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Accomplishments

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

The overall goal of Long-Term Ecological Research at Hubbard Brook Experimental Forest (HBR-LTER) is to advance the understanding of the response of northern forest ecosystems to natural and anthropogenic disturbances. The HBR serves as a hub for ongoing forest ecosystem research in the northeastern region where a suite of natural and anthropogenic disturbance agents causes unprecedented pace of change in ecosystem structure and function. We conduct an integrated suite of long-term monitoring, experimental manipulations, modeling and quantitative analysis, and public outreach and education activities. The HBR-LTER is providing both fundamental insights about forest ecosystem dynamics and applications to help guide policy and management responses concerning human-accelerated environmental change. In our current LTER funding cycle we are evaluating landscape scale patterns and processes. New studies have been initiated to improve theoretical understanding of the dependence and interconnections of ecological, hydrologic, and biogeochemical phenomena within and across various landscape scales.

Long-term collection of precipitation and surface water for complete chemical characterization has been maintained continuously since the 1960s. Our biogeochemical monitoring program is

designed to provide baseline measurements from which human-induced deviations can be resolved. Similarly, we quantify the hydrologic budget of a suite of small watersheds that allows us to detect global change effects on hydrologic fluxes with extremely high sensitivity. We also maintain a comprehensive, long-term monitoring program on forest vegetation composition, biomass, productivity and chemistry and the population trends of a suite of heterotrophic organisms, focused on passerine birds and their food web. These surveys indicate local and global phenomena shaping trends and a baseline for development of deeper theoretical understanding of ecological interactions.

Our most prominent ongoing watershed-scale experiments quantify ecosystem recovery from forest harvests and ecosystem responses to restoration of pristine conditions of soil base saturation. A variety of plot-scale experiments and manipulations also provides additional process-based understanding of ecosystem function in northern hardwood forest ecosystems. We synthesize the work at Hubbard Brook using simulation models, model-data fusion and uncertainty analysis to improve understanding of ecosystem dynamics at various spatial and temporal scales. Our dynamic hydrochemical models are useful tools for understanding and predicting the interactive effects of climate change, atmospheric CO₂, and atmospheric deposition on the hydrology and water quality of forested watersheds. Evaluation of uncertainty in ecosystem dynamics has been limited by the complexity of ecosystem data sets and processes, but new computational tools provide the means to improve this situation. A major ongoing activity in the HBR-LTER project has been to advance error analysis in biogeochemical budgets.

The HBR LTER project has an active program of outreach and education activities coordinated through the Hubbard Brook Research Foundation. Long-term research should play a crucial role in addressing grand challenges in environmental stewardship at local and national scales. The HBR LTER takes this responsibility very seriously. We attempt to inform policy decisions through our Science Links program. The project also takes very seriously its responsibilities for the training and development of scientists and educators. Most of these activities also are coordinated through the auspices of the Hubbard Brook Research Foundation, a “friends” group of the HBR-LTER.

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

Major Activities:

We organize this year’s annual report around six groups of activities for which significant new results have come to fruition in the past year.

NITROGEN DYNAMICS AND DENITRIFICATION: Long-term study of the nitrogen balance of the Hubbard Brook watershed has revealed many surprises over 50 years of monitoring and measurements. In early years of the study N was accumulating in the forest biomass at a greater rate than measured sources could account for. In recent decades biomass accumulation of N has ceased and despite high atmospheric N inputs, stream N export is exceedingly low, suggesting either soil accumulation or gaseous losses, or both. More detailed error analysis of N budgets and application of new

approaches to soils and gaseous N fluxes is providing indications of likely explanation of the N budget anomalies.

NUTRIENT MANIPULATION OF WATERSHEDS AND FOREST PLOTS: Long-term budget studies in HBR-LTER indicate gradual changes have occurred in soil nutrient availability, especially for base cations and nitrogen. We conducted soil nutrient manipulations to quantify the mechanisms of ecosystem response to changing nutrient availability. We replaced the quantity of soil Ca that budgetary studies indicated was depleted during the 20th century by forest harvest and leaching by acid deposition. The whole watershed manipulation, initiated in 1999, is now yielding valuable insights into the effects of human activities on ecosystem processes including soil and surface water chemistry and vegetation composition, structure and productivity. We are also evaluating the shifting balance of limiting nutrients, N and P, resulting from chronic anthropogenic N addition through a factorial nutrient manipulation experiment on 13 northern hardwood stands in and around the HBR-LTER site. By applying relatively small quantities of N (3 g/m²-yr) and P (1 g/m²-yr) we aim to gradually alter site quality over the long-term without inducing artifacts associated with more typical high applications.

