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Runoff, sediment and nutrient dynamics at plot and catchment scale following fire in wet eucalypt forests

Patrick Lane, Gary Sheridan, Phillip Noske, and Chris Sherwin
University of Melbourne, Department of Forest and Ecosystem Science, Parkville, Australia (patrickl@unimelb.edu.au)

Two small mountain research catchments in SE Victoria, Australia, vegetated with wet eucalaypt forests were burnt in a wildfire in 2003. The experimental design produced a high resolution data set at plot and catchment scale on runoff, sediment and nutrient generation and fluxes, and the processes driving changes.

The key findings were:

• Annual discharge increased by around 70%, after the fire, and persisted for at least three years. At the plot scale there were orders of magnitude increases in overland flow generation under rainfall simulation
• Flow duration curve analysis showed there was no apparent change in the runoff processes delivering water to the stream network, despite the rainfall simulation results
• Suspended and coarse sediment fluxes increased by 8-9 times in the first year post-fire, but relaxed to pre-fire levels by the end of the second year
• Phosphorus and nitrogen fluxes increased by perhaps 5-6 times, and showed the same recovery rate as sediment, with the majority of both P and N transported in fine particulate form
• P enrichment ratios from plot to catchment were around 2, and the data suggests a relatively even split between organic and mineral P
• Water quality recovery was a function of the ground cover recovery
• There were no debris flows observed in these catchments despite rainfall and soil conditions that has triggered them in drier forest types nearby
• Hillslope process experiments revealed the importance of soil water repellency and the spatial arrangement of saturated hydraulic conductivity in pollutant pathway length, and these data suggested near-stream areas to be the pollutant source areas
• These experiments demonstrated that existing erosion process models do not work in these environments
• The results from this study are germane to a wet eucalypt environment under “average” rainfall conditions and good vegetation recovery
• A probabilistic approach to modelling is recommended to deal with extreme variation in post-fire rainfall and vegetation recovery over large burnt areas.

The relatively rapid recovery of these severely burnt landscapes suggests a high ecosystem resilience to wildfire. However a subsequent fire event that burnt an third of the catchments 4 years after the initial fire has resulted in an ecological response that suggests a fragility when subjected to repeated fires.