

From the forest to the sea and back again: Biogeochemistry in the Oregon Coast Range

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Variations in plant community composition across the landscape can influence nutrient retention and loss at the watershed scale. A striking example of plant species influence is the role of N₂-fixing red alder (*Alnus rubra*) in the biogeochemistry of Pacific Northwest forests. Anadromous fish also can serve as a significant source of nutrients and energy to the streams where they return and die, although these inputs are not traditionally considered in watershed nutrient budgets. We studied the chemistry of 26 small watershed streams within the Salmon River basin of the Oregon Coast Range. Nitrate and dissolved organic nitrogen (DON) concentrations were positively related to broadleaf cover (dominated by red alder), particularly when near-coastal sites were excluded ($r^2 = 0.65$ and 0.68 , for nitrate-N and DON). Annual N export was highly variable among watersheds (2.4 to 30.8 kg N ha⁻¹ yr⁻¹), and best described by a linear regression with the red alder cover as basal area % of watershed area ($r^2 = 0.76$). Our findings provide evidence for strong control of ecosystem function by a single species, where leaching from N saturated red alder stands is a major control on N export from these coastal watersheds. To understand the relative importance of terrestrial and marine nutrient sources, we also compared the watershed export of N, C and P with the delivery of these elements in returning chinook and coho salmon. Dissolved element export from the mainstem Salmon River at Otis was 9.7 kg N ha⁻¹ yr⁻¹, 16 kg C ha⁻¹ yr⁻¹, and 0.19 kg P ha⁻¹ yr⁻¹. These data are compared with the flux of nutrients returning from the ocean as spawning salmon in the 2000s. The ratio of terrestrial to marine derived nutrients is very high, indicating that under present conditions, most of the C and N passing through the stream is derived from the watershed. Present-day salmon runs are only 1-5% of historic runs, however, indicating that marine-derived N, C and P were much more important before the decline of salmon runs. The rate, form and timing of nutrient supplies to streams, as well as the mode of entry into stream food webs, are important factors to consider for management related to water quality.