

Annual Report for Period:07/2010 - 06/2011**Submitted on:** 05/10/2011**Principal Investigator:** Goodale, Christine L.**Award ID:** 0949854**Organization:** Cornell University**Submitted By:**

Goodale, Christine - Principal Investigator

Title:

Collaborative Research: Nutrient co-limitation in young and mature northern hardwood forests

Project Participants

Senior Personnel

Name: Goodale, Christine**Worked for more than 160 Hours:** No**Contribution to Project:**

Goodale's commitment to the project is 0.4 mo/academic year, with none of that salary support coming from NSF. Academic year support is from Cornell University.

Name: Fahey, Timothy**Worked for more than 160 Hours:** No**Contribution to Project:**

Fahey was committed to 0.5 mo/yr in for this project (unfunded), which he has exceeded through multiple field trips to establish the soil respiration and root sampling procedures.

Name: Cleavitt, Natalie**Worked for more than 160 Hours:** No**Contribution to Project:**

Supervised collection and analysis of soil and root samples

Post-doc

Graduate Student

Name: Li, Ang**Worked for more than 160 Hours:** No**Contribution to Project:**

Assisted with field work.

Name: Bae, Kikang**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Conducted field measurements and data analysis on soil respiration.

Supported on the NSF award for this collaborative project to SUNY-ESF (Yanai).

Name: Melvin, April**Worked for more than 160 Hours:** Yes**Contribution to Project:**

April Melvin led the soil-coring work to characterize pre-treatment stocks of C and N across all plots to a depth of 50+ cm. She led the collection team and has overseen sample processing in Ithaca.

Name: Thomas, Robert**Worked for more than 160 Hours:** No**Contribution to Project:**

Quinn worked with Ed Rastetter to develop the MEL model and its application to the N x P experiments in this study. (See progress report for Rastetter piece of this collaborative award for detail).

Undergraduate Student

Name: Mackellar, Gavin

Worked for more than 160 Hours: Yes

Contribution to Project:

Gavin Mackellar assisted with soil sample collection, and has worked through much of the processing of soil C and N samples, including sieving, weighting, drying, and data management.

Technician, Programmer

Name: Wood, Cynthia

Worked for more than 160 Hours: Yes

Contribution to Project:

Assisted with field work and laboratory processing of soil and root samples.

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

Formal collaborators on this project include:

Ruth Yanai - lead PI, SUNY-ESF Syracuse

Ed Rastetter - Ecosystems Center, Marine Biological Lab, Woods Hole

Melany Fisk - Miami University of Ohio

Joel Blum - University of Michigan

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

Findings:

See file for 'Project Activities and Findings' (above)

Training and Development:

Research skills include training in field installation and sampling techniques such as soil respiration (Kikang Bae, PhD student), root sampling (Ang Li, MS student), quantitative soil sampling (April Melvin, PhD student), and soil processing (Gavin Mackellar, BS 2011). Additional training in model development was provided by project collaborator Rastetter for Quinn Thomas.(PhD student).

Outreach Activities:

None yet.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Conference Proceedings

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Organizational Partners

Any Journal

Any Book

Any Web/Internet Site

Any Product

Contributions: To Any within Discipline

Contributions: To Any Other Disciplines

Contributions: To Any Human Resource Development

Contributions: To Any Resources for Research and Education

Contributions: To Any Beyond Science and Engineering

Any Conference

NSF Award 0949854 – Collaborative Research: Nutrient co-limitation in young and mature northern hardwood forests

Progress Report, year 1, Cornell University

Christine Goodale, Department of Ecology & Evolutionary Biology (EEB)

Timothy Fahey, Department of Natural Resources (DNR)

Project Collaborators:

Ruth Yanai, Project Lead PI, SUNY-ESF, Syracuse, NY

Ed Rastetter, Ecosystems Center, Marine Biological Lab, Woods Hole, MA

Melany Fisk, Miami University, Oxford OH

Joel Blum, University of Michigan, Ann Arbor, MI

Cornell-Associated Personnel:

Fine Root and Soil Respiration Work

Timothy Fahey, Professor, Cornell University, Department of Natural Resources (DNR)

