# Deer browsing is not stopping the densification of Eastern forests

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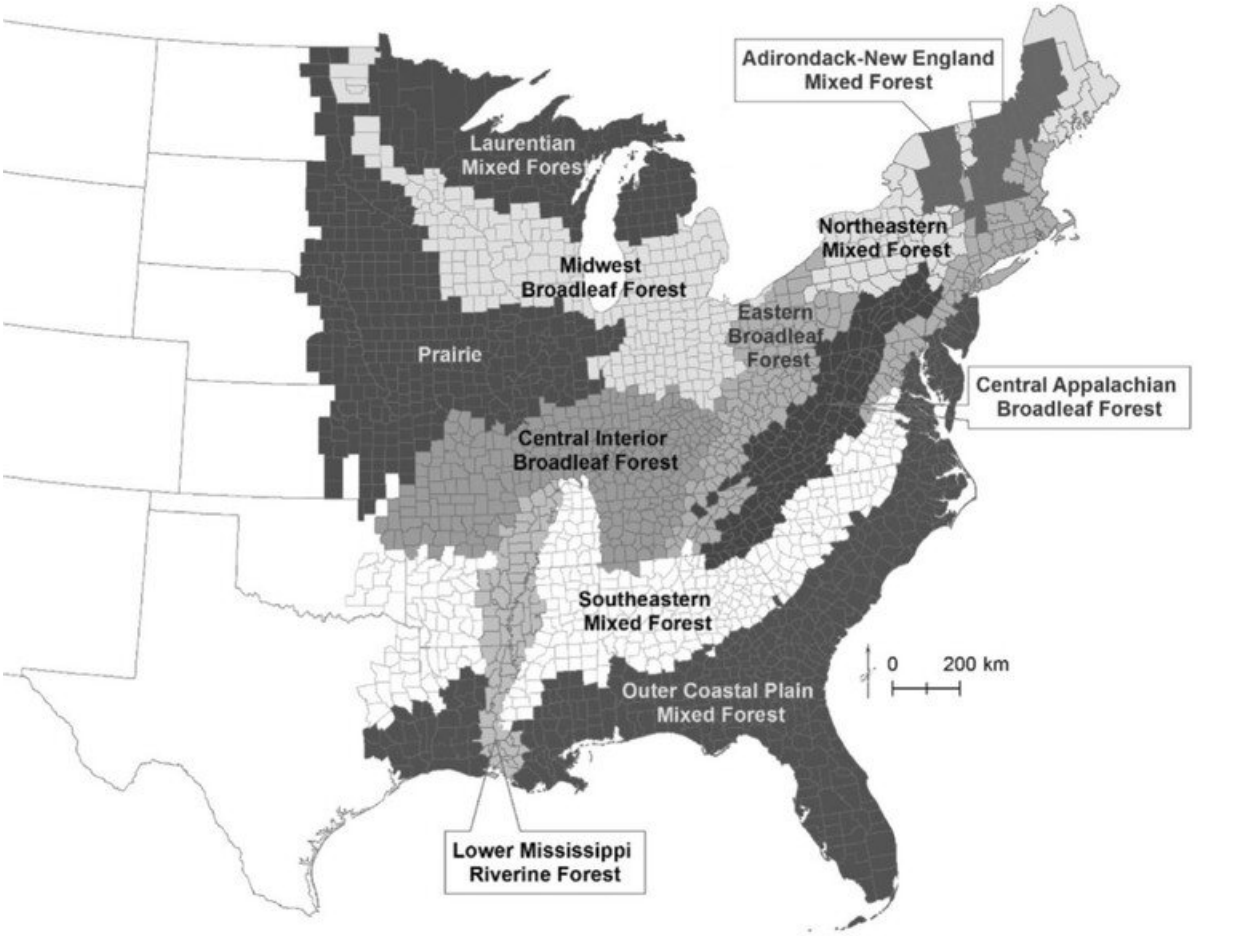


This map shows units where the researchers collected data from forest inventory areas maintained and surveyed every five years by the US Department of Agriculture Forest Service, along with forest types in the eastern United States. Credit: Penn State

Selective browsing by white-tailed deer has been blamed by many for changing the character and composition of forest understories in the eastern U.S.; however, its impact on the forest canopy was previously unknown.

