

HISTORY, DISPERSAL, AND DISTRIBUTION OF *BUDDLEJA DAVIDII* (SCROPHULARIACEAE) IN KENTUCKY

Ralph L. Thompson

Berea College Herbarium
Berea College, Biology Program
Berea, Kentucky 40404-2121, U.S.A.
ralph_thompson@berea.edu

J. Richard Abbott

Missouri Botanical Garden
P.O. Box 299
Saint Louis, Missouri 63166-0299, U.S.A.
richard.abbott@mobot.org

ABSTRACT

Buddleja davidii Franch. (Scrophulariaceae), orange-eye butterfly bush, an introduced ornamental shrub from China, is reported with documentation as unequivocally naturalized in Kentucky for the first time. It was first documented outside of horticultural cultivation with voucher specimens from Pike County (1960 and 1982), Calloway County (2003), Greenup County (2010), Powell County (2011), and Laurel County (2012). A discussion of *Buddleja davidii* in Kentucky concludes with a diagnostic description from recent Laurel County specimens.

KEY WORDS: *Buddleja davidii*, Buddlejaceae, dispersal, distribution, Kentucky, naturalized, orange-eye butterfly bush, Scrophulariaceae, summer lilac

RESUMEN

Buddleja davidii Franch. (Scrophulariaceae), Arbusto de las mariposas de ojo naranja, un arbusto ornamental introducido de la China, se reporta por primera vez con documentación como planta inequívocamente naturalizada en Kentucky. Se documenta por primera vez fuera de un lugar de cultivo hortícola con muestras testigo del condado de Pike (1960 y 1982), condado de Calloway (2003), condado de Greenup (2010), condado de Powell (2011) y condado de Laurel (2012). Una discusión de *Buddleja davidii* en Kentucky concluye con una descripción diagnóstica de muestras recientes del condado de Laurel.

INTRODUCTION

The genus *Buddleja* was named by Linnaeus (1753, 1754) to commemorate the English botanist and clergyman Adam Buddle (1660–1715). A New World specimen of *B. americana* from the Caribbean was brought to Linnaeus in the 1730s by Dr. William Houston (Stuart 2006; Dirr 2009). *Buddleja* is a cosmopolitan group of some 90–100 species of which many of the Asiatic taxa have been grown as ornamentals in arboreta, botanical gardens, landscape gardens, nurseries, parks, garden clubs, and yards (Stuart 2006; Dirr 2009). The centers of diversity for *Buddleja* are South Africa and Chinese-Himalayan Asia in the Old World (Leeuwenberg 1979; Stuart 2006; Tallent-Halsell & Watt 2009) and South America, Central America, and southwestern United States in the New World (Norman 2000; Tallent-Halsell & Watt 2009).

Buddleja davidii Franch. (Scrophulariaceae), summer lilac or orange-eye butterfly bush (Bailey & Bailey 1976; Norman 2012), are unarmed, multi-stemmed Chinese deciduous to semideciduous shrubs up to 5.0 m tall and a spread of 6.5 m. *Buddleja davidii* gained its specific epithet, *davidii*, by Franchet (1888) to honor Père Armand David (1826–1900), a French Jesuit missionary and naturalist in eastern Tibet, who introduced the first *B. davidii* to Adrian René Franchet (1834–1900) at the Paris Museum of Natural History (Stuart 2006; Tallent-Halsell & Watt 2009).

It was introduced from China by the English plant collector, E.H. Wilson into the Royal Botanic Garden, Kew, England, in 1896, and then at the Arnold Arboretum, Harvard University, around 1900 (Stuart 2006; Tallent-Halsell & Watt 2009). Orange-eye butterfly bush is native to 13 provinces of central and southwestern China and has been introduced into Japan (Zheng-Yi & Raven 1996; Stuart 2006). The 13 Chinese provinces are mapped by Zheng et al. (2006) and Tallent-Halsell & Watt (2009).

Buddleja davidii has been variously placed by recent workers in the Loganiaceae, Buddlejaceae, and most recently in the Scrophulariaceae (IPNI 2005; Norman 2012; Tropicos 2012; USDA, ARS 2012a; Weakley 2012).

Buddleja certainly has strong affinities within the Scrophulariaceae in the order Lamiales based on current molecular systematics. Nomenclature for all taxa in this article follows Weakley (2012).

