

Mitigating Old Tree Mortality in Long-unburned, Fire-dependent Forests

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Background

Many forested ecosystems in the United States have adaptations that enable them to survive frequent fire. Decades of fire suppression around the country have led to many unintended consequences in these fire dependent forests, including increased tree densities and fuel, increased stress on older trees, and greater risk of bark beetle attack. In fire-dependent forests, prescribed burning is often used as part of a larger effort to restore historical stand conditions and prevent mortality from wildfires. Maintaining the old, large diameter fire-resistant trees on the landscape is often the primary goal of restoration. However, in the absence of fire, deep basal duff accumulates around overstory trees, making them susceptible to increased injury and mortality from fire.

To address this issue we have an ongoing raking study that examines the effect of raking basal duff on old ponderosa and Jeffrey pine tree mortality. We have also written a GTR that synthesizes information about reducing old tree mortality from fire.

Raking Study

We examined the effect of raking basal duff on old ponderosa and Jeffrey pine prior to prescribed burning in northern California. Treatments included 1) control, 2) burn, 3) rake and burn, and 4) burn only. We monitor trees annually for mortality and bark beetle attacks.

Results:

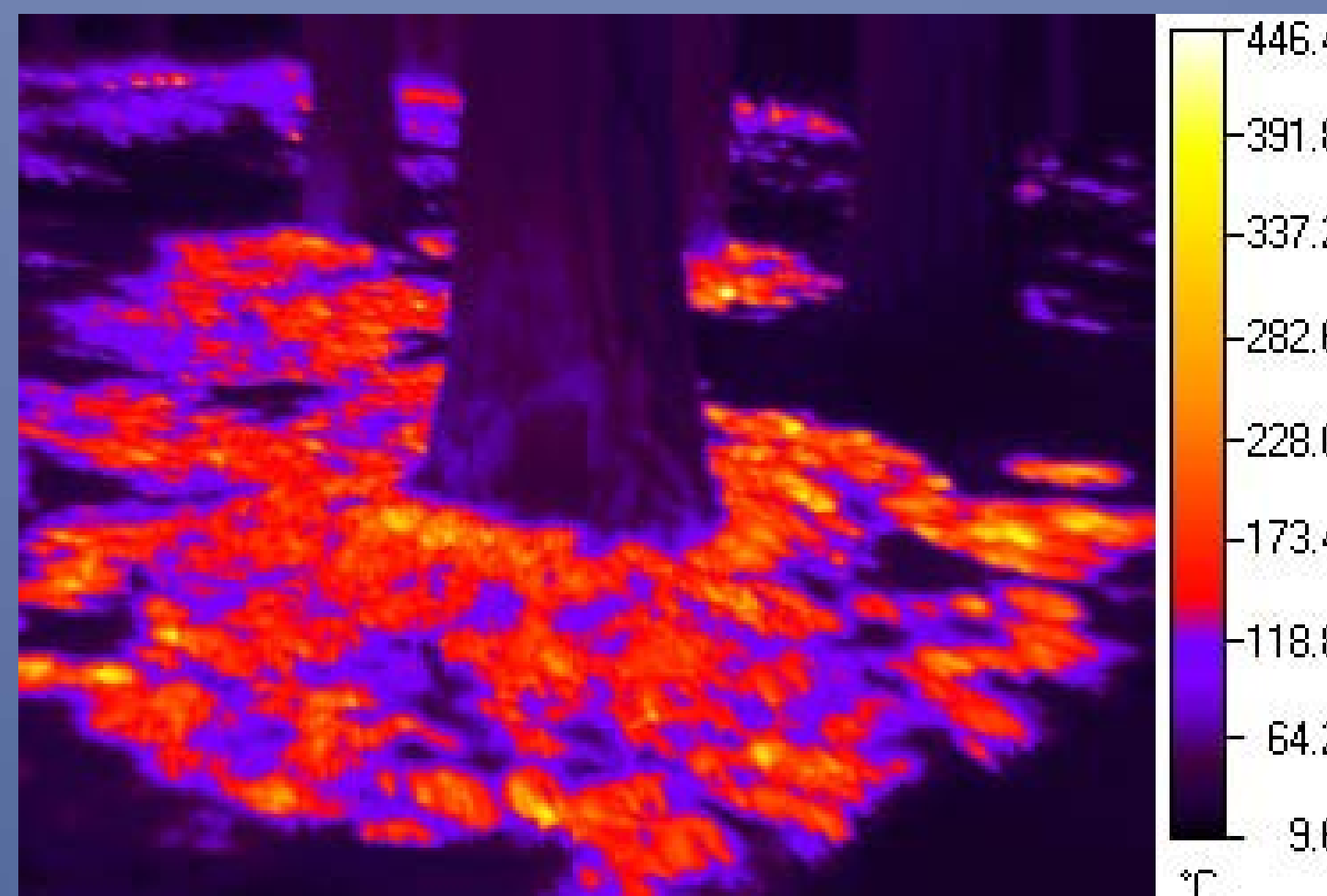
- Raked trees had reduced cambium kill and red turpentine beetles attacks.
- No difference in mortality between raked and unraked trees for either burned and unburned units 4 years after burning.



