without an actual mistletoe specimen documented.

The eight identified host tree species by abundance and number of collectors, counties, and herbarium specimens (Appendix 2) are as follows: *Ulmus americana* (12 collectors/16 counties/54 specimens), *Nyssa sylvatica* (9/6/9), *Gleditsia triacanthos* (5/3/6), *Acer saccharinum* (2/2/2), *Platanus occidentalis* (2/1/2), *Robinia pseudoacacia* (2/1/2), *Juglans nigra* (1/1/1), *Ulmus alata* (1/1/1), and no host identified including the two *Quercus* sp. (10/9/20). In the Illinois herbaria search, the major host by far was American elm followed distantly by black gum. These data were reported in previous botanical literature (Tehon 1942; Jones 1945, 1963; Jones & Fuller 1955; Carter 1964).

A summary of the 97 voucher specimens is listed by decade followed by the 26 collectors, number of their specimens, and collection year (Table 3). Fifty-five of the 97 specimens (56.70%) within 18/19 counties were collected by three taxonomists, H.E. Ahles (7 counties/9 specimens), R.A. Evers (16 counties/23 specimens), and G.S. Winterringer (12/23). Several of their representative specimens at ILL, ILLS, and ISM list the same locality information and dates, denoting they often were field collecting companions (Appendix 2). The years, 1948–1949, were clearly the zenith of 20th century Illinois mistletoe collecting (Table 3). It is important to note that 77/97 (79.38%) specimens were collected by 16/26 collectors during 1860–1949, or 154 to 65 years ago (see: Tables 2, 3).

Illinois Mistletoe Documented from 2013 Reconnaissance

The 2013 collecting trip to 14 southern Illinois counties on March 30–31 and April 1–2, 2013, provided 39 more mistletoe herbarium specimens with 37 ILLS duplicates, or 76 herbarium specimens on deposit at

Table 3. Summary of 97 Illinois *Phoradendron leucarpum* ssp. *leucarpum* specimens by decade, collector, number of specimens, and year (s).

Decade	Collector	Specimens	Collection Year(s)
1860s	Brendel	1	1860
	Welsch	1	1861
	Raymond	1	1869
1880s	Schneck	7	1882–1883
1900s	Gleason	1	1902
1910s	Trelease	1	1912
	Palmer	1	1919
1930s	Schopf	1	1931
	Boewe	1	1939
	Evers	2	1939
1940s	Bailey	7	1947
	Carter	1	1948
	Evers	18	1948–1949
	Winterringer	23	1948–1949
	Ahles	9	1949
	Sievert	1	1949
	Walker	1	1949
1950s	Evers	1	1950
	Buser	1	1955
	Evers	1	1955
	Neill	1	1955
	Mohlenbrock	1	1956
	Evers	1	1958
1960s	Neill	2	1961
1970s	Furray	1	1970
	Huston	1	1970
	Ebinger	2	1973
	Shildneck	1	1977
1980s	Nickrent	3	1985
	Winslip	3	1989
1990s	Phillippe	1	1992
Totals:	26 Collectors	97 Specimens	24 years represented

BEREA and ILLS (Appendix 2). These 76 Illinois specimens plus the 52 Cairo specimens contributed 128 mistletoe specimens toward this Illinois mistletoe study. Fourteen host tree species were documented during this southern Illinois reconnaissance; eight were also present in the Cairo survey (Table 1). Four new host trees documented for Illinois were *Celtis occidentalis* and *Fraxinus americana* (Hardin and Pulaski counties), and Japanese maple (*Acer palmatum* Thunb.) and *Quercus palustris* (Pulaski County).

Aside from the Cairo survey (Appendix 1), 11 counties provided 76 mistletoe specimens from the 2013 reconnaissance (Appendix 2). County specimen collections were as follows: Alexander (American elm, silver maple), Gallatin (silver maple), Hardin (American elm, black gum, black walnut, hackberry, red maple, sugar maple, white ash), Jackson (black gum, silver maple), Johnson (American elm, silver maple), Massac (red maple [2], silver maple), Pope (black gum, silver maple), Pulaski (American elm, black gum, black locust, green ash, hackberry, honey locust, Japanese maple, pin oak, red maple, silver maple [3], sugarberry, white ash), Randolph (black gum), Union (black gum, red maple, silver maple), and Wabash (American elm). Regardless of extensive searches, mistletoe was not found in Saline, White, and Williamson counties, even though historical collections are known.

Alexander County had the greatest host tree richness with 14 different hosts, Pulaski County provided 13 host tree species with 10 hosts from Mounds City and four from Mounds, and Hardin County accounted for seven host tree species at Cave-in-Rock State Park (Table 2; Appendix 2). Excluding Cairo data (Table 1, Appendix 1), the three leading hosts in the 2013 reconnaissance, were silver maple (8 counties/9 specimens), black gum (6 counties/6 specimens), and American elm (5 counties/5 specimens). Six of the eight host tree spe-

cies previously annotated in the herbarium searches for Illinois specimens (American elm, black gum, black locust, black walnut, honey locust, silver maple) were also collected (Appendix 2). Winged elm and American sycamore were not redocumented as host trees during this study.

The recent observations reveal silver maple to be the most abundant and prevalent mistletoe-infested tree of southern Illinois counties (Table 1; Overlease & Overlease 2005; Appendix 1, 2). This feature is a contrast to the incidence of mistletoe-infested American elm as evidenced from herbarium searches and botanical literature (Appendix 2; Tehon 1942; Jones 1945; Carter 1964; Mohlenbrock 1990). Reasons are not clear for this observation on the abundance of silver maple, although inferences may be made: historical collectors could possibly have ignored or overlooked silver maple as a host tree as only 2/97 were documented with specimens (Appendix 2). American elm certainly was the most collected mistletoe-infested host as evidenced with an occurrence in 16/19 counties and 54 herbarium specimens prior to the 2013 survey. The original Dutch Elm Disease [*Ophiostoma ulmi* (Buism.) Nannf.] and its more aggressive subspecies, the New World Dutch Elm Disease (*Ophiostoma novo-ulmi* Brasier spp. *americana* Brasier & S.A. Kirk) may have taken their toll upon American elms (Brasier & Buck 2001). However, American elm and other host species are not as dominant in 2013 as it was in the 1940s-1960s and latter part of the 20th century. The intensive mistletoe survey of Cairo was the one exception to the occurrence of mistletoe-infested American elm, even then, it was nearly a 3:1 ratio of mistletoe-infested silver maple to American elm with mistletoe (Table 1).

The abundance of American mistletoe in the extreme southern counties and the scarcity as the geographical range progresses upward to the northern and central counties was the paramount observation. Winter climate was clearly the limiting factor in Illinois mistletoe distribution as evidenced by number of collections and specimens through the historic herbarium searches, relevant literature (Schneck 1884a, b; Spooner 1983), and the 2013 county reconnaissance. *Phoradendron leucarpum* ssp. *leucarpum* is near its northernmost distribution in southern Illinois (e.g., its southern extraneous affinity) due to low and prevalent winter temperatures during the past and at the present time. The American mistletoe distribution pattern has remained similar through time: the occurrence of mistletoe-infested host trees *and* number of infested host tree species, continually decreased as counties were inventoried northward along the Mississippi and Ohio Rivers and within the south-central counties both in the past and the present (Table 1, 2, 3; Appendix 1, 2).