Buddleja davidii is the most widely cultivated species grown especially for its attractive dark green and grayish-white pubescent foliage, flowers which vary from colorful lilac-rose to lilac-lavender, lilac-blue, red-violet, purple to white, pleasant fragrance, and a high nectar content for the attraction of butterflies, moths, bees, wasps, and birds (Norman 2000; Stuart 2006; Dirr 2009; Tallent-Halsell & Watt 2009). *Buddleja davidii* has over 150 cultivars and hybrids recognized to date (see: Leeuwenberg 1979; Stuart 2006; Dirr 2009). A vigorous, cold hardy ornamental shrub, it is well adapted to USDA hardiness zones 5–9 (Stuart 2006; Dirr 2009). In Kentucky, *B. davidii* grows well in zone 6 (–10 to 0°F [–20.6 to 17.8°C]) within the United States Hardiness Zone Map (USDA, ARS 2012b).

We report *Buddleja davidii* as unequivocally naturalized in Kentucky for the first time with documentation based on recent plant collections, examination of herbarium specimens, data from plant collector's log notebooks, and a Kentucky literature survey. Our research indicates *B. davidii* has non-introduced populations established in five counties during the last 30 year period.

DISCUSSION

Buddleja davidii is currently naturalized (*sensu lato*), i.e., growing without cultivation, in Australia, Europe, Fiji, and New Zealand in the Eastern Hemisphere and in Canada, Central America, Puerto Rico, South America, and the United States in the Western Hemisphere (Tallent-Halsell & Watt 2009; Norman 2012). Tallent-Halsell and Watt (2009) mapped 20 states of the USA and the Canadian Provinces of British Columbia and Ontario. The USDA, NCRS (2012) mapped the same USA distributions, but deleted Alabama and added Illinois. In the conterminous United States, Kartesz (2011) included the District of Columbia, Delaware, Indiana, Kansas, and Rhode Island in addition to the above 21 states in his Biota of North America Program (BONAP). The USDA, FS (2012) mapped the combined distributions in the United States of Kartesz (2011), Tallent-Halsell and Webb (2009), and the USDA, NRCS (2012), but also included Arizona, Arkansas, Louisiana, Mississippi, Nevada, New Mexico, Texas, and Utah. Tropicos (2012) included Missouri based on voucher specimens (G. Yatskievych & K. Yatskievych 02-62; T.E. Smith 3832) deposited at the Missouri Botanical Garden Herbarium (MO). The overall distribution of *B. davidii* in the United States and Canada from these five distribution sources totals 34 states (including Hawaii), as well as the District of Columbia, the territory of Puerto Rico, and the Canadian Provinces of British Columbia and Ontario.

The above distribution sources do not specify whether the non-native status of *Buddleja davidii* in the United States (e.g. in Kentucky) is cultivated, introduced, persisting, adventive, or naturalized according to the definitions by Nesom (2000). In essence, these map distribution sources probably represent a combination of all those non-native classification categories from literature reports and herbarium vouchers.

Common temperate habitats for *Buddleja davidii* growing without cultivation in the United States include railroad lines, limestone quarries, coal surface-mined lands, abandoned cultivated areas, urban disturbed areas, successional woodland edges, roadsides, riparian corridors, streambeds, floodplains, and sandy lake shores, among many others (Tallent-Halsell & Watt 2009; Norman 2012). Orange-eye butterfly bush plainly has a broad ecological amplitude, which favors colonization, establishment, and naturalization in a diversity of open, insolated and weedy disturbed habitats.

As with numerous woody plants, *Buddleja davidii* has also become invasive in several countries where it has been naturalized, e.g., Australia, England, France, New Zealand, and Hawaii, Oregon, and Washington in the USA (Tallent-Halsell & Watt 2009; USDA, ARS 2012a; Young-Mathews 2011; Norman 2012). *Buddleja davidii* was listed as one of the invasive Asian plants established in the United States by Zheng et. al. (2006). In Oregon, *B. davidii* is classified as a "B" designated noxious weed subject to quarantine, and in Washington it is listed as a Class "C" noxious weed (Tallent-Halsell & Watt 2009; Young-Mathews 2011; USDA, NRCS 2012). Tallent-Halsell and Watt (2009) have provided the most comprehensive discussion on the biology, distribution, ecology, and invasiveness of *Buddleja davidii*.

