**PROPOSAL TITLE**

Species-specific water use patterns in response to nutrient-amended plots at the Hubbard Brook Experimental Forest

**MAJOR HYPOTHESES**

H1: Soil amendment with nitrogen (N), phosphorus (P), and +N&P would result in increased transpiration compared to control plot.

**MEASUREMENTS**

The proposed sap flux measurements would occur on the N, P, and N+P fertilization plots for the Yanai et al. nutrient co-limitation study. The student will compare the water response of one or more of the three studied species in the project (Yellow Birch, Beech, Sugar maple) according to his interests and available time. He will be trained to download data from data storage equipment (Datalogger, Multiplexer, Campbell Sci.), identify equipment malfunction and maintenance, work with the data base to convert sap flux to whole tree water use, use basic statistical analysis to compare the effects of the different treatments on the water use of the species selected at the Hubbard Brook Experimental Forest, interpret the results and write them. The study will be conducted from mid-June to mid-August to include both relatively wet and dry periods, respectively.

The student will work with the Heat Ratio Method (HRM) as described in Burgess et al. (2001). This method uses probe sets with thermocouples and heat pulses to measure sap flux density. A single heat-pulse “probe set’ consists of two thermocouple temperature probes and one heater probe attached to 10-m cable (maximum). Each of the two thermocouple temperature probes we will use have three thermocouples. The total length of the probes is 4.2 cm, and the thermocouples are situated at 1.2 cm (outer), 2.4 cm (middle) and 3.7 cm (inner).

To calculate water use per tree based on the sap flux densities, measurements of the conducting sapwood area are needed. Sapwood will be delimited based on wood color and translucency. Sapwood area will be estimated by coring the studied trees with a Pressler increment borer at the end of the experiment. Thus, whole tree water use will be obtained as the product of sap flux density at the center of a band described by the thermocouple location and the band cross-sectional area.

The student may also participate in the calibration of the HRM sapflow sensors. The calibration will consist of cutting two young individuals of each study species. Each sample tree will be suspended to adjacent trees for support and then cut near the ground under water (by flooding around the base of the tree using a plastic “skirt” attached to the stem) with a sharp chisel and immediately, a bucket with water and vegetable dye will be placed under the cut stem. The water level will be marked on the bucket with a wire such that the tip of it breaks the water surface meniscus. The bucket will be covered with plastic to avoid evaporation from the bucket and water uptake will be measured every hour by creating a small opening in the plastic and bringing up the water level to the fixed position using a graduated cylinder. This procedure will be conducted continuously during a full day in the driest period (August). The following day, the stem will be cut just above where the HRM probe set will be installed, enabling the measurement of the averaged depth of heartwood for trees, defined as the portion of the unstained wood.

**SPECIFIC ACTIVITIES AND TIMELINE**

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| **Activity** | **Time** |
| Download data and change batteries of data loggers | One day/week |
| Review downloaded data and determine whether data loggers and sapflow sensors are functioning properly | On-going |
| Calibration of the sensors | 2-3 days in early August |
| Data analysis | August-September, as time allows |
| Assist with other plant ecophysiological measurements | As time allows, and depending on interest |