Forest canopies buffer against climate change

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When temperatures rise and less water falls, forests respond. Forest canopies can buffer juvenile trees from drought and heat by providing shade for the younger trees below the leaf and needle cover. Adult trees have deep roots and can handle hot and dry conditions better than juveniles of the same species.

However, current models of how forests will respond to climate change don't account for this difference between adult and juvenile trees. Recent research by Solomon Dobrowski, a University of Montana professor of forest landscape ecology, finds that climatic buffering from forest canopies is important to consider when projecting the likelihood of regeneration in future forests.

"Models that forecast forest change should consider where juvenile trees can make a living - and this might not be where the adult trees currently grow," Dobrowski said.

His research is featured in "Forest structure and species traits mediate projected recruitment declines in western U.S. tree species," published this month in the journal *Global Ecology and Biogeography*.

The National Science Foundation recently awarded Dobrowski a $410,000 grant for more research in this area. That grant, "Quantifying Risk of Tree Species Regeneration Failure and Ecosystem Transitions in Lower Elevation Forests," also involves UM research collaborators Anna Sala and Marco Maneta.

For the research in the journal, Dobrowski and colleagues looked at where juvenile trees are found relative to adults of the same species and how this might change under future climates. They suspected a forest canopy might protect juvenile trees from some of the limiting factors that kill juvenile trees like high wind speeds, solar radiation and high temperatures. Projections into the future suggest juvenile trees fare better with a protective forest canopy overhead. Remove the shade-providing tree canopy, however, and juvenile trees may suffer. Eventually, a forest with no juveniles will decline.

"Extensive losses of forest canopy from disturbances such as severe wildfire, will amplify the effects of climate change," Dobrowski said.

The differences between juvenile and adult trees of the same species are most pronounced in the hottest and driest geographic extent of a tree species' range. In dry habitats, juvenile trees tend to occupy wetter locations. In shade-tolerant tree species, juvenile trees are found in cooler settings than adult trees.

Look at many forests in the western United States and you'll see the impact of this difference. Where ponderosa pine trees meet dry grasslands, for instance, you won't find many juveniles. They're likely growing in wet spots, north-facing slopes or further up the mountain.

"We're not sure what the future holds for western forests, but comparing where juveniles and adults currently make a living can give us some unique insights," Dobrowski said.

More information: Find the paper online at http://onlinelibrary.wiley.com/doi/10.1111/geb.12302/abstract.

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