Kikang Bai, PhD candidate, SUNY-ESF, kbae02@syr.edu

Natalie Cleavitt, research associate, Cornell University, DNR, nlc4@cornell.edu

Ang Li, MS candidate, Cornell University, DNR, al654@cornell.edu

Cynthia Wood, technician, Cornell University, DNR

Soil Carbon and Nitrogen Pools

Christine Goodale, Associate Professor, Cornell University, EEB, clg33@cornell.edu

April Melvin, PhD candidate, Cornell University, EEB, amm243@cornell.edu

Gavin Mackellar, BS 2011, Cornell University, DNR, gmm64@cornell.edu

Modelling, Multiple Element Limitation (MEL) model

R. Quinn Thomas, PhD candidate, Cornell University, EEB, rqt2@cornell.edu

Project Activities and Findings

Our efforts during the first year of the project were directed towards site characterization prior to the initiation of treatments in spring 2011, including characterization of fine roots, soil respiration, and soil C and N stocks.

Fahey et al. were responsible for quantifying fine root biomass (FRB) in the upper 20 cm of soil in 52 experimental plots across the thirteen research sites. This work consisted of collecting ten replicate soil cores in each plot and sorting by hand all the roots in each core into three size (diameter) classes: 0-1 mm, 1-2 mm, and 2-5 mm. Roots are cleaned of debris, dried to constant mass and weighed to ± 0.01 g. As of this writing FRB analysis has been completed for six of the thirteen sites (24 plots). Not surprisingly, FRB is much lower in young forests (30-35 yr) than mature stands and slightly lower in more fertile than infertile sites.

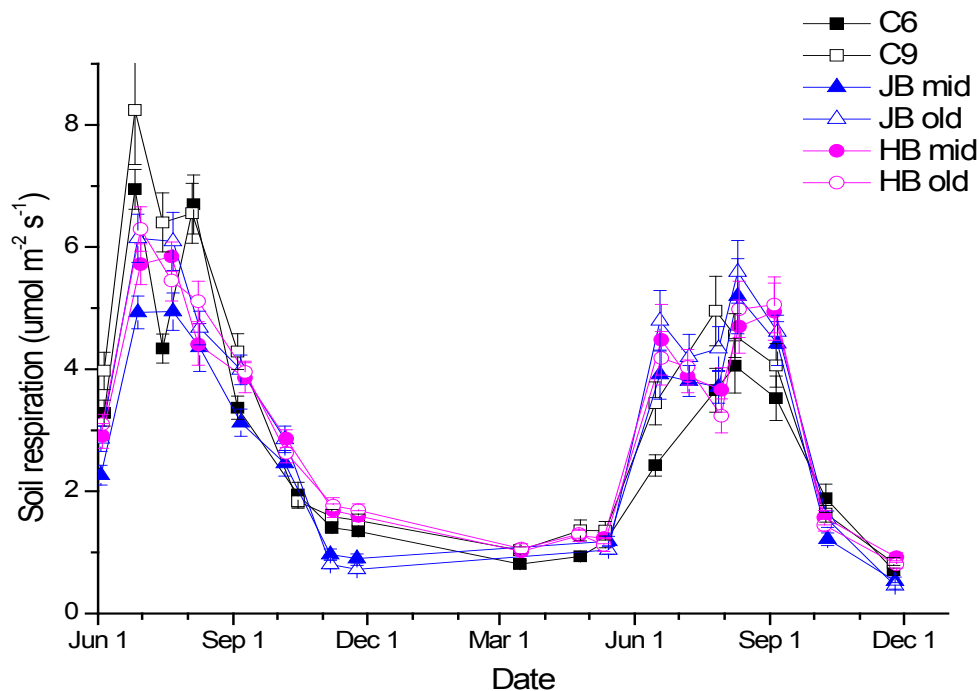


Figure 1. Total soil respiration in six northern hardwood stands over two years of measurement (2009-2010).

We have also quantified annual total soil respiration (TSR) in these six sites, based upon 18 measurement dates across two years (Fig. 1). Annual TSR also was lower in younger than mature forests and decreased more strongly than FRB across the fertility gradient. We observed that TSR was strongly correlated with FRB across the mature forests whereas it correlated with aboveground litterfall in the young stands (Fig. 2). We have completed TSR measurements pre-treatment in four additional stands (16 plots) during 2010; data analysis is underway. In general, these pre-treatment data on FRB and TSR indicate that we will be able to detect moderate changes (i.e., 10-20%) in these two key variables in response to treatments, and pairing of control and treatment plots is reasonably good.

