AN ABSTRACT OF THE THESIS OF

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Title: The Use of $\delta^{15}N$ and $\delta^{13}C$ to Analyze Food Webs and Identify Source-Sink Relationships in Riparian Canopy Vegetation of the Oregon Coast Range

Abstract approved:

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In the Coast Range of western Oregon, some natural resource managers are converting red alder-dominated riparian areas to conifers to increase the future source of in-stream large wood for salmonid habitat. However, studies in Alaska have shown red alder-dominated riparian areas support greater invertebrate biomass compared to conifer-dominated areas. In addition, red alder can influence the nutrient dynamics of a site with N-rich litter inputs. Thus, these forest conversions have the potential to change riparian food webs and nutrient dynamics.

The objectives of this thesis were to determine the utility of natural abundance stable isotopes of nitrogen and carbon in food web analyses and to describe nutrient dynamics and source-sink relationships in red alder- and Douglas-fir-dominated riparian areas of the central Oregon Coast Range. We address three questions in this study: 1) What is the degree and source of $\delta^{15}N$ and $\delta^{13}C$ variation in foliage of Douglas-fir and red alder? 2) Are Douglas-fir and red alder isotope signatures sufficiently distinct to be used in food web analysis? and 3) Are there differences in nutrient dynamics and source-sink relationships between Douglas-fir- and red alder-dominated riparian areas? To address these questions, we sampled foliage, litterfall, forest floor material, and soil from ten Douglas-fir- and red alder-dominated riparian sites as well as foliage from plantation Douglas-fir and red alder for $\delta^{15}N$, $\delta^{13}C$, and nutrient concentrations.

Douglas-fir had greater variation in foliage $\delta^{15}N$ within a tree crown, within a site, and among sites than red alder. Red alder had consistent foliage $\delta^{15}N$ at all scales, near –1.5‰, a value that is characteristic of nitrogen fixing species. Both species had similar levels of variation in foliage $\delta^{13}C$ at all scales. Douglas-fir was slightly enriched in ^{13}C compared to red alder suggesting greater water-use efficiency in Douglas-fir. Overall, the difference between $\delta^{15}N$ and $\delta^{13}C$ of red alder and Douglas-fir at our study sites were, on average, less than 2.0‰. It is unlikely stable isotopes could be used over broad geographic areas as a tool for determining the contributions of Douglas-fir versus red alder to food webs, although site-specific research may be possible where Douglas-fir and red alder demonstrate greater isotopic differences.

Douglas-fir and red alder exhibited opposite source-sink relationships with soil for N exchange: Douglas-fir was a sink for soil N whereas red alder served as a N source. Douglas-fir sites had a higher N status and lower soil $\delta^{15}N$ along the stream compared to upslope, trends not found at red alder sites. Soil $\delta^{15}N$ near streams on Douglas-fir sites was similar to the soil $\delta^{15}N$ on red alder sites suggesting that a legacy of past red alder along the stream may have contributed to the N status and soil $\delta^{15}N$ gradients on Douglas-fir sites. Soil $\delta^{15}N$ and soil %N did not indicate a presence of marine N on our sites. $\delta^{15}N$ and $\delta^{13}C$ of foliage and soil suggested decomposition processes of leaf litter differed between Douglas-fir and red alder, likely due to different litter chemistries and possible influences on decomposition enzymes. A shift in species composition from red alder-dominated to Douglas-fir-dominated riparian areas would alter source-sink relationships with soil N and litter decomposition processes, although some legacies of soil enrichment in N by red alder would persist.