CATCHMENT HYDROLOGY ACROSS SCALES AND LANDSCAPES: Regional climate changes are driving gradual changes in hydrologic processes in forested catchments, with uncertain implications for water yield and biogeochemical transport processes. We are conducting detailed investigations at various scales to better understand these interactions. Studies at the landscape scale within the HBEF focus on water flowpaths and their continuity across hydrogeologic units. At the regional scale we are evaluating hydrologic responses of undisturbed headwaters, as well as impounded and developed basins in the Merrimack Watershed, NH-MA. At the continental scale we are working with a hydrologic research network across North America to evaluate likely responses of water yield in catchments with differing vegetation and climate. Finally, we are evaluating the efficiency of hydrologic monitoring programs aimed at detecting responses of hydrologic processes to human-accelerated environmental change.

SURFACE WATER CHEMISTRY: MONITORING AND MECHANISMS OF CHANGE: We conduct routine weekly collections of surface water chemistry from gaged watersheds at the HBR-LTER to document long-term changes in ecosystem biogeochemistry. This monitoring program is complemented by process studies and experiments to better understand mechanisms controlling surface water biogeochemistry. For example, we conducted a detailed, spatial network analysis of surface water chemistry across the entire Hubbard Brook Valley that has yielded new insights into controls on solute fluxes. We have been concentrating efforts on understanding the chemical characteristics and reactivity of dissolved organic matter in surface waters and how these are affected by natural and anthropogenic disturbances. As for the hydrologic studies, above, we are conducting uncertainty analyses to improve the efficiency of sampling programs and to better constrain budgetary calculations at the small watershed scale.

WINTER CLIMATE CHANGE: A major initiative in the HBR-LTER has been to improve understanding of ecosystem processes operating during the winter season and the mechanism of their response to changing climate. Earlier studies demonstrated that soil freezing can cause mobilization of nitrate to streams and our recent process studies are investigating mechanisms contributing to this response. In addition to snow manipulation studies we have investigated a natural snowpack gradient within the Hubbard Brook valley associated with the elevation gradient. This work is providing new insights into likely effects of the rapidly warming winter climate on vegetation and soil processes.

HETEROTROPH POPULATIONS AND COMMUNITIES: The usefulness of long-term data sets for quantifying and understanding population dynamics of mobile heterotrophs has been repeatedly demonstrated with the 45-year record from the HBR-LTER. Recent activities using these data have demonstrated the utility of complex mark-recapture models for quantifying the demography of the focal bird population of our studies, the black-throated blue warbler. We have also used the long-term records of the breeding bird community to evaluate a baseline of community change that allows us to distinguish between natural and anthropogenic driven changes through time. Among the key anthropogenic pressures on bird survivorship is changes along migratory routes between summer and winter habitat. We are developing new approaches for evaluating the migratory connectivity for common breeding birds at the HBR-LTER. We have also evaluated how representative are the intensive sites at the HBR-LTER in comparison with large-scale extensive bird community surveys. These activities are contributing to better understanding the causes of rapid changes in bird communities across the northeastern regions.

Specific Objectives:

Our specific objectives include 1) maintaining long-term measurements of climate, hydrology, vegetation, soils, solution chemistry and heterotroph populations across the site; 2) exploring the interactions among hydrogeochemical templates, vegetation structure and microbial dynamics, and key heterotroph populations and habitats at the large landscape scale; 3) providing new discovery on the nature and mechanisms of nutrient limitation in forest ecosystems and its interaction with natural and human-accelerated environmental change; and 4) synthesizing biogeochemical and ecological knowledge using simulation models and regional surveys.

