**Request to Conduct Research on the Bartlett Experimental Forest**

***Our review process has two deadlines to submit proposed work – April 1 and October 1. We try to get approvals back within a month.*** Providing a complete set of information will facilitate the review process. Be as specific as possible regarding your potential sampling locations and methods.

**I.** Investigator(s) Name(s), Affiliation(s), E-mail address, and if you’ve worked at BEF: add additional lines if necessary -- \* is a required field

Name\* Affiliation\* E-mail address\* Prior BEF work\* (y/n)

Ruth Yanai SUNY-ESF rdyanai@syr.edu y

Tim Fahey Cornell tjf5@cornell.edu y

Melany Fisk Miami University fiskmc@muohio.edu y

Ed Rastetter MBL erastetter@mbl.edu y

**ll.** Proposal Information -- you can also attach a short proposal summary with this form

Title:\* Nutrient co-limitation in young and mature northern hardwood forests

Major hypotheses:\* We will test the patterns of resource limitation predicted by the MEL model, which predicts a greater response of aboveground productivity to N+P than N or P alone.

Funding sources (please indicate both pending or currently available sources):\* NSF LTER

Proposed study start date:\*

Estimated duration of study:\* Ongoing. We began pre-treatment measurements last year and hope to keep the treatments going beyond the current funding cycle.

**III**. Type of system involved/work proposed: Please address items a-c:

a. System (check all that apply):

Terrestrial Aquatic Watershed Atmosphere **Other Forested System**

b. Type of work proposed:

Large-scale manipulation (e.g., compartment/watershed treatment of vegetation/site) X **Small-scale manipulation (e.g., plot level treatment of vegetation/site)**

Large/small-scale non-manipulative measurements

Type of sampling proposed:

\* **Non-destructive sampling**

\* **Destructive sampling**

**\* Long-term monitoring**

\* Other

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c. Key words – check any descriptors that apply to your proposal:

|  |  |  |  |
| --- | --- | --- | --- |
| Forestry | Hydrology | Community ecology | Autecology |
| Wildlife | Remote Sensing **Population biology** | Physical ecology |
| Soils | Physics | **Biogeochemistry** | Other |
| Chemistry | Geology | **Ecosystem ecology** |  |

List the types of organisms or substances you intend to study (e.g., trees, amphibians, mammals, soils, calcium, etc): \*

 Plant and soil

**IV**. In which Bartlett compartments would you like to work?\* The same sites we have been working on since 2005

Have you discussed these sites with either Bill Leak/Mariko Yamasaki?\* Yes If so, when? Since 2003

**V**. What Bartlett ongoing research or publications are related to your proposed research?\*

Nezat, C.A., J.D. Blum, R.D. Yanai, and B.B. Park. 2008. Mineral sources of calcium and phosphorus in soils of the northeastern USA. Soil Science Society of America Journal 72(6): 1786–1794

Yanai, R.D., M.C. Fisk, T.J. Fahey, N.L. Cleavitt, and B.B. Park. 2008. Identifying roots of northern hardwood species: patterns with diameter and depth. Canadian Journal of Forest Research 38(11): 2862-2869

Blum, J., A.A. Dasch, S.P. Hamburg, R.D.Yanai, and M.A. Arthur. 2008. Use of foliar Ca/Sr discrimination and 87Sr/86Sr ratios to determine soil Ca sources to sugar maple foliage in a northern hardwood forest. Biogeochemistry 87(3): 287-296

Vadeboncoeur, M.A., S.P. Hamburg, and R.D. Yanai. 2007. Validation and refinement of allometric equations for roots of northern hardwoods. Can. J. For. Res. 37: 1777-1783.

Park, B.B., R.D. Yanai, M.A. Vadeboncoeur, and S.P. Hamburg. 2007. Estimating root biomass in rocky soils using pits, cores and allometric equations. Soil Sci. Soc. Am. J. 71: 206-213.

Yanai, R.D., B.B. Park, and S.P. Hamburg. 2006. The vertical and horizontal distribution of roots in northern hardwood stands of varying age. Can. J. For. Res. 36: 450-459.

