Sustainability of Coastal PNW Douglas-fir Forests for Biofuel Feedstocks

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Introduction: In many forest plantation ecosystems, concerns exist regarding nutrient removal rates associated with sustained whole-tree harvesting. In the coastal North American Pacific Northwest, we predicted the depletion risk of nitrogen (N), the region's most growth-limiting nutrient, for 68 intensively managed Douglas-fir (Pseudotsuga menziesii var. menziesii [Mirb.] Franco) plantations varying widely in productivity.

Procedures: We projected stands to rotation age using the individual-tree growth model ORGANON and then calculated a stability ratio for each stand, defined as the ratio of N removed during harvest to total site N store (soil and forest floor). We assigned a risk rating to each site based on its stability ratio under whole-tree and stem-only harvest scenarios.

Results & Discussion: Under whole-tree harvest, 49% of sites were classified as potentially at risk of long-term N depletion (i.e., 10% N store removed in harvest), whereas under stem-only harvest, only 24% of sites were at risk. Six percent and 1% of sites were classified as under high risk of N depletion (i.e., 30% N store removed in harvest) under whole-tree and stem-only harvest, respectively. The simulation suggested that sites with 9.0 and 4.0 Mg ha1 site N store are potentially at risk for long-term N depletion and productivity loss under repeated whole-tree and stem-only harvest, respectively. Sites with 2.2 and 0.9 Mg/ha site N store are at high risk of N depletion under whole-tree and stem-only harvest, respectively. The areas with the highest concentrations of at-risk sites were those with young, glacially derived soils on Vancouver Island, Canada, and in the Puget Sound region of Washington. Recent studies of deep soil N stores show that sampling deeper than 1 m can result in much larger N pools than 1 m. Though strong correlations between productivity and soil depth have been shown in previous studies, is unknown at this time whether these additional pools of N can be exploited by new plantations and whether this normally unmeasured N can decrease stability ratios further, and increase resiliency to biomass harvesting further.

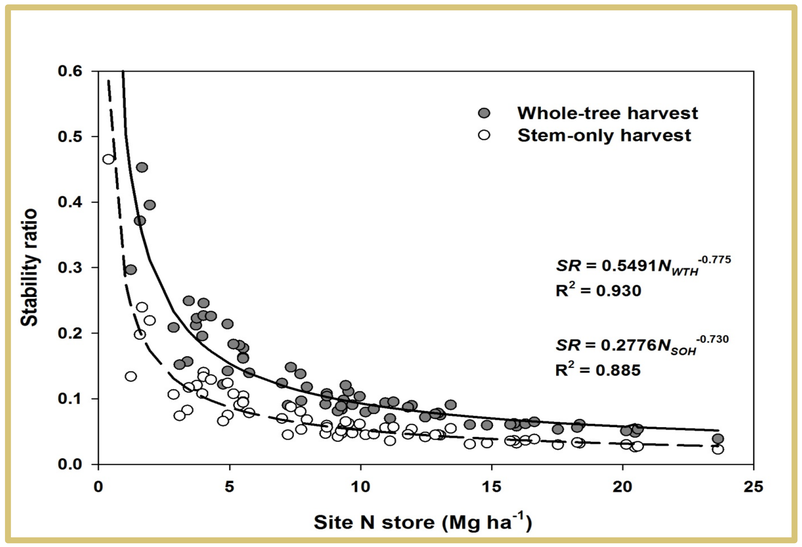

Figure 3. Stability ratios for whole-tree and stem-only harvest in 68 coastal Pacific Northwest Douglas-fir plantations, by site N store (total soil N to 1.0-m plus forest floor).

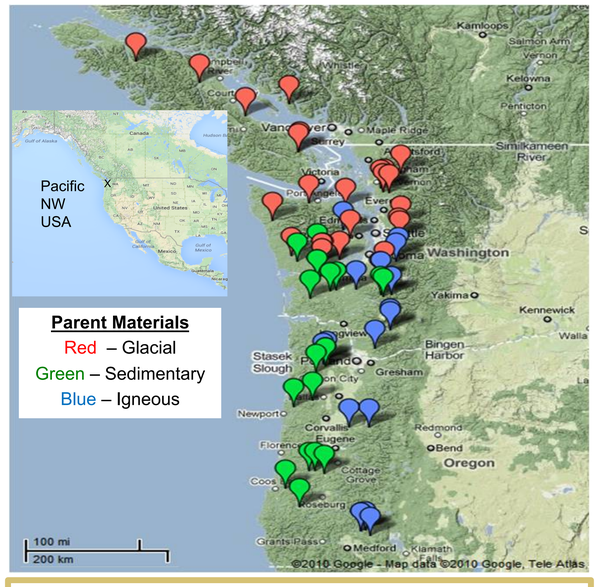

Figure 1. Locations of 68 Douglas-fir plantations evaluated in this study by soil parent material.

