

# By reducing forest floor temperature, invasive shrubs stifle native species

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A researcher using a ceptometer measures light energy reaching the forest floor.  
Credit: Erynn Maynard-Bean/Penn State

Invasive shrubs in Northeastern forests that sprout leaves earlier in the spring and keep them longer in the fall not only absorb more sunlight than native shrubs, but their foliage lowers air temperatures on the forest floor, likely giving them another competitive advantage.

That's the conclusion of Penn State researchers who conducted a three-year study of the effect of invasive shrub removal on native forest plants in The Arboretum at Penn State on a tract called the Hartley Wood.

Invasive shrubs are flourishing in temperate, deciduous forest understories of eastern North America where resources—especially light—are limited, explained postdoctoral researcher Erynn Maynard-Bean, who led the study. The extended leaf phenology of invasive shrubs provides photosynthetic advantages, but these plants also benefit from seasonally novel shade they create.

"Light and [temperature](#) influence ecosystem processes, likely slowing the growth of native plants," she said. "We saw a pattern of reduced maximum air temperature in the presence of invasive shrubs during the growing season of most years."

In findings recently published in *Natural Areas Journal*, the researchers reported that they detected 26.8% less light energy infiltration below invasive shrubs compared to under native shrubs, with differences largest in the spring.

Because photosynthesis is driven by the number of photons of sunlight within the spectral range that plants use, researchers quantified photons in plots with native and invasive shrubs with a ceptometer, above and below the shrub layer. Those two measurements were taken at approximately 10 feet above and about 4 inches above the forest floor, at the same 20 collection points, on 27 dates spanning three years.

That difference in light energy is significant, Maynard-Bean noted. "Think of it this way, it's like a 60-watt lamp in every 10 square feet of the forest is removed by the presence of invasive shrubs, on average, across the growing season," she said.

Researchers recorded temperature data hourly and daily periodically during the study. To understand the influence of invasive shrubs on the daily minimum and maximum temperatures, they calculated the difference in temperatures between invasive shrub plots and native shrub plots. However, temperatures fluctuated in the experiment, according to Maynard-Bean.

That variation resulted from different surfaces the sunlight hits on the forest floor, she explained, and how much moisture is present.

"Sunlight warms the surface, and then that heat transfers to the air. But it turns out to be extremely variable, because it depends on how wet the surfaces are—water will absorb a lot of that energy, not changing the temperature. It's also dependent on the type of material on the forest floor. It's mostly leaf litter, but also sticks, logs and rocks change the rate of transfer of light energy into temperature."

The study results may explain a phenomenon that scientists have witnessed associated with invasive forest plants, Maynard-Bean pointed out.

"First, we know that invasive shrubs negatively impact bees, butterflies and amphibians in forest understories," she said. "Those are exothermic species, meaning their activity and development is highly influenced by light and temperature in the understory. So, this could help explain why we don't find as many butterflies, bees and amphibians in invaded understories as we do in uninvaded understories."

The findings also may suggest a reason why Eastern forests have grown increasingly fire resistant, to the detriment of fire-tolerant plant species such as oak, Maynard-Bean noted, adding that lower light conditions have potential implications for forest litter quality and decomposition rates.

"The darker, cooler conditions caused by the invasion of nonnative shrubs have the potential to exacerbate the mesophication—the transition of a fire-adapted community to a fire-intolerant one—of Eastern deciduous U.S. forests," she said. "Decades of forest fire suppression have allowed mesophytic, or shade-tolerant, species to shift the understory toward more cool, damp and shaded conditions resistant to burning."

Margot Kaye, associate professor of forest ecology, contributed to the study. Her research group in the College of Agricultural Sciences has studied plant communities at The Arboretum at Penn State for more than a decade.

**More information:** Erynn Maynard-Bean et al, The Seasonal Influence of Invasive Shrubs on Light and Temperature in an Eastern Deciduous Forest Understory, *Natural Areas Journal* (2021). [DOI: 10.3375/043.041.0304](https://doi.org/10.3375/043.041.0304)

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