Supplement

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 04-23

FOR NSF USE ONLY

NSF PROPOSAL NUMBER

0620180

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)

DEB - ECOSYSTEM SCIENCE CLUSTER

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
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EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL
☐ AN ACCOMPLISHMENT-BASED RENEWAL

0235650

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☐ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

SUNY College of Environmental Science and Forestry

AWARDEE ORGANIZATION CODE (IF KNOWN)

0028514000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

SUNY College of Environmental Science and Forestry
PO Box 9
Albany, NY. 122010009

NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE

PERFORMING ORGANIZATION CODE (IF KNOWN)

ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING 9 DIGIT ZIP CODE

IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions)
☐ SMALL BUSINESS ☐ MINORITY BUSINESS
☐ FOR-PROFIT ORGANIZATION ☐ WOMAN-OWNED BUSINESS

☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT **Biotic Control of Calcium Supply: Distinguishing Sources to Regrowing Forests**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 12,000	0 months		

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.A)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.B, II.C.1.d)
☐ HISTORIC PLACES (GPG II.C.2.j)
☐ SMALL GRANT FOR EXPLOR. RESEARCH (SGER) (GPG II.D.1)
☐ VERTEBRATE ANIMALS (GPG II.D.5) IACUC App. Date _____
☐ HUMAN SUBJECTS (GPG II.D.6)
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)
_____
☐ HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.G.1)

PI/PD DEPARTMENT

Forest and Natural Resources Management

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CO-PI/PD				
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We are requesting a **supplement to fund two REU students** to work on a project directly related to the research being conducted under the framework of our "Biotic Control of Ca biogeochemistry" project. The project (outlined below) is well suited to undergraduate participation because we will have a team of researchers (undergraduates, graduate students, technicians, and professors) working together at the Bartlett and Hubbard Brook Experimental Forests in New Hampshire. There are many possible research questions that can be asked in the context of our project, and the considerable information already collected will provide the necessary background to interpreting new results.

We are requesting two students, as the proposed project is both large and well-suited to undergraduate research. In the past, REU students have used some portion of the data collected during the field season as the basis for senior theses, In the summer of 2005 three of the undergraduates working with us on the project used the data they collected as the basis for their theses, the production of which is a requirement for Environmental Studies students at Brown. Undergraduates in this program often publish their thesis work in peer-reviewed journals once they graduate.

As part of a larger research community, students will have the opportunity to explore the other branches of ecological research going on at Bartlett and Hubbard Brook, and will have the option of presenting their work alongside Ph.D. scientists and graduate students at the annual Hubbard Brook Cooperators meeting in July (in 2005 three undergraduates presented). They will become familiar with the species of the northern hardwood forest, with methods of forest inventory and sample collection, and about the research approaches scientists use to study ecosystems. Perhaps most importantly, the student will learn about research planning, time management, project coordination, and the scientific method, through shared exploration and problem solving with the many other members of the team.

Both students would be housed primarily at the Hubbard Brook Experimental Forest and supervised day-to-day by Steven Hamburg (co-PI Brown University), who will be in residence at Hubbard Brook site all summer. The other PIs will be involved through their regular visits to the site. The students will be integrated into the larger undergraduate and graduate student research community at the Hubbard Brook Experimental Forest, where they will be housed.

Previous REU Supplement Support

In 2003, this project supported one REU student, Erick Phillips, who divided his time between field work in New Hampshire and lab work in Syracuse. Erick took responsibility for analyzing changes in the depth of the forest floor in thirteen stands of different ages, which had been sampled two or three times previously. He was also involved in collecting and processing roots from soil pits. Erick remained involved as a Research Aide in the fall, so that he could process and weigh the samples he had helped to collect. He learned the statistical techniques necessary to analyze the data, and

concluded that the depth and mass of the forest floor had not increased over time, in contrast to a recent regional study.

This project supported two REU students in the summer of 2004. Meredith Germain worked in New Hampshire as part of the field crew and took a special interest in vegetation measurements. Asuka Matsuzaki also worked in the field for a period of time but spent most of her efforts working on roots once they arrived in the lab from the field. She has remained involved in the lab on other root related projects.

In 2005, the two students funded by the REU supplement were Kent Garrison and Dave Messmer. Kent Garrison was primarily involved in collecting and processing leaf material for the long-term study of litterfall mass and chemistry. Dave Messmer was the lead investigator on an ancillary project exploring the long-term effect of liming on N mineralization and P availability. He made a presentation at the annual Cooperators' Meeting at the Hubbard Brook Experimental Forest.