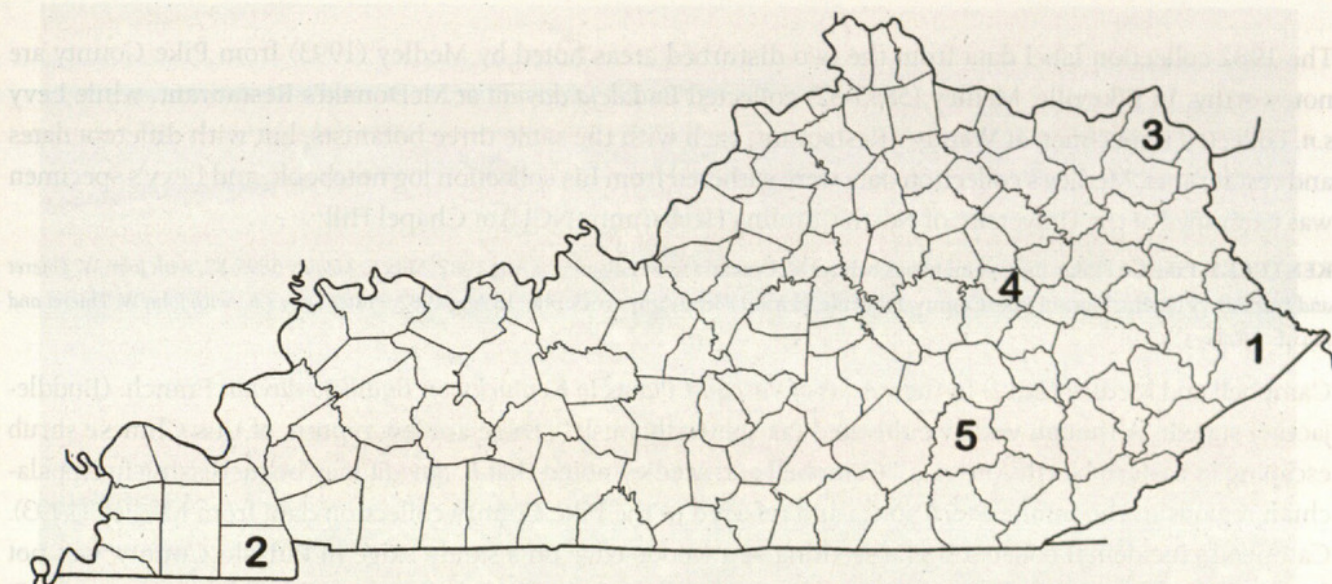


FIG. 1. Kentucky counties with naturalized *Buddleja davidii*: 1=Pike (1960 & 1982), 2=Calloway (2003), 3=Greenup (2010), 4=Powell (2011), 5=Laurel (2012).

Kentucky Literature and *Buddleja davidii* in Pike County

The ascription of this species to the flora of Kentucky warrants a discussion of previous Kentucky literature accounts. *Buddleja davidii* was credited as established in Kentucky by Medley (1993) and state-mapped by the USDA, NRCS (2012), and other workers (e.g., Kartesz 2011; USDA, FS 2012; USDA, ARS 2012a). Tallent-Halsell and Webb (2009) used these distribution resources and further based naturalization of *B. davidii* in their North America map on being “escaped from cultivation.” However, their reported Kentucky distribution was founded in part on the misapplication of *Buddleja alternifolia*, which was planted at the Bernheim Forest and Arboretum (see: Gunn 1959).

Browne and Athey (1992) in their *Vascular Plants of Kentucky: an Annotated Checklist*, did not list *Buddleja davidii*. Likewise, Jones (2005) in the *Plant Life of Kentucky* did not include *B. davidii* (Buddlejaceae) as part of the Kentucky flora, but noted it was “to be expected as an escape in Kentucky.” Clark and Weckman (2008) did not discuss or map *B. davidii* in their *Annotated Catalog and Atlas of Kentucky Woody Plants*.

The first *Buddleja davidii* specimen in a Kentucky herbarium was a cultivated plant collected in Fayette County in Lexington at the University of Kentucky Agricultural Experiment Station, 24 Aug 1923, H. Garman s.n. (BEREA, UK). The first report of a potentially escaped, non-cultivated orange-eye butterfly bush for Kentucky is a Pike County voucher (Fig. 1) from 1960 on file at the University of Kentucky Herbarium (UK); but, this specimen was not referenced by Medley (1993). The label data is:

KENTUCKY. Pike Co.: Cedar Street near Chloe Creek, 15 Oct 1960, Mary Louise Miniard 42 (UK)!