Significant Results:

NITROGEN DYNAMICS AND DENITRIFICATION: A synthesis of our budgetary studies for the biogeochemical reference watershed at the HBR-LTER demonstrated a major shift in N dynamics between the interval 1965-77 and recent decades (Fig. 1). In recent years the ecosystem has been storing N in soil pools and/or losing N in gaseous form at an average of ca 8 kg N ha⁻¹-yr⁻¹, comparable to the annual input in atmospheric deposition (Yanai et al. 2014). Accumulating evidence suggests that much of this imbalance may be accounted for by denitrification. We compared two methods for

quantifying denitrification – soil core incubation and ^{15}N tracer. The former method indicated that the $\text{N}_2\text{O}:\text{N}_2$ ratio of denitrification is very low (< 0.02) and that denitrification rates are probably much higher than previously suggested even in relatively well-drained, upland soils (Kulkarni et al. 2014). These observations are reinforced by isotopic evidence from shallow, perched groundwater that indicate extensive denitrification occurs during midsummer (Wexler et al. 2014). A broader, regional analysis suggests that denitrification is not primarily associated with atmospheric N deposition but rather with internal microbial cycling of N (Morse et al. 2014).

NUTRIENT MANIPULATIONS OF PLOTS AND WATERSHEDS: The addition of calcium to watershed 3 at HBR-LTER resulted in profound responses of soils and vegetation, but surprisingly small changes in forest floor organic matter (FFOM). Only in the high-elevation conifer forest zone were changes in organic matter chemistry observed (Balara et al. 2014). Soil pH and exchangeable Ca increased significantly. Pools of exchangeable Al decreased steadily and only 3% of the added Ca was exported from the watershed through 11 years (Johnson et al. 2014). These soil chemical changes resulted in a striking recovery of forest health and productivity on watershed 3 (Figure 2). Initially, this recovery was associated primarily with improved wood production efficiency, but thereafter continuing vegetation recovery included an increase in watershed-wide leaf area index (Battles et al. 2014).

Nitrogen deposition may be changing the balance between N and P as limiting nutrients in northeastern forest soils. Our experimental results in a factorial N x P nutrient manipulation experiment indicate synergistic responses of microbially-mediated processes: nitrogen availability is raised much more by adding N + P than N alone (Fig. 3; Fisk et al. 2014). Complementary studies of soil C mineralization indicated that N suppresses microbial respiration in surface organic horizons, and P constrains mineralization of C derived from new organic matter inputs (Fisk et al. 2015). This may help to explain observations of N and P co-limitation of forest productivity. Continuing forest product removals for lumber and solid biofuels could further contribute to nutrient imbalances in northern forest soils. Sites with widely differing soil nutrient capital are observed regionally and short-rotation biomass harvest could eventually severely deplete available Ca or P in a few rotations (Figure 4; Vadeboncoeur et al. 2014).

CATCHMENT HYDROLOGY ACROSS SCALES AND LANDSCAPES: Recent work demonstrates the complex connections between soil morphological units and water flow pathways (Gannon et al. 2014). These connections apparently lead to non-linear threshold responses in storage-discharge relationships of subsurface flow regardless of river regulation and land development. Surprisingly, high flows are more impacted by climate variation than land development. At a continental scale water yield responses to climate change demonstrate differential sensitivity among ecosystem types; water yield in conifer forest watersheds is the least sensitive to climate warming (Creed et al. 2014). However, the data needed to fully evaluate hydrologic responses across ecosystem types are still inadequate to the task, reinforcing the need for high efficiency in environmental monitoring programs (Levine et al. 2014).

SURFACE WATER CHEMISTRY: Continued monitoring of precipitation and stream chemistry at HBR illustrates striking, broad trends of decreasing chemical concentrations, with surface water now apparently a more dilute solution than in pre-Industrial Revolution conditions (Figure 5). The development of surface water chemistry patterns within a large watershed (5th-order stream network) illustrates the scaling of spatial structure for various dissolved constituents (McGuire et al. 2014). Both fine-scale and broad, landscape-scale processes as well as in-stream processes exert significant influences, depending upon the particular solute. Our results show that streams draining three watersheds at HBR-LTER that were clearcut between 1970 and 1985 had lower DOC and higher proportions of microbially-derived and protein-like features than reference streams (Cawley et al. 2014). Differences in DOC chemistry can influence the transport of metals including Al. Conversely, the binding between Al and DOC can influence the acid behavior of DOC and the consequent toxicity of Al. About 5% of DOC participates in ion binding, and organic acids include both strong and weak acids. A detailed analysis of sources of uncertainty in stream solute export indicated that natural variation was larger than most other sources of uncertainty; coefficients of variation across watersheds or across years exceeded uncertainty associated with measurement and interpolation (Yanai et al. 2014).

