Slope Failure as an Upslope Source of Stream Wood

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Presentation Abstract

Large woody debris is recognized as an important component of stream geomorphology and stream ecosystem function, and forest-land management is recognized as an important control on the quantity (and size and species distributions) of wood available for recruitment to streams. Much of the wood present in streams comes from adjacent forests, and riparian management practices now reflect our understanding of the role these forests play in modulating and maintaining stream environments. In steep terrain, slope failures also carry wood (and sediment) to streams from upslope source areas. In these environments, periodic inputs of wood and sediment from landslides and debris flows also play an important role in stream geomorphology and ecosystem dynamics.

Channel environments are naturally dynamic systems. Depending on where you are in the channel network, discharge can vary from none in the summer to bed-scouring, channel-avulsing floods in the winter. Slope failures also drive variability in this system. Deposition of wood and sediment occur at discrete points in time and space, thereby creating temporal and spatial variability in channel environments. Redistribution and decay of deposited materials over time further add to this variability, and act to hide the original source of these materials, thereby masking the role of landsliding in setting stream environments. Landslide effects thus depend on when and where you look, and can be difficult to discern if the landslide occurred some time ago. This makes efforts to anticipate the effects of landsliding very challenging. Are we interested in the short term? The long term? Are we interested in a single reach? Or effects over a basin? Observations also suggest that landslide effects depend on a host of factors, including valley geometry, channel geometry, the quantity and size of sediment and wood in the deposit, the amount of wood and sediment already in the channel, and the amount of wood and sediment that enter the channel over the lifespan of the landslide deposit.

This sets the stage for considering slope failure as an upslope source of stream wood, particularly if we are to consider in-stream wood in the context of a stream ecosystem. I will briefly review the evidence on which to base conceptual and empirical models for identifying and characterizing upslope landslide source areas, and for placing them into a channel-network context. Then I'll illustrate the data-analysis and modeling approaches that we and our collaborators have been experimenting with to identify upslope source areas for stream wood and for anticipating the in-stream consequences of management decisions in those areas. These methods span a range of complexity. At the most basic, we use digital elevation data coupled with empirical models to identify the source areas and runout tracks for landslides that could potentially carry material to specified portions of the channel network (e.g., fish-bearing streams). To gain insights to effects of management, we couple stand-growth, wood recruitment, and landscape dynamics models to estimate wood abundances over time and space.

Keywords: large woody debris, slope failure, stream wood, wood recruitment modeling.

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