Invasive shrubs in Northeast forests grow leaves earlier and keep them longer

August 19 2020, by Jeff Mulhollem

Lead researcher Erynn Maynard-Bean trains Penn State undergraduate researcher Richard Novak to collect leaf phenology data during a field trip in 2016. Credit: Warren Reed/Penn State

The rapid pace that invasive shrubs infiltrate forests in the northeastern United States makes scientists suspect they have a consistent advantage over native shrubs, and the first region-wide study of leaf timing, conducted by Penn State researchers, supports those suspicions.

With the help of citizen scientists spread over more than 150 sites in more than 20 states, researchers collected thousands of observations over four years of exactly when both invasive and native shrubs leaf out in the spring and lose their leaves in the fall. The study area was expansive, stretching from southern Maine to central Minnesota south to southern Missouri, to North Carolina.

"Eastern North America is the recipient of more invasive shrub species into natural areas than any other geographic region of the world," said lead researcher Erynn Maynard-Bean, postdoctoral researcher in the College of Agricultural Sciences, working under the guidance of Margot Kaye, associate professor of forest ecology. "Invasive shrubs are growing in both abundance and in the number of species established at the expense of many types of native species."

The researchers reported in *Biological Invasions* that invasive shrubs can maintain leaves 77 days longer than native shrubs within a growing season at the southern end of the area studied. The difference decreases to about 30 days at the northern end of the study area. At the southern end of the study area, the time when invasive shrubs have leaves and native shrubs do not is equally distributed between spring and fall; in the northern reaches of the study area, two-thirds of the difference between native and invasive growing seasons occur in fall.

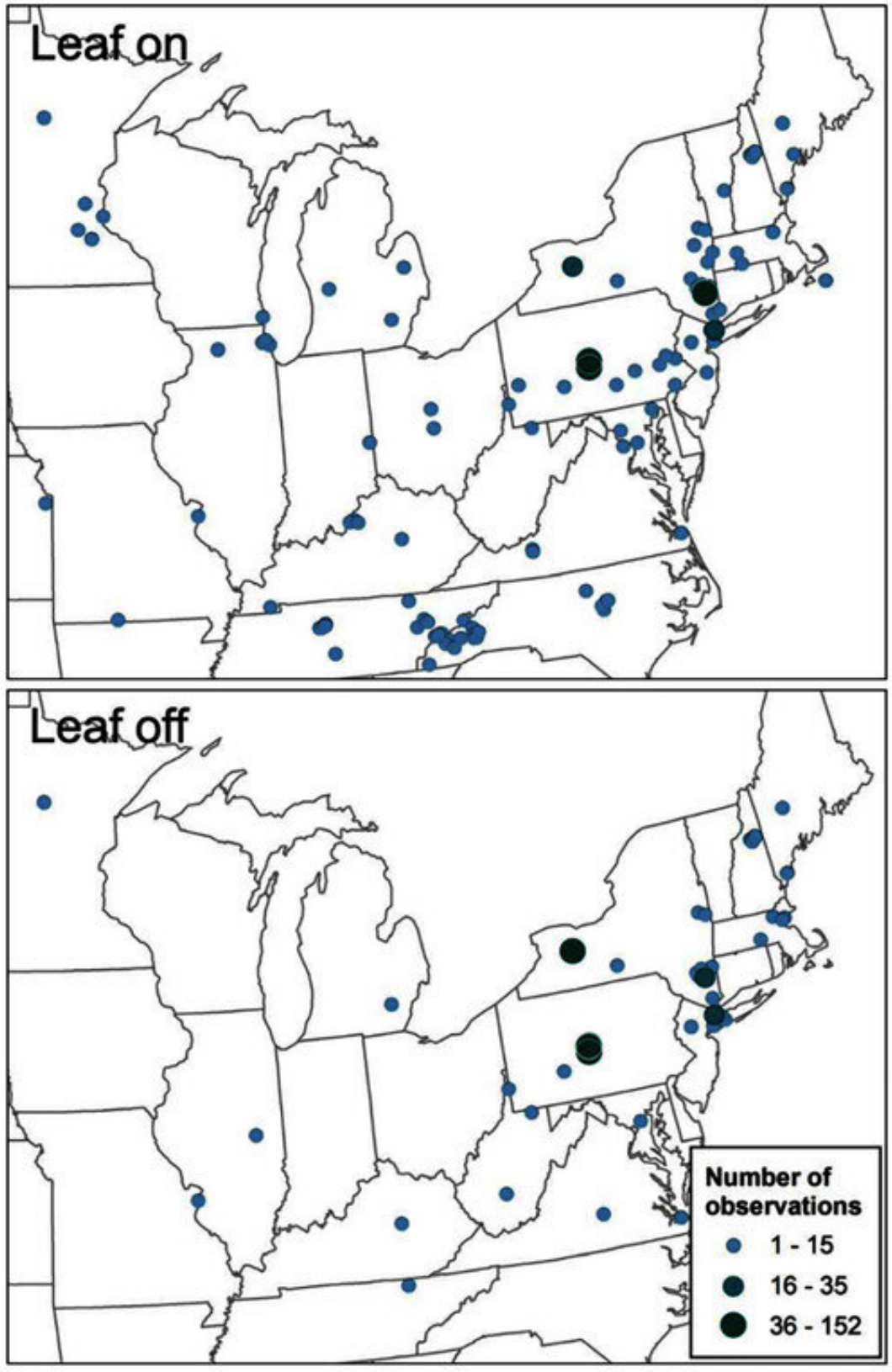
In the spring, the invasive shrubs in the understory at Shaver's Creek have green leaves to take advantage of extra sunlight while the overstory canopy is leafless. However, native shrubs have barely burst leaf buds. Citizen scientists collected data on this phenomenon of extended leaf phenology across the Northeast. Credit: Erynn Maynard-Bean/Penn State