Synopsis of Illinois American Mistletoe Study

1) A total of 225 herbarium specimens (97 from herbarium searches, 52 from Cairo, 76 from 2013 county survey) were annotated from 19 southern Illinois counties (Appendix 1, 2); counties ranked by number of host species, collectors, specimens, and years of collection are located in the southernmost Illinois counties (Table 2; Fig. 3).
2) American mistletoe was recorded from 21 different host tree species representative of 11 plant families (Appendix 1, 2); three new exotic host trees for North America documented with *Phoradendron leucarpum* ssp. *leucarpum* are Japanese maple (*Acer palmatum* Thunb.), Himalayan white birch [*Betula utilis* D. Don ssp. *jacquemontii* (Spach) Winkl.], and Japanese pagoda tree [*Styphnolobium japonicum* (L.) Schott].
3) The Cairo survey in Alexander County, documented 26 voucher specimens and 26 duplicates (52 specimens) from 13 hosts with 9 hosts new to Illinois; silver maple and American elm are the two dominant host trees (Table 1; Appendix 1).
4) The herbarium searches for Illinois specimens generated 97 specimens (84 vouchers and 13 duplicates) and provided eight identified host trees for Illinois; American elm and black gum are the two major host trees (Appendix 2).
5) The 2013 reconnaissance survey of 14 southern Illinois counties yielded 39 vouchers and 37 duplicates (76 specimens) within 11 counties from 14 hosts; hackberry, pin oak, white ash, and Japanese maple are four new Illinois hosts, and silver maple, black gum, and American elm are the three leading host trees by county (Appendix 2).
6) American mistletoe was much more abundant and with greater host tree diversity near cities; e.g., Cairo, Metropolis, Mounds, Mounds City, and the major rivers in the extreme eastern (Wabash), southern (Cache,

Ohio, Saline), and western (Mississippi) counties; mistletoe is very scarce in the northern and central counties as evidenced in this study and the herbarium searches (Fig. 3; Table 2; Appendix 1, 2).

CONCLUSIONS

Cairo has the highest incidence of American mistletoe [*Phoradendron leucarpum* (Raf.) Rev. & M.C. Johnston ssp. *leucarpum*] and the greatest number of host species for any town or city in Illinois. In Cairo, the Mistletoe Occurrence Value (MOV) was 13.41 trees/km from 547 mistletoe-infested trees per 40.8 km of roads travelled.

The major parameter for mistletoe occurrence and distributional spread in southern Illinois is largely related to climatic conditions (e.g., a continued mild winter climate and buffering effects by major rivers along open lowland topography). Other important factors for the incidence of mistletoe include the availability of mature, open-canopied host trees, culturally derived habitats of towns and cities, and influence of the Mississippi Flyway corridor for bird dispersal of fruits and seeds. The rather mild winter temperatures for the last several years within the USDA Plant Hardiness 6b Zone has been conducive for evergreen mistletoe establishment, growth, proliferation, and migration in southern Illinois. The incidence of mistletoe in different hosts species and in quantities correlates with its southern extraneous geographical affinity. Further American mistletoe surveys, preferably with winter twigs or branchlets added to mistletoe vouchers specimens, would enhance host tree identification and overall host species toward mistletoe distribution in southern Illinois counties.