Broader Implications of the Proposed Study
Four of the six senior scientists conducting this project are women. It is important for male as well as female students to learn from women scientists, and we will consider both. Over the past few years, more than half the students on the Hamburg Lab field crew have been female, and a majority of students employed by the lab over the past few years have been members of racial minority groups.

Participant selection
We will select students based on academic and career interests, previous academic course work and field experience, and aptitude for research. We are particularly interested in providing the opportunity for Environmental Studies and Biology students at Brown to lay the groundwork for senior theses. We have contact with many potential students through teaching and academic year lab employment; where we don't have first-hand knowledge of student ability and interests, we will interview their referees, rather than relying solely on written references.

Project Background and Justification:
In the northern hardwood regions of the northeastern US there is growing evidence of a systematic shift in climate. At the Hubbard Brook Experimental Forest in central New Hampshire the average temperature has increased by 0.2ºC per decade and annual growing degree days have increased by 26ºC-days per decade over the past 50 years. These climatic shifts suggest that species ranges should also be shifting, something that would profoundly effect the forest and biogeochemical cycles. We are proposing an REU project that would develop the first data set testing this assumption in the northern hardwood forest, with direct links to our ongoing biogeochemical research.

Historically, northern red oak (*Quercus rubra* L.) has been an infrequent associate of northern hardwood forests (Burns and Honkala 1990), and is on the northern edge of its historic range in the White Mountain region of New Hampshire (Cogbill *et al*. 2002). Vegetation inventories and leaf litter collections in our permanent Ca study sites in and

near the Bartlett Experimental Forest reveal the presence of northern red oak at elevations where it was historically rare or not present according to presettlement witness tree surveys. In particular, clearcuts appear to offer a colonization opportunity for northern red oak, which is present in two of our study sites above 500m elevation that were clearcut in the 1970's. We have not directly observed oaks in the mature forest areas adjacent to these cut stands, and it is unclear how far the acorns that germinated into these trees must have been dispersed by small mammals. Oak expansion does appear to be widespread, however. We recorded oak seedlings at long-term monitoring plots in Campton, NH (50km SW of Bartlett) for the first time in 2005.

Our research plots, in which all trees >10 cm dbh are tagged, provide an excellent opportunity to study competition between oaks and more typical northern hardwood species, including American beech (*Fagus grandifolia* Ehrh.), sugar maple (*Acer saccharum* L.), and yellow birch (*Betula alleghaniensis*), as the stands mature. These plots are particularly well positioned on the landscape for such a study, as they are near the upper elevational limit of northern red oak, and should therefore be particularly sensitive to climatic changes over time.

It is important to understand changes in species composition in these plots because of the potential effect on nutrient cycling processes. For example, the leaf litter of northern red oak has a higher C:N ratio than any other species currently found in the northern hardwood forest (Lovett and Mitchell 2004), which would lead to slower decomposition of the forest floor (Melillo *et al*. 1982). This may in part exacerbate biogeochemical effects of the widespread decline of sugar maple, which appears to be regenerating poorly in these stands. Sugar maple has the lowest C:N ratio and highest rate of litter decomposition among northern hardwood species. Oak litter is also high in tannins and other organic acids, which further inhibit decomposition. Finally, oaks, which mast heavily in some years and very lightly in others, also have the potential to alter the population dynamics of small mammals and some birds, which currently rely heavily on beech mast as a food resource.

Research Approach:
We will conduct an exhaustive search for oaks at all life stages in each of our studied clearcuts. In addition, we will survey a number of other clearcuts of similar age nearby, which range in elevation between 300m and 700m. We will also run transects in areas of mature forest adjacent to each clearcut.

- Each oak that we find will be tagged and its location recorded using a GPS.
- Each oak >10cm will be cored, along with the nearest 4 trees of other species in the same diameter class. Comparison of annual growth increments will provide information about relative success at each site.
- We will search for and tag oak seedlings on four radial transects (upslope, downslope, and along-slope in each direction), surrounding each mature oak found. The survivorship of these seedlings will be assessed over time.
- In mature stands, we will take quantitative forest floor samples under mature oaks and nearby under other dominant species, to determine the long-term impact of oaks on forest floor nutrient cycling and carbon storage.

We will repeat this approach at several of our other study sites elsewhere in the White Mountain region for which we have long-term vegetation data. These include sites in the towns of Jackson, Campton, Livermore, and Waterville Valley, as well as within the Hubbard Brook Experimental Forest.