Medley (1993) in his dissertation, *An Annotated Catalog of the Known and Reported Vascular Flora of Kentucky*, reported *Buddleja davidii* Franch. (Buddlejaceae) as “Rarely established along railroads and in disturbed areas in at least two localities in Pike County on the Allegheny Plateau.” His two specimens from Pike County, Medley & Levy 5895-82 and 6364-82 (DHL) were eventually transferred to the Western Kentucky University Herbarium (WKU). However, these unmounted specimens were not available for study by us since they have not yet been incorporated into WKU from the Davies Herbarium (DHL) of the University of Louisville. Fortunately, Medley’s original 1982 collection log notebook was available at WKU and the relevant data (pp. 175–182) are:

KENTUCKY. Pike Co.: Pikeville 7-5 minute Quadrangle, Pikeville, spontaneous along abandoned railroad track in SW part of town, associates: *Chaenorhinum minus*, *Desmodium* spp., *Eupatorium* sp., *Ipomoea lacunosa*, *Oenothera biennis*, and *Sonchus asper*, 16 Aug 1982, Max E. Medley & Foster Levy 6364-82 (DHL).

The 1982 collection label data from the two disturbed areas noted by Medley (1993) from Pike County are noteworthy: In Pikeville, Medley (5895-82) collected *Buddleja davidii* at McDonald's Restaurant, while Levy s.n. collected a specimen at Wendy's Restaurant, each with the same three botanists, but with different dates and restaurants. Medley's collection data were gathered from his collection log notebook, and Levy's specimen was examined at the University of North Carolina Herbarium (NCU) at Chapel Hill:

KENTUCKY. Pike Co.: Pikeville, spontaneous behind McDonald's in weedy area, 8 Aug 1982, Max E. Medley 5895-82, with John W. Thieret and Foster Levy (DHL); Flora of Pike County, Pikeville, behind Wendy's in a rock pile, 18 Aug 1982, Foster Levy s.n., with John W. Thieret and Max E. Medley (NCU)!

Campbell and Medley (2012) in their *Atlas of Vascular Plants in Kentucky* on *Buddleja davidii* Franch. (Buddlejaceae) stated, "Although widely cultivated (as "butterfly bush"), there are few reports of this Chinese shrub escaping in eastern North America." Campbell and Medley noted that *B. davidii* may be increasing in Appalachian regions in the southeastern states and referred to the Pike County collection data from Medley (1993). Campbell's incidental collection of a seedling at a woods edge on a sandy ridge in Pulaski County, was not found in any Kentucky herbarium. Regardless of their discussion, Campbell and Medley (2012) did not map *B. davidii* in their Kentucky vascular plant atlas.

***Buddleja davidii* in Calloway County**

In Calloway County (Fig. 1), during the summer 2003, two flowering specimens of *Buddleja davidii* were collected (Thompson 03-389) in Quaternary Ochlockonee alluvial gravelly loam soils along a roadside ditch thicket near the southernmost boundary of Hancock Biological Station on Kentucky Lake. The vouchers were deposited in the Berea College Herbarium (BEREA) and Murray State University Herbarium (MUR). The mature shrub was treated as a non-cultivated escape since there were no homesteads or building remains anywhere within its vicinity, nor was it close to any populated area. The nearby Pacer Point Marina, an asphalt boat ramp landing, was not likely a source for the plant. Exact label data from this Calloway County site are:

KENTUCKY: Calloway Co.: Pacer Point Marina area, 0.8 mi E from jct. of Lancaster Road to Watersport Road, and 0.5 mi S on Watersport Road to ditch thicket near sandy beach, introduced shrub from China, 2–3 m with lilac salverform flowers with an orange center, rare, 24 Jun 2003, R.L. Thompson 03-389 (BEREA, MUR)

***Buddleja davidii* in Greenup County**

Orange-eye butterfly bush was collected in Greenup County (Fig. 1) on a roadside along a creek near a residential area in 2010, but without a town or city listed on the label data. It is not known if the shrub was from a cultivated or non-cultivated plant, although it may well have been an escaped plant. The label data from this specimen at Morehead State University Herbarium (MDKY) are:

KENTUCKY. Greenup Co.: roadside at end of creek with much *Quercus* and *Ambrosia*, elev. 617 ft, near residential area, 38°26'24"N and 83°41'25"W, 4 Oct 2010, Steffany Seagraves 31 (MDKY)!