APPENDIX 1

ANNOTATED CAIRO MISTLETOE COLLECTIONS

ILLINOIS. Alexander Co.: Cairo: Cedar St. sidewalk jct. Cross St. adj. to abandoned Southern Medical Center Hospital, 37°00′9.50″N, 89°10′44.61″W, elev. 97 m, hemiparasitic on *Acer saccharinum*, 2 Mar 2011, *R.L. Thompson 11-02* (BEREA, ILLS); 25th St. & Sycamore St. in yard behind Spirit's House Liquor, 37°00′32.49″N, 89°10′30.76″W, elev. 94 m, on *Juglans nigra*, 2 Mar 2011, *R.L. Thompson 11-05* (BEREA, ILLS); 7th St. & Washington Ave. median, 36°59′59.09″N, 89°9′58.43″W, elev. 96 m, moderately-infested *Acer saccharinum*, 2 Mar 2011, *R.L. Thompson 11-07* (BEREA, ILLS); DayStar Care Center, 2001 Cedar St. at end of Cross St., 37°00′39.52″N, 89°10′44.25″W, elev. 95 m, on introduced *Pyrus calleryana*, 2 Mar 2011, *R.L. Thompson 11-08* (BEREA, ILLS); St. Mary's Park, founded 1872, lawn bordering Magnolia Drive, 37°00′38.18″N, 89°11′8.49″W, elev. 95 m, on *Acer rubrum*, 8 Mar 2011, *R.L. Thompson & R.J. Trites 11-14* (BEREA, ILLS); St. Mary's Park lawn near park pavilion, 37°00′36.57″N, 89°11′9.24″W, elev. 95 m, on *Betula nigra*, 8 Mar 2011, *R.L. Thompson & R.J. Trites 11-15* (BEREA, ILLS); 36th St. & Washington Ave. median, 36°59′59.09″N, 89°9′58.43″W, elev. 96 m, on *Acer saccharum*, 8 Mar 2011, *R.L. Thompson & R.J. Trites 11-21* (BEREA, ILLS); 19th St. jct. with Washington Ave. (US 51N) in yard behind Dairy Hut and Dairy Mart, 1808 Washington Ave., 37°00′16.77″N, 89°10′29.33″W, elev. 96 m, heavily-infested on *Ulmus americana*, 8 Mar 2011, *R.L. Thompson & R.J. Trites 11-24* (BEREA, ILLS); St. Mary's Park lawn, 37°00′35.15″N, 89°11′9.09″W, elev. 96 m, on lightly-infested ornamental *Styphnolobium japonicum*, 22 Apr 2011, *R.L. Thompson & R.J. Trites 11-69* (BEREA, ILLS); St. Mary's Park lawn adj. to Magnolia Drive, 37°00′37.18″N, 89°11′8.14″W, elev. 95 m, on *Celtis laevigata*, 22 Apr 2011, *R.L. Thompson & R.J. Trites 11-70* (BEREA, ILLS); St. Mary's Park lawn adj. Park Place, 37°00′31.69″N, 89°11′10.54″W, elev. 96 m, lightly-infested *Gleditsia triacanthos*, 22 Apr 2011, *R.L. Thompson & R.J. Trites 11-71* (BEREA, ILLS); 418 Cross St. and M.L. King Ave., 37°00′13.77″N, 89°10′41.47″W, elev. 95 m, on three infested *Fraxinus pennsylvanica*, 5 Jul 2011, *R.L. Thompson 11-447* (BEREA, ILLS); St. Mary's Park lawn, 37°00′35.15″N, 89°11′9.09″W, elev. 96 m, on exotic *Styphnolobium japonicum* with three clumps, 5 Jul 2011, *R.L. Thompson 11-448* (BEREA, ILLS); St. Mary's Park lawn across from 2817 Park Place, 37°00′31.69″N, 89°11′10.54″W, elev. 96 m, three clusters on planted *Gleditsia triacanthos*, 13 Aug 2011, *R.L. Thompson 11-550* (BEREA, ILLS); St. Mary's Park yard near pavilion, 37°00′35.21″N, 89°11′9.00″W, elev. 95 m, on *Acer saccharum*, 13 Aug 2011, *R.L. Thompson 11-551* (BEREA, ILLS); back yard behind 3111 Washington Ave. residence adjacent to Magnolia Ave., 37°00′38.75″N, 89°11′6.90″W, 96 m elev., on *Betula nigra*, 13 August 2011, *R.L. Thompson 11-556* (BEREA, ILLS); Cairo High School, 37°1′11.25″N, 89°11′15.41″W, elev. 96 m, on *Acer rubrum*, 13 Aug 2011, *R.L. Thompson 11-564* (BEREA, ILLS); Cairo High School, moderately-infested ornamental *Pyrus calleryana* at front entrance, 37°1′9.57″N, 89°11′14.43″W, elev. 96 m, 13 Aug 2011, *R.L. Thompson 11-565* (BEREA, ILLS); 25th St. & 2501 Holbrook Ave., 37°00′9.33″N, 89°10′45.36″W, elev. 95 m, a single clump on mature *Fraxinus pennsylvanica*, 13 Aug 2011, *R.L. Thompson 11-566* (BEREA, ILLS); 229 12th St. E of Poplar St., yard of Ronnie Garrett, 37°00′7.82″N, 89°10′9.95″W, elev. 95 m, on introduced ornamental *Betula utilis* ssp. *jacquemontii* with four clusters, 11 Sep 2011, *R.L. Thompson & K. Rivers Thompson 11-633* (BEREA, ILLS); Johnson Terrace in yard at jct 38th St., on *Juglans nigra*, 9 Dec 2011, *R.L. Thompson 11-738* (BEREA, ILLS); 229 12th St. east of Poplar St., yard of Ronnie Garrett, 37°00′7.82″N, 89°10′9.95″W, elev. 95 m, on lightly-infested planted *Betula utilis* ssp. *jacquemontii*, 25 Jun 2012, *R.L. Thompson & J.R. Abbott 12-827* (BEREA, ILLS); 424 16th St. jct. M.L. King Ave. (Walnut St.), yard of William Little, 37°00′8.39″N, 89°10′26.41″W, elev. 95 m, on planted *Broussonettia papyrifera* with six clumps, 25 Jun 2012, *R.L. Thompson & J.R. Abbott 12-830* (BEREA, ILLS); abandoned Church of Christ yard at 26th St. & Sycamore St., 37°00′33.44″N, 89°10′48.40″W, elev. 94 m, on *Ulmus americana*, 1 Apr 2013, *R.L. Thompson & W.W. Overbeck 13-63* (BEREA, ILLS); abandoned Church of Christ yard at 26th & Sycamore St., 37°00′24.75″N, 89°10′42.72″W, elev. 94 m, on *Celtis laevigata*, 1 Apr 2013, *R.L. Thompson & W.W. Overbeck 13-64* (BEREA, ILLS); abandoned Church of Christ lawn at 26th St. & Sycamore, 37°00′34.87″N, 89°10′46.78″W, elev. 94 m, on escaped *Broussonettia papyrifera*, 1 Apr 2013, *R.L. Thompson & W.W. Overbeck 13-65* (BEREA, ILLS).

