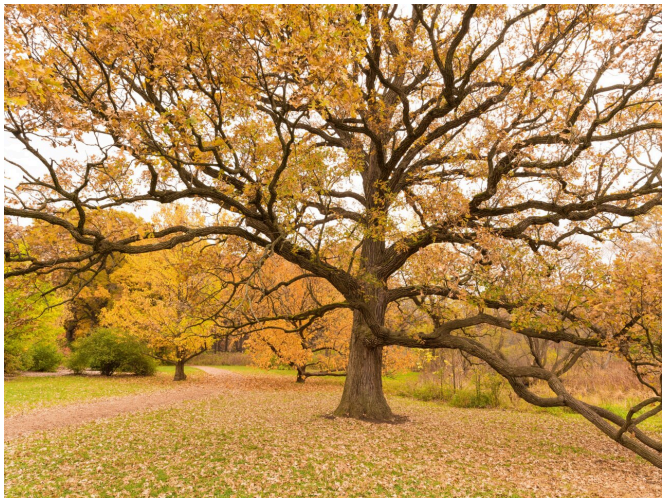
Ancient trees deemed vital to forest survival

31 January 2022



Old Burr Oak at The Morton Arboretum. Credit: The Morton Arboretum

New research suggests that ancient trees possess far more than an awe-inspiring presence and a suite of ecological services to forests—they also sustain the entire population of trees' ability to adapt to a rapidly changing environment.

In the February edition of *Nature Plants*, Chuck Cannon, Ph.D., director of The Morton Arboretum's Center for Tree Science in Lisle, Ill., U.S., and collaborators at Tuscia University in Italy and the University of Barcelona in Spain, report that old and ancient trees (often more than 10 to 20 times older than the average individual in the forest) radically change the overall genetic diversity and composition fitness of their surrounding populations. The findings also indicate that these trees contribute evolutionary properties to forests that are vital to their long-term survival.

"We examined the demographic patterns that emerge from old-growth forests over thousands of years, and a very small proportion of trees emerge as life-history 'lottery winners' that reach far higher ages that bridge environmental cycles that span centuries," said Cannon. "In our models, these rare, ancient trees prove to be vital to a forest's long-term adaptive capacity, substantially broadening the temporal span of the population's overall genetic diversity."

The authors report that the death of ancient trees is more a random product of their environment rather than a predictable process, like in humans. These trees, which comprise less than 1% of a population, given model conditions, contribute a vitally important amount of genetic and biological diversity to a forest's overall population, representing a broad range of historical environmental conditions that span hundreds or even a thousand years.

To put it simply, according to the authors, ancient trees have survived countless environmental changes over hundreds or thousands of years, and in turn, this genetic resilience is passed on to the forest. Moreover, these old trees provide invaluable services to their ecosystem. They provide a habitat for endangered species and sequester a disproportionate amount of carbon compared to typical mature trees.

Impossible to cultivate

Unfortunately, old-growth forests around the world are under threat. According to the study, deforestation of natural forests is continuing around the world, and there is evidence that the overall mortality rate of trees may be increasing globally from the boreal biome to the tropics.

The researchers found in their models that the maximum age that trees could reach was particularly sensitive to the lower range of observed mortality rates. However, at higher mortality rates, like those that might be seen as resulting from climate changes, the ability of trees to reach the same impressive ages is very limited or virtually impossible.

"As the climate changes, it is likely that mortality rates in trees will increase, and it will become

increasingly difficult for ancient trees to emerge in forests," said Cannon. "Once you cut down old and ancient trees, we lose the genetic and physiological legacy that they contain forever, as well as the unique habitat for nature conservation," he added.

The authors note that while forest restoration and tree planting efforts are important tools to improve both local and global environments, ancient trees cannot be recovered or regenerated without many centuries and generations of trees passing. They are an emergent property of old-growth forests that are impossible to recreate in newly regenerating forests, and must be protected, urge the authors.

"This study recalls the urgent need for a global strategy to conserve biodiversity, not only by preserving intact forests, but in particular the small remnant of a few ancient trees that have survived in managed forest landscapes," said Piovesan.

More information: Charles Cannon, Old and ancient trees are life history lottery winners and vital evolutionary resources for long-term adaptive capacity, *Nature Plants* (2022). DOI: 10.1038/s41477-021-01088-5.

Provided by The Morton Arboretum