Now, a new study led by a Penn State researcher suggests that while deer browsing has impacted tree regeneration in the understory, it has not had much of an impact on forest canopies—and in fact likely has slowed the forest densification process slightly.

"Forests in the region are becoming increasingly dense, and that is a major ecological problem," said Marc Abrams, professor of forest ecology and physiology in the College of Agricultural Sciences. "Indeed, deer can be thought of as an agent slowing down the densification problem, albeit not very effectively."

Abrams, who has spent most of his 40-year career studying how and why forests in the eastern U.S. have changed over the last few centuries, has assessed the role of increasing deer populations on reducing or eliminating tree regeneration in many forests.

"In addition to deer, a particularly important driver of forest change has been the near elimination of fire after the 1930s, attributed to the Smokey Bear campaign," said Abrams, the endowed Nancy and John Steimer Professor of Agricultural Sciences. "This has led to a densification of Eastern forests, in particular caused by red maple."

Recently Abrams realized that there is a paradox with the overstory densification occurring in the face of increasing deer pressure. So working with Brice Hanberry, a research scientist with the U.S. Forest Service, he compared forest overstory density with deer populations over time, by county, in the major forest types in the eastern U.S. The researchers found that the eastern U.S. has only a small proportion of

understocked forests, and they have no statistical relationship to deer population.

The overstocking of forests is a major problem in the management of Eastern forests, Abrams believes.

"The densification greatly threatens the sustainability of many historically important tree species, such as oak, pine and hickory," he said. "For example, the increase in trees has been mainly from less-desirable species, particularly red maple, at the expense of oak, hickory and pine."

Red maple's success can be attributed more to its shade tolerance than it being a less-favored species for deer browsing, because its preference as food by deer varies by region. Therefore, the suppression of fire has been a more powerful driver of forest change on a landscape level than has deer browsing, Abrams explained.

"Management goals for the Eastern forests should include reducing the overstory density of undesired tree species and restoring natural fire cycles," he said. "These actions will help promote the historically dominant trees in the eastern U.S. A reduction in deer density may help promote some desirable tree species but may also exacerbate the densification problem."

Historically, forests in the region were more open and drier than those growing today. Long before the Smokey Bear period, Abrams noted, Native Americans burned large forest tracts regularly. And then, from 1870 to after 1930—mostly because of land clearing and logging during the clear-cut era that left a huge amount of fuel and resulted in catastrophic fires—burning frequency increased and peaked in the 1930s.

To regenerate, desired tree species such as oak require sunlight to reach the forest floor, so with the densification problem, many of the historically dominant trees in the East no longer can regenerate well, and they are being replaced by shade-tolerant species such as red maple.

Deer browsing has not controlled tree density on a landscape level, Abrams said, because certain tree species—whether preferred or not by deer—generally have increased in the eastern U.S. during the past century. The exceptions are the fire-adapted species such as oak, hickory and pine, which have suffered from a lack of fire.

"If deer control tree regeneration, preferred tree species generally should decline relative to nonpreferred tree species," he said. "In Eastern forests with high deer densities, however, both decreasing and increasing tree species are favored browse for deer. Thus, deer densities do not explain compositional shifts between historical and current forests."

This research, published recently in *Ecological Processes*, is novel and was not possible before the advent of modern computers capable of handling huge amounts of data, Abrams pointed out. Information from more than 1,000 forest-inventory areas in the 26 states east of the Mississippi River—maintained for many decades by the U.S. Forest Service—was used to calculate changes in tree stocking and species. Those permanent plots are surveyed every five years.

"The finding of this research may greatly change how scientists and forest managers view the role of deer in the ecology of Eastern forests," he said. "They may realize that densification is an even larger problem."

**More information:** Brice B. Hanberry et al, Does white-tailed deer density affect tree stocking in forests of the Eastern United States?, *Ecological Processes* (2019). DOI: 10.1186/s13717-019-0185-5

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