

FOREST RESTORATION TREATMENTS IN A PONDEROSA PINE FOREST ENHANCE PHYSIOLOGICAL ACTIVITY AND GROWTH UNDER CLIMATIC STRESS

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Study Description

Stand-density reduction treatments are widely applied to restore historic stand structure and increase resistance to high-severity fire in dry ponderosa pine forests. Little is known about whether the removal of competition also alters tree responses to drought, and if so, how long those effects persist, or the underlying mechanisms. This study evaluates tree growth, seasonal tree-ring stable-carbon isotope patterns, and tree mortality over 23 years following thinning treatments with and without prescribed fire in a ponderosa pine forest of western Montana, USA. The treatments increased tree growth, enhanced carbon assimilation under drought stress, and reduced mortality under increased bark beetle pressure.

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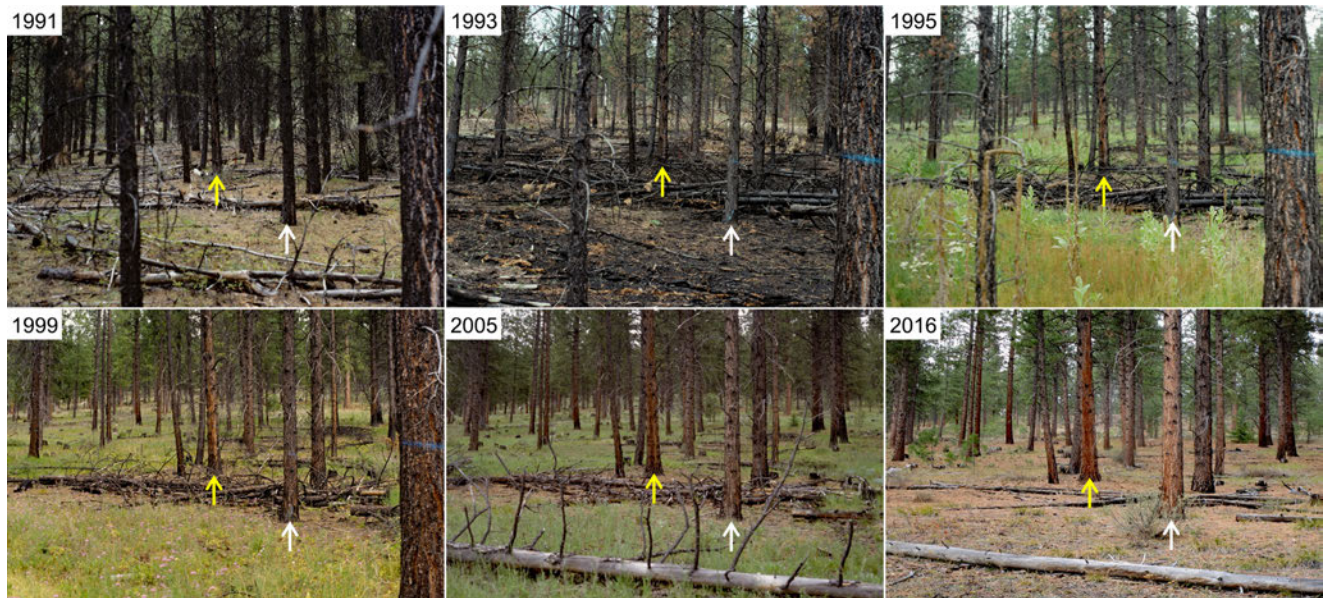


Photo I. A series of six repeat photographs taken from the same photograph point within a treated unit of the heavy thinning (i.e., retention shelterwood) experiment at the Lick Creek Demonstration-Research Forest of western Montana. The photographs illustrate changes in stand conditions over time from the year before treatments (1991) until the year that increment cores were collected for the present study (2016). Harvesting was conducted in 1992, followed by prescribed burning shortly before the second photograph was taken in 1993. There were no additional treatments to the present. Colored arrows track individual trees over successive photographs. (The photographs were taken by the US Forest Service and are available in the following archive: Hood, S. M., D. C. Lutes, J. S. Crotteau, C. R. Keyes, A. Sala, M. G. Harrington, and G. T. Munger. 2018. Lick Creek historic photographic series: a century of change in a ponderosa pine forest in western Montana, US. Fort Collins, CO: Forest Service Research Data Archive. Updated 04 June 2019. <https://doi.org/10.2737/RDS-2018-0023>).

