



Research Brief for Resource Managers

Release:
October 2018

Contact:
Becky Estes

Phone:
530-642-5161

Email:
bestes@fs.fed.us

Sierra Nevada Fire Science Delivery Consortium | 2132 Wickson Hall, One Shields Ave., Davis, CA 95616

How to Protect Old Trees When Reintroducing Fire

Hood, Sharon M. 2010. Mitigating old tree mortality in long-unburned, fire dependent forests: a synthesis. Gen. Tech. Rep. RMRS-GTR-238. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 71 p.
http://www.fs.fed.us/rm/pubs/rmrs_gtr238.pdf

Reintroducing fire in mature forest ecosystems, particularly following a period of fire suppression, can have negative impacts to large and old trees, causing injury and mortality. This synthesis covers recent research documenting effects of introducing fire in fire suppressed forests, provides necessary background information to understand the breadth of the problem, provides realistic management solutions to reduce impacts and defines monitoring techniques to identify treatment effects. The synthesis covers all fire dependent ecosystems and this brief highlights those systems in the Western US.

Large diameter and old-growth trees provide a number of key ecological characteristics to forested systems across the Western US. Over the last century, old-growth trees have diminished as a result of management. Historically, many forests in the US and the West in particular burned frequently, maintaining low tree densities, composed mainly of fire tolerant species, and low fuel loadings. Following the imposition of fire exclusion in the early 1900s, tree densities increased and ladder, litter, duff and other fuels have accumulated beyond the natural range of variation. This has resulted in trees experiencing increased competitive stress and a greater susceptibility to insect attack and drought.

Management Implications

- Landscape, stand and individual tree-level, treatments are necessary to meet resource management objectives where minimizing injury to large-diameter and old trees is a priority;
- Reducing the risk of high-intensity fire, including crown fire, should be the first treatment priority when restoring forests that historically burned frequently;
- Consider the decision key to determine how best to reintroduce fire to fire suppressed stands.

Reintroducing fire to an already stressed system can be problematic. Trees can be directly killed following a crown fire where active flaming can cause crown injury, such as foliar and bud kill, reducing a tree's photosynthetic capability. Trees can also be killed following a ground fire where duff and organic materials burn during the smoldering combustion stage leading to root and cambium damage. Trees can also succumb secondarily to bark beetles, which typically are triggered after fire.

Ground fire is a more common concern following prescribed fires in fire suppressed forested stands. These stands have developed unprecedented litter and duff accumulation at the bases of the trees. Although mechanical treatments are common to reduce ladder fuels and subsequent crown injury, duff mounds often

are overlooked and increase the likelihood of stem and root injury. When left unaltered, a tree might die if the circumference of its cambium is girdled. Additionally, fire exclusion has altered the vertical arrangement of roots in the soil, allowing more fine roots to occupy the duff layer. Prolonged smoldering in the duff layer during and after a prescribed fire has been known to contribute to the mortality of large diameter trees through excessive root damage.

There are many tools available to help predict the probability of cambium death before prescribed fire, as well as tools to evaluate the char on bark as an indicator of stem injury and ground char to provide an assessment of potential root damage in common Sierra Nevada trees.

Landscape, stand and individual tree-level, treatments may all be necessary to minimize large-diameter old tree injury and mortality in fire-dependent systems in the Sierra Nevada. At the landscape level, the primary focus should be minimizing the probability of high severity crown fire. At the landscape scale, treatments should focus on encompassing a diversity of areas that favor large diameter old-growth trees for restoration or potentially managing in a wildfire situation where a natural ignition can meet project objectives. At the stand level, prescribed fire or other restoration treatments can be beneficial, but managers must recognize that multiple entries are probably necessary.

At the individual tree level, management options exist for areas with deep duff and are summarized in the decision key below. Options are: (1) burning when the basal duff layer is moist, (2) reducing basal duff and litter around trees and (3) heavy mop-up post fire.



Figure1. Duff can accumulate at the base of ponderosa pines after 100 years of fire suppression. These pines are susceptible to cambium kill and the loss of critical roots following a prescribed fire.

Suggestions for further reading:

Hood, S. M.; Cluck, D. R.; Smith, S. L.; Ryan, K. C. 2008. Using bark char codes to predict post-fire cambium mortality. *Fire Ecology*. 4: 57-73.

Kobziar, L.; Moghaddas, J. J.; Stephens, S. 2006. Tree mortality patterns following prescribed fire in a mixed conifer forest. *Canadian Journal of Forest Research*. 36: 3222-3238.

