



Western Ecological Research Center <http://www.werc.usgs.gov>

Long-Term Research in Forest Dynamics

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Forests provide humans with irreplaceable goods and services like wood products, clean water, biodiversity and recreational and spiritual opportunities. To sustain the health and production of America's forests, federal agencies such as the **National Park Service** and **USDA Forest Service** depend on sound science to guide their management decisions.

Yet our ability to understand and predict how forests are affected by environmental changes — like air pollution, introduced pathogens and climate change — is remarkably limited, in part because of the challenges of studying organisms that can live for centuries.

Many key questions can only be addressed by forest research that spans decades. In cooperation with the National Park Service, the **USGS Western Ecological Research Center** provides such a long-term research program as part of the **USGS Western Mountain Initiative (WMI)** climate change project.

USGS maintains a network of 30 long-term forest research plots in Sequoia and Yosemite national parks in California's Sierra Nevada range. These plots provide the world's longest ongoing annual-resolution record of forest dynamics, in which the birth, growth, health and deaths of some 30,000 individual trees have been tracked annually for up to 30 years.

Studies in the plots broadly focus on climate change impacts; effects of fire exclusion and reintroduction; causes and consequences of tree deaths; effects of an introduced forest pathogen; forest carbon dynamics; and other topics. The rich detail of this long-term data set has led to landmark discoveries, including an apparent temperature-induced increase in tree deaths across the western U.S., and the revelation that tree birth and death rates follow global patterns of forest productivity — a remarkable finding with implications for our understanding of the global carbon cycle.

As climate and forest resource issues continue to influence our changing world, resource agencies will continue to benefit from USGS long-term forest research.



Seeing the Forest for the Trees

- USGS maintains the world's longest ongoing annual-resolution forest dynamics data set (currently 30 years).
- Data from the USGS plot network have been used in textbooks and in dozens of peer-reviewed publications in high-impact journals like *Science*, *Ecological Monographs*, *Ecology Letters*, *Journal of Ecology*, *Ecology*, and *Ecological Applications* — that collectively have been cited more than 1,500 times.
- The data led to the discovery of one of the few documented examples of a pervasive, subcontinental-scale climatic change effect on the biosphere — an apparently temperature-driven increase in tree mortality across the western U.S. — and have also resulted in discoveries that challenge some fundamental assumptions about the effects of environmental changes on forests.
- Findings from the long-term USGS forest research have been cited in at least five congressional testimonies, and were noted as an example of the value of long-term, place-based research.
- USGS findings from long-term forest research inform decision-makers in federal land management agencies — especially the National Park Service and USDA Forest Service — about emerging issues and possible adaptive management actions.

Research Highlights

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- Das, A, J Battles, PJ van Mantgem, NL Stephenson. 2008. Spatial elements of mortality risk in old-growth forests. *Ecology* 89:1744-1756. doi: 10.1890/07-0524.1 <http://www.werc.usgs.gov/ProductDetails.aspx?ID=3606>
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- van Mantgem, PJ, NL Stephenson, M Keifer, JE Keeley. 2004. Effects of an introduced pathogen and fire exclusion on the demography of sugar pine. *Ecological Applications* 14:1590-1602. doi: 10.1890/03-5109 <http://www.werc.usgs.gov/ProductDetails.aspx?ID=2830>

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Long-Term Forest Research Partners

- National Park Service • USDA Forest Service • USGS Fort Collins Science Center • USGS Water Resources • Smithsonian Institution • Department of Energy • Oregon State University • University of Washington • University of Colorado • Northern Arizona University • University of California • Pennsylvania State University • Stanford University • numerous international universities

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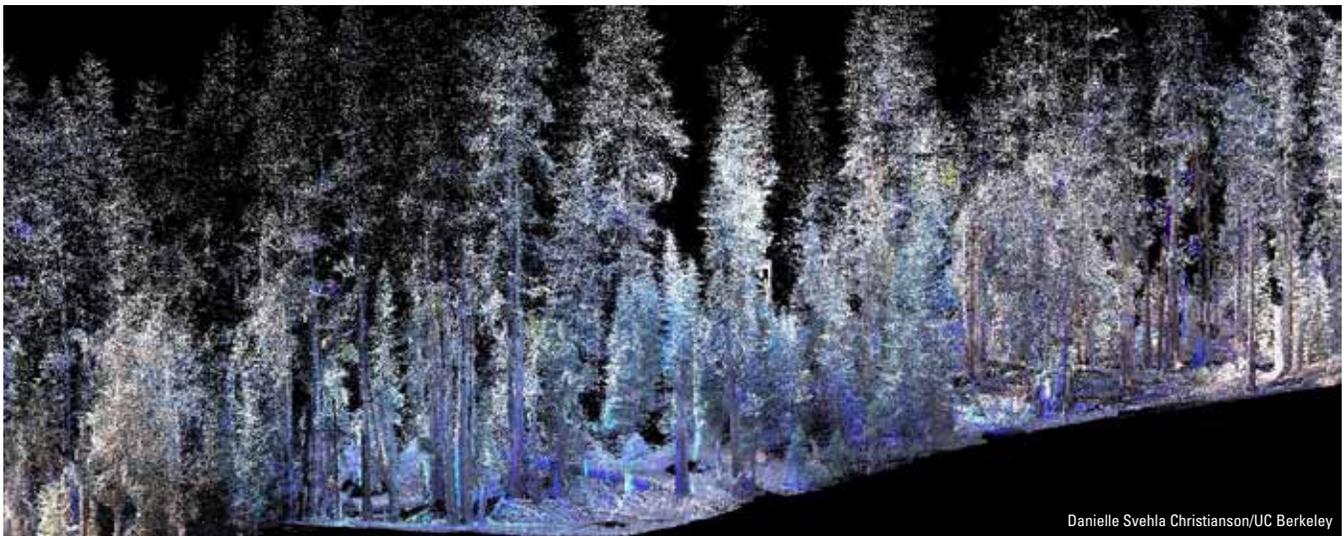
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The USGS forest plot network supports studies such as this LiDAR analysis to help determine potential climate change effects on tree seedling establishment and survival.