Comparing Regional and Site-Specific Biomass and Nutrient Budget Models for Douglas-fir

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ABSTRACT

Biomass estimation models are often used to aid in developing site nutrient budgets. However, readily available biomass models are regional and thus potentially mask nutritional affects of site-type. Site nutrient richness may influence Douglas-fir allometric relationships and could affect the nutrient content of tree components. To test this, we selected mature stands of consistent climate regime that were deemed either poor site nutrition (quartzite parent material, 3 sites) or good site nutrition (basalt parent material, 3 sites). This comparison will help define when and where generalized or site-specific biomass models.

NARATIVE

Rationale and Justification: Many of the biomass models developed for tree species of the Intermountain West were initiated several decades ago during the last energy crisis (Brown, 1978; Gholz et al., 1979; Cochrane et al., 1984). These models were developed from regionally based on allometric relationships (e.g. diameter at breast height – DBH, total tree height) and tree biomass as measured by mass of foliage, stemwood, branchwood, and bark. The creation of regional, species-specific allometric equations enabled estimation of forest biomass across broad geographic landscapes without the need for destructive sampling. However, the very nature of these regional models introduces a scaling error into biomass estimations and raises the question: Does a regional biomass model accurately predict, within an acceptable level of error, biomass at the site level? Many of the regional biomass models were created by destructively sampling trees across a wide range of site productivity conditions which mask the affect of site-specific attributes on forest productivity (Brown, 1978; Gholz et al., 1979; Cochrane et al., 1984).

Site productivity as it relates to native soil fertility, parent material, and moisture regime, has a direct effect on biomass production (Shen et al., 2000). Few, if any, of these regional biomass equations allow model adjustment for site specific variables such as soil nutrient or moisture status (Ter-Mikaelian and Korzukhin, 1997). Comparisons between generalized and site-specific biomass models for *Pseudotsuga menziesii* var. *menziesii* in southern British Columbia found that site nutrient status and geographic location significantly influenced biomass model parameters, especially on sites with low site productivity (Feller, 1992). Monserud and Marshall (1999) found that site-specific, tree crown biomass models for three northern Idaho conifer species showed strong differences in biomass estimates compared to other Intermountain West biomass models. Consequently, we suspect that accounting for site-specific moisture and nutrient status in total tree biomass models will improve biomass estimates within Intermountain West forests.

Objectives: This research will test the hypotheses that 1) generalized biomass models for *Psuedotsuga menziesii* (Mirb.) Franco var. *glauca* significantly differ from measured, site-specific tree biomass, and 2) site-specific biomass models significantly improve biomass estimates of *Psuedotsuga menziesii* (Mirb.) Franco var. *glauca* over existing regional models. Results from these tests will be used to 1) improve biomass estimates for use in regional forest bioenergy research, 2) suggest modifications to the biomass estimator function within the Forest Vegetation Simulator (FVS) as developed by the United States Forest Service, and 3) develop protocols for creating multi-species, site-specific biomass models across the Intermountain West.

Procedures: A matrix of potential research sites will be created by stratifying forested landscapes of the Inland Northwest by soil temperature and moisture regimes and geologic formations derived by digital surveys of the Natural Resource Conservation Service and the United States Geological Survey. The initial phase of this project will select 4-6 sites that support near rotation age forest structures and fall within the Xeric-Frigid soil regime. Within the Xeric-Frigid regime, 2-3 sites will be selected that reflect poor site nutrition (quartzite) and 2-3 sites that reflect better relative soil nutrition (basalt).

A pre-harvest forest inventory will be conducted on each research site to collect mensurational and physiology data for use in sample size/selection development and model parameter selection (Avery and Burkhart, 2002; Brown, 1978; Monserud and Marshall, 1999). From each site inventory, a stratified sample of 3-5 DBH size classes will be determined for destructive sampling. Three random trees within each size class will be felled, measured, cut to 10ft sections, and de-limbed. Biomass weights will be collected for the following categories: i) foliage, ii) live branches, iii) dead branches, iv) stemwood, and v) bark. Each category will be weighed in the field for green weight and then a subsample identified for lab analysis of dry weight and wood density.

Field and laboratory measures of each biomass category will be compared against regional biomass models. Model error will be computed to determine generalized model estimates of an acceptable error. Site specific biomass equations will be developed using mensurational, physiology, and site status data. Site-specific biomass estimates will be compared to generalized biomass estimates and the utility of the models assessed.

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