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Study: Warming climate to create 'impoverished version' of northern forests

Northern Minnesota research published in the journal Nature found modest warming may devastate some tree species.

Researchers assess the survival and growth of saplings on an experimental plot at a University of Minnesota field site near Ely. While the research continues, a paper published Wednesday in the journal Nature found that even a modest warming of the Northland climate could be devastating for some of the region's tree species.
Contributed / University of Minnesota / Artur Stefanski

By John Myers
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DULUTH — Research in northern Minnesota forest plots using heaters to warm the air and roots around young trees has found more evidence that even a modestly warmer climate will have a devastating impact on some tree species.

The experiments have been ongoing at University of Minnesota research stations near Cloquet and Ely since 2009 using infrared lamps and soil warming cables to mimic climate conditions expected as the Earth warms due to human-caused greenhouse gasses.

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June 10, 2022 08:00 AM

The research has been warming thousands of small trees of nine Northland species around the clock from spring to fall and found that even a modest, 2.9-degree Fahrenheit climate warming produced major problems for many species, including reduced growth and increased mortality.

The research also robbed some trees of some rainfall, to mimic possible drier conditions, which served to amplify the negative effects of warming on the survival of several boreal species.

A researcher measures growth and survival of tree saplings at a University of Minnesota experimental forest plot near Ely. Thousands of seedlings of nine native tree species have been studied to measure the mpact of a warming climate.
Contributed / University of Minnesota / Raimundo Bermudez

Pines and spruce may be the hardest hit by a warmer climate, the study found, while oaks and maples did better. But oaks and maples may not move north at a fast enough pace to fill-in for the lost trees.

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Minnesota's northern forests will look much different in coming decades as a warming climate encourages tree species like oaks and maples and pushes others, including spruce and fir, out of the region.

January 20, 2015 08:59 PM

"Our results spell problems for the health and diversity of future regional forests," said Peter Reich, lead author of the study. Reich, a

forest ecologist, is now working through both the University of Minnesota as well as the University of Michigan at Ann Arbor.

“In the experiment, we are subjecting forest plots to temperatures that we won't see for another 40 or 50 or 60 years to understand what those oncoming temperatures will do," he said.

Nine tree species are studied: balsam fir, white spruce, jack pine, white pine, red maple, sugar maple, paper birch, bur oak and red oak.

The results were published Wednesday in the journal Nature.

Reich said that in a worst case scenario, at nearly 5-degree warming, a mark expected later this century if carbon emissions aren't reduced, found northern Minnesota species did even worse.

The latest results were from small trees studied from 2012 to 2016 and match results of a previous study that followed trees at the Ely and Cloquet stations from 2009 to 2011 and reported in 2015.

“The latest results are entirely consistent with what we published earlier,” Reich told the News Tribune. Additional experiments will continue at the sites.

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March 10, 2017 06:08 PM

The problem isn’t just for northern Minnesota, but for all of the world’s boreal forests, Reich noted, which are considered among the largest still-intact ecosystems on Earth. They also serve as carbon sinks,

soaking up carbon dioxide, a greenhouse gas caused by burning fossil fuels that science shows traps heat and causes climate change globally.

"Present-day southern boreal forest may reach a tipping point with even modest climate warming, resulting in a major compositional shift with potential adverse impacts on the health and diversity of regional forests," said Reich.

A researcher checks a thermocouple panel, part of a system that uses heat lamps and soil cables to warm experimental plots at a University of Minnesota field site near Cloquet. The five-year study, led by forest ecologist Peter Reich, found that even modest climate change may lead to sweeping changes in the northernmost forests, which are called boreal forests. Contributed / University of Minnesota / David Hansen

Those impacts include reduced capacity of forests to produce lumber or paper pulp or to cushion against floods and provide habitat for northern animals.

The researchers found that warming alone, or combined with reduced rainfall, increased juvenile mortality of all nine tree species and severely reduced growth in several northern conifer species — balsam fir, white spruce and white pine — common in boreal forests.

Modest warming enhanced the growth of some hardwoods, including some oaks and maples, which are rare in the boreal forest, but much

more common in temperate forests to the south.

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June 11, 2021 01:18 AM

But the new study concludes that hardwoods are likely too rare in northern Minnesota's boreal forests to rapidly fill the void left by vanishing conifers. Because the climate is warming faster than southern tree species can move north, the near-term projected climate change will likely shift present-day boreal forest into "a new state" of altered composition.

"That new state is, at best, likely to be a more impoverished version of our current forest," Reich said. "At worst, it could include high levels of invasive woody shrubs, which are already common at the temperate-boreal border and are moving north quickly."

Reich noted that efforts to get ahead of the problem b\y planting southern tree species farther north are a good idea "but are really just a Band-Aid. The solution is to stop the climate from warming any more."

Other authors of the Nature paper include Raimundo Bermudez, Rebecca Montgomery, Karen Rice, Sarah Hobbie and Artur Stefanski of the University of Minnesota and Roy Rich of the Smithsonian Environmental Research Center. The research was supported by the U.S. Department of Energy, National Science Foundation, Minnesota Agricultural Experiment Station and University of Minnesota.

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