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Landslide Sediment Flux and Forest Management in Northeastern Vancouver Island, Coastal British Columbia

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To evaluate landslide response of mountain drainage basins to forest management we examine a historical inventory in northeastern Vancouver Island. The study area is underlain by extrusive (upper Triassic Karmutsen Formation) and intrusive rocks (Jurassic Island Intrusions). The dataset, compiled via interpretation of sequential aerial photosets, helicopter traverses, and extensive fieldwork, comprises a total of 1961 sediment sources, including 798 field-measured events. Field- and photo-based data cover a time window of approximately 70 years. The effects of forest management on landslide activity are assessed in terms of landslide density, sediment production, landslide geometry, landslide magnitude-frequency relations, topographic conditions of landslide initiation and deposition, and sediment redistribution across landscape components.
Results indicate that forest management alters natural landslide dynamics in many respects. Logging-related debris avalanches are typically smaller. Consequently, the magnitude-frequency relation in logged terrain occupies the small-medium magnitude spectrum (< 6000 m3), with frequencies increasing by over an order of magnitude. Lithologic effects on sediment production appear amplified, in that terrain underlain by extrusive rocks become increasingly more unstable than intrusive ones. Analysis of landslide initiation and deposition zones reveals that forest management promotes colluvial aggradation on mid and lower hillslopes and in gullies. This pattern, which accelerates sediment recharge of gully systems, has the potential of increasing the frequency of channelized debris-flows, hence cause an extended period of disturbance, before sediment dynamics recover to pre-logging conditions. The effects of forest clearing on hillslope-channel coupling are composite: in cutblocks the percentage of sediment delivered to streams is reduced by 20-60% whereas road-related landslides are associated with highest connectivity to streams.