Honoring the Ecological Legacy of the Braun Sisters with Grave Site Restoration Plantings (Spring Grove Cemetery, Ohio)

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Dr. Emma Lucy Braun (1889–1971) was a pioneer in the field of Plant Ecology. Her influential book, *Deciduous Forests of Eastern North America* (Braun 1950), in which she popularized such terms as "mixed mesophytic forest" is a classic. Dr. E. Lucy Braun was the first woman elected president of the Ecological Society of America. Her sister, Dr. Annette Braun (1884–1978), was the first woman to earn a Ph.D. at the University of Cincinnati and was a leading authority on microlepidoptera. Dr. E. Lucy Braun was the third woman to earn a Ph.D. at the University of Cincinnati. During her career Dr. E. Lucy Braun had over 180 publications in the form of journal articles and books (Lafferty 1979). She was a founding member of the Cincinnati Wild Flower Preservation Society in 1917 whose motto is to "Enjoy: Do Not Destroy" and was a very important advocate for the preservation of natural areas (Meyn and Buck 2012). For instance, her conservation efforts in Adams County, Ohio has led to the preservation of 20,000 acres in The Edge of Appalachia Preserve System. The Braun sisters are buried side by side with their parents in section 101 at Spring Grove Cemetery in Cincinnati, Ohio.

It is a common practice to use the non-native, evergreen vines *Hedera helix* (English Ivy), *Euonymus fortunei* (Wintercreeper), and *Vinca minor* (Lesser Periwinkle) as ground covers on graves in cemeteries. These plants are easily propagated ground covers that are still extensively used by landscapers (Dirr 1983). *Hedera helix* and *V. minor* are native to Europe and Western Asia, and *E. fortunei* is native to Asia. When *H. helix* and *E. fortunei* vines climb trees and walls they can flower and produce fruits which are eaten by birds and small mammals that spread the seeds into wooded natural areas. Over the past few years wooded natural areas in Southwestern Ohio have experienced an explosive increase in the spread of *H. helix* and *E. fortunei*, where they can form a dense ground cover and form vines on trees that choke out native species (Conover et al. 2016, Swearingen 2009a, Swearingen 2009b.). This is of major concern because Southwestern Ohio is also where the highly invasive Asian shrub *Lonicera maackii* (Amur Honeysuckle) first became adventive in Ohio (Braun 1961, Conover and Sisson 2016).

Until recently the graves of the Braun sisters were covered with *H. helix*. Out of respect for these eminent conservationists it was decided to kill the *H. helix* on their graves and to replace it with native species. The first foliar application of herbicide was done on September 28, 2017. The temperature was 22.2°C and the sky was mostly sunny. The solution used for the initial application consisted of 4.9 mL of Kinetic (a spreader/sticker and penetrant combination, Helena Agri-Enterprise Collierville, TN) 88.7 mL of Ranger Pro glyphosate herbicide (Monsanto, St. Louis, MO), and 29.6 mL of Remedy Ultra triclopyr herbicide (Corteva agriscience, Wilmington, DE) with water added to make 3.8 L of finished spray solution. This solution had a concentration of 2.3% glyphosate, 0.01% trichlopyr, and 0.01% Kinetic. After one month the patch of *H. helix* was still alive, so on November 2, 2017 the patch was sprayed a second time. For this second spraying the temperature was 18.9°C and the sky was cloudy. The second solution consisted of 4.9 mL of Pentrabark surfactant and 88.7 mL of Ranger Pro with water added making a 1.9 L finished spray solution. This second solution had a concentration of 4.7% glyphosate and 0.03% surfactant. By the spring of 2018 the *H. helix* was significantly browned out. When the *H. helix* was stripped off the area, no green was evident in the shoots or stems. More testing is being done on other patches of *H. helix* at Spring Grove Cemetery to determine the most effective way to kill it.

After the *H. helix* was removed from the Braun graves, it was replaced with the native American ground cover species Creeping Mint (*Meehania cordata*), Golden Star (*Chrysogonum virginianum*), and Allegheny Spurge (*Pachysandra procumbens*). After two years of growth these native plants have become established and are serving as effective ground covers on the graves of the Braun sisters.

References

Braun, E.L. 1950. *Deciduous Forests of Eastern North America*. Philadelphia, PA: Blakiston.

Braun, E.L. 1961. *The Woody Plants of Ohio*. Columbus, OH: Ohio State University Press.

Conover, D.G, D.R. Geiger and T. Sisson. 2016. Dormant season foliar spraying slows the spread of wintercreeper, English ivy, and lesser periwinkle in wooded natural areas. *Ecological Restoration* 34:19–21.

Conover, D.G, and T. Sisson, 2016. Resurgence of Native Plants After Removal of Amur Honeysuckle from Bender Mountain Preserve, Ohio. *Ecological Restoration* 34:187–190.

Dirr, M.A. 2011. *Dirr's Encyclopedia of Trees and Shrubs*. Portland, OR: Timber Press, Inc.

Lafferty, M.B 1979. *Ohio's Natural Heritage*. Columbus, OH: Ohio Academy of Science.

Meyn, S.L. and A. Buck, 2012. *On the Edge: A History of the Richard and Lucille Durrell Edge of Appalachia Preserve System, Adams County, Ohio*. Cincinnati, OH: The Cincinnati Museum Center.

