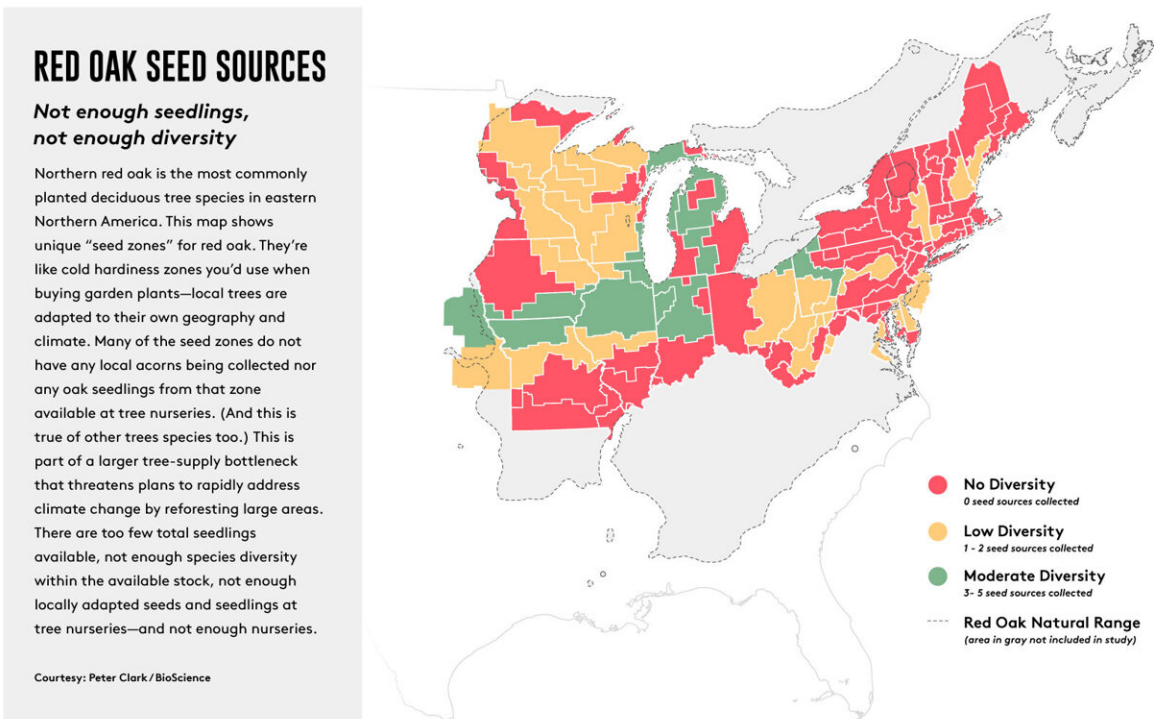


Plans to plant billions of trees threatened by massive undersupply of seedlings

July 31 2023



This map of red oak seed sources provides an example of a major threat to an important effort against climate change: major government and private funding is being invested in planting trees as a powerful tool to fight local and global warming. But new research in the journal Bioscience, from which this map is adapted, shows a troubling bottleneck that could threaten these efforts: U.S. tree nurseries don't grow close to enough trees—nor have the species diversity needed—to meet ambitious planting goals. Credit: adapted from Peter Clark/BioScience

The REPLANT Act provides money for the US Forest Service to plant more than a billion trees in the next nine years. The World Economic Forum aims to help plant a trillion trees around the world by 2030. Many US cities have plans to shade their streets with millions of trees. Major government and private funding is being invested in planting trees as a powerful tool to fight climate change, protect water, clean air, and cool cities. In short, trees are hot.

But new research shows a troubling bottleneck that could threaten these efforts: U.S. tree nurseries don't grow close to enough trees—nor have the [species diversity](#) needed—to meet ambitious plans. The study was published in the journal *Bioscience* on July 31, 2023.

Seedling scarcity

"Trees are this amazing natural solution to a lot of our challenges, including climate change. We urgently need to plant many millions of them," says University of Vermont scientist Tony D'Amato who co-led the new research. "But what this paper points out is that we are woefully underserved by any kind of regional or national scale inventory of [seedlings](#) to get the job done."

A team of 13 scientists, led by D'Amato and UVM post-doctoral scientist Peter Clark, studied 605 plant nurseries across 20 [northern states](#). Only 56 of these grow and sell seedlings in the volumes needed for conservation and reforestation and only 14 of them were government-operated, they report.

The team was more dismayed to discover an "overwhelming scarcity of seedlings," they write, from different [species](#) and "seed collection zones"—trees adapted to local conditions and climate.