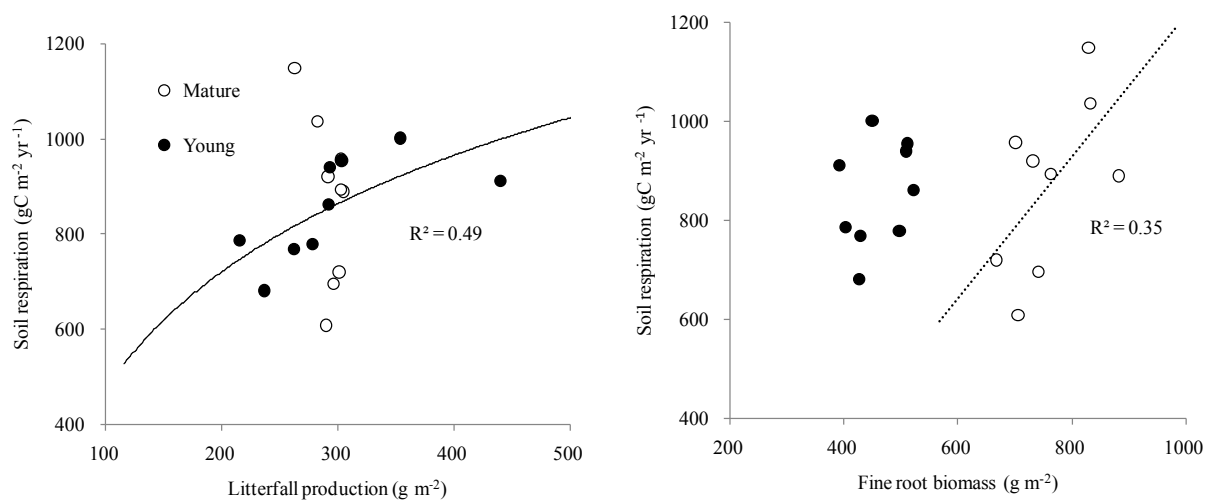


Figure 2. Relationship between soil respiration and litterfall (left) or fine root biomass (right) in young (filled circles) and mature (open symbols) northern hardwood forests.

Finally, we have completed methods testing and installations for quantifying fine root dynamics and mycorrhizal colonization. A total of 160 minirhizotron access tubes were installed during summer 2010 and measurements will commence following the standard one-year conditioning period. Macroscopic approaches for quantifying relative

changes in ectomycorrhizal vs. arbuscular mycorrhizal colonization of fine root tips are currently under development.

Goodale et al. were responsible for characterizing pre-treatment soil carbon and nitrogen stocks across all plots, to a depth of 50+ cm. In July 2010 we sampled 24 plots, or 4 plots located at each of six sites: Hubbard Brook Mid, Hubbard Brook Old, Jeffers Brook Mid, Jeffers Brook Old, Bartlett C5, and Bartlett C7. Five locations per plot were sampled: four locations were located in the buffer (to-be-fertilized) area near the plot corners, and one near the center of the plot. At each coring location the Oi/Oe and Oa forest floor layers were manually removed in a 15 cm x 15 cm area using a pin-block device. Mineral soil samples were taken from this same area using an engine-driven, diamond-tipped coring device (internal diameter 9.5 cm) for 4 depth increments: 0-10 cm, 10-20 cm, 20-30 cm, and 30-50 cm. For the 30-50 cm increment, roots were removed in the field or in the lab immediately following collection, then frozen. The remaining soil for this depth increment was split in half and the root subsample bag was frozen. Processing of the 480 mineral soil samples (24 plots x 5 locations/plot x 4 depths/location) includes sieving (to 2 mm) and grinding in preparation for C and N analysis. We expect this processing to be complete by the end of May 2011. Future work includes sieving and grinding of forest floor samples, weighing (and possible sorting by size class) of all roots removed during sieving, and C and N analysis on all samples.