Yanai, R.D., J.D. Blum, S.P. Hamburg, M.A. Arthur, C.A. Nezat, and T.G. Siccama. 2005. New insights into calcium depletion in northeastern forests. J. For. 103:14-20.

Hamburg, S.P., R.D. Yanai, M.A. Arthur, J.D. Blum and T.G. Siccama. 2003. Biotic control of calcium cycling in northern hardwood forests: acid rain and aging forests. Ecosystems 6:399-406

**VI**. Proposal abstract (or a brief description of your proposed research attached to this form): \*

Theory suggests that ecosystem productivity should be co-limited by multiple nutrients, although temperate forests have long been thought to be primarily nitrogen limited. Experimental tests of nitrogen vs. phosphorus limitation in temperate forest systems are lacking, but evidence is mounting that both terrestrial and aquatic systems are most commonly co-limited by N and P. Our proposed research combines modeling and field studies to explore processes mediating nutrient colimitation in relation to successional change in managed hardwood forest systems. The Multi-Element Limitation (MEL) model is unique in representing co-limitation from the perspective of resource optimization theory and whole-ecosystem biogeochemistry. We have extended the model to include P as well as N, carbon, light, and water, and applied it to simulate primary and secondary succession in northern hardwood forests. Using nutrient manipulations (N, P, N+P) in replicated stands of different ages, we will test the patterns of resource limitation predicted by the model and multiple mechanisms of allocation of effort to acquire N and P. Specifically, the model predicts a greater response of aboveground productivity to N+P than N or P alone. In older stands, it predicts a greater response to N than to P addition, but in younger stands, the model suggests that the supply of N from detritus should be sufficient to create P limitation.

The overall study design involves, in addition to the stands at Bartlett, W101 and adjacent mature forest at Hubbard Brook, and a similar pair of young and old stands at Jeffers Brook.

**VII**. Proposed field methods and sampling procedures with sufficient information to determine potential disturbance and sampling impacts

A. Plots were established in 9 stands in 2004 and 2005, 3 in each of 3 age classes, as part of an earlier study on Ca cycling. There are 4 50 m x 50 m plots in each stand. They will be treated with N (as urea), P (as monosodium phosphate), N&P, and control. The application rates will be 30-50 kg/ha/year (still under discussion) and they will begin in May 2011.

B. We will continue to monitor vegetation on the plots, including herbs as well as trees.

C. We measure soil respiration monthly on a subset of plots (Kikang Bae is the graduate student; Tim Fahey is the PI).

D. We will sample roots and soils in the stands not already sampled previously (Tim Fahey, Christy Goodale).

E. Melany Fisk will collect soil samples for heterotropic soil respiraition and for differences in mycorrhizae using root tips and metabolites. She will also monitor nutrient availability using resin bags.

F. Foliar samples will be collected from sun leaves of five trees of the three dominant species in each plot using a 12-gauge shot gun. Actually, this year we will sample only stands that we didn’t sample in both 2008 and 2009. (Quinn Thomas, Bali Quintero,

G. Litter baskets are out in 6 stands, and we will collect fresh litter for nutrient analysis as well as continuing to monitor litterfall mass.

H. We might put out traps for isopods (pieces of carrot and potato in cages).

**VIII**. Safety-The USFS is committed to increasing safety awareness among its employees and research cooperators.

The WMNF and the Bartlett Experimental Forest occur on rugged terrain with severe weather patterns throughout the year and appropriate preparations are necessary prior to engaging in field work. Please provide us with a description of your safety guidelines for personnel working in both the field and in the lab. For example, your check in/check out procedures, job hazard analysis, relevant training, safety equipment.

Our crew leaders have a plan everyday for the location of all personnel and are provide with emergency contact information.

Special considerations – If the proposed research involves potentially hazardous techniques (e.g., shotgun sampling, tree/tower climbing) provide specific information about the techniques and materials, including justifications for use, potential problems and concerns, and any statements on necessary precautions and safety factors that will be utilized in the process.

