

Compaction and ground cover as controls on runoff generation and soil erosion following post-fire logging

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Soil compaction during post-fire logging activities enhances post-fire runoff and soil erosion at small spatial scales. Increasing ground cover by mulching or adding wood can reduce post-fire soil erosion and may reduce runoff, but the impact on compacted soils is unclear. We tested the effects of soil compaction and adding surface cover with sequoia bark mulch and logging slash on runoff infiltration, runoff generation, and splash, sheet, and rill erosion of burned soil using simulated rainfall. Plots were prepared with one of two bulk densities (0.8 or 1.2 g cm⁻³) and one of three surface cover conditions (0%, 60% ground cover by sequoia bark mulch, or 60% cover by logging slash) in a factorial design. Three rainfall/runoff conditions were applied to each plot: Dry condition rainfall; Wet condition rainfall, approximately 1 hour after each Dry run; and Flow, which was a pulsed addition of surface runoff following each Wet run. Soil moisture, leaching through the soil, surface runoff, sediment concentration and yield, and rainsplash were determined separately for each run. The compacted soils produced less leaching and 30% more runoff but only 17% greater total sediment yield than the uncompacted controls. The increase in total sediment yield was made up of 53% more splash erosion and 106% more sheetwash erosion but 49% less rill erosion than the uncompacted plots. In contrast, the increase in ground cover by mulching or addition of slash had no effect on the hydrologic responses except for a delay in runoff initiation. The increased cover by mulch reduced splash, interrill, and rill erosion for a combined reduction of 70% total sediment yield as compared to the bare soil plots. However, the slash only reduced splash erosion by 76%, with no changes in interrill erosion, rill erosion, or total sediment yield. Both the compaction and surface cover are important for assessing impacts of post-fire forest management. The type of surface cover may therefore have an effect on its ability to reduce runoff and sediment delivery from burned areas and soils compacted by logging equipment.