APPENDIX 2

ANNOTATED ILLINOIS MISTLETOE HERBARIUM COLLECTIONS

ILLINOIS. Alexander Co.: Miller City, tree in Mississippi River bottoms, 25 Nov 1939, *R.A. Evers & F.W. Evers 93* (ILL†, ILLS); old floodplain roadside between Horseshoe Lake and the Mississippi River, on *Ulmus americana*, 18 Oct 1947, *W.M. Bailey & J.R. Swayne 256* (EIU, NCU, SIU); 1.0 mile S of Olive Branch, on *Quercus*, 10 Oct 1970, *Furray 148* (EIU); Horseshoe Lake, wet woods, Sec.7–10, 15–18, 20–22, T 16 S, R 2 W, wet bottomland woods, 5 Nov 1970, *J.S. Huston 562* (SIU); a side road off Rt. 3/127 near pond and small homes in Cache, on *Acer saccharinum*, 1 Nov 1985, *D. Nickrent & K. Robertson 2076* (ILL); Ozark Hill Prairie Research Area, Shawnee National Forest, Mill Creek 7.5-minute topo, in *Nyssa sylvatica* on steep wooded slope, 8 Apr 1992, *L.R. Phillippe & J. Olson 19792* (ILLS); Urbandale, jct. of US 51 & IL 37, 37°2′23.14″N, 89°11′10.37″W, elev. 94 m, heavily-infested *Ulmus americana*, 29 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-04* (BEREA, ILLS); Urbandale, jct. of US 51 & IL 37, behind residence, 37°2′20.90″N, 89°11′15.37″W, elev. 94 m, lightly-infested *Acer saccharinum*, 29 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-05* (BEREA, ILLS). **Clark Co.:** E of West Union, on *Ulmus americana*, 3 Nov 1949, *R.A. Evers 21997* (ILLS). **Crawford Co.:** SE of Palestine, on *Ulmus americana,* 26 Nov 1949, *R.A. Evers 22043* (ILLS); Palestine, on *Ulmus americana*, 26 Dec 1949, *H.E Ahles 1892* (ILL†, ISM); Sec. 2, R 11 W, T 6 N., growing on *Ulmus americana*, 29 Dec 1973, *J.E. Ebinger 14345* (EIU, ILLS). **Gallatin Co.:** 2 mi. N of Lawler, on *Ulmus*, 13 Nov 1948, *J.C. Carter s.n.* (ILLS); 3.0 mi. N of Saline Mines, on *Robinia pseudoacacia*, 10 Dec 1949, *H.E Ahles 1894* (ILL†); 1.5 mi. N of Inman; on *Ulmus americana*, 10 Dec 1949, *G.S. Winterringer 2844* (ISM); 3.0 mi. N of Saline Mines, on *Robinia pseudoacacia*, 10 Dec 1949, *G.S. Winterringer 2851* (ISM); Cave-in-Rock Road (IL 1), yard of Greg Mayne, Box 71, 37°36′03.75″N, 88°12′27.04″W, elev. 109 m, heavily-infested *Acer saccharinum*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-35* (BEREA, ILLS). **Hardin Co.:** Cave-in-Rock State Park, in the SE part of Hardin Co., T 12 S, R 9 or 10 E, bordering on the N shore of the Ohio River, tree growing on the sides of the stony limestone bluffs, 11 Nov 1947, *W.M. Bailey & J.R. Swayne 292* (EIU, ILLS, NCU, SIU); 3.0 mi. from Cave-in-Rock, on *Ulmus americana*, 10 Dec 1949, *H.E Ahles 1897* (ILL†); S of Lamb, NE of Cave-in-Rock, on *Ulmus americana*, 10 Dec 1949, *G.S. Winterringer 2849* (ISM); Cave-in-Rock State Park, N of lodge, 37°28′10.65″N, 88°9′3.75″W, elev. 138 m, two small sprigs in *Nyssa sylvatica*, 31 Mar 2013, *R.L. Thompson 13-36* (BEREA); Cave-in-Rock State Park, S of lodge, 37°28′8.20″N, 88°9′7.28″W, elev. 141 m, 12–15 clumps on *Acer rubrum*, 31 Mar 2013, *R.L. Thompson 13-37* (BEREA, ILLS); Cave-in-Rock State Park, SE of lodge, 37°28′10.25″N, 88°9′2.45″W, elev. 130 m, moderately-infested *Juglans nigra*, 31 Mar 2013, *R.L. Thompson 13-38* (BEREA, ILLS); Cave-in-Rock State Park, NE of lodge, 37°28′10.88″N, 88°9′2.78″W, elev. 134 m, lightly-infested *Acer saccharum*, 31 Mar 2013, *R.L. Thompson 13-39* (BEREA, ILLS); Cave-in-Rock State Park, NW of lodge restaurant across blacktop, 37°28′8.90″N, 88°9′9.79″W, elev. 146 m, in *Fraxinus americana*, 11–15 clumps, 31 Mar 2013, *R.L. Thompson 13-40* (BEREA, ILLS); Cave-in-Rock State Park, S of visitor center on blufftop, 37°28′10.72″N, 88°9′5.92″W, elev. 120 m, on *Celtis occidentalis* with 2-3 clusters, 31 Mar 2013, *R.L. Thompson 13-41* (BEREA, ILLS); Cave-in-Rock State Park, W of lodge, 37°28′10.72″N, 88°9′5.92″W, elev. 144 m, in *Ulmus americana* with 7–10 clumps, 31 Mar 2013, *R.L. Thompson 13-42* (BEREA, ILLS). **Jackson Co.:** N of Grand Tower, on *Ulmus americana*, 12 Dec 1948, *R.A. Evers 15674* (ILLS); N of Grand Tower, on *Ulmus americana*, 12 Dec 1948, *G.S. Winterringer 1807* (ILL†, NY†); near Grand Tower, on *Ulmus americana*, 2 Nov 1949, *G.S. Winterringer 2473* (ISM); N of jct. with Rt. 144 in tree along Rt. 3, 12 Dec 1956, *R.H. Mohlenbrock 8615* (SIU); 3.0 mi. NW of jct. with Rt. 149 along N side of Rt. 3 near a homestead along hillside creek, on a large *Ulmus americana*, 1 Nov 1985, *D. Nickrent & K. Robertson 2075* (ILL); Grand