Prior to burning, crews rake duff away from the base of a tree to reduce basal heating. Such treatments may reduce fire-caused tree mortality.



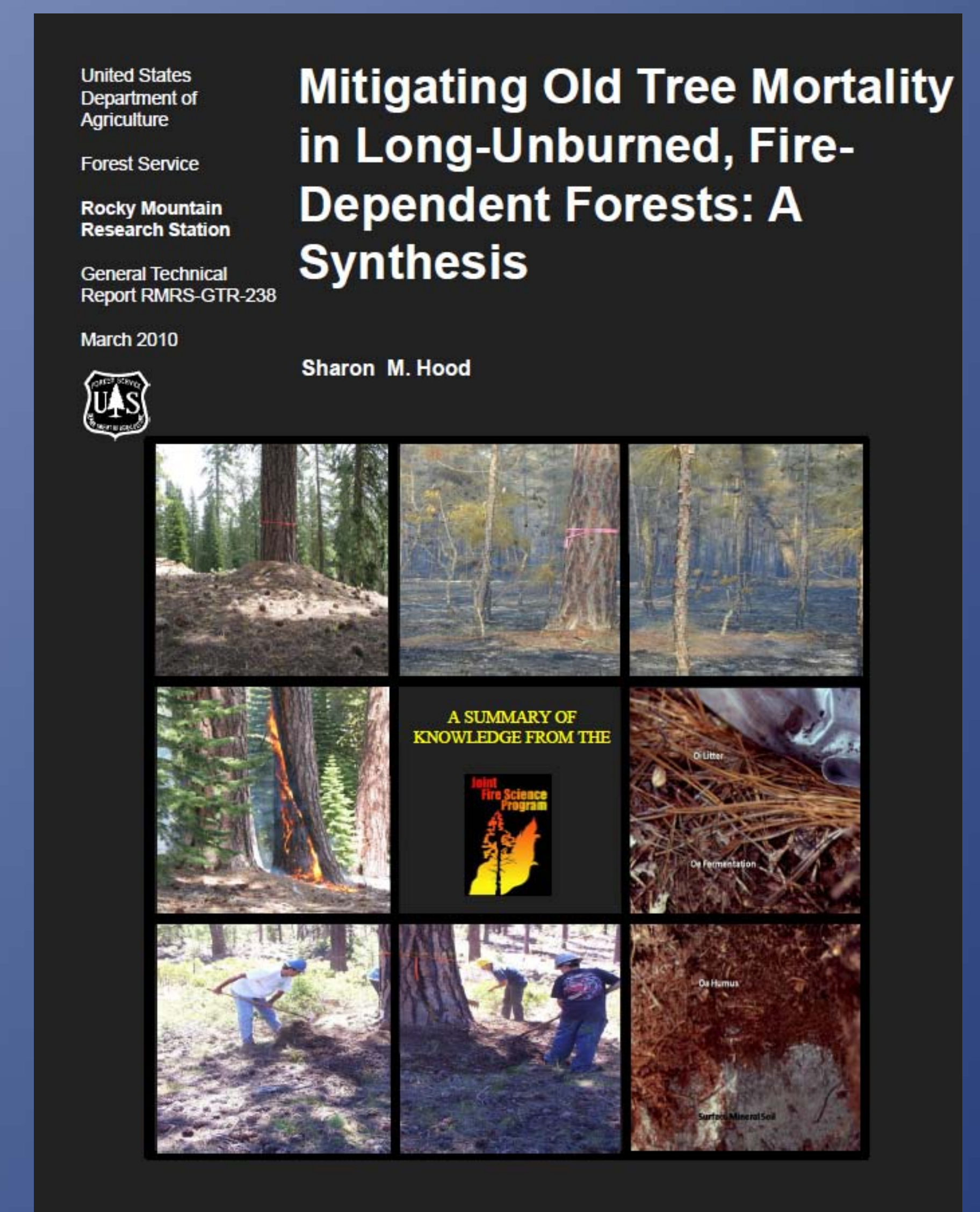
Deep duff around the base of an old ponderosa pine that hasn't burned in 100+ years.



Thermal image indicating duff smoldering at the base of a tree. Long duration of high temperatures can kill roots and basal cambium.

Literature Synthesis

We synthesized the literature pertaining to reintroducing fire in long-unburned, fire dependent U.S. forests and the impact of these introductory fires on overstory tree injury and mortality. Treatment options that minimize old, large diameter tree injury and mortality in areas with deep duff are discussed. Methods to reduce duff accumulations are included. Pertinent background information on tree physiology, properties of duff, and historical versus current disturbance regimes is also discussed.



Future research needs:

- Long-term studies that document pre-fire forest and fuel conditions, fire and silvicultural treatments, and post-fire effects for old trees
- Relationship of time-temperature profiles of soil heating to root kill
- Deep duff moisture-of-extinction limits
- Feasibility and parameters of reducing only a portion of deep basal duff layers during prescribed burns
- Critical microsite characteristics and parameters that affect basal duff consumption and potential cambium injury
- Impact of season and timing of raking to prescribed burning on tree mortality
- Relationship between level of cambium injury to insect attack level
- Horizontal and vertical distribution and abundance of fine roots adjacent to the tree bole



Fire, Fuel, and Smoke Science Program

