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 sédiment 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

Gordon E. Grant, U.S. Department of Agriculture Forest Service, Pacific Northwest Research Station, 3200 Jefferson Way, Corvallis, Oregon 97331; R. Dennis Harr, U.S. Department of Agriculture Forest Service, College of Forest Resources (AR-10), University of Washington, Seattle, Washington 98195; and George Leavesley, U.S. Geological Survey, Box 25046 MS 412, Denver Federal Center, Denver, Colorado 80225-0046

Current interest in effects of forest management and other disturbances has prompted the need to develop large-scale hydrology models that are sensitive to land-use changes. Such models should allow researchers to investigate the effects of alternative cutting patterns on stream flows and provide managers with a tool for planning harvest activities across the landscape. We currently are developing such a model for watersheds within the H. J. Andrews Experimental Forest in Oregon. Data sets collected at the Forest over several decades include hydrologic information on basins ranging in size from 10 to 6,000 hectares, a detailed meteorologic record, and a well-documented land-use history.

A computer model developed by the junior author called the Precipitation-Runoff Modelling System (PRMS) explicitly treats land-use effects. PRMS analyzes the watershed as a mosaic of hydrologic response units (HRUs) which are characterized by slope, aspect, vegetation, soil, and precipitation distribution. A water and energy balance are calculated for each HRU and flows are routed through the stream network utilizing energy and mass balance equations. Both daily and storm hydrographs can be simulated. By partitioning the watershed into HRUs, the effects of land-use changes over part or all of the watershed can be evaluated. Because the system is modular, it can be tailored to specific landscapes and climatic regimes.

We have begun to apply and test the model using the hydrologic data sets for three small (approximately 100 ha) watersheds located in the Andrews Forest, two of which were logged during the 1960s. If the model accurately simulates the measured hydrologic response of these basins, we will examine its applicability for larger streams. Included in this effort will be an examination of the effect of rain on melting snow under different forest stand conditions. When used with Geographic Information Systems (GIS), we expect the model to be able to predict the hydrologic response to different cutting patterns. For example, we will use the model to predict the hydrologic effects of dispersed as opposed to aggregated cutting units over the landscape. This will assist resource managers in minimizing risks of floods and other deleterious hydrologic effects when harvesting old- and second-growth forests.

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Remote Sensing of Canopy Structure in the Pacific Northwest

Warren B. Cohen and Thomas A. Spies, U.S. Department of Agriculture Forest Service, Pacific Northwest Research Station, Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oregon 97331

Disturbance histories and site conditions in the Pacific Northwest vary greatly. This has led to a complex pattern of canopy structures