The stand provides a unique opportunity to study the spread and damage caused by root disease and associated bark beetles in an undisturbed state.

In 1987, 50 permanent plots were established in a 25-ha area to measure tree mortality over several decades. In one 2-ha area of concentrated tree mortality, the stems of all living and dead trees on the study plot were mapped to measure spread of the root disease into healthy portions of the stand. In 1989, half of the 25-ha area, including a portion of the 2-ha mortality center, was partially harvested. Annual mortality and spread data may be used to calibrate a model that has been recently developed to better estimate timber growth and yields on root disease-affected sites (Stage, A. R., C. G. Shaw III, M. A. Marsden, J. W. Byler, D. L. Renner, B. Eav, P. McNamee, T. Webb, and G. Sutherland. 1990. *User's manual for Western Root Disease Model*. USDA For. Serv. (Gen. Tech. Rep., INT-267), Intermountain Research Station, Ogden, Utah). Because the model operates on 10-year time steps and stands are grown on 100-year rotations, this study is designed to examine disease spread and tree mortality over several decades.

Policies to either manage or preserve old-growth mixed-conifer forests in the interior West must account for the dynamics of stand growth and mortality as influenced by root diseases and other catastrophic pests, if objectives are to be met.

## Long-Term Patterns of Sediment Transport Following Timber Harvest, Western Cascade Mountains, Oregon

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The objective of this study was to quantify the long-term effects of two intensities of timber harvest on sediment delivery at seasonal and yearly time scales. Differences in total sediment flux over a 30-year period were compared for three small forested watersheds (WS 1, 2, and 3) located in the H. J. Andrews Experimental Forest in the Western Cascade range of Oregon. The landscape is steeply dissected, underlain by mixed volcanic rocks, and vegetated with 400- to 500-year old stands of Douglas-fir and hemlock. Sampling of suspended and bedload sediment was initiated in 1957 and continued through 1988 on all three watersheds which have drainage areas of 96, 60, and 101 ha, respectively. Three different treatments were compared: a 100% clearcut watershed without roads completed in



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1966 (WS 1), a 25% harvested patch-cut watershed with 6% of area in roads completed in 1963 (WS 3), and a forested control (WS 2), which was not harvested. Suspended sediment was sampled during and between storms. Bedload was measured annually in a stilling reservoir.

The variation of annual suspended and bedload sediment yields among watersheds has been great. Total yield over the period 1957 to 1985 was 73,000; 10,000; and 294,000 kg/ha in WS 1, 2, and 3, respectively. Over 80% of the entire 28-years sediment production in WS 3 occurred during two days in 1964 when a series of debris flows initiated at road crossings and scoured the channel to bedrock. Excluding this event, WS 1 has produced over twice as much sediment as WS 3 in the first 20 years following cutting.

The pattern of long-term sediment production from these three watersheds reflects their mass movement history. High sediment yields in WS 1 can be attributed to accelerated debris avalanche erosion after clearcutting. Seven debris avalanches (>75 $m^3$ each) moved soil downslope in WS 1 between 1964 and 1972. Total sediment yield following clearcutting has steadily declined in WS 1, while sediment discharge in WS 3 has remained quite low since the 1964 debris flows. Presumably these flows removed most of the available sediment from storage in the channel and supply of additional sediment from hillslope areas has been slow.

This study points up the importance of mass erosion events in controlling rates of sediment transport in mountainous areas. Timber harvest activities may primarily affect sediment production and transport in this region by changing the magnitude and frequency of mass erosion events rather than by directly affecting supply of sediment to the stream system. Conversion of natural or old-growth stands to managed plantations increases sediment delivery to streams and may pose risks to downstream aquatic and riparian resources.

## Effects of Forest Land Use on Watershed Hydrology: A Modelling Approach

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Current interest in effects of forest management and other disturbances has prompted the need to develop large-scale hydrology