INTERNAL REPORT 134

NUTRIENT RETENTION, MOBILIZATION AND LOSS IN UNDISTURBED FOREST ECOSYSTEMS ON EXPERIMENTAL WATERSHEDS AT THE H. J. ANDREWS EXP. FOREST

R. L. Fredriksen and D. G. Moore

INTERNAL REPORT 134

NUTRIENT RETENTION, MOBILIZATION AND LOSS IN UNDISTURBED FOREST ECOSYSTEMS ON EXPERIMENTAL WATERSHEDS AT THE H. J. ANDREWS EXPERIMENTAL FOREST - B18

R. L. Fredriksen and D. G. Moore
USDA Forest Service, Corvallis, Oregon

INTRODUCTION

Experimental watersheds are a means of measuring the contribution of forests to regional and global biogeochemical cycles. Forested watersheds receive nutrients in atmospheric dust and dissolved materials in precipitation. Nutrient losses from the watershed are carried in streamflow, either dissolved in water or transported as sediment. Elements with a volatile phase--such as carbon, hydrogen, nitrogen, and oxygen--are largely supplied by the atmosphere and are returned to the atmosphere as a result of combustion reactions such as respiration or fire. Measurement of these fixation and release processes require special methods of study which are beyond the scope of this study.

Two sets of experimental watersheds were established by the Forest Service for hydrologic and biogeochemical studies. Vegetation on watersheds 9 and 10 is representative of lower elevation old-growth Douglas-fir forests on warm, dry habitats (see attached figure). The Hi-15 watersheds (6, 7, and 8) are located in mid-elevation Douglas-fir forests which are transitional between the lower elevation western hemlock climax forests and the high elevation alpine forests composed mainly of various true firs and mountain hemlock.

Only undisturbed forests have been studied so far, manipulations are scheduled for 1974 on both sets of watersheds. Clearcutting is planned for watershed 10, while at the Hi-15 area clearcutting will be compared to shelterwood cutting.

In addition to research at the watershed level, studies of nutrient transfer through soils and nutrient movement by soil erosion are located within some of the various habitat types characteristic of watershed 10.

Objectives of these studies are: 1) To establish nutrient budgets of these forests for nitrogen, phosphorus, silica, and the cations, sodium, potassium, calcium and magnesium. The budgets will include nutrients dissolved in water and those carried in particulate matter as a component of precipitation and streamflow; 2) To measure the rate and timing of nutrient release and transfer in soil solution, and by processes of erosion; and 3) To identify where possible the mechanisms involved in (2) above.

PROGRESS DURING 1972

Nutrient Budgets

The initial nutrient budget of watershed 10 for those nutrients dissolved in precipitation and streamflow was summarized in Proceedings - Research on Coniferous Forest Ecosystems - 1972, p. 115-131. Results reported in that publication show that nitrogen is carried into and out of the ecosystem mainly as a component of dissolved organic matter. Only trace amounts of nitrate are present in streamflow even though much larger amounts of nitrate (0.20 kg/ha) are received in precipitation. Losses of organic nitrogen in solution amounting to 0.5 kg/ha were only half of the input in precipitation (1.0 kg/ha). Total phosphorus outflow of 0.5 kg/ha was nearly double the input. Cation outflows were very large compared to inputs and are indicative of the rapid geochemical weathering rate of tuff-breccia parent materials that form the soils of the watershed. Bicarbonate and calcium are very predictable from streamflow rate alone and confirm the regulating role of mobile anions on cation loss.

Nutrient budget information for both watershed 9 and 10 and Hi-15 watersheds, including both water and sediment as a carrier of nutrients, is up to date through 1972. Precipitation and streamflow data have been tabulated through 1972. This data will be published within the next year.

Nutrient Release From Forest Floor

The nutrient transfer from forest floor to surface soil is currently being monitored by tension lysimetry on two contrasting habitat types representing plant communities on a hot-dry habitat type on south aspects and cool-moist habitat types commonly found on north aspects. We expect to observe different nutrient release and transfer rates mainly due to different decomposition rates of forest floors on the two sites. These studies will be expanded in 1973 to include 3 habitat types, broader replication, and nutrient transfer in soil solution.

In order to relate nutrient transfer more directly to decomposition rate, a litter bag study of Douglas-fir needles of known nutrient composition has recently been installed on these sites. The bags will be picked up quarterly so as to isolate seasonal climatic differences on decomposition rate. The study will cover a three-year period.

Total Erosion Loss From Experimental Watersheds

As this watershed experiment was originally conceived, soil erosion rate was measured only by the suspended sediment sampled with proportional streamflow samplers positioned at the outlet of the watersheds. In order to obtain complete information on the total erosion from watersheds 9 and 10, bedload sampling basins were installed below each gaging station during the summer of 1972. The basins are of a special design suitable for the efficient measurement of bedload deposition following each winter storm event and assessment of the nutrient contents of that sediment from subsamples taken. The relative importance of soil erosion within the watersheds from side slopes, creek banks and within channels will be determined in 1973.

Determination of Soil Nutrient Capital

From an examination and description of 35 soil pits, a soil map was made in 1971. The mapping units were based upon stone content and depth phases of the Frissell series. Eight soil pits were selected from the original number which would represent the soils of the predominant soil mapping units. The horizon samples from these pits were analyzed for total nitrogen, available phosphorus, total carbon (by loss on ignition and wet dichromate digestion), pH, cation exchange capacity and exchangeable sodium, potassium, calcium and magnesium. Total chemical and mineralogical analysis of soil and parent material is planned for 1973.

Nitrogen and phosphorus budget for watershed 10, H. J. Andrews Experimental Forest - kg/ha.

		N	P
INPUT:	Dissolved in precipitation	.90	.27
	In atmospheric dust	.08	.05
	Total	.98	.32
OUTFLOW:	Dissolved in streamflow	.38	.52
	In sediment	.60	.14
	Total	.98	.66