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Tree Mortality in Water- and Energy-Limited Forests

Tree mortality has been increasing in forests across the western U.S., apparently in response to a warming climate. However, the mechanisms driving such changes remain unresolved. Temperature could increase tree mortality in two substantially different, but not mutually exclusive, ways: 1) by decreasing tree health through drought stress; or 2) by increasing the effectiveness of tree-killing insects and pathogens.

The degree to which each of these mechanisms is operating in a given forest stand could have important implications for how that stand is best managed. A study in *PLOS ONE* explores the scenarios in which these two mechanisms come in play.

The first mechanism — drought stress — appears to dominate climatically-induced changes in mortality in forests limited by water, such as hotter and drier forests. The second mechanism — increased effectiveness of insects and pathogens — appears to become increasingly important in forests limited by energy, such as cooler and wetter forests.

These results emphasize the importance of considering the dynamics of a given forest when trying to understand and manage it in the face of climate change.

Researchers also found that even when underlying climatic drivers have been identified (e.g., drought stress), there are still substantial knowledge gaps affecting our ability to model those climate-mortality relationships accurately. They demonstrate that even small conceptual changes in a given model can result in drastically different predictions about which parts of the landscape will be most vulnerable to climatic change. Given such uncertainty, managers should take great care in interpreting current forecasts of forest change.

Management Implications

- Warming temperatures can cause changes in the rate of tree mortality through two substantially different mechanisms.
- In forests limited by water, drought stress appears to be the primary driver, while in forests limited by energy the effect of climate on the agents that kill trees becomes increasingly important.
- There is still considerable uncertainty in how to model the relationship between climate and tree mortality. Such uncertainties can lead to drastically divergent predictions about which parts of the landscape are most vulnerable to climatic change.

THIS BRIEF REFERS TO:

Das, A.J., N.L. Stephenson, A. Flint, T. Das, P.J. van Mantgem. 2013. Climatic Correlates of Tree Mortality in Water- and Energy-Limited Forests. *PLoS ONE* 8(7): e69917. doi: 10.1371/journal.pone.0069917

<http://www.werc.usgs.gov/seki>

<http://www.werc.usgs.gov/ProductDetails.aspx?ID=4928>



Warming climates will trigger different mortality mechanisms in different forests.