The longer period with leaves gives invasive plants an advantage in acquiring more energy from sunlight and their leaves create shade in early spring and late fall that may limit growth of native species, such as forest ephemeral wildflowers, Maynard-Bean explained. "This helps

explain their negative impact on native tree regeneration, plant diversity and abundance," she said. "But invasive shrubs also have a negative impact on communities of animal species sensitive to light and temperature, such as bees, butterflies and amphibians."

Small, local studies in Northeast forests have shown that invasive shrubs have leaves longer than native shrubs. However, because the phenomenon—known as extended leaf phenology—varies geographically, the degree to which it benefits invasive shrubs across the region had previously been unknown.

The difference between native plants and invasive plants having leaves is not consistent, Maynard-Bean noted. It varies, depending on latitude, species studied and weather for the study period.



The location of observations used for modeling leaf emergence and leaf off. The

final number of observations used to model leaf emergence by citizen scientists was 911 across 153 sites, and for leaf off was 589 observations across 72 sites. Credit: Erynn Maynard-Bean/Penn State

"But with the help of citizen scientists with U.S. National Phenology Network watching plants with us from around the eastern U.S., we found a pattern of greater extended leaf phenology as you move south," she said. "This provides a unified framework for connecting local-scale research results from different parts of the eastern U.S. that had previously not agreed with one another."

With the goal of understanding on-the-ground implications for eastern deciduous forest ecosystems, the researchers chose common, widespread species that co-occur in forest understories. Native shrubs followed in the study included alternate-leaf dogwood, flowering dogwood, gray dogwood, spicebush, mapleleaf viburnum, southern arrowwood, hobble-bush and black haw. Invasive shrubs native to Europe or Asia followed in the study included Japanese barberry, burning bush, multiflora rose and several species of honeysuckles and privet.

In early spring, northern spicebush (Lindera benzoin) is a native shrub that is just breaking buds on the left, while an invasive shrub, Morrow's honeysuckle (Lonicera morrowii), has well-developed leaves on the right. Credit: Erynn Maynard-Bean/Penn State

