Measuring and Predicting Road Sediment Production in the Southern Sierra Nevada, California

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Abstract. Unpaved roads are a major source of sediment in many forested watersheds, but there are relatively few data on road sediment production rates and the factors controlling sediment production. The primary goals of this study are to: (1) quantify sediment production rates from different road surfaces; (2) determine the key controls on road sediment production rates and develop an empirical predictive model; and (3) to better understand road erosion and transport processes by comparing the particle size distribution of sediment sources and sinks.

The study is part of the Kings River Experimental Watershed study (KREW) in the southern Sierra Nevada Mountains in east-central California. Elevations range from 1485 m to 2420 m, and most of the precipitation falls as snow. Sediment production was measured with sediment fences from 36 road segments and 9 undisturbed swales over the 2003-2004 wet season, and from 41 road segments and 18 undisturbed swales over the 2004-2005 wet season. The road segments are stratified into native-surface roads, ditches adjacent to paved roads, gravel roads, and mixed-surface roads.

Precipitation for the 2003-2004 wet season was 700 mm or 75% of the long-term mean. Native surface roads had the highest mean sediment production rate at 0.44 kg m-2, while the mixed-surface roads averaged 0.10 kg m^{-2} and the gravel roads generated only 0.06 kg m^{-2}. No sediment was produced from the ditches adjacent to the paved roads or the undisturbed hillslopes. The total precipitation for the second wet season was 150% of the long-term mean, and sediment production rates were 2-4 times higher than in the first wet season. An empirical model using road segment area, segment slope, segment percent bare soil, and rill density accounts for 80% of the variability in road sediment production. These results show that native surface roads are an important and highly variable source of sediment.