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Research Brief

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The Effectiveness of Prescribed Fire

Prescribed burning, a strategy to reduce wildfire risk, significantly cuts wildfire severity and smoke emissions, especially outside populated areas.

Background

Over the past several years, wildfires in the Western United States, and especially in California, have increased in frequency, intensity, and destructiveness. Fueled by a combination of a warming climate, drought, decades of fire suppression, and expanding development in the wildland-urban interface (WUI), what was once a seasonal hazard is now a year-round challenge. From 2017 to 2021 alone, wildfires caused over $70 billion in damages nationwide, with California bearing the largest share. The costs include not only the destruction of homes, infrastructure, and ecosystems, but also large firefighting expenses, insurance losses, and long-term impacts on industries such as agriculture and utilities.

Evidence is also growing that links smoke from wildfires to serious public health threats. Smoke from large fires blankets areas far beyond the burn areas, exposing millions to dangerous levels of fine particulate matter ($PM_{2.5}$), worsening air quality, and contributing to respiratory and cardiovascular illnesses, especially for those living in the WUI. The 2020 fire season, for instance, produced air quality conditions in California and the Pacific Northwest worse than those in the most polluted global cities.

Prescribed fires have been proposed as a proactive strategy to reduce wildfire risk and limit smoke pollution, but limited evidence exists of the efficacy of prescribed burning in reducing fire severity and overall smoke $PM_{2.5}$ emissions. A new study led by Stanford researchers sought to fill in these gaps of understanding by investigating the effects of prescribed fire treatments on burn severity across the western United States and on smoke particulate matter emissions in California. Their study shows that prescribed burns conducted within two years before a wildfire significantly reduced both fire severity and smoke emissions during the extreme 2020

POINTS FOR POLICYMAKERS

■ **Prescribed fire use can meaningfully reduce wildfire severity and smoke emissions, even when factoring in smoke from the prescribed fires themselves:** In examining the 2020 wildfire season, areas across the western U.S. that were treated with prescribed burns experienced on average 16 percent lower burn severity. In California, using prescribed fire reduced smoke-related $PM_{2.5}$ pollution by about 101 kilograms per acre, though the exact amount can vary. Overall, prescribed fire led to a 14 percent net reduction in smoke emissions when accounting for both wildfire and the prescribed fire smoke.

■ **Prescribed fires are significantly more effective than mechanical thinning:** Compared to untreated areas, prescribed fires reduced burn severity by an average of 27 percent, while mechanical thinning only reduced severity by about 8 percent. Prescribed fires treat a broader type and size of fuels while mechanical thinning typically targets only larger vegetation.

■ **Prescribed fire treatments are less effective within the wildland-urban interface (WUI) compared to outside it:** The reduced effectiveness of prescribed fire within the WUI highlights the challenges of implementing effective prescribed fire in areas with dense human populations and infrastructure. Several factors related to the WUI could be contributing to the limited effectiveness, including: the application of prescribed fire mixed with other methods such as thinning, the weather conditions at the time of ignition, and National Environmental Policy Act (NEPA) mitigation requirements. The need to adopt extremely cautious approaches, due to factors concerning community smoke exposure, the risk of escaped prescribed burns, and the higher density of structures, could further reduce the treatment's overall effectiveness in the WUI.

■ **Policy could consider averted smoke exposure as a benefit:** Federal and state wildfire mitigation policies rarely include the avoided emissions from wildfires as a benefit of prescribed fire treatments. Including these in risk-benefit analyses could justify greater investment and public support.

wildfire season. On average, areas treated with prescribed fire saw a 16 percent reduction in burn severity and emitted 101 kilograms less smoke $PM_{2.5}$ per acre during wildfires.

Scaling these efforts could deliver substantial benefits. In California, treating one million acres annually as outlined in the state's wildfire resilience plan could prevent up to 655,000 tons of $PM_{2.5}$ emissions over five years, equivalent to over 52 percent of the smoke pollution produced by the state's catastrophic 2020 wildfire season.

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ABOUT THE AUTHORS

Makoto Kelp is a postdoctoral fellow in Earth system science at Stanford University funded through the National Oceanic and Atmospheric Administration Climate and Global Change Postdoctoral Fellowship Program.

Noah Diffenbaugh is the Kara J Foundation Professor in the Stanford Doerr School of Sustainability and the Kimmelman Family Senior Fellow at the Stanford Woods Institute for the Environment at Stanford University.

Marshall Burke is an associate professor of environmental social sciences and Earth system science (by courtesy), a senior fellow at the Stanford Woods Institute for the Environment, the Freeman Spogli Institute for International Studies, and the Stanford Institute for Economic Policy Research, and a member of Bio-X and the Wu Tsai Neurosciences Institute at Stanford University.

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