Effects of Forest Thinning on Sediment Production and Soil Moisture in the Central Colorado Front Range

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Abstract. Mechanical thinning has been increasingly used to reduce the threat of catastrophic wildfires in forested areas, and there is an urgent need to understand how thinning affects soil erosion rates and other site conditions. This paper reports on the effects of mechanical thinning on ground cover, erosion, and soil moisture in mid-elevation forests in the central Colorado Front Range. Since 2001 we have established 23 pairs of zero-order basins (swales) in five study areas near Deckers, Colorado. In 20 pairs one swale was mechanically thinned with a Hydro-Ax, while in the other 3 pairs the litter and duff layers were experimentally removed. The other swale in each pair was left as a control. Measurements in each swale include ground and tree cover, sediment production, contributing area, percent disturbance, and slope. Soil moisture at 0-5 cm was monitored in five pairs at 3-week intervals in summer 2004. Precipitation was measured at each site with tipping bucket rain gages.

Thinning increased the amount of wood as ground cover from 3% to 6% ($p=0.003$), and the amount of bare soil from 8% to 14% ($p=0.017$). Thinning did not significantly change the amount of surface cover from litter (80%), live vegetation (7.6%), or rock (0.8%). Neither the thinned nor the control swales produced any sediment, even though slopes ranged up to 50% and the 30-minute rainfall intensities ranged up to 61 mm hr^{-1}. Similarly, removal of the duff layer did not result in any sediment production, although the maximum 30-minute rainfall on these sites was only 11 mm hr^{-1}. In the thinned swales the mean surface soil water content was significantly higher at 12.5% than in the control swales (9.3%; $p=0.074$). These results indicate that mechanical thinning has minimal effects relative to high-severity wildfires. Additional monitoring is needed to determine the longer-term effects of thinning on surface vegetation, the precipitation needed to initiate erosion from thinned and undisturbed swales, and the persistence of the increase in soil moisture.