tower, Redtown, S of IL 3 at Wills Rd., yard of Willie Smith at 1927 Brunkhorst Ave., 37°38′28.36″N, 89°30′37.06″W, elev. 111 m, moderately-infested *Acer saccharinum*, 30 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-30* (BEREA, ILLS); IL 3 N at Box 16178 in yard, 37°43′26,65″N, 89°17′14.95″W, elev. 110 m, seven heavily-infested *Acer saccharinum*, 30 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-31* (BEREA, ILLS); Murphysboro, S of IL 13 at 340 Niemann Lane near Walmart, 37°45′46.54″N, 89°17′14.95″W, elev. 118 m, moderately-infested *Nyssa sylvatica*, *R.L. Thompson & W.W. Overbeck 13-32* (BEREA, ILLS). **Johnson Co.:** SW of Belknap, on *Ulmus americana*, 11 Dec 1948, *R.A. Evers 15670* (ILLS); 0.5 mi. S of Belknap, on *Ulmus americana*, 11 Dec 1948, *G.S. Winterringer 1805* (ILL†, NY†); 4.0 mi. SW of Goreville below Draper Bluff, in rocky woods on *Quercus*, 2 Apr 1949, *G.S. Winterringer 1910* (ILL†); Lower Cache River Natural Area, T 14 S, R 3 E, Sect. 10, Karnak 7.5-minute topo map, tree near river, 30 Mar 1989, *K. Winship 1007* (ILLS); Barkhausen Cache River Wetlands Center, 200 m inside & S of county line on ditch floodplain, 37°18′30.36″N, 89°1′5.59″W, elev. 100 m, a single clump in young *Ulmus americana*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-48* (BEREA, ILLS); Cache River abandoned Railroad bed adj. to S. Franklin St. between Belknap & Karnak, 37°18′38.15″N, 88°57′16.02″W, elev. 102 m, lightly-infested *Acer saccharinum* specimens obtained with shotgun, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-49* (BEREA, ILLS). **Lawrence Co.:** 4.0 mi. S, 0.5 mi. east of Lawrenceville, woods, in *Ulmus*, 16 Mar 1949, *J.P. Sivert s.n.* (ILL); 1.0 mi. NE of St. Francisville, on *Ulmus americana*, 11 Nov 1949, *R.A. Evers 22046* (ILLS); 1.0 mi. NE of St. Francisville, on *Ulmus americana*, 26 Dec 1949, *H.E Ahles 1891* (ILL†, ISM). **Massac Co.:** Metropolis, Ill., on *Ulmus americana*, 14 Aug 1902, *H.A. Gleason s.n.* (ILL); SE of Boaz in wet ground on *Ulmus americana*, 11 December 1948, *R.A. Evers, J. Hall, & G.S. Winterringer 15669* (ILLS, SIU); SE of Boaz, on *Ulmus americana*, 11 Dec 1948, *G.S. Winterringer 1803* (ILL†, NY†); NE of Joppa, on *Nyssa sylvatica*, 11 Dec 1949, *G.S. Winterringer 2843* (ISM); Metropolis, US 45, Fort Massac State Park, lawn at Campground space 10 R , 37°8′47.64″N, 88°42′26.52″W, elev. 102 m, four clumps in *Acer rubrum*, 31 Mar 2013, *R.L. Thompson 13-45* (BEREA, ILLS); Metropolis, Fort Massac State Park in front of Visitor Center, 37°8′41.47″N, 88°43′18.95″W, elev. 102 m, a single large cluster in *Acer rubrum*, 31 Mar 2013, *R.L. Thompson 13-46* (BEREA, ILLS); Metropolis, in yard of Wilma Flemister, 719 A, East 5th St. (US 45) tree planted in 1956–57, 37°8′44.45″N, 88°43′18.95″W, elev. 103 m, moderately-infested *Acer saccharinum*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-47* (BEREA, ILLS). **Pope Co.:** Golconda Quad., R 8 E, T 12 S, on Lotton farm 1.0 mi. NE of town, on a *Gleditsia triacanthos*, 9 July 1931, *J. Schopf s.n.* (ILLS); Bay Creek bottoms east of Rose Hill, on *Ulmus americana*, 11 Dec 1948, *R.A. Evers, J. Hall, & G.S. Winterringer 15666* (ILLS); near Golconda, on *Ulmus americana*, 11 Dec 1948, *G.S. Winterringer 1806* (ILL†); N of Golconda, on *Nyssa sylvatica*, 10 Dec 1949, *G.S. Winterringer 2842* (ISM); IL 1, S of Zander's Lane, Rauch's Hill in hilly dry woods, 37°22′39.36″N, 88°29′31.45″W, elev. 138 m, on three *Nyssa sylvatica*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-43* (BEREA, ILLS); Golcanda, IL 146, Patton St. off Bay City Dr., 37°21′29.20″N, 88°29′4.71″W, 147 m, in *Acer saccharinum* with 15–30 clumps, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-44* (BEREA, ILLS). **Pulaski Co.:** *Phoradendron flavescens*, 1860, *F. Brendel s.n.* (ILL); Villa Ridge, tree with *Phoradendron flavescens*, 1869, *Raymond s.n.* (ILL); Mounds, Ill., in low ground, on *Ulmus alata*, 1 Oct 1919, *E.J. Palmer 16638* (MO†); 2.0 mi. NW of Olmstead along highway, on *Ulmus americana*, 11 April 1939, *G.H. Boewe s.n.* (ILLS); NW of Karnak in a swamp, 14 April 1949, *R.A. Evers 15745* (ILLS); E of Karnak, on *Ulmus americana*, 11 Dec 1949, *G.S. Winterringer 2847* (ISM); S of Mounds in swamp, on *Acer saccharinum*, 10 Jun 1950, *R.A. Evers 23568* (ILLS); 1.0 mi. east of Rt. 3/127 on Ill. Rt. 3 in a field