WINTER CLIMATE CHANGE: As the depth and duration of snowpack declines the frequency of soil freezing events increases. Soil freezing results in significant reduction in root uptake of NH_4^+ . As a result NH_4^+ accumulates in soil, stimulating autotrophic nitrification and consequent increased NO_3^- leaching (Campbell et al. 2014a). The processes operating during thaw and melt events are more complex, as flushing of limited soil pools of N and C is accompanied by recycling of N through the microbial-pool (Campbell et al. 2014b).

Studies of N cycling processes along the elevation gradient at HBR-LTER provided a proxy for likely response to warming winter climate. At lower elevations higher variation in winter soil temperature and more freeze-thaw events resulted in lower microbial processing of N during winter followed by higher microbial activity during the growing season (Duran et al. 2014); nitrate production rates were particularly sensitive to springtime variability in soil temperature. The effects of variation in winter soil climate on N cycling processes were greater than for C-related processes, suggesting higher sensitivity of N cycles than soil C to warming winter climate.

HETEROTROPH POPULATIONS AND COMMUNITIES: The ability of a new modeling approach that utilizes simple count data for a population to estimate demographic parameters was evaluated using 25-yr of intensive data collection for warblers at HBR-LTER (Zipkin et al. 2014). Although the model performed well in estimating population abundance and annual recruitment, survival probability was underestimated. Thus, accurate and precise demography rates will necessarily require a combination of intensive and extensive data sources for application at large spatial and temporal scales. The long-term bird community record for HBR-LTER also has proven valuable for identifying a baseline of community change over time to distinguish primeval systems from those exhibiting human impact (Kampichler et al. 2014). Time-lag

analysis (TLA) indicated an increasing rate of temporal compositional change from primeval systems to disturbed and protected areas to distinctly successional systems. Regardless of the intensity of human impact changes in bird communities were slow; only large periodic pulses in food resource availability appeared to drive short-wave periodicity in bird communities.

Key outcomes or Other achievements:

INFORMATION MANAGEMENT and ENVIRONMENTAL SENSOR NETWORK

HBR data collection: During the past year, we have continued efforts to improve the availability and standardization of HBR data packages. This effort has centered on the following three efforts (which are described in more detail in the 2013 Annual Report). 1) *Upgrades/access to existing data packages:* The HBR data packages have been updated to incorporate numerous new requirements for standardized metadata (EML best practices, PASTA congruency, etc). All data are openly available on the <http://hubbardbrook.org> website. The process of updating data packages relies heavily on the resources provided by the PASTA web services and staging area. 2) *Development of new data packages:* Efforts are directed at both a) identifying and incorporating earlier HBR-LTER datasets (from 1988 onward), b) development of a 'Project' database in coordination with the HBR Research Approval Committee(RAC). The latter allows us to track and monitor the completion of projects, publication of data, and maintain timely submissions to the HBR data collection. 3) *Implementation of metadata database:* Work continues on the migration of HBR metadata content and project database to a PostgreSQL implementation of the metabase schema.

Website (<http://hubbardbrook.org>): The website for HBR is hosted on a server at the University of NH and managed by the HBR-Information Manager (HBR-IM). The physical location of this server is at the Research Computing and Instrumentation (RCI) Center, in a climate controlled environment, with emergency power. A service level agreement (SLA) between the Earth Systems Research Center and RCI provides system administration, upgrades, backups, helpdesk support, and expertise for special projects as needed. Website content is updated on an ongoing basis (researcher profiles, research highlights, bibliography, etc). A major revision to the Education virtual tour is underway – when finalized (in 2015), this will incorporate updates to both content and delivery, with the addition of spatial storymaps, video clips of current research projects, and links to realtime data. This section of the website is used extensively by tour groups visiting Hubbard Brook.

HBR Environmental Sensors: HBR Information management provides support for the environmental sensor network at the site; the HBR sensor network monitors height/temperature/conductivity from 9 watersheds in the Hubbard Brook valley, and meteorological data from 10+ stations throughout Hubbard Brook, and from a number of project-level sensor networks. Maintenance and operation of the sensors is done by Forest Service staff, and the HBR-IM works closely with that team on the

implementation and operation of data processing and quality control. We are in the process of finalizing the implementation of a GCEdata Toolbox (developed by GCE-LTER) workflow to provide quality controlled data products for the research community. The analysis of overlapping chart/sensor data (~2008-2012) has established the baseline necessary for moving forward with HBR core meteorological and hydrological, datasets derived now from digital sensors.

