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Capturing the Influence of Large Wood on Fluvial Bedload Transport with RFID Tracers and Linear Mixed Modelling

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Bedload transport is a fundamental process by which coarse sediment is transferred through landscapes by river networks and may be well described stochastically by distributions of grain step length and rest time obtained through tracer studies. To date, none of these published tracer studies have specifically investigated the influence of large wood in the river channel on distributions of step length or rest time, limiting the applicability of stochastic sediment transport models in these settings. Large wood is a major component of many forested rivers and is increasing due to anthropogenic 'Natural Flood Management' (NFM) practices. This study aims to investigate and model the influence of large wood on grain-scale bedload transport.

We tagged 957 cobble – pebble sized particles ($D_{50} = 73$ mm) and 28 pieces of large wood (> 1 m in length) with RFID tracers in an alpine mountain stream. We monitored the transport distance of tracers annually over three years, building distributions of tracer transport distances. Empirical data was used in linear mixed modelling (LMM) statistical analysis, determining the relative influence proximity to wood had on likelihood of entrainment, deposition, and the transport distances of sediments.

Tracer sediments accumulated both up and downstream of large wood pieces, with LMM analysis confirming a reduction in the probability of entrainment of tracers closer to wood in all three years. Upon remobilisation, tracers entrained from positions closer to large wood had shorter subsequent transport distances in each year. In 2019, large wood also had a trapping effect, significantly reducing the transport distances of tracer particles entrained from upstream, i.e. forcing premature deposition of tracers. This study demonstrates the role of large wood in influencing bedload transport in alpine stream environments, with implications for both natural and anthropogenic addition of wood debris in fluvial environments.