



## CUMULATIVE DISTURBANCES ON THE LANDSCAPE

### LESSONS FROM THE POLE CREEK FIRE, OREGON

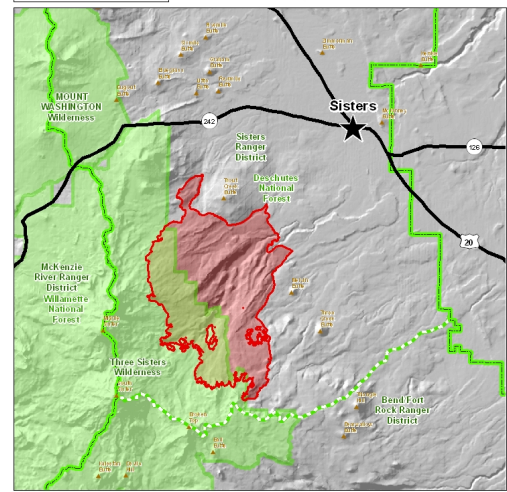
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Recent mountain pine beetle (*Dendroctonus ponderosae*, MPB) outbreaks have caused extensive lodgepole pine mortality in the western United States (and Canada) and have raised concern over increased fuel loadings and fire behavior. Consequently, the relationship between MPB and fire has been well-studied. However, the lodgepole pine forests of central Oregon are ecologically distinct from those of the Intermountain West where much of the previous research was based. In central Oregon, lodgepole pine is a climax species and the fuel characteristics associated with vegetation development are unique compared to the upper montane forests of the Rocky Mountains where spruce and fir are often the climax species. Central Oregon lodgepole pines typically form single-species, uneven-aged stands with low levels of cone serotiny and are characterized as having a mixed-severity fire regime. This may have a strong influence on the relationship between MPB severity and fire severity. As a result, there is an increased need to understand the influence of MPB on fuels succession and potential fire behavior in central Oregon lodgepole pine forests following a MPB outbreak.

Previous research has focused on quantifying fuel loadings and using operational fire behavior models to understand changes in fire severity following MPB outbreaks. In this study however, researchers used direct field measurements taken from the 2012 Pole Creek Fire that burned in lodgepole pine forests in central Oregon's Eastern Cascade Mountains, which had experienced a MPB epidemic 8-15 years prior to the fire. They examined the combined effects of MPB and fire disturbances on stand structure, and investigated the influence of previous MPB severity and fire weather on subsequent fire severity and cumulative disturbance severity.



**Pole Creek Fire  
OR-DEF-000537  
Vicinity Map  
September 21, 2012  
25,553 Acres**



Map credit: Pole Creek Fire Deschutes National Forest Long-term Assessment and Implementation Plan

## KEY FINDINGS

- Fire severity metrics for both crown fire and surface fire decreased with increased MPB severity under extreme burning conditions.
- High severity crown fire was present despite hypothesized low canopy fuel loadings during the gray stage.<sup>1</sup>
- Cumulative disturbance severity metrics were unrelated or weakly related to MPB severity, with the exception of basal area mortality.

<sup>1</sup> Gray stage (4-15 years post-MPB attack) begins when dead foliage is absent from the canopy

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## RESULTS

### Structural changes

Stand structure within the Pole Creek Fire area was significantly altered by the MPB and fire disturbances. Live density and basal area decreased while snag density and snag basal area increased between pre-MPB and post-fire stages. Additionally, quadratic mean diameter and percent basal area, of lodgepole pine, decreased from pre-MPB to post-MPB then increased from post-MPB to post-fire stages. However, there was considerable variation in these structural attributes at the plot level, indicating heterogeneity at the landscape scale.

### Influence of MPB severity on fire and cumulative disturbance severity

Several landscape-scale assessments have shown that MPB activity in a forest does not increase the likelihood that the forest will experience wildfire. However, it is important to understand the combined effects of these disturbances when they do overlap in space and time. Crown fire, surface fire, and overall fire severity decreased with increasing MPB severity under extreme burning conditions. This result generally supports the findings of previous post-MPB fuels and potential fire behavior research for gray stage stands. However, decreases in surface fire severity (proportion of ground charred and soil char depth) with increases in MPB severity was unexpected and might be due to the unique structure of central Oregon lodgepole pine stands that typically have sparse understory vegetation with a high amount of bare ground and discontinuous surface fuels. This study also showed that high severity crown fire was more common than expected in the gray stage during the Pole Creek Fire, as low canopy fuel is typically associated with the gray stage. The uneven age of central Oregon lodgepole pine forests may have partially contributed to the variability of MPB severity.

This study did not find any evidence to suggest that the combined effects of the compound disturbance events altered ecosystem recovery patterns or pushed the ecosystem into a novel state. Cumulative basal area mortality was the only cumulative disturbance severity metric that was strongly related to MPB severity under moderate burning conditions.

## MANAGEMENT IMPLICATIONS

As disturbance magnitude and frequency are expected to increase under changing climate conditions, it is important to understand the cumulative impacts of and interactions between successive forest disturbances. Understanding the effect of one disturbance on the severity of the next disturbance is instructive for management objectives such as allocation of fuels treatments in stands with increased fire hazard and identification of areas that may pose additional difficulties during firefighting operations. This study suggests that given the unique structure of central Oregon lodgepole pines stands, it may be beneficial to use MPB severity data to target individual stands within gray stage post-MPB for fuels reduction treatments.



Photo: Michelle Agne

## MORE INFORMATION

### This brief is based on the following article :

Michelle C. Agne, Travis Woolley, and Stephen Fitzgerald. 2016. Fire severity and cumulative disturbance effects in the post-mountain pine beetle lodgepole pine forests of the Pole Creek Fire. *Forest Ecology and Management* 366: 73-86.

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