Other projects involving HBR-IM:

SensorNIS: This LTER working group grew out of an initial workshop which was funded by an HBR LTER supplement in 2011. This group continues to collaborate and produce resources for the the LTER and wider research communities. In May 2014, the “EnviroSensing Cluster - Documenting best practices for sensor networks and sensor data management” (<http://esipfed.org/node/2434>) was released. This document on best practices for sensor networks and sensor data management provides 6 core chapters covering Sensor Site and Platform Selection, Sensor Data Acquisition, Sensor Management Tracking and Documentation, Sensor Data Management Middleware, Sensor Data Quality, and Sensor Data Archiving. This document is maintained in a Wiki style as a living document, allowing others to contribute knowledge and experience, provide updates and corrections, or initiate new chapters to expand the scope of the document. Anyone can register for an account with the EnviroSensor ESIP wiki, and upon approval, may edit and/or add content. In addition to this online document, an ongoing monthly EnviroSensing telecon has been established with presentations on emerging technology, software, etc by members so fthe community (http://wiki.esipfed.org/index.php/EnviroSensing_Monthly_telecons).

Smart Forests for the 21st Century initiative: this US Forest Service effort extends sensor technology to sites within the USFS Experimental Forests and Ranges Network, and is led by the Hubbard Brook Experimental Forest. In the past year, this project has supported the development of sensor networks at the Marcell and Fernow Experimental Forests and at an urban site in New York City (Alley Pond Park, Queens). The GCE Toolbox provides both the quality control workflow for data from these sites, and the centralized data portal for this emerging network (<http://smartforests.org>).

Legacy data: The effort to capture data from paper charts continues (the 60-year HBR chart archive exceeds 40,000). With a focus on extreme events, this work targets the top precipitation events over the past 60 years, wherein data are extracted from the charts at an hourly resolution (historically, only daily precipitation totals had been read from the charts). Although this process of data extraction is semi-automated (using <http://datathief.org>), it is still quite time-consuming - this initial narrow focus on one meteorolgical station allows us to generate a new dataset end-to-end, and will provide a baseline for expansion of this effort to additional datasets available for extraction from the chart archive.

Innovative data outreach: A water cycle visualization and sonification have been developed for Hubbard Brook (<http://smartforests.org/waterviz>). To support this

collaborative between hydrological scientists, educators, artists, musicians, and data visualization specialists, the HBR-IM has developed a real-time data workflow that combines data from multiple dataloggers, calculates variables on-the-fly (e.g. evapotranspiration), and stages an hourly custom datafile for access by this interdisciplinary team. L. Rustad (USFS) is the lead in this collaborative effort, and funding has come from a number of different entities (see website). Outreach with these data products has included presentations at the International Union of Forest Research Organizations (IUFRO; Salt Lake City, UT), Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI; St. Johnsbury, VT), NH-EPSCoR Ecosystems & Society meeting (Concord, NH), NH Water and Watersheds Conference (Plymouth, NH), Communicating Conservation Symposium (Nicholas School for Environment, Duke Univ). Note that a USFS Cooperative Agreement with UNH provides funds to the HBR-IM to support both this and the SmartForest projects.

HBR-IM participation in LTER Network activities: Participation in monthly LTER-IM Virtual Watercooler teleconferences and the EnviroSensor telecons (an extension of the LTER Sensor Working Group), Databits (co)editor (Spring and Fall 2014), election to the LTER Network Information System Advisory Committee (NISAC).

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

The Hubbard Brook LTER project takes very seriously its responsibilities for the training and development of scientists and educators. Most of these activities also are coordinated through the auspices of the Hubbard Brook Research Foundation, a non-profit, “friends” group associated with the HBR LTER. At the undergraduate level we provide a structured program of activities in the form of tours, lectures and research mentoring.

Undergraduate Research Program: 2014 marked year two of the renewal for our REU site program, entitled “Investigating and Communicating Change in Ecosystems.” We hosted 10 undergraduates through a combination of the LTER-supported REU and the site REU, which we administer with Plymouth State University. The students were paired with researchers and developed and conducted independent research projects on topics representing the range of research at the Hubbard Brook LTER, including hydrology, population ecology, biogeochemistry, and animal behavior. The students also participated in weekly science communications workshops which examined successful communications strategies aimed at policy, informal science education, and secondary science. The students interacted with teachers in our RET program, graduate students, other undergraduates serving on field crews, and a spectrum of Hubbard Brook scientists at weekly Science Night dinner/talks.