adjacent to some homes, on *Ulmus americana*, 1 Nov 1985, *D. Nickrent & K. Robertson 2077* (ILL); Lower Cache River Natural Area, portion of Porter Ditch Rd., 30 Mar 1989, *K. Winship 1011* (ILLS); Hillerman, near 304 Tick Ridge Rd. (Co. Rd. 2), Burnett family residence, 37°14′15.60″N, 88°56′27.98″W, elev. 140 m, one canker with sprigs in *Fraxinus americana*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-50* (BEREA, ILLS); Cache River along abandoned railroad (So. Franklin Rd.), near Johnson Co. boundary, 37°18′3.04″N, 88°58′4.34″W, elev. 101 m, single clump in small *Nyssa sylvatica*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-51* (BEREA, ILLS); Olmstead, lawn of Olmstead Missionary Baptist Church, IL 37S & jct. of Marigold St., 37°10′28.66″N, 89°5′53.21″W, elev. 105 m, lightly-infested *Acer saccharinum* 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-52* (BEREA, ILLS); Mounds City, off IL 37, N levee by welcome sign, 37°5′42.74″N, 89°9′16.24″W, elev. 100 m, on *Celtis occidentalis*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-53* (BEREA, ILLS); Mounds City, off IL 37, N levee by welcome sign, 37°5′42.74″N, 89°9′16.24″W, elev. 100 m, on *Ulmus americana*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-54* (BEREA, ILLS); Mounds City, off IL 37, N levee adj. to welcome sign, 37°5′42.74″N, 89°9′16.24″W, elev. 100 m, on *Robinia pseudoacacia*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-55* (BEREA, ILLS); Mounds City, Hopkin's Rd. (Commercial Ave.) adj. by IL 37 in lowland yard, 37°5′38.86″N, 89°9′14.04″W, elev. 97 m, on *Celtis laevigata*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-56* (BEREA, ILLS); Mounds City, Hopkin's Rd. (Commercial Ave.) adj. IL 37 in lowland yard, 37°5′38.86″N, 89°9′14.04″W, elev. 97 m, on *Acer saccharinum*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-57* (BEREA, ILLS); Mounds City, Hopkin's Rd. (Commercial Ave.) adj. to IL 37 in lowland yard, 37°5′38.86″N, 89°9′14.04″W, elev. 97 m, seven clumps on *Gleditsia triacanthos*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-58* (BEREA, ILLS); Mounds City, Illinois Ave. & Pearl St. by First Missionary Baptist Church near IL 37, 37°5′19.95″N, 89°9′44.11″W, elev. 97 m, on *Fraxinus pennsylvanica*, 31 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-59* (BEREA, ILLS); Mounds, off US 51N, yard of Zack Hannan, 124 N. Spencer St. jct. Thistletown St., 37°6′55.27″N, 89°11′34.46″ W, elev. 99 m, one large branch clump on *Quercus palustris*, 1 Apr 2013, *R.L. Thompson & W.W. Overbeck 13-66* (BEREA, ILLS); Mounds, off US 51N, yard of Zack Hannan, 124 N. Spencer St. jct. Thistletown St., 37°6′54.29″N, 89°11′33.93″W, elev. 99 m, on lightly-infested *Acer rubrum*, 1 Apr 2013, *R.L. Thompson & W.W. Overbeck 13-67* (BEREA, ILLS); Mounds, off US 51N, yard of Zack Hannan, 124 N. Spencer St. jct with Thistletown St., 37°6′54.70″N, 89°11′34.46″W, elev. 99 m, small sprigs on two branches of *Acer palmatum*, 1 Apr 2013, *R.L. Thompson & W.W. Overbeck 13-68* (BEREA); Mounds, off US 51N, on *Acer saccharinum*, yard of Zack Hannan, 124 N. Spencer St. jct. Thistletown St., 37°6′54.90″N, 89°11′34.68″W, elev. 99 m, 1 Apr 2013, *R.L. Thompson & W.W. Overbeck 13-69* (BEREA, ILLS). **Randolph Co.:** 1.0 mi. NE of Fort Gage, on *Nyssa sylvatica*, 10 Dec 1949, *R.A. Evers 22056* (ILLS); SW of Ellis Grove, 18 Aug 1955, *J.O. Neill 7121* (ILLS); E of Fort Gage in barnyard, on *Nyssa sylvatica*, 19 Aug 1955, *R.A. Evers 49019* (ILLS); Chester, vicinity of cove off Rt. 3, *Phoradendron* in tree, 18 Nov 1961, *J.O. Neill 15903* (ILLS); Dupo along Ill. Rt. 3, *Ulmus americana*, 26 Nov 1961, *J.O. Neill 15904* (ILLS); 0.5 mi. west of Cora in cemetery on slope by N shoulder of Rt. 3, on *Nyssa sylvatica*, 27 Mar 1977, *P. Shildneck 9231* (ISM); Chester, lawn at 8948 Edgemont Drive off IL 3 across from Mill St., 37°53′57.61″N, 89°48′37.23″W, elev. 196 m, two small clusters in a *Nyssa sylvatica*, 30 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-34* (BEREA, ILLS). **Saline Co.**: NE part of Stonefort, on *Ulmus americana*, 14 Apr 1949, *R.A. Evers & J. Hall 15731* (ILLS); Stonefort, SW corner of Saline County, in *Ulmus americana*, 11 Dec 1949, *H.E Ahles 1896* (ILL†); Stonefort, SW corner of Saline County, on *Ulmus americana*, 11 Dec 1949, *G.S. Winterringer 2848* (ISM). **St. Clair Co.:** Mascoutah, Ill., *Phoradendron flavescens*, 1862, *W. Welsch s.n.* (ILL); SW of Ellis Grove, in *Nyssa sylvatica*, 19 Aug 1955, *J.O. Neill 7121* (ISM).. **Union Co.:** Jonesboro, at the Ranger Station, on *Nyssa sylvatica*, 12 Dec 1948, *R.A. Evers 15671* (ILLS); E of Wolf Lake, on *Platanus occidentalis*, 12 Dec 1948, *R.A. Evers 15672* (ILLS); E of Wolf Lake, on *Gleditsia triacanthos*, 12 Dec 1948, *R.A. Evers 15673* (ILLS); Jonesboro, on *Nyssa sylvatica*, 12 Dec 1948, *G.S. Winterringer 1804* (ILL†); on *Gleditsia triacanthos*, 12 Dec 1948, *G.S. Winterringer 1810* (ILL); on *Platanus occidentalis*, 12 Dec 1948, *G.S. Winterringer 1811* (ILL); foresters' headquarters, on *Nyssa sylvatica*, 2 Nov 1949, *G.S. Winterringer 2471* (ISM); 0.5 mi. E of town of Wolf Lake at S end of Pine Hills on low slope, Sec. 3, T. 11 S., R. 3 W., on *Juglans nigra*, 10 Jan 1955, *F.B. Buser 5777* (ILL); Cavaness Road by 750 East State IL 3 near drainage ditch and railroad tracks, 37°28′26.96″N, 89°10′38.76″W, elev. 105 m, a single cluster in an *Acer rubrum*, 30 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-27* (BEREA, ILLS); Wolf Lake, 4955 State IL 3, Murphy's family yard off Jacob St., 37°30′18.45″N, 89°26′20.14″W, elev. 107 m, a single clump on *Acer saccharinum*, 30 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-28* (BEREA, ILLS); Jonesboro, off IL 146 & Main St. at USDA Shawnee National Forest, Ranger Station Picnic Shelter area, 37°27′25.51″N, 89°16′9.99″W, elev. 160 m, four clumps in a *Nyssa sylvatica*, 30 Mar 2013, *R.L. Thompson & W.W. Overbeck 13-29* (BEREA, ILLS). **Wabash Co.:** Mt. Carmel, Illinois, *Phoradendron flavescens* on *Ulmus americana*, abundant fruits ripe, 25 Dec 1882, *J. Schneck s.n.* (ILL); Mt. Carmel, Illinois, *Phoradendron flavescens* fruits all gone from cold weather effects, 15 Jan 1883, *J. Schneck s.n.* (ILL,); Mt. Carmel, Illinois, *Phoradendron flavescens* inflorescences developing, 20 Apr 1883, *J. Schneck s.n.* (ILL,); Mt. Carmel, Illinois, *Phoradendron flavescens* ovaries prominent, 26 Jun 1883, *J. Schneck s.n.* (ILL); Mt. Carmel, Illinois, *Phoradendron flavescens* very small berries, 27 Jul 1883, *J. Schneck s.n.* (ILL); Mt. Carmel, Illinois, *Phoradendron flavescens* green fruits, staminate and pistillate flowers open, 15 Sep 1883, *J. Schneck s.n.* (ILL); Mt. Carmel, Illinois, *Phoradendron flavescens* berries full grown, flowers full anthesis, 23 Oct 1883, *J. Schneck s.n.* (ILL); Mt. Carmel, Illinois, *Phoradendron flavescens* white berries ripe, 6 Dec 1883, *J. Schneck s.n.* (ILL); Mt. Carmel, Illinois, *Phoradendron flavescens* on *Ulmus americana*, Dec 1912, *Trelease s.n.* (MO); 2.0 mi. NE of Keensburg, on *Ulmus americana*, 26 Nov 1949, *R.A. Evers 22047* (ILLS); 1.5 mi. NE of Allendale, on *Ulmus americana*, 9 Dec 1949, *G.S. Winterringer 2845* (ISM); I-64E adj. to S. Water St., 2.0 km S of Grayville on Wabash River floodplain, 38°13′42.21″N, 87°59′14.80″W, elev. 124 m, one clump on *Ulmus americana*, 2 Apr 2013, *R.L. Thompson 13-70* (BEREA, ILLS). **Wayne Co.:** 5.0 mi. E of Fairfield, in *Quercus*, 20 Dec 1949, *M. Walker s.n.* (ILL); 5.0 mi. S of Fairfield along roadside, in *Gleditsia triacanthos*, 20 Oct 1958, *R.A. Evers 59540* (ILLS, MU). **White Co.:** NE of Crossville, on *Ulmus americana*, 10 Dec 1949, *H.E Ahles 1898* (ILL†); NE of Crossville, Ill. Rt. 1, on *Ulmus americana*, 10 Dec 1949, *G.S. Winterringer 2850* (ISM); S of Herald in extreme southeast corner of Williamson County, on *Ulmus americana*, 12 Dec 1949, *R.A. Evers 22059* (ILLS). **Williamson Co.:** 1.5 mi. SW of Stonefort, on *Ulmus americana*, 11 Dec 1949, *H.E Ahles 1895* (ILL†); 1.5 mi. SW of Stonefort in extreme SE corner of Williamson County, on *Ulmus americana*, 11 Dec 1949, *G.S. Winterringer 2846* (ISM); village of Crab Orchard, on *Ulmus americana*, 12 Dec 1949, *R.A. Evers 22058* (ILLS).

