Biomass and carbon storage estimates: finding nondestructive parameters for root-to-shoot ratios in young Douglas-fir, grand fir and redwood in northwest California

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Forests sequester and store carbon above- and belowground. Less is known about belowground carbon storage in tree roots due to inherent difficulties in destructive sampling. To simplify forest biomass and carbon estimation, there is demand for equations that predict total biomass and carbon, and belowground biomass and carbon in tree roots from easily-obtainable above-ground measurements. We excavated three species of Pacific northwest conifer: Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis)*, and coast redwood (*Sequoia sempervirens),* and measured tree-size attributes. We then dried each young tree to determine oven-dry biomass and carbon storage. Root carbon storage comprised up to thirty percent of the total carbon storage, showing the potential for forests to store much carbon belowground in coarse roots. Height, stem diameter, and crown width data were correlated with root mass among sample trees of each individual species. By measuring individual coarse roots of each species, we created prediction equations to compensate for coarse root breakage during excavation. We used these equations to predict missing root mass among sample trees which improved our estimates of total tree root biomass and carbon stored below ground. Our findings inform forest carbon offset analyses and demonstrate the potential for forest trees to sequester and store carbon in tree roots below ground.