***Buddleja davidii* in Powell County**

David Taylor, USDAFS botanist, discovered a volunteering *Buddleja davidii* shrub in Powell County (Fig. 1) during the summer 2011 in the Daniel Boone National Forest within the Red River Gorge on Alticrest-Ramsey-Rock Outcrop complex soils over Pennsylvanian-aged Lee Formation conglomeratic sandstone. The plant was found during a reconnaissance of an area severely burned in the fall of 2010. The wildfire burned organic matter to mineral soil and killed most overstory, midstory and understory trees, and 50–60% of the shrubs. At the time of collection, bare mineral soil accounted for 60–70% of the surface cover (D.D. Taylor pers. comm. 2012). Data from his specimen, "On Permanent Loan From USDA Forest Service," are as follows:

KENTUCKY. Powell Co.: Daniel Boone National Forest, Red River Gorge, lat. 37.825827, long. -83.678275, elev. 1220 ft asl, in moist soil ca. 60 ft W of Auxier Ridge trail, ca. 250 air ft S of jct. with Court House Rock Trail, with *Tussilago farfara*, *Paulownia tomentosa*, *Sonchus asper*, *Eupatorium serotinum*, *Dichanthelium commutatum* subsp. *ashei*, and *Marchantia polymorpha*, 24 Aug 2011, David D. Taylor 18772 (BEREA).

Establishment and Dispersal of *Buddleja davidii* in Laurel County

The most recent Kentucky collections of *Buddleja davidii* were from three local sites of Laurel County (Fig. 1)



FIG. 2. Habitat of *Buddleja davidii* by CSX Railway tracks at concrete culvert in London, Laurel County, Kentucky, September 10, 2012.



FIG. 3. Flowering branchlet of *Buddleja davidii* (R.L. Thompson 12-1090, BERA).

during September and November 2012. While on a September 4th collecting trip towards a vascular flora of Laurel County, we discovered a non-cultivated *B. davidii* established along the CSX Railway in the city of London and voucher specimens were deposited in BEREa and the Missouri Botanical Garden Herbarium (MO). A single established orange-eye butterfly bush 1.5 m high with a cymose panicle of lilac-colored flowers with orange-eyed throats was present and appeared locally naturalized at this site. A second collecting trip to the general site on September 10th revealed another flowering individual a short distance away from the first collection site. On November 4th, a third trip was made to collect fruits from the two previous colonies at which time three additional fruiting shrubs and four scattered seedlings were discovered on the east side of the CSX railroad right-of-way, ca. 100 m south from either of the two previous plant sites. Representative voucher specimens were taken from the populations of the second and third trips and placed on file in BEREa, MO, and NCU. Duplicate specimens from the collecting trips have been distributed to other herbaria as designated by herbarium acronyms from Thiers (2012).

Our collection label data of *Buddleja davidii* from these three reconnaissance trips to the CSX Railway in London, Laurel County, are summarized below:

KENTUCKY. Laurel Co.: London Quadrangle, London, East 4th Street (KY 80) E of Flowers Bakery (501 E. 4th St.) and 2.0 m W of the CSX railroad tracks in granite aggregate at a concrete culvert by a drainage ditch just W of jct. KY 354N (Tobacco Road) and KY 80, elev. 358 m, lat. 37.116908, long. -84.066789, 4 Sep 2012, R.L. Thompson & J.R. Abbott 12-1072 (BEREA, MO); 10 Sep 2012, R.L. Thompson 12-1090 (BEREA, MO, NCU); 4 Nov 2012, R.L. Thompson & K. Rivers Thompson 12-1137 (BEREA, BRIT, EKY, KNK, MDKY, MO, MUR, NCU, UK); R.L. Thompson & Katrina Rivers Thompson 12-1141 (BEREA, MO, NCU).