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REFERENCES

Abbott, J.R. & R.L. Thompson. 2011. New combinations in *Phoradendron leucarpum* (Viscaceae). J. Bot. Res. Inst. Texas 5:139–141.

Audubon. 2013. Mississippi Flyway. National Audubon Society, Inc., Washington D.C. U.S.A. (www.audubon.org/programs/Mississippi-flyways)

Basinger, M.A., J.S. Huston, R.J. Gates, & P.A. Robertson. 1997. Vascular flora of Horseshoe Lake Conservation Area, Alexander County, Illinois. Castanea 62:82–99.

Beadles, J.A. 1990. A history of southernmost Illinois. The Gateway Press, Des Peres, Missouri, U.S.A.

Bradsby, H.C. 1883. History of Cairo, and History of Alexander County. In: W.H. Perrin. History of Alexander, Union and Pulaski Counties, Illinois. Pp. 11–220 & Pp. 443–499. O.L. Baskin Co., Historical Publishers, Chicago, Illinois, U.S.A.

Brasier, C.M. & K.W. Buck. 2001. Rapid evolutionary changes in a globally invading fungal pathogen (Dutch Elm Disease). Biological Invasions 3:233–233.

Braun, E.L. 1950. Deciduous Forests of Eastern North America. Hafner Press, New York, New York, U.S.A.

Cain, S.A. 1930. Certain floristic affinities of the trees and shrubs of the Great Smoky Mountains and vicinity. Butler. Univ. Bot. Studies 1:129–150.

Carter, J.C. 1964. Illinois trees: their diseases. Illinois Natural History Survey, Circular 46, 3rd edition, printed with alterations, Urbana, Illinois, U.S.A.

Coder, K.D. 2008. American mistletoe (*Phoradendron serotinum* var. *serotinum*) infection in trees. Warner School of Forestry and Natural Resources, Tree Health Series (WSFNRO 8-25). University of Georgia, Athens, Georgia, U.S.A. (www.forestry.uga/edu/outreach/pubs/pdf/forestry/mistletoemonographpub08-25.pdf)

Deam, C.C. 1932. Shrubs of Indiana. Publication No. 44, revised edition, State of Indiana Department of Conservation, Division of Forestry, Indianapolis, Indiana, U.S.A.

Dodge, G. 1861. Letter of 24 December 1861 from Camp McClernand, Cairo, to Friend Danforth. In: *Rock Island Argus*, 27 December 1861. NIU Libraries Digitization Projects, Lincoln, Nebraska, U.S.A. (www.lincoln.lib.niu.edu/file.php?file=riargus12271861.html)

Dyer, J.M. 2006. Revisiting the deciduous forests of eastern North America. BioScience 56:341–352.

Ewing, Jr., P. & J.P. Roddy. 1996. Let my people go: Cairo, Illinois—1967–1973. Southern Illinois University Press, Carbondale and Edwardsville, Illinois, U.S.A.

Fenneman, N.M. 1938. Physiography of the eastern United States. McGraw-Hill Book Company, New York, New York, U.S.A.

Garman, H. 1913. Woody plants of Kentucky. Univ. Kentucky Agric. Sta. Bull. 169:3–62.

Google Earth. 2013. Cairo, Illinois, and southern Illinois county maps. Image Landsat. U.S. Dept. of State Geographer 2013.

Hall, J. 1838. Notes on the western states; containing descriptive sketches of their soil, climate, resources, and scenery. Harrison Hall, Philadelphia. In: J. White. 1997. Cache River area assessment, Vol. 2, Part II. Early accounts of the ecology of the Cache. Pp. 19–21. Critical Trends Assessment Program, Illinois Department of Natural Resources, Office of Scientific Research and Analysis, Natural History Survey Division, Champaign, Illinois, U.S.A.

Hemmerly, T.E. 1989. Mistletoe parasitism in Tennessee. J. Tennessee Acad. Sci. 64:121–122.

Hosner, J.F. & L.S. Minckler. 1963. Bottomland hardwood forests of southern Illinois—regeneration and succession. Ecology 44:29–41.

Illinois Demographics. 2013. U.S. Census 2010 Decennial Survey. Demographics of Cairo, Illinois, U.S.A. (www.illinois.demographics.com/Cairo.demographics)

Jones, G.N. 1945. Flora of Illinois. Amer. Midl. Naturalist, Monogr. 2:1–317.

Jones, G.N. 1963. Flora of Illinois, 3rd Edition. Amer. Midl. Naturalist, Monogr. 7.

Jones, G.N. & G.D. Fuller. 1955. Vascular flora of Illinois. Illinois State Museum, University of Illinois Press, Springfield, Illinois, U.S.A.

Kammerer, J.C. 1990. Largest rivers in the United States (revised). U.S. Department of the Interior, U.S. Geological Survey, Water Resources Division, Reston, Virginia, U.S.A. (www.pubs.usgs.gov/of/1987/ofr87-242/pdf/ofr8787242.pdf).

Keys, Jr., J.E., C.A. Carpenter, S.L. Hooks, F.G. Koenig, W.H. McNab, W.E. Russell, & M.L. Smith. 1995. Ecological units of the eastern U.S.—first approximation (colored map and booklet of map unit table—Map scale 3,500,000). United States Department of Agriculture, Forest Service, Atlanta, Georgia, U.S.A.

Küchler, A.W. 1964. Manual to accompany the map of potential natural vegetation of the conterminous United States. Special Publ. Amer. Geogr. Soc. 36.

Kuijt, J. 1982. The Viscaceae of the southeastern United States. J. Arn. Arbor. 63:401–410.

Kuijt, J. 2003. Monograph of *Phoradendron* (Viscaceae). Syst. Bot. Monogr. 66:1–643.

Lansden, J.M. 1910. A history of the city of Cairo, Illinois. R.R. Donnelley & Sons. Reprinted by Southern Illinois University Press, Carbondale and Edwardsville, Illinois, U.S.A.

Lantz, H.R. 1972. A community in search of itself: a case history of Cairo, Illinois. Southern Illinois University Press, Carbondale and Edwardsville, Illinois, U.S.A.

Leighton, M.M, G.E. Ekblaw, & L. Hornberg. 1993. Physiographic provinces of Illinois. Updated color map, scale 1:3,000,000. Illinois State Geological Survey, Champaign, Illinois, U.S.A. (www.isgs.illinois.edu/maps-data-pub/publications/pdf-files/physio-w-color-8x11.pdf)

Lewis, M., W. Clark, & Members of the Corps of Discovery. 2005. November 21, 1803. In: G. Moulton, ed. The journals of the Lewis and Clark Expedition. University of Nebraska Press/University of Nebraska-Lincoln Libraries-Electronic Text Center, Lincoln, Nebraska, U.S.A. (http://lewisandclarkjournals.unl.edu/read)

Midwest Regional Climate Center. 2013. Climate of the Midwest. Illinois: Cairo, Alexander County: Station 111166, Cairo 3 N. Illinois State Water Survey, Champaign, Illinois, U.S.A. (http://mrcc.isws.illinois.edu/climate_midwest/mwclimate_data_summaries.hth)

Mohlenbrock, R.H. 1990. The illustrated flora of Illinois: nightshades to mistletoe. Southern Illinois University Press, Carbondale and Edwardsville, Illinois, U.S.A.

Mohlenbrock, R.H. 2002. Vascular flora of Illinois. Southern Illinois University Press, Carbondale and Edwardsville, Illinois, U.S.A.