Graduate students are provided with formal and informal opportunities for training and development. Most students’ present oral talks at the Annual Meetings of the HBES and a formalized evaluation is provided. Graduate students work closely with their research advisors and with senior research staff in the HBES in the development and conduct of their research.

They are also provided opportunities to mentor undergraduate students and to lead tours of their research sites for visiting scientists. The success of our project in graduate student mentoring and training is clearly reflected in our strong record for placing students into academic and other research positions.

The HBR LTER project actively participates in training and development of K-12 teachers, in part with supplementary funding from NSF-RETs as well as independent programs in conjunction with HBRF and USDA Forest Service staff. In the past year K-12 teachers have participated directly in our ongoing research on heterotrophs, vegetation dynamics and forest nutrient manipulations. They have worked with our field crew and participated in project planning meetings to gain a better understanding of the scientific research process. Our work with the K-12 audiences is organized by HBRF through the Environmental Literacy Program (ELP). ELP is a joint project of the HBRF and the USDA Forest Service Northern Research Station to use ecological knowledge to promote informed decision-making for a sustainable future. It is funded through both the USDA-Forest Service and the LTER Schoolyard program. ELP focuses on middle- and high school teachers and their students through the following three programs:

1. **Data-based lessons:** A central aim of our ELP program is to provide HBES data to teachers in a format which supports their efforts at building both science-process skills and content knowledge in their students. To this end we have worked with teachers and scientists to develop data sets, lessons, and slideshows that emphasize the evaluation of data as well as the thought processes that lead to the research questions. These resources are supported by teacher workshops and on-going interactions with HBRF staff. Current offerings can be found at: <http://hubbardbrookfoundation.org/middle-and-high-school-2/>
2. **Teacher professional development:** We continue to present at teacher workshops and are active cooperators with the New Hampshire Science Teachers' Association. This year we presented a session to promote our data-centered teaching resources and acquaint the teachers in the state with the site as an educational resource. We also partner with the New Hampshire Education and Environment Team (NHEET) to provide teacher workshops focusing on science process skills, including a state-wide Math-Science Partnership which works with 2 school districts in the state with the aim of integrating their science education from grades K-8. In addition, in 2014 we continued our summer research experience (RET), incorporating one new teacher, supporting one for a third and final year, and partnering with colleagues to support two more RET alumni on a supplement to a different NSF grant.
3. **School partnerships:** We are active with a number of local schools and school districts. Through our RET program we have developed close working relationships with Lin-Wood School (grades 6-12), Kennett Middle School (grades 6-12), Bartlett Middle School (grades 6-12), Newfound Regional High School (9-12), and Oyster River High school (9-12) all of which are fairly close to the site and have had one or more teachers engaged with us for multiple years. In addition we work with Plymouth Elementary (grades 6-8), Bethlehem Elementary (4-6), Littleton High School (9-12), and Plymouth Regional High School (9-12) on an as-requested basis. Together these represent the 5 school districts closest to Hubbard Brook. We also provide tours to other schools as requested.

Other K-12 support activities: The Hubbard Brook Research Foundation is a member of the New Hampshire Education and Environment Team (NHEET), which is a collaboration of organizations working to support science education in the state. Additional members include the GLOBE Program, Project Learning Tree, Project WET at NH Department of Environmental Services, Projects WILD and Aquatic WILD at NH Fish and Game Department, and the USDA Forest Service. The focus of the group is to support the vertical alignment of science curriculum within districts and to assist teachers in the acquisition of content and development of science process skills. The main activity of the group in 2014 was the Math-Science Partnership program, described above. Additionally, HBRF and USDA Forest Service staff give elementary and secondary school tours of the site upon request. Six schools, in addition to our regular school partnership schools, visited Hubbard Brook in the past year.

On-site tours: The HBEF provides educational tours of the research site on a frequent basis throughout the academic year. Undergraduate partner schools bring at least one class per year to the site and provide the Hubbard Brook staff with syllabi and written statements describing how the site visit is incorporated into the course curriculum. These schools include: Yale University, Plymouth State University, the University of New Hampshire, Colby-Sawyer College, Boston University, Cornell University, and Wellesley College. Secondary school tours are offered to our ELP partner schools (described above) and other schools where our teaching resources are being used in the classroom.