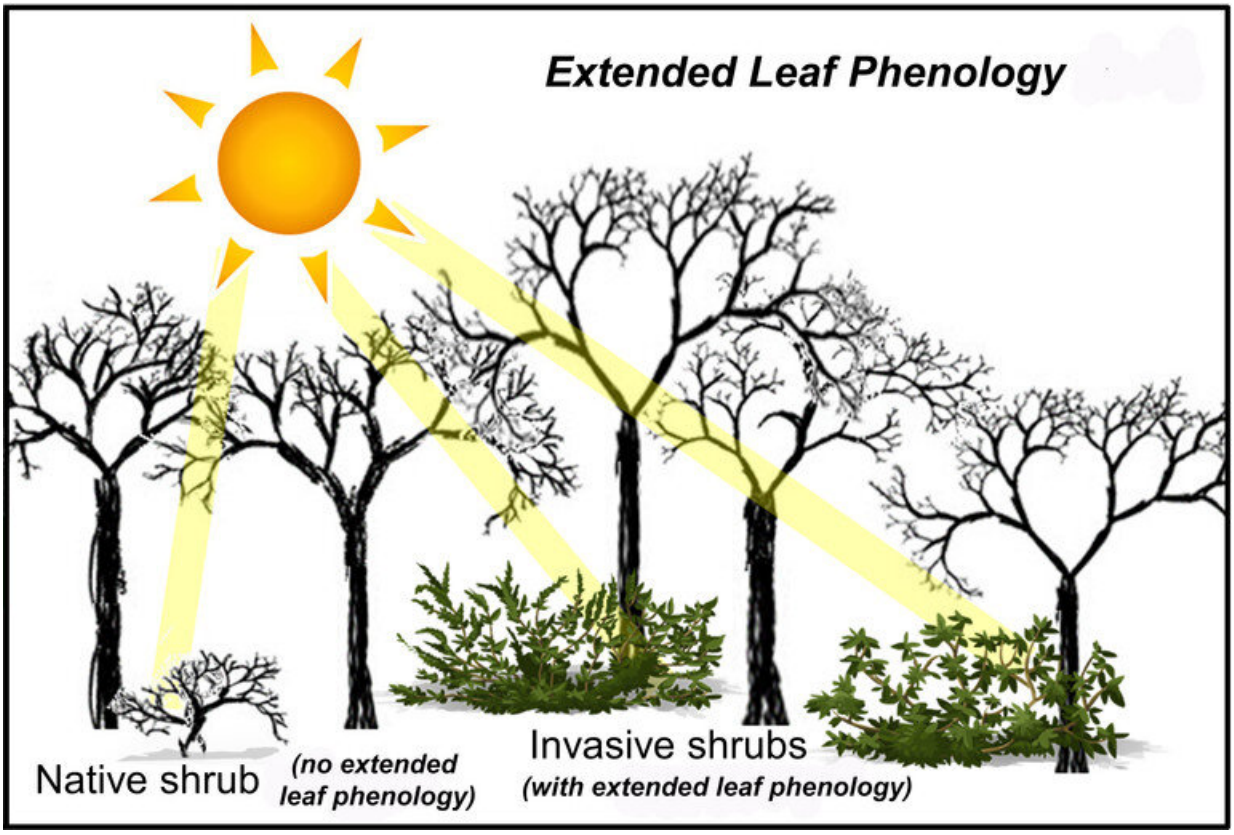
About 800 citizen scientists collected more than 8,000 observations of leaf timing for 804 shrubs at 384 sites, from 2015 through 2018. In addition, Maynard-Bean made observations at three sites in Pennsylvania.

In late fall, the native shrub, mapleleaf viburnum (Viburnum acerifolium), exhibits fall color prior to the adjacent invasive privet (Ligustrum obtusifolium) which is still bright green and photosynthetically active. Credit: Erynn Maynard-Bean/Penn State

The patterns of extended leaf phenology for invasive shrubs compared to native shrubs found in this study have important implications for policy and management, according to Kaye, whose research group has been evaluating invasive shrubs in Northeast forests for more than a decade. She pointed out that invasives included in this study are still commonly used for horticultural purposes in some states but are banned in others.

In late fall, the native shrub northern spicebush (Lindera benzoin), with yellow fall color surrounded by Japanese barberry (Berberis thunbergii) that still has deep green foliage as well as red fruits. Credit: Erynn Maynard-Bean/Penn State

"The presence of this phenomenon may serve as a predictive trait for the invasion potential of new horticultural specimens," Maynard-Bean said. "From a management perspective, extended leaf phenology makes invasive shrubs an easier 'green target' in the spring and fall for detection, removal and treatment, which can protect dormant, non-target native species."



Extended leaf phenology becomes apparent at the ends of the growing season — in early spring and late fall — when most native woody species have lost their foliage. Credit: Erynn Maynard-Bean

More information: Erynn Maynard-Bean et al, Citizen scientists record novel leaf phenology of invasive shrubs in eastern U.S. forests, *Biological Invasions* (2020). DOI: 10.1007/s10530-020-02326-1

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