# Preview of Award 0949317 - annual Project Report

[< Back](https://reporting.research.gov/rppr-web/rppr?execution=e1s37&_eventId=continue)

## Cover

Federal Agency and Organization Element to Which Report is Submitted:

4900

Federal Grant or Other Identifying Number Assigned by Agency:

0949317

Project Title:

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

PD/PI Name:

* Melany C Fisk, Principal Investigator

Submitting Official (if other than PD\PI):

* Melany C Fisk
* Principal Investigator

Submission Date:

07/13/2013

Recipient Organization:

Miami University

Project/Grant Period:

07/01/2010 - 06/30/2015

Reporting Period:

07/01/2012 - 06/30/2013

Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)

Melany C Fisk

## Accomplishments

### \* What are the major goals of the project?

The goals of this project are to 1) test nutrient limitation in northern hardwood forests and whether it differs by forest age, 2) test species-specific differences in responses to nutrients to evaluate the possibility of community-level colimitation, and 3) examine plant-soil feedbacks that potentially contribute to nutrient colimitation or modify limitation, via processes that promote balance among available nutrients.  If we find evidence of colimitation, we will learn the underlying mechanisms in our combination of work on ambient landscape-scale spatial patterns and responses over time to treatments.

### \* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities:

 Fertilization of 13 forest stands of 3 forest ages, distributed across different parent materials, continued.   Soil nutrient availability and enzyme activities were quantified in all stands. Two major studies were initiated:  one tests the possibility of species-specific for aging by fine roots for different nutrients, and the other characterizes growth and allocation by sugar maple and beech seedlings beginning with a really large cohort of germinants of both species in spring, 2012.

Specific Objectives:

We are examining mechanisms by which plants and soil organisms allocate effort to balance nutrient acquisition, over the long-term (across spatial variation in fertility), and in the shorter-term response to nutrient manipulations.  Objectives of our specific measurements in 2012 were to 1) test fine root foraging responses by 4 dominant tree species to N, P, Ca , and water, 2) test responses by N-, P-, and C-mineralizing enzymes and N and P availability  to fertilization with N, P, and Ca, and 3) compare over time the leaf area, root system architecture and mycorrhizal colonization with above- and below-ground growth and survivorship of seedlings of two dominant tree species.

Significant Results:

Nutrient availability clearly responded to treatments.  In addition to predictable increases in availability of the added nutrient, we found that Ca addition reduced NO3- and especially P availability.  We were surprised to find that soil enzyme activities did not respond to treatments, and we did not detect any shifts in enzyme kinetics with treatment.  We will repeat these measurements periodically over time to learn about changes in enzyme activities in relation to resource availability and other measures of biotic response to our treatments.  In the first year after germination, seedlings allocated more to root growth where soil moisture was higher; other results of the seedling studies are still in progress and will continue for several years.

Key outcomes or Other achievements:

nothing to report

### \* What opportunities for training and professional development has the project provided?

Shinjini Goswami, a PhD student, is developing her research abilities in this project by designing her own research (the germinant and fine-root foraging studies),  learning field methods and lab techniques in both chemistry and molecular biology, and mentoring undergraduate assistants.  Austin McDonald, an REU student in summer 2012, gained excellent research experience as a member of the general project crew and also by carrying out his own research project (the enzyme activity study), which he continued through the following school year by completing analyses and writing up his results in a paper for independent study credit.  We expect to submit his manuscript for publication soon.

Rick Biche is a teacher in the NH public schools who has become involved in our work through the RET program.   He has learned about the general scientific process by participating in our summer field crew and associated activities (weekly "science night" talks by Hubbard Brook scientists, preparation of his own research proposal and sharing proposals for review  among different field crew members and lead scientists).  He has also initiated his own litter decomposition study testing N x P effects and their interactions with different size classes of invertebrates.  Rick involved his middle school classes in this work, bringing students to the field site to process litter and learn about methods of studying decomposition, and involving them is each step of the process.  Rick is now mentoring an undergraduate student in the invertebrate work and developing invertebrate-based studies for use in his classroom.

### \* How have the results been disseminated to communities of interest?

Shinjini Goswami and Melany Fisk presented at the 2012 Long-term Ecological Research  All Scientist's meeting.  A manuscript on the first year's treatment effects (Fisk, Ratliff, Goswami and Yanai, "Synergistic soil response to nitrogen plus phosphorus fertilization in hardwood forests") is under review in Biogeochemistry.

### \* What do you plan to do during the next reporting period to accomplish the goals?

We will continue quantifying various feedbacks to nutrient availability and will quantify nutrient flux through fine litterfall.  We will begin testing fertilizer effects on plant-root mediated weathering of apatite, a Ca-P mineral, and will continue work on ongoing projects by identifing fine roots to species in the foraging experiment and quantifying mycorrhizal responses to treatments on seedlings.   Forest productivity response to treatments will be quantified in the 4th or 5th year of treatment.

## Products

### Journals

* Nothing to report.

### Books

* Nothing to report.

### Book Chapters

* Nothing to report.

### Thesis/Dissertations

* Nothing to report.

### Conference Papers and Presentations

* Nothing to report.

### Other Publications

* Nothing to report.

### Technologies or Techniques

* Nothing to report.

### Patents

Nothing to report.

### Inventions

Nothing to report.

### Licenses

Nothing to report.

### Websites

Nothing to report.

### Other Products

Nothing to report.

## Participants

### Research Experience for Undergraduates (REU) funding

How many REU applications were received during this reporting period?

1

How many REU applicants were selected and agreed to participate during this reporting period?

1

### What individuals have worked on the project?

| **Name** | **Most Senior Project Role** | **Nearest Person Month Worked** |
| --- | --- | --- |
| Melany C Fisk | PD/PI | 2 |
| Shinjini Goswami | Graduate Student (research assistant) | 8 |
| Austin McDonald | Research Experience for Undergraduates (REU) Participant | 4 |
| Brittany Perkins | Undergraduate Student | 2 |

### What other organizations have been involved as partners?

| **Name** | **Location** |
| --- | --- |
| Cornell University | Ithaca, NY |
| Marine Biological Laboratory | Woods Hole, MA |
| SUNY-Environmental Science and Forestry | Syracuse NY |
| University of Michigan | Ann Arbor, MI |

### Have other collaborators or contacts been involved? N

## Impacts

### What is the impact on the development of the principal discipline(s) of the project?

Nothing to report.

### What is the impact on other disciplines?

Nothing to report.

### What is the impact on the development of human resources?

Nothing to report.

### What is the impact on physical resources that form infrastructure?

Nothing to report.

### What is the impact on institutional resources that form infrastructure?

Nothing to report.

### What is the impact on information resources that form infrastructure?

Nothing to report.

### What is the impact on technology transfer?

Nothing to report.

### What is the impact on society beyond science and technology?

Nothing to report.

## Changes

### Changes in approach and reason for change

Nothing to report.

### Actual or Anticipated problems or delays and actions or plans to resolve them

Nothing to report.

### Changes that have a significant impact on expenditures

Nothing to report.

### Significant changes in use or care of human subjects

Nothing to report.

### Significant changes in use or care of vertebrate animals

Nothing to report.

### Significant changes in use or care of biohazards

Nothing to report.

[Back to the top](https://reporting.research.gov/rppr-web/rppr?execution=e1s37#pageFrame)

[< Back](https://reporting.research.gov/rppr-web/rppr?execution=e1s37&_eventId=continue)

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