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

Policy and regional stakeholder outreach: In 2014 the Hubbard Brook Research Foundation received an Advancing Informal STEM Learning grant from the National Science Foundation (Award #DRL 1322871) for a two-year pilot project called Forest Science Dialogues. The project is to develop and pilot a model for engaging ecosystem scientists and local citizens in action-oriented dialogue about social, economic, and policy-related issues and concerns in the rural regions of northern New England. Elements of the model are: 1) mechanisms and processes for rural community dialogue events that support multi-directional dialogue and mutual learning among nonscientists and scientists; 2) workshops with scientists to develop their comfort and skills with public engagement; and 3) infrastructure for recruitment, communication, and ongoing support for initiatives that arise from these dialogues. In 2014, highlights of the project include a Public Engagement with Science workshop for the Hubbard Brook Committee of Scientists meeting at the Cary Institute in New York and a two-day Hubbard Brook Roundtable with twenty-four participants representing region-wide leaders from diverse stakeholder groups and including five Hubbard Brook scientists.

Other specific products:

Product type: Website

Product description: <http://hubbardbrookfoundation.org/education-programs-at-hubbard-brook-an-overview/>

Sharing information: The Hubbard Brook Research Foundation hosts a dynamic website with teaching resources developed with support of the LTER Schoolyard program and the USDA-Forest Service. It contains data activities developed by our RET teachers, mock-NECAP exams developed with our partner schools, and teaching guides on acid rain and migratory birds. Contents of the website are promoted at state-wide and regional science teacher conferences and through our various partnerships with teacher professional development organizations.

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

We plan to continue our long-term activities in ecosystem monitoring, biogeochemical experiments, landscape studies, modeling and quantitative analysis, data management, education and outreach during the next reporting period.

Supporting Files

	Filename	Description	Uploaded By	Uploaded On
(Download)	2014 ANNUAL PROJECT REPORT REFERENCES.pdf	Literature Citations within report	Timothy Fahey	01/22/2015
(Download)	2014 Annual Report Figure File.pdf	Figure File with Figures 1-5 as referenced within report	Timothy Fahey	01/22/2015

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Products

Books

Book Chapters

- Bytnerowicz, A., M. Fenn, S. McNulty, F. Yuan, A. Pourmokhtarian, C.T. Driscoll, and T. Meixner. (2013). Interactive effects of air pollution and climate change on forest ecosystems in the United States: Current understanding and future scenarios.. *Developments in Environmental Science. Climate Change, Air Pollution and Global Challenge* R. Matyssek, N. Clarke, P. Cudlin, T. N. Mikkelsen, J.-P. Tuovinen, G. Wieser, and E. Paoletti.. Elsevier Physical Sciences Series.. 333. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes
- Clair, Thomas and Blett, Tamara and Aherne, Julian and Aidar, Marcos and Artz, Richard and Bealey, William and Budd, William and Cape, Neil and Curtis, Chris and Duan, Lei and Fenn, Mark and Groffman, Peter and Haeuber, Richard and Hall, Jane and Hettelingh, Jean-Paul and López-Hernández, Danilo and Mathieson, Scot and Pardo, Linda and Posch, Maximilian and Pouyat, Richard and Spranger, Till and Sverdrup, Harald and Dobben, Hans and Hinsberg, Arjan (2014). The critical loads and levels approach for nitrogen. *Nitrogen Deposition, Critical Loads and Biodiversity* Springer