Characteristic associates growing in the granite, gneiss, and limestone railroad aggregate ballast were *Ambrosia artemisiifolia*, *Cichorium intybus*, *Conyza canadensis*, *Digitaria sanguinalis*, *Euphorbia maculata*, *E. nutans*, *Ipomoea coccinea*, *Kummerowia striata*, *Lathyrus latifolius*, *Oenothera biennis*, *Sonchus asper*, *Symphyotrichum pilosum*, and *Trifolium repens*. Some associated plants at the ditch margin included *Acer negundo*, *A. rubrum*, *A. saccharinum*, *Ambrosia trifida*, *Catalpa speciosa*, *Echinochloa muricata*, *Eupatorium serotinum*, and *Paspalum dilatatum*.

KENTUCKY. Laurel Co.: London Quadrangle, London, East 4th Street (KY 80) S of Flowers Bakery and 4.0 m S 2.0 m W of the CSX railroad tracks adjacent to Railroad Street, elev. 359 m, lat. 37.116905, long. -84.066788, flowering shrub severely cut back, although not herbicide-sprayed, 10 Sep 2012, R.L. Thompson 12-1097 (BEREA, MO); 4 Nov 2012, R.L. Thompson & K. Rivers Thompson 12-1138 (BEREA, BRIT, MO, NCU).

This orange-eye butterfly bush represents a second non-cultivated individual 16 m diagonally across from the shrub at the concrete culvert, probably from a seed source spread by trains. Ruderal associated species observed around *Buddleja davidii* in the railway aggregate between KY 80 and Railroad Street were *Ambrosia artemisiifolia*, *Conyza canadensis*, *Daucus carota*, *Digitaria sanguinalis*, *Echinochloa crusgalli*, *Eleusine indica*, *Eragrostis pectinacea*, *Eupatorium serotinum*, *Euphorbia dentata*, *E. maculata*, *E. nutans*, *Kummerowia striata*, *Lespedeza cuneata*, *Polygonum aviculare*, *Setaria pumila*, *Solidago altissima*, *Symphyotrichum pilosum*, and *Verbascum thapsus*.

KENTUCKY. Laurel Co.: London Quadrangle, London, S of KY 354N, across East 4th Street (KY 80) S 120 m down to 216 McLemore Street on E side of CSX Railroad right-of-way and grassy street margin, elev. 357 m, lat. 37.116880, long. -84.066782, 04 Nov 2012, R.L. Thompson & K. Rivers Thompson 12-1140 (BEREA, BRIT, EKY, KNK, MDKY, MO, MUR, NCU, TENN, UK).

This third collection corroborates further evidence for the naturalization of *Buddleja davidii*, as three additional fruiting shrubs and four seedlings were scattered for 35 m along the east side of the railroad right-of-way. A personal account from a local resident (C. House, pers. comm. 2012) noted several seedlings had become established at the edge of his yard at 216 McLemore Street and the ballast of the railroad bed during the last 2 or 3 years. He remarked "this area hasn't been [herbicide] sprayed and those three shrubs first appeared 3 or 4 years ago."

Only 12 depauperate associates were identified at this grassy habitat due to recent heavy fall frosts. Exotic and native herbaceous taxa in this habitat were *Amaranthus hybridus*, *Andropogon virginicus*, *Conyza canadensis*, *Croton monanthogynus*, *Cynodon dactylon*, *Digitaria sanguinalis*, *Euphorbia nutans*, *Lamium amplexicaule*, *L. purpureum*, *Muhlenbergia schreberi*, *Schedonorus arundinaceus*, and *Setaria pumila*.

***Buddleja davidii* Naturalized in Kentucky**

We have classified *Buddleja davidii* as clearly naturalized for the first time in Kentucky based on our interpretation of the “naturalized” category of Nesom (2000): a non-native plant population introduced into the flora from other introduced populations, which are spreading or dispersing from year to year without deliberate anthropogenic assistance.

The data from voucher specimens in Pike, Calloway, and Greenup counties indicate the naturalization of *B. davidii* in Kentucky over the last 30 years. Even if the species were originally introduced into these three counties, their habitat locations would infer otherwise and they would still provide potential diaspore sources into other non-cultivated areas. The 2011 Powell County collection of a volunteering, established non-introduced *B. davidii* validates naturalization in Kentucky. In Laurel County, the five new non-introduced shrubs and seedlings growing without cultivation within the railroad right-of-way habitats of London provide conclusive evidence of naturalization of orange-eye butterfly bush in Kentucky. Nevertheless, the naturalization of *B. davidii* in Kentucky at this time clearly does not imply classification of it as an “invasive species” based on classification standard criteria from the KY-EPPC (2012).