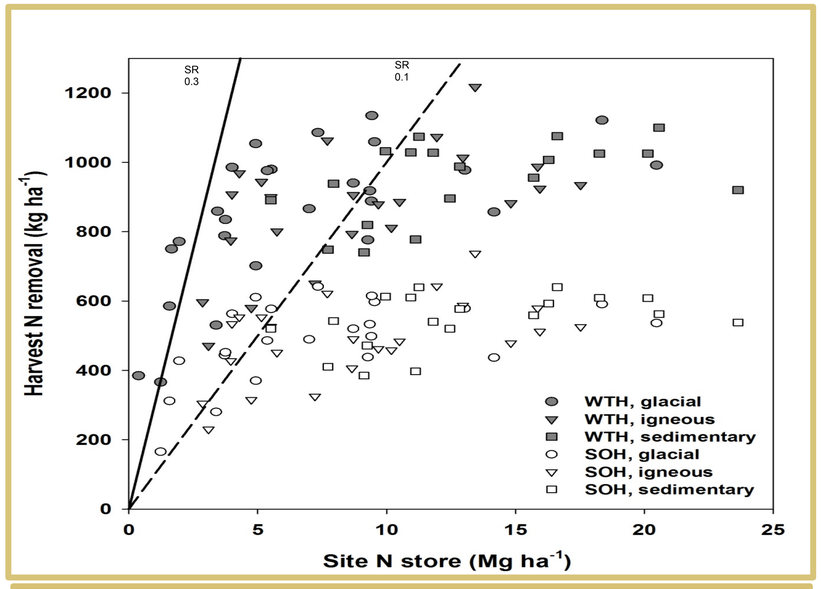

Figure 2. Estimated N removal under WTH and SOH for 68 Douglas-fir plantations, by site N store (total soil N to 1 m depth plus forest floor) and parent material.

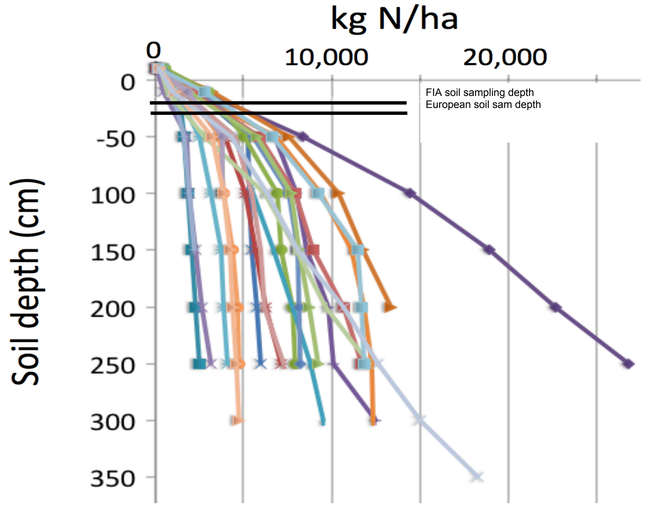

Figure 4. Total N found at depth at 22 of the sites sampled for the sustainability evaluation.

Studies upon which this poster is based.
Himes, AJ, EC Turnblom, RB Harrison, KM Littke, WD Devine, D. Zabowski and DG Briggs. 2013. Predicting Risk of Long-Term Nitrogen Depletion under Whole-Tree Harvesting in the Coastal PacificNorthwest. Forest Science 60:382-390.
James, Jason, Warren Devine, Rob Harrison and Thomas Terry. 2014. Deep Soil Carbon: Quantification and Modeling in Subsurface Layers. Prepublished Soil Sci. Soc. Am. J. doi:10.2136/sssaj2013.06.0245nafsc.

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