

Measuring and Predicting Road Sediment Production and Watershed-scale Sediment Delivery

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Abstract. Unpaved roads are generally believed to be the major source of sediment in forested watersheds. A long-term study is underway to investigate the effects of forest thinning, prescribed fires, and roads in the Kings River Experimental Watersheds (KREW) in the southern Sierra Nevada, CA. The objectives of this study are to: (1) quantify sediment production rates from three different road surface types (native, mixed and graveled) as well as the ditches adjacent to paved roads; (2) develop empirical predictive models for road sediment production; (3) predict basin-scale sediment production and delivery; and (4) compare predicted road-generated sediment inputs to measured basin-scale sediment yields.

Sediment production was measured with sediment fences from 112 road segments and 45 undisturbed hillslopes over three wet seasons (2003–2006). Road surveys measured the characteristics of each segment and evaluated the connectivity between roads and streams. On average, native and mixed surface roads each produced just over $0.7 \text{ kg m}^{-2} \text{ yr}^{-1}$. Graveled roads produced significantly less sediment ($0.23 \text{ kg m}^{-2} \text{ yr}^{-1}$), and the ditches adjacent to paved roads produced almost no sediment ($0.034 \text{ kg m}^{-2} \text{ yr}^{-1}$). Annual erosivity, road segment length, soil erodibility, and percent bare soil explained 67% of the variability in sediment production from native and mixed surface roads. Annual precipitation and cutslope length explained 77% of the variability in sediment production from graveled roads.

Watershed-scale, road-generated sediment yields were predicted for three of the KREW watersheds. Road densities ranged from 0.70 to 2.8 km km^{-2} , and between 15% and 47% of the road length in each basin was hydrologically connected to the stream network. The estimated road-related sediment yields accounted for less than 10% of the measured sediment budget in two of the three watersheds. However, a single mixed-surface road segment with significant rill formation generated 25-50% of the measured sediment budget in the third watershed.