In essence, forest nurseries tended to maintain a limited inventory of a

select few species, electing to prioritize those valued for commercial timber production over species required for conservation, ecological restoration, or climate adaptation. Moreover, many areas had no locally adapted tree stock available. (See map for example.) And within the seedlings available, there were not enough types of trees and "future-climate-suitable" genetics to meet goals for conservation and forest restoration in a hot future.

"The world is thinking about a warming climate—can we plant towards that warming climate? We know we're losing ecologically important species across North America and around the world. So, the goal is: can we restore these trees or replace them with similar species? It's a powerful idea," says UVM's Peter Clark, the lead author on the new study. "But—despite the excitement and novelty of that idea in many policy and philanthropy circles—when push comes to shove, it's very challenging on the ground to actually find either the species or the seed sources needed."

"The number of seedlings is a challenge," Clark says, "but finding the diversity we need to restore ecologically complex forests—not just a few industrial workhorse species commonly used for commercial timber operations, like white pine—is an even bigger bottleneck."



University of Vermont forest scientists Peter Clark and Tony D'Amato at an experimental forest in Vermont. They led new research showing a troubling bottleneck that could threaten efforts to fight climate change with tree planting: U.S. tree nurseries don't grow close to enough trees—nor have the species diversity needed—to meet ambitious planting goals. Credit: Joshua Brown/UVM

One extreme example is red spruce. This ecologically important species along hundreds of miles of eastern North America has been under stress for decades from climate change, pests, and land clearing. Yet, in their 20-state survey, the team only found two tree nurseries that had inventory of red spruce, a species from which many millions of seedlings are needed to meet restoration goals. "Remarkably, only 800 red spruce seedlings were commercially available for purchase in 2022, enough to reforest less than one hectare," the team reports.

"It really points to just how bare the cupboard is when it comes to the diversity of options," says Tony D'Amato, director of the Forestry Program in UVM's Rubenstein School of Environment and Natural Resources, "but also the quantity that's needed to make any meaningful impact."

Increased investment

The team argues that dramatic increases in both seedling production and diversity at many regional nurseries will be central to any successful campaign to address [climate change](#) with tree planting.

However, the novelty and risk involved, "likely generates uncertainty among forest nurseries, hampering investment," they write. This appears to be especially true in regions, like the Northeast, where nurseries have declined over recent decades, the study reports, and where speculative investment—in growing new, future-climate-adapted, non-timber species and seedlots—may carry high financial risk.

Additionally, seedlings brought in from outside a region may be less likely to succeed. The new study reports that the vast majority (80%) of seedlings in the northern states, where the study was conducted, are produced in the North Central states—and very few in the Northeastern states.

"Such concentration of production will hinder tree planting efforts," they write, "because species and seed sources likely originate from similar geographic or bioclimatic zones." On top of this challenge, seedlings are sensitive to stress. A misalignment between when seedlings are available—say in a southern nursery months before northern soils are frost free—and when they are needed, may doom their chances.

The team of researchers—including scientists from UVM; the USDA's

Northern Forest Research Stations in Minnesota, Michigan and New Hampshire; Minnesota Department of Natural Resources; Wisconsin Department of Natural Resources; Michigan Department of Natural Resources; University of Minnesota; the USDA's Northern Institute of Applied Climate Science; and The Nature Conservancy (Albany, NY)—recommend a series of improvements from improved policy and financing to better training and expanded research.

For example, today government agencies, such as the US Forest Service and many US state governments, lack clear policies about the movement of tree species and tree genetics. They often rely on seed zones established in the 1970s based on historical climate conditions, not future ones—even though up-to-date guidelines for moving species under a warming climate are becoming available. Additionally, much forest policy and research has been framed around species important for timber production—rather than efforts to diversify species and climate-adapted seed-sourcing.

The team of scientists suggest that expanded federal and state investment will be needed to boost both public tree nurseries and seed collection efforts. "This strategy may stimulate production from private nurseries once a stable demand is apparent," they write.

In 2023, the federal government made an investment of \$35 million in expanding federal nursery capacity. "However, given the existing (and growing) reforestation backlog, declines in [nursery](#) infrastructure, and complex needs for diverse seeds and seedlings, it is likely that substantially more public investment in the form of grants, loans, and cost-share programs will be needed to reinvigorate, diversify, and expand forest nurseries," they write.

"People want trillions of trees," says the University of Vermont's Peter Clark, "but often, on the ground, it's one old farmer walking around to

collect acorns. There's a massive disconnect."

More information: Peter Clark et al, Lack of ecological diversity in forest nurseries limits achievement of tree planting objectives in response to global change, *Bioscience* (2023). [DOI: 10.1093/biosci/biad049](https://doi.org/10.1093/biosci/biad049)

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