Mooney, J.L. 1968. Dictionary of American Naval fighting ships (DANFS), Vol. IV: L-M. Office of the Chief of Naval Operations, Naval History & Heritage Center, Washington, D.C., U.S.A. (www.history.navy.mi/danfs/m12/mistletoe-i.htm).

Nelson, W.J. 2008. Geology of the Cairo Quadrangle, Alexander and Pulaski counties, Illinois. Illinois Geologic Quadrangle Map, IGQ Cairo-G, scale 1:24,000, 2 sheets. Illinois State Geological Survey. (www.isgs.illiinois.edu/maps-data-pub/isgs-quads/c/pdf-files/cairo-g/pdf)

Omernik, J.M. 2007. Level III Ecoregions of the conterminous United States. Map (scale 1:7,500,000). National Health and Environmental Effects Research Laboratory, U.S. Environmental Protection Agency, Corvallis, Oregon, U.S.A. (www.epa.gov/wed/pages/ecoregions.htm)

Overlease, W. & E. Overlease. 2005. Our search for the mystical mistletoe: a field study of the distribution, abundance, and host species of mistletoe (*Phoradendron serotinum*) in the eastern United States. AuthorHouse Publishers, Bloomington, Indiana, U.S.A. (www.authorhouse.com)

Parks, W.D. & J.B. Fehrenbacker. 1968. Soil survey Pulaski and Alexander counties, Illinois. United States Department of Agriculture, Soil Conservation Service, and Illinois Experiment Station, No. 85. Washington, D.C., U.S.A.

Pilotlight. 2005. Historic Cairo, Illinois. (www.pilotlight2000.com/historic/index.htm)

Reveal, J.L. & M.C. Johnston. 1957. A new combination in *Phoradendron* (Viscaceae). Taxon 38:107–108.

Rosenberg, M. 2013. Köppen climate classification system. Geography and climate. (www.geography.about.com/od/physicalgeography/a/Köppen.htm)

Schneck, J. 1884a. Notes on *Phoradendron flavescens*, Nuttall I. Bot. Gaz. 9:94–96.

Schneck, J. 1884b. Notes on *Phoradendron flavescens*, Nuttall II. Bot. Gaz. 9:101–103.

Schwegman, J.E., G.B. Fell, M. Hutchinson, G. Paulson, W.H. Shepherd, & J. White. 1973. Comprehensive plan for the Illinois Nature Preserve System, Part 2. The natural divisions of Illinois. Illinois Nature Preserves Commission, Rockford, Illinois, U.S.A.

Soil Survey Staff. 2013. Cairo, Illinois, Alexander County, Illinois, U.S.A. (IL003). National Resource Conservation Service, United States Department of Agriculture. Web Soil Survey. (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey/aspx)

Spooner, D.M. 1983. The northern range of eastern mistletoe, *Phoradendron serotinum* (Viscaceae), and its status in Ohio. Bull. Torrey Bot. Club 110:489–493.

Taft, J. & A. Mankowski. 1997. Natural terrestrial communities/vegetation descriptions. In: A. Mankowski, D. Baker, & K. Miller, eds. Cache River area assessment, Vol. 1, Part II: Living resources. Critical Trends Assessment Program (CTAP). Illinois Department of Natural Resources, Office of Scientific Research and Analysis, Natural History Survey Division, Champaign, Illinois, U.S.A. Pp. 33–46.

Tehon, L.R. 1942. Fieldbook of native shrubs of Illinois, manual 3. Natural History Survey Division, Urbana, Illinois, U.S.A.

Thiers, B. 2014 [continuously updated]. Index Herbariorum: a global directory of public herbaria and associated staff, New York Botanical Garden's Virtual Herbarium. (http://sweetgum.nybg.org/in/).

Thompson, D.T. & G.W. Bennett. 1938. Lake management reports. 1. Horseshoe Lake near Cairo, Illinois. Biological Notes No. 8, Division of the Natural History Survey, Urbana, Illinois, U.S.A.

Thompson, R.L. 2005. Host occurrence of eastern mistletoe (*Phoradendron leucarpum*, Viscaceae) in Robertson County, Kentucky. J. Kentucky Acad. Sci. 66:137–138.

Thompson, R.L. & C.A. Evans. 2010. Eastern mistletoe (*Phoradendron leucarpum*, Viscaceae) infestation of host trees in Jessamine County, Kentucky. J. Kentucky Acad. Sci. 71:19–25.

Thompson, R.L. & R.L. Jones. 2001. Woody plants of Rock Creek Research Natural Area and watershed uplands, Laurel County, Kentucky. Castanea 66:275–287.

Thompson, R.L. & F.D. Noe, Jr. 2003. American mistletoe (*Phoradendron leucarpum*, Viscaceae) in Rockcastle County, Kentucky. J. Kentucky Acad. Sci. 64:29–35.

Thompson, R.L. & D.B. Poindexter. 2005. Host specificity of American mistletoe (*Phoradendron leucarpum*, Viscaceae) in Garrard County, Kentucky. J. Kentucky Acad. Sci. 66:40–43.

Thompson, R.L., K. Rivers Thompson, E.A. Fleming, R.D. Cooks, J.R. Price, M.N. Naseman, & A.J. Oles. 2008. Eastern mistletoe (*Phoradendron leucarpum*, Viscaceae) in the city of Berea: A high incidence of infestation and eight new host species for Kentucky. J. Kentucky Acad. Sci. 69:3–10.

Trelease, W. 1916. The genus *Phoradendron*: a monographic revision. University of Illinois, Urbana, Illinois, U.S.A.

USDA, ARS. 2013. Interactive USDA plant hardiness zone map. USDA, Agricultural Research Service. (www.planthardiness.ars.usda.gov/phzmweb/interactivemap.aspx)

USDA, NRCS. 2013. United States Department of Agriculture, Natural Resources Conservation Service. The PLANTS Database Team, Greensboro, North Carolina, U.S.A. (http://plants.usda.gov/)

Voigt, J.W. & R.H. Mohlenbrock. 1964. Plant communities of southern Illinois. Southern Illinois University Press, Carbondale, Illinois, U.S.A.

Weiser, K.R. 2012. Legends of America. Illinois legends: Cairo, Illinois—Death by racism, a travel site for the nostalgic & historic minded. (www.legendsofamerican.com/il-cairo.html)

White, J. 1997. Early accounts of the ecology of the Cache River area. Cache River area assessment, Vol. 2, Part II. Critical Trends Assessment Program (CTAP). Illinois Department of Natural Resources, Office of Scientific Research and Analysis, Natural History Survey Division, Champaign, Illinois, U.S.A.

White, J. & M.H. Madany. 1978. Classification of natural communities in Illinois, Appendix 30. In: J. White, ed. Illinois natural areas inventory technical report, Vol. 1, Survey methods and results. Illinois Natural History Inventory, Urbana, Illinois, U.S.A. Pp. 305–405.

Williams, D.R., B.C. Fitch, & S.J. Indorante. 2007. Soil survey of Alexander County, Illinois. United States Department of Agriculture and Natural Resources Conservation Service.