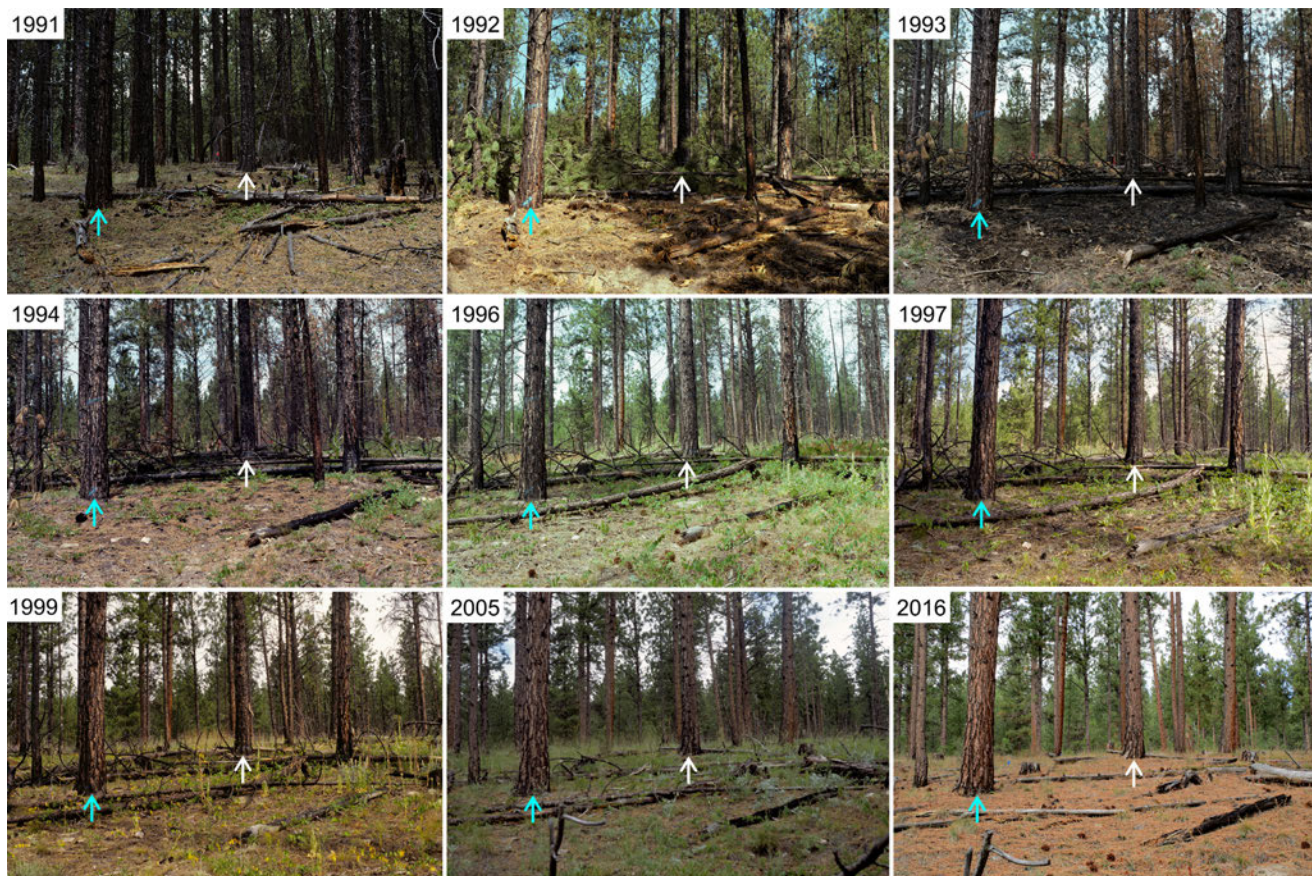


Photo 2. A series of nine repeat photographs taken from the same photograph point within a treated unit of the heavy thinning (i.e., retention shelterwood) experiment at the Lick Creek Demonstration-Research Forest of western Montana. The photographs illustrate changes in stand conditions from the year before treatments (1991) to the year that increment cores were collected for the present study (2016). The 1992 photograph was taken after harvesting but before the stand was treated with prescribed fire. The 1993 photograph was taken shortly after prescribed burning. The additional photographs illustrate changes in stand conditions with no additional treatments to 2016. Colored arrows track individual trees over successive photographs. (The photographs were taken by the US Forest Service and are available in the following archive: Hood, S. M., D. C. Lutes, J. S. Crotteau, C. R. Keyes, A. Sala, M. G. Harrington, and G. T. Munger. 2018. Lick Creek historic photographic series: a century of change in a ponderosa pine forest in western Montana, US. Fort Collins, CO: Forest Service Research Data Archive. Updated 04 June 2019. <https://doi.org/10.2737/RDS-2018-0023>).



Photo 3. Photograph taken in 2018 within one of the control units of the heavy thinning (i.e., retention shelterwood) experiment. Note that Douglas-fir comprises the majority of the smaller, regenerating trees, whereas the overstory is composed largely of ponderosa pine with a smaller component of Douglas-fir (Photo credit: A. Tepley).



Photo 4. Photograph taken in 2018 of one of the units that was thinned in 1992, followed by prescribed burning in 1993 within the heavy thinning (i.e., retention shelterwood) experiment (Photo credit: A. Tepley)

These photographs illustrate the article “Forest restoration treatments in a ponderosa pine forest enhance physiological activity and growth under climatic stress” by Alan J. Tepley, Sharon M. Hood, Christopher R. Keyes, and Anna Sala published in *Ecological Applications*. <https://doi.org/10.1002/eap.2188>.