Forests not keeping pace with climate change: study

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More than half of eastern U.S. tree species examined in a massive new Duke University-led study aren't adapting to climate change as quickly or consistently as predicted.

"Many models have suggested that trees will migrate rapidly to higher latitudes and elevations in response to warming temperatures, but evidence for a consistent, climate-driven northward migration is essentially absent in this large analysis," says James S. Clark, H.L. Blomquist Professor of Environment at Duke's Nicholas School of the Environment.

Nearly 59 percent of the species examined by Clark and his colleagues showed signs that their geographic ranges are contracting from both the north and south.

Fewer species -- only about 21 percent -- appeared to be shifting northward as predicted. About 16 percent seemed to be advancing southward, and around 4 percent appeared to be expanding in both directions.

The scientists analyzed data on 92 species in more than 43,000 forest plots in 31 states. They published their findings this month in the journal Global Change Biology.

The study found no consistent evidence that population spread is greatest in areas where climate has changed the most; nor do the species'

response patterns appear to be related to seed size or dispersal characteristics.

"Warm zones have shifted northward by up to 100 kilometers in some parts of the eastern United States, but our results do not inspire confidence that tree populations are tracking those changes," says Clark, who also holds appointments at Duke as a professor of biology and statistics. "This increases the risk of serious lags in tree migrations."

The concept of climate-driven migration is based on the assumption that as temperatures warm, the southern edge of some tree species' ranges could begin to erode as adult trees die and the seeds they leave behind in the soil can no longer sprout. At the same time, the species could spread to higher latitudes as seedlings dispersed on their northern boundaries are able to take root in newly favorable climates there.

To test whether this predicted response was occurring in real life, Clark and his colleagues pored through decades of data compiled by the U.S. Forest Service's Forest Inventory and Analysis Program. They compared the relative distributions of seedlings, saplings and adult trees of 92 widely distributed eastern U.S. species at 43,334 plots in 30 different longitudinal bands, and factored in things like seed characteristics, and changes in climate and precipitation.

"The patterns of tree responses we were able to document using this seedling-versus-tree analysis are more consistent with range contraction than with northward migration, although there are signs some species are shifting to higher elevations," Clark says.

The fact that the majority of the northernmost latitudes documented for seedlings was lower than those for adult trees of the same species indicates "a lack of evidence for climate-mediated migration, and should increase concern for the risks posed by climate change," he says.

More information: "Failure to migrate: lack of tree range expansion in response to climate change," Kai Zhu, Christopher W. Woodall, James S. Clark. *Global Change Biology*, accepted article online. DOI: 10.1111/j.1365-2486.2011.02571.x

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