Mulch effects on runoff and sediment production at the hillslope scale in the High Park Fire

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Abstract. The 2012 High Park Fire (HPF) burned 330 km^2 of Front Range forests surrounding the Cache la Poudre River just upstream of the municipal water supply intakes for the cities of Fort Collins and Greeley. From 2012-2014, millions of dollars were spent on mulch treatments to stabilize burned soils and protect water supplies. The objective of this research is to evaluate how runoff and sediment production vary with precipitation (P) on two unmulched and two mulched hillslopes of the HPF during the 2014 summer thunderstorm season. The four hillslopes are moderate to severely burned zero-order catchments 0.2-0.4 ha in area. Sediment fences were installed at the base of each hillslope to collect bedload sediment; each fence was fitted with a V-notch weir and a series of flow splitters to collect proportional samples of runoff and suspended sediment. Runoff and sediment were captured during 3-7 events for the unmulched sites and 1-9 events for the mulched sites; some P events that produced bedload sediment did not produce measurable runoff. The 30-minute maximum P intensity thresholds for runoff and sediment production were lower for unmulched (10 mm hr^{-1}) than mulched hillslopes (16 mm hr^{-1}). Runoff ratios were similar for the unmulched (0.01-0.10) and mulched sites (0.00-0.08); however, runoff production (m^3 ha^{-1}) was lower for unmulched (0.77-24.41) than mulched sites (3.24-51.36). The ratio of suspended sediment to bedload was similar for the unmulched (0.24-1.97) and mulched sites (0.16-2.52); however, total sediment production (bedload + suspended load; Mg ha^{-1}) for the unmulched sites was up to three times greater (0.02-1.54) than the mulched sites (0.01-0.50). The results of this research suggest that (1) bedload sediment measurements under-represent hillslope sediment production, and (2) mulching may reduce sediment production in zero-order catchments, but the magnitude of the mulch effect varies by catchment and by rain event.