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The key role of log jams in the influence of transport and deposition of woody debris in a mountain stream

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Log jams in mountains streams are preferred storage sites for bedload material and woody debris. The resulting formation of steps and pools within a channel reduces flow velocities and thereby mitigates natural hazards in case of flood events. However, this requires analysing the resilience of log jams during high discharge events which in case of failure can release large amounts of stored material. In this study we investigate log jams in the Erlenbach mountain stream in the Swiss Prealps regarding their storage function of woody debris and residence times of stored logs. Nine log jams were surveyed in detail regarding their position, extent and volume. Artificially introduced wood pieces were tagged with Radio Frequency Identification (RFID) transponders and tracked along a study reach for five months. These tracers confirmed the hypothesis of debris dams being a preferred storage site for dead wood in mountain streams by the calculating tracer data point densities. The average point density for obstruction free channel reaches amounts to 0.13 pieces per m2 while it increases to 0.46 pieces per m2 for channel areas covered by log jams. The size and position of the log jams are mainly determined by bank erosion and hillslope activity as log jams are situated in highly active zones. Large logs of coniferous wood within the jams were dated using tree-ring analysis and their residence times within the channel determined based on the year of tree dieback. The residence times of large logs stored within the jams show a strong connection to the last two exceptional discharge events that occurred at the Erlenbach in 2007 and 2010 (flood events with return times of 50 and 20 years, respectively). The highest number of logs died back in 2007. The year with the second largest number of introduced logs is 2010. The consecutive years after those two high discharge events showed a declining number of trees entering the stream. So both events presumably caused a reactivation of channel-hillslope coupling and in this way promoted debris dam formation. On the contrary there are almost no logs stored in the channel that died back before 2007. This indicates that the 50 annual flood event other than the 20 annual flood event is responsible for a zeroing of in-stream wood conditions.