The most prudent explanation of plant propagule spread for this population of *Buddleja davidii* is the phenomenon of “slipstreaming,” the low pressure drag and blowing of scattered diaspores caused by methods of moving transportation (Eskridge & Hunt 1979; Garnier et al. 2008; von der Lippe et al. 2013). The numerous, minute, winged wind-dispersed seeds of *Buddleja davidii* could have been easily scattered in the slipstreaming wake of railway train locomotives and freight boxcars.

Dispersal Mechanism by Railways

Although *Buddleja davidii* populations in North America are not restricted to active or abandoned railroad habitats, we consider these three established colonies of *B. davidii* in Laurel County, Kentucky, to have been naturalized through the dispersal of propagules by the CSX Railway.

Railways have played an important role in providing suitable habitats and dispersal means of vascular plants. Slipstreaming along railroads has been verified as a means for the rapid dissemination of non-native fruits and seeds in the United States from literature reports and herbarium vouchers, e.g., *Chaenorhinum minus* (Plantaginaceae s.l.). The seeds of this naturalized European annual have been effectively and rapidly dispersed by the action of railway trains and their linked boxcars (Arnold 1979, 1981, 1991; Widrechner 1982; Sauer 1988). Railroad rights-of-ways have been correlated with numerous exotic weedy invaders in Illinois, Missouri, and Kentucky (Thompson & Heineke 1977; Thompson 1979; Cranfill & Thieret 1981; Medley et al. 1983; Thieret & Thompson 1984).

Four examples from the literature and herbarium specimens illustrate the occurrence of railroad transportation of wind-dispersed seeds and establishment specifically for *Buddleja davidii*. Miller (1984) in his dissertation reported that *B. davidii* had been originally spread throughout Great Britain along railroad tracks by being carried on freight cars and through train slipstreaming.

Mühlenbach (1979) related the slipstream dragging effect by trains in St. Louis railroad yards and the addition of aggregate ballast as two means of dispersing propagules of herbaceous and woody plants, including *Buddleia davidii*, as documented by:

MISSOURI. St. Louis Co.: collections from Railroad Sites: St. Louis Union Station on track 9, one big specimen, about 5 ft apart from a *Fragaria* sp. colony of huge size, not planted, determined by E. Norman, 18 Jul 1971, V. Mühlenbach 3622 (MO)!

Radford et al. (1968) in the *Manual of the Vascular Flora of the Carolinas* similarly reported *Buddleja davidii* as a rare introduction along a railroad in North Carolina. Label data from NCU confirms that information:

NORTH CAROLINA. Haywood Co.: cinder bed along railroad, 1.9 mi E of Canton, US 19-23, 15 Jul 1958, Harry E. Ahles & J.A. Duke 46516 (NCU)!

In Knoxville, Knox County, Tennessee, an escaped population of *Buddleja davidii* was documented on November 21, 2012, along a railroad bed adjacent to Mead's Quarry Lake, a part of the Ijams Nature Center. This population was discovered from information given by Dr. Dwayne Estes, Austin Peay State University Herbarium



FIG. 4. Inflorescence and flowers of *Buddleja davidii* (Thompson 12-1090, BERA).



FIG. 5. Infructescence and seed capsules of *Buddleja davidii* (Thompson & Rivers Thompson 12-1140, BERA).

(APSC) curator, who discovered the *B. davidii* population in 2003 (D. Estes, pers. comm. 2012).

Many mature shrubs as well as smaller volunteering shrubs and seedlings have colonized a 75 m extension of a railroad bed to the SSE of the three demolished limestone kilns. Orange-eye butterfly bush is locally naturalized at this Tennessee site, which provides evidence on the concept of wind-dispersed seeds being spread and established shrub populations being created through the slipstreaming action of active trains. This railway quarry site data are:

TENNESSEE. Knox Co.: Knoxville, Mead's Quarry Lake of the Ijams Nature Center, elev. 269 m, lat. 35.950533, long. -83.867525, several established shrubs between the limestone kiln wall and along the railroad track bed in agricultural lime slag spoils, frequent in abundance, 20 Nov 2012, R.L. Thompson & K. Rivers Thompson 12-1153 (APSC, BERE, MO, NCU, TENN).

