

Western Ecological Research Center

Publication Brief for Resource Managers

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Increasing Tree Mortality Across the Western United States

A new study by a team of scientists from the U.S. Geological Survey (USGS), U.S. Forest Service, and academia reports rapidly rising death rates for trees in old-growth forests across the western United States. The increase in mortality was not compensated by changes in tree recruitment, potentially leading to changes in forest structure, habitat quality, fire hazard and carbon storage. This study, led by two USGS scientists, Drs. Phil van Mantgem and Nate Stephenson, appears in the journal *Science*.

Analyses of longitudinal data from unmanaged old forests in the western United States showed that background (non-catastrophic) mortality rates increased rapidly in recent decades, with a doubling period of approximately 18 years. Increases were pervasive across forest types, elevations, tree sizes, dominant genera, and past fire histories. Forest density and basal area declined slightly, suggesting that increasing mortality was not caused by increasing competition due to crowding. Mortality increased in small trees, meaning the overall increase in mortality rates could not be attributed solely to aging of large trees. Regional warming and consequent increases in drought stress were likely contributors to the increases in tree mortality rates.

In some cases, increasing mortality rates could be symptomatic of forests that are stressed and vulnerable to abrupt die-back, as has already been experienced recently in parts of the Southwest, Colorado, and British Columbia.

Management Implications:

- Systematic changes in tree mortality may alter key attributes of forest ecosystems, such as habitat quality, fire hazard, and carbon storage.
- Ongoing climatic changes may be driving chronic changes in forests that otherwise appear to be healthy, and those relatively subtle, chronic changes may in some cases be a prelude to acute changes, such as sudden forest die-back.
- In the face of rising temperatures, forest managers may wish to place extra emphasis on reducing other stresses, such as reducing competition due to overcrowding or controlling non-native insects and pathogens, rather than attempting to restore historic forest structure.

These results pose a challenge to managers. Forest restoration often attempts to mimic conditions prior to Euro-american settlement. However, if forests respond rapidly to warming temperatures, attaining conditions similar to this relatively cooler target era may not be feasible or desirable.

van Mantgem, P.J., N.L. Stephenson, J.C. Byrne, L.D. Daniels, J.F. Franklin, P.Z. Fulé, M.E. Harmon, A.J. Larson, J.M. Smith, A.H. Taylor, T.T. Veblen. 2009. *Widespread increase of tree mortality rates in the western United States. Science* 323:521–524. doi: 10.1126/science.1165000