Ecological Restoration Vol. 38, No. 3, 2020
ISSN 1522-4740 E-ISSN 1543-4079

Swearingen, J. 2009a. WeedUS Database of Plants Invading Natural Areas in the United States: Climbing Euonymus (*Euonymus fortunei*). www.invasive.org/weedus/subject.html?sub=3024.

Swearingen, J. 2009b. WeedUS Database of Plants Invading Natural Areas in the United States: English Ivy (*Hedera helix*). www.invasive.org/weedus/subject.html?sub=3027.

Detecting Invasive Amur Honeysuckle in Urban Green Spaces of Cincinnati, Ohio Using Landsat-8 NDVI Difference Images

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Lonicera maackii (Amur honeysuckle) is a predominant invasive mid-level shrub introduced to North America from Asia in the late 1800s as an ornamental shrub. It prohibits native plants from growing over large areas of hardwood forests in the Midwestern and Eastern United States (Luken and Thieret 1996). *Lonicera maackii* was first documented as an escaped invasive in Hamilton County, Ohio around 1960 (Braun 1961) and has successfully invaded many green spaces in southwest Ohio (Hutchinson and Vankat 1998). When it invades a forest it alters the natural patterns of forest succession, reducing the growth rate of overstory trees by more than 50% (Hartman and McCarthy 2008). *Lonicera maackii* outcompetes many native plants with its growth pattern and extended growing season (McEwan et al. 2009, Wilfong et al. 2009). Early detection of invasive species is important to urban forest management because it curtails their spread (Moody and Mack 1988). Remote sensing methods can be a valuable tool for increasing knowledge about spatial patterns and predictors of invasion (Bradley 2014). Natural vegetation in cities is essential for maintaining biodiversity; this is known due to the extensive studies on adverse effects of natural habitat loss and fragmentation (e.g., Saunders et al. 1991, Gardner et al. 1993, Opdam et al. 1995, With et al. 1997). Urban green spaces support wildlife including rare and endangered species (Gibson 1998, Mortberg and Wallentinus 2000) and provide environmental services (e.g., air filtration, micro climate regulation, noise reduction, rainwater drainage, and recreation) (Bolund and Hunhammer 1999, Elmqvist et al. 2004).

Ecological Restoration Vol. 38, No. 3, 2020
ISSN 1522-4740 E-ISSN 1543-4079

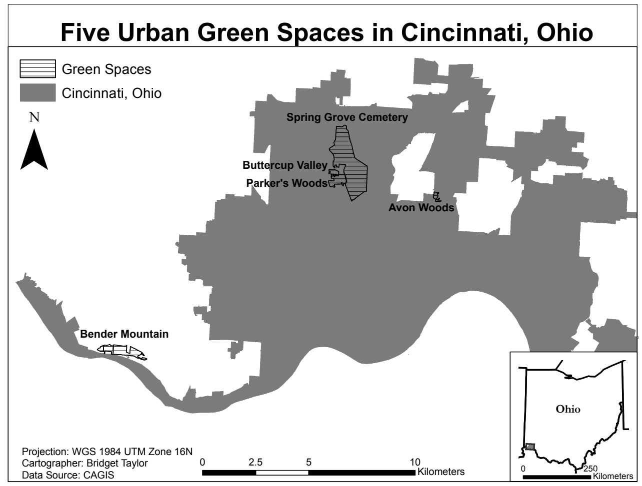

Figure 1. Study area: five urban green spaces in Cincinnati, Ohio.

Due to the extended leaf phenology, *L. maackii* can potentially be separated from native vegetation using remotely sensed data. The foliage of green plants strongly absorbs wavelength energy in the visible red band (Red) and somewhat reflects near infrared (NIR) (Rouse et al. 1973). A ratio of the red to near infrared reflectance, known as Normalized Differential Vegetation Index (NDVI), provides a valuable index of the greenness of a vegetation landscape. Wilfong et al. (2009) demonstrated mapping of *L. maackii* using Landsat-5 Thematic Mapper (TM) satellite imagery and Landsat-7 Enhanced Thematic Mapper Plus (ETM+) imagery by creating a difference image from a January NDVI image and a November NDVI image. Combining Landsat images with medium to fine spatial resolution and recorded GPS known locations was shown to be an effective method for early detection of *L. maackii* in a rural setting (Johnston et al. 2012) and in an urban setting (Shouse et al. 2013).

Remote sensing of *L. maackii* in urban forests is lacking, even though there is growing evidence to suggest *L. maackii* grows extensively in areas that are more urbanized (Reichard and White 2001, Harris et al. 2009, White et al. 2014). Shouse et al. (2013) compared *L. maackii* imagery detection methods in Cherokee Park (Louisville, KY) between more expensive and accurate high spatial resolution (HSR) imagery to freely available medium spatial resolution (MSR) imagery. Landsat-5 MSR imagery (30 m^2 spatial resolution) was less accurate but still beneficial for detecting invasive versus native species (Shouse et al. 2013). *L. maackii* is more pervasive in urban forests compared with rural ones (Borgmann and Rodewald 2005). Urban landscapes are often highly fragmented, irregularly shaped, and with multiple land uses making remote sensing more challenging compared to rural areas (Gong et al. 1992, Barnsley et al. 1993, Giner and Rogan 2012).

Our research objective was to develop an inexpensive and efficient *L. maackii* mapping approach for urban forest