Representative herbaceous associates with *Buddleja davidii* included *Ambrosia artemisiifolia*, *Andropogon virginicus*, *Conyza canadensis*, *Croton monanthogynus*, *Daucus carota*, *Lespedeza cuneata*, *Panicum flexile*, *Polymnia canadensis*, *Schedonorus arundinaceus*, *Solidago altissima*, *Sorghum halepense*, and *Symphotrichum pilosum*, among several others. Characteristic woody taxa between the railway tracks and kilns were *Acer negundo*, *Ailanthus altissima*, *Celtis occidentalis*, *Juniperus virginiana*, *Ligustrum sinense*, *Lonicera japonica*, *L. maackii*, *Platanus occidentalis*, *Rhus glabra*, *Robinia pseudoacacia*, *Rubus occidentalis*, *Pyrus calleryana*, and *Rosa multiflora*.

Diagnostic Description of Laurel County *Buddleja davidii* Specimens

The diagnostic description of *Buddleja davidii* here provides the first baseline taxonomic description directly from Kentucky material. It is notably modeled after the excellent species descriptions of Norman (2000, 2012).

Measurements were made of 33 living branches from the three Laurel County habitats prior to preparation as herbarium specimens. Measurements of flowers, fruits, and seeds were made with the use of a 5 mm Micro-Scale™ and a 10 mm Micro-Scale™ Micro-Tools from Electron Microscopy Sciences, Hatfield, Pennsylvania, in combination with a Bausch & Lomb StereoZoom 4 Microscope™.

Shrubs deciduous, unarmed, multi-stemmed, 1.2–2.2 m tall, 1.0–1.8 m spread, older branchlets greenish brown to brown, sparse stellate-tomentose to glabrescent; young branchlets tetragonous, densely grayish white canescent to stellate-glandular tomentose (Fig. 2). **Leaves** opposite, simple, pinnate, 10–15 lateral veins, blade narrowly to broadly elliptic-lanceolate to lanceolate-ovate 6.0–13.0 × 1.5–5.5 cm, dark forest green and glabrous adaxially, white stellate-tomentose abaxially, apex sharply acute, base cuneate-attenuate, margin serrate, new lateral leaf flushes white-canescens; petiole 5.0–10.0 mm, stipules, narrow auriculate, 1.0–2.0 mm high, forming prominent stem lines adjoining leaf bases (Fig. 3). **Inflorescences** terminal, indeterminate thyrsoïd cymes, tapered and secund, 10.0–36.0 × 3.0–5.5 cm, often with two lateral branches, pseudoverticillate cymes, 15–30 pairs each with 3–20 flowers, peduncles 5.0–15.0 mm (Fig. 3). **Flowers** numerous, perfect, 4-merous. Calyx campanulate, sessile to pedicellate 1.0 mm, persistent, greenish to red-purple, tube 2.4–3.1 × 1.0–1.6 mm, stellate and glandular outside, glabrous inside; lobes acute, 0.8–1.5 mm. Corolla salverform, lilac-rose, lilac-lavender, lilac-blue to red-purple, tube subcylindrical 8.0–12.0 × 1.0–1.2 mm, glabrous to sparsely stellate outside, pilose inside, lobes suborbicular to spatulate, 2.0–3.0 mm, glabrous, margin crenate-serrate, limb, 7.0–9.0 mm with a narrow white to yellow ring around an orange circle (eye) extending 1.0–1.5 mm into throat. Stamens 4, sessile, anthers dorsifixed, 1.0–1.2 mm, inserted at or near the middle of the pilose corolla tube. Ovary superior, ovoid, glabrous, syncarpous bicarpellate, 2.0–3.0 × 0.9–1.1 mm, placentation axile, stigma clavate, 1.5–2.0 × 0.8–1.3 mm (Fig. 4). **Capsules** septicidal, two-valved dehiscence, light olive green to brown at maturity, narrowly linear-oblong to elliptic, 9.0–15.0 × 1.8–2.3 mm (Fig. 5). **Seeds** 30–40, linear-fusiform, long-winged, 4.0–5.3 × 0.4–0.5 mm, dark brown, dorsiventrally compressed, wings translucent tan-brown, tapered at both ends, 1.7–2.1 mm (Fig. 5).

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