

Publication Brief for Resource Managers

Release:
March 2011

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Raking May Help Reduce Sugar Pine Mortality Following Prescribed Fires

Prescribed fire is an important tool for fuel reduction and other forest management needs, but accumulated fuels associated with historical fire exclusion can cause undesirably high tree mortality rates following prescribed fires. This is especially true for sugar pine (*Pinus lambertiana*), a species already under threat from white pine blister rust and beetle attacks.

A study published in *Fire Ecology* by researchers from University of California-Berkeley and USGS suggests that raking may enhance the probability of post-fire survival in sugar pines. Raking away leaf litter, fallen limbs and other fuels to create a clearing around individual trees could reduce fire temperature at the tree base and lessen damage to vital cambial tissue.

Researchers tested this raking treatment at three sites in Sequoia and Kings Canyon National Parks, California. Of 457 sugar pines at the sites, half were raked to clear a 0.5 m radius down to mineral soil around each tree stem; the other trees were left unraked. Fire effects and pre-fire fuel depth were assessed and tree mortality was recorded for three years after the prescribed fires.

The results showed that raking improved sugar pine survival probability under specific conditions: if pre-fire fuel depth around a tree was more than 15 cm (especially if more than 30 cm), and if the fire severity experienced was moderate (1% to 80% scorch). Raking also reduced the likelihood of bole charring and bark beetle activity three years post-fire, although the exact causes are unclear.

Raking rarely took longer than five minutes per tree and required minimal staff training. Aside from taking precautions to minimize damage to fine roots in the duff layer, raking could be a relatively efficient way to reduce mortality after prescribed fires in Sierra Nevada sugar pines.

Management Implications

- Raking fuels away from the base of individual trees may help to reduce mortality following prescribed fires.
- For sugar pine in the Sierra Nevada, raking reduced stem char and beetle attack following prescribed fires.
- Raking only affected sugar pine mortality when forest fuel depths were moderate or heavy, and where fire severity was moderate.
- Managers should consider the specific conditions of their site and the expected fire severity to evaluate the merits of raking.

THIS BRIEF REFERS TO:

Nesmith, J.C.B., K.L. O'Hara, P.J. van Mantgem, P. de Valpine. 2010. The Effects of Raking on Sugar Pine Mortality Following Prescribed Fire in Sequoia and Kings Canyon National Parks, California, USA. *Fire Ecology* 6(3): 97-116. doi: 10.4996/fireecology.0603097

<http://www.werc.usgs.gov/redwood>

<http://www.werc.usgs.gov/ProductDetails.aspx?ID=4189>



Forest fire fuels were removed from the base of the tree to mineral soil to a distance of 0.5 m using hand rakes and loppers. Image credit: USGS.