Partitioning Soil Respiration to Quantify Carbon Sequestration: A Regional Synthesis of Fertilization and Throughfall Reduction

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Predicting forest carbon (C) sequestration, or net ecosystem productivity (NEP), depends on quantifying C fluxes at the ecosystem scale (Fig. 1). Often these fluxes cannot be directly measured and must be modeled. For example, the model 3-PG estimates gross primary productivity (GPP) and autotrophic respiration (R_A) to predict net primary productivity (NPP). In order to use this information to predict NEP, we must also know soil respiration (R_S) and what proportion of R_S is heterotrophic (R_H). The goal of this work is to integrate field observations of these C fluxes (Fig. 2; Aim 1) into regional models (Aim 2) to better predict the potential of managed pine forests to sequester C in the future. Field observations show consistency across treatments, sites, and times of year (Fig. 3; R_H/R_S = 84%). This will significantly simplify efforts to model NEP, and reduce the need for more detailed field studies.

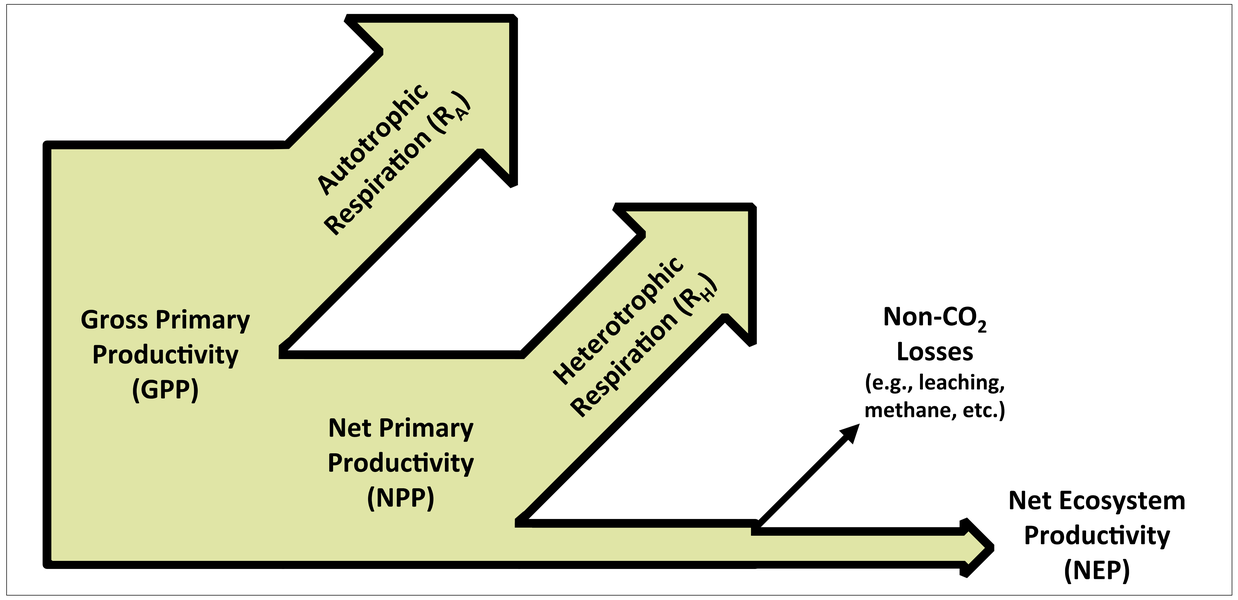

Figure 1. Carbon flow in a forest ecosystem.

Fig. 2. R_H measurement.

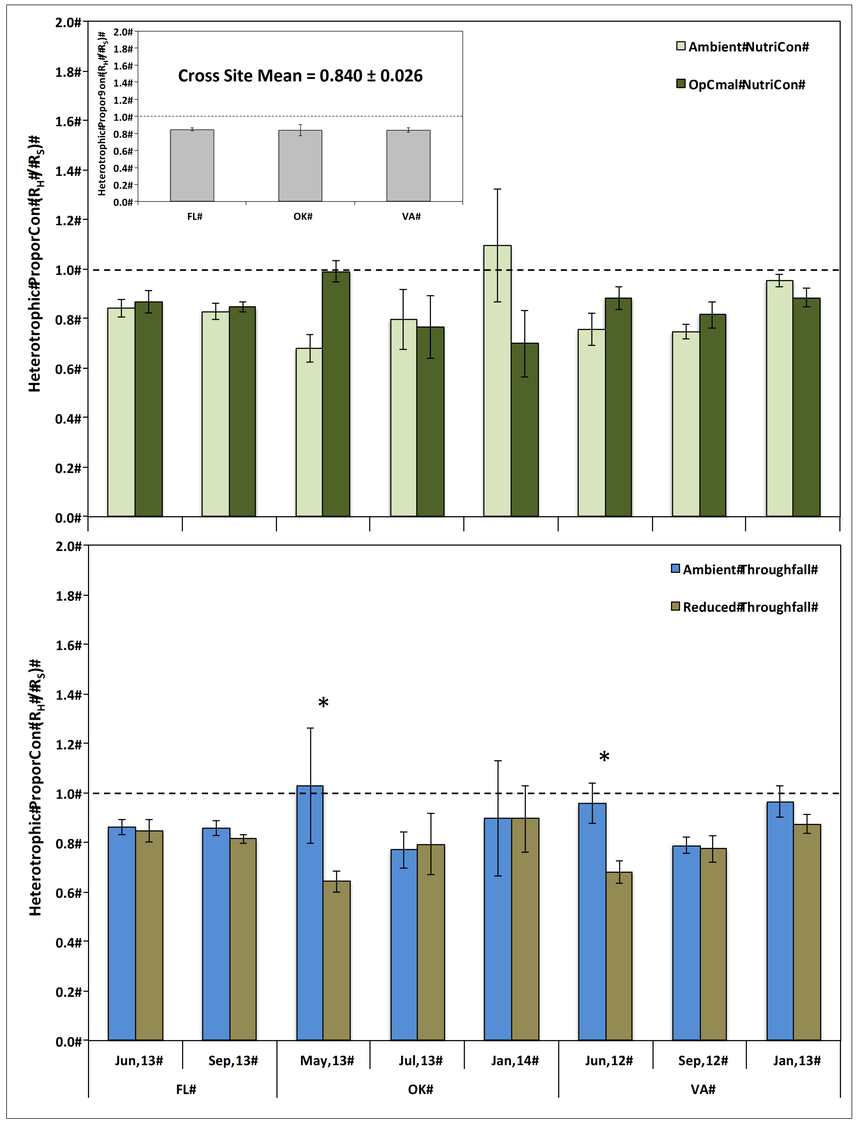

Figure 3. Proportion of total soil respiration (R_S) from R_H at the Tier III sites in Florida (FL), Oklahoma (OK), and Virginia (VA) at multiple times. Top shows main effect of fertilization; bottom shows main effect of throughfall reduction; inset provides site and regional means. Asterisks represent a significant main effect ($p < 0.05$).

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