The operators of the guns have gone through the required safety training. When shotgun sampling occurs, we notify the local ranger district, town police, and county police on the day of collection. We also hang signs to notify researchers of our collection efforts - all protocol outlined by the Forest Service to follow.

Some degree of NEPA assessment on the part of the researcher will be required for any of the following manipulative treatments that use contaminating materials (e.g., isotopes, introduced plants or animals, fertilizers, insecticides, and herbicides). At a minimum, a scoping letter describing the proposed experiment will be sent to all BEF abutters and WMNF for comment and a letter to the file as a categorical exclusion will be needed. A determination of the degree and extent of assessment required will be made at the time of the proposal by the Project Leader. See this link for more information: [**http://www.fs.fed.us/emc/nepa/**](http://www.fs.fed.us/emc/nepa/)

**Research Stipulations:** If you are granted permission to work at BEF: (1) any plots you establish within compartments will need to be geo-referenced with plot centers and corners identified; and a plot data file will need to be provided as soon as possible for our records; and (2) all researchers will be required to remove all field sampling material and equipment from plots and laboratory site at the conclusion of their work. All GIS data shall be in the following format:

**Projection** – NH State Plane, NAD83 Ft.  **Coordinates** – Decimal Degrees

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Site**  | **USFS Designation** | **Age in 2004** | **Elevation (m)** | **Aspect** | **GIS Coordinates** |
| **C1** | Davis Brook West Timber Sale | 12 | 570 | flat to SE | C1-1: 44.042824,-71.320720C1-2: 44.042538,-71.321201C1-3: 44.041931,-71.321822C1-4: 44.042574,-71.321958 |
| **C2** | Saco RD Cmpt 51 | 14 | 340 | NE | C2-1: 44.059038,-71.269333C2-2: 44.059480,-71.268800C2-3: 44.059813,-71.269119C2-4: 44.059526,-71.269901 |
| **C3** | Saco RD Cmpt 52 stand 17 | 19 | 590 | NNE | C3-1: 44.038185,-71.291325C3-2: 44.037742,-71.291219C3-3: 44.037665,-71.291834C3-4: 44.037222,-71.291729 |
| **C4** | Saco RD Cmpt 52 stand 8 | 26 | 410 | NE | C4-1: 44.053436,-71.268748C4-2: 44.053117,-71.268069C4-3: 44.053147,-71.267087C4-4: 44.052826,-71.266443 |
| **C5** | no stand # on map | 28 | 550 | flat to NW | C5-1: 44.039193,-71.316669C5-2: 44.039836,-71.315839C5-3: 44.040121,-71.315342C5-4: 44.040463,-71.314936 |
| **C6** | Saco RD Cmpt 51 stand 6  | 29 | 460 | NNW | C6-1: 44.040352,-71.275200C6-2: 44.039902,-71.275202C6-3: 44.040350,-71.274576C6-4: 44.039900,-71.274579 |
| **C7** | BEF cmpt 33/34 | mature | 440 | ENE | C7-1: 44.052278,-71.302577C7-2: 44.052730,-71.303198C7-3: 44.053180,-71.303195C7-4: 44.053908,-71.303122 |
| **C8** | BEF cmpt 33/29 | mature | 330 | NE | C8-1: 44.054080,-71.297186C8-2: 44.053793,-71.297666C8-3: 44.053333,-71.297457C8-4: 44.054807,-71.299769 |
| **C9** | Saco RD Cmpt 52 stand ? | mature | 440 | NE | C9-1: 44.043814,-71.278167C9-2: 44.043933,-71.278769C9-3: 44.043340,-71.279463C9-4: 44.044128,-71.279415 |

**E-mail or mail this form to:**

Mariko Yamasaki, Silviculture/Wildlife Team Leader U. S. Forest Service, Northern Research Station Forest Sciences Lab

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Durham, NH 03824

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**NEPA requirements have been reviewed and approved as follows:**

This project can proceed without further assessment.

This manipulative project can proceed as a categorical exclusion after completing a scoping letter to the public and a letter to the file.

This manipulative project will require further environmental assessment work before approval.

**Approved by:**

**Project Leader**

**Date**