Van Mantgem, P.; Nesmith, J.; Keifer, M.; Brooks, M. 2013. Tree mortality patterns following prescribed fire for *Pinus* and *Abies* across the Southwestern United States. *Forest Ecology and Management*. 289: 463-469.

Keyser, T. L.; Smith, F. W.; Lentile, L. B.; Shepperd, W. D. 2006. Modeling postfire mortality of ponderosa pine following a mixed severity wildfire in the Black Hills: The role of

tree morphology and direct fire effects. Forest Science. 52: 530-539.

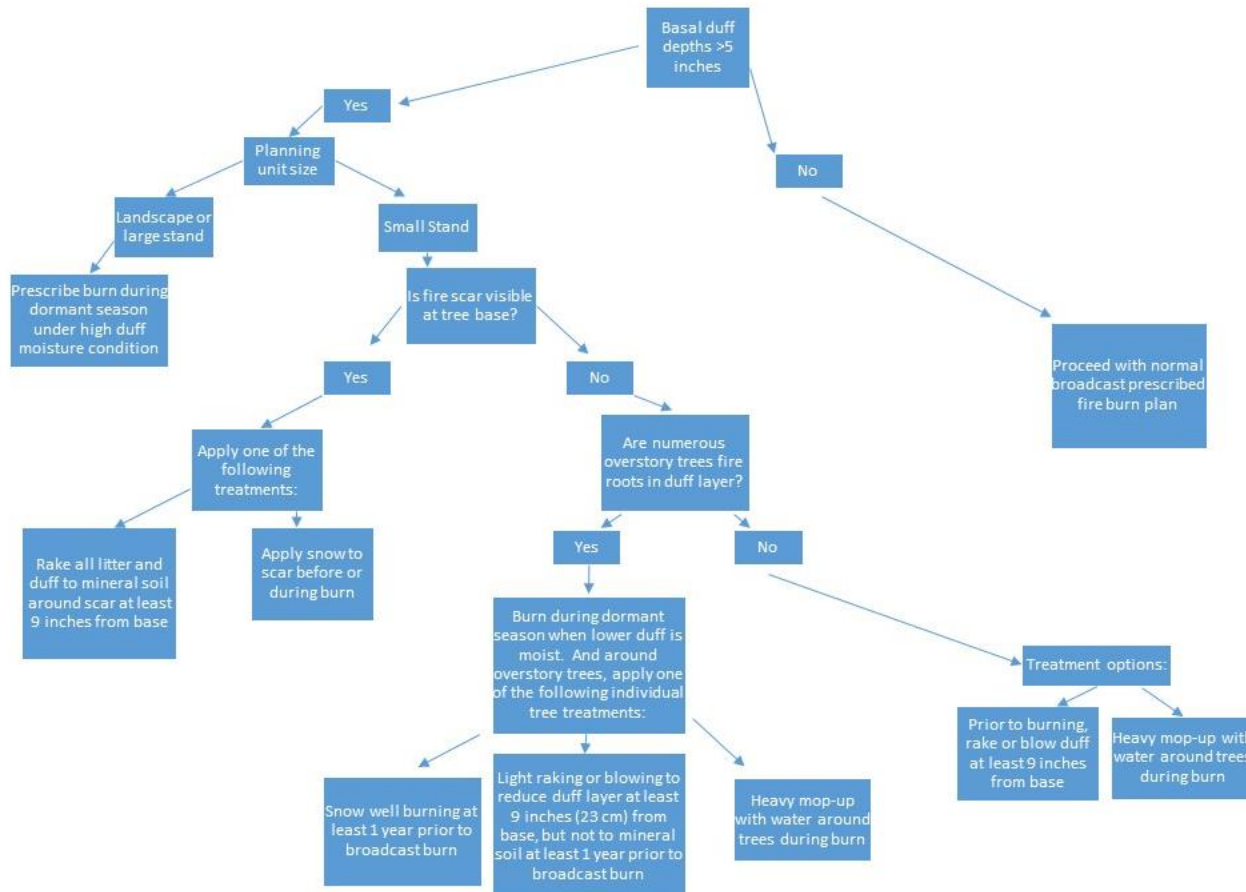


Figure 2. A decision key to determine how best to reintroduce fire to long-unburned forests to reduce large tree mortality. This key has been modified from the original to highlight treatments in the Sierra Nevada.