- Netherlands. Dordrecht. 481--491. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-94-007-7938-9.
- Groffman, P.M, P. Kareiva and Kareiva, S.L. and Carter, S.L. and Grimm, N.B. and Lawler, J.J. and Mack, M.C. and Matzek, V. and Tallis, H. (2014). Ch. 8: Ecosystems, Biodiversity, and Ecosystem Services.. *Climate Change Impacts in the United States: The Third National Climate Assessment* Melillo, J.M. and Richmond, T. and Yohe, G.W.. {US} Global Change Research Program. 195--219. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes
 - Groffman, P.M, P. Kareiva and Kareiva, S.L. and Carter, S.L. and Grimm, N.B. and Lawler, J.J. and Mack, M.C. and Matzek, V. and Tallis, H. (2014). Ch. 8: Ecosystems, Biodiversity, and Ecosystem Services.. *Climate Change Impacts in the United States: The Third National Climate Assessment* Melillo, J.M. and Richmond, T. and Yohe, G.W.. {US} Global Change Research Program. 195--219. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes
 - Hornbeck, J.W., Eagar, C., Bailey, A.S. and Campbell, J.L. (2014). Comparisons with results from the Hubbard Brook Experimental Forest in the Northern Appalachians. *Response of a Forest Watershed Ecosystem: Commercial Clearcutting in the Southern Appalachians* Oxford University Press. New York. 213--228. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes
 - Likens, Gene E. and Bailey, Scott W. (2014). The Discovery of Acid Rain at the Hubbard Brook Experimental Forest: A Story of Collaboration and Long-term Research. *{USDA} Forest Service Experimental Forests and Ranges* Hayes, Deborah C. and Stout, Susan L. and Crawford, Ralph H. and Hoover, Anne P.. Springer New York. 463--482. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-1-4614-1817-7, 978-1-4614-1818-4.
 - Vose, James M. and Swank, Wayne T. and Adams, Mary Beth and Amatya, Devendra and Campbell, John and Johnson, Sherri and Swanson, Frederick J. and Kolka, Randy and Lugo, Ariel E. and Musselman, Robert and Rhoades, Charles (2014). The Role of Experimental Forests and Ranges in the Development of Ecosystem Science and Biogeochemical Cycling Research. *{USDA} Forest Service Experimental Forests and Ranges* Hayes, Deborah C. and Stout, Susan L. and Crawford, Ralph H. and Hoover, Anne P.. Springer New York. 387--403. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-1-4614-1817-7, 978-1-4614-1818-4.

Conference Papers and Presentations

- Pourmokhtarian, A., Driscoll, C. T., Campbell, J. L., Hayhoe, K., A.M.K. Stoner (2014). *A tale of statistical downscaling: the good, the bad, and the ugly!*. 51st Annual Hubbard Brook Cooperators' Meeting. Hubbard Brook, NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C. T (2014). *Air Quality Co-Benefits of a Carbon Emission Standard*. Annual Hubbard Brook Cooperators Meeting. West Thornton, NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C.T. (2014). *Air Quality and Health Co-Benefits of Carbon Standards: Summary of the Carbon Standards Co-Benefits Study*. Briefing given by teleconference to

the Environmental Defense Fund. . Status = OTHER; Acknowledgement of Federal Support = Yes

- Driscoll, C.T. (2014). *Air Quality and Health Co-Benefits of Carbon Standards: Summary of the Carbon Standards Co-Benefits Study*. Presentation to the Central New York Council for the Social Studies (CNYCSS) Professional Development Day. Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C.T. (2014). *Air quality and health co-benefits associated with policy options for a carbon standard for electric utilities*. Presentation given at the Environmental Group seminar to graduate and undergraduate students in the Department of Civil and Environmental Engineering. Syracuse University, Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Lany, N.K., E.E. Stange, and M. P. Ayres (2014). *Can inter-annual variation in foliar nitrogen explain the synchronous fluctuations of forest Lepidoptera?*. Entomological Society of America Annual Meeting. Portland, OR. Status = OTHER; Acknowledgement of Federal Support = Yes
- Lany, N. (2014). *Can interannual variation in foliar nitrogen explain the concordant fluctuations of forest Lepidoptera?*. Annual Hubbard Brook Cooperators' Meeting. North Woodstock, NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Kolka, R.K., Sebestyen, S.D., Campbell, J.L., Dymond, S.F., and Green, M.B. (2014). *Climate change effects on hydrologic processes in Northern forests*. 99th Annual Meeting, Ecological Society of America. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C.T. (2014). *Co-Benefits of Carbon Standards Study, Air Quality Benefits*. White House briefing via webinar to the Council on Environmental Quality (CEQ). . Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C.T. (2014). *Co-Benefits of Carbon Standards Study, Air Quality Benefits*. Briefing via teleconference given to the U.S. Environmental Protection Agency. . Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C. T. (2014). *Co-Benefits of Carbon Standards Study, Air Quality Benefits*. Presentation given to U.S. EPA Regional Administrator at the Climate Change Roundtable discussion at the Center of Excellence. Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C. T. (2014). *Co-Benefits of Carbon Standards Study, Part 1*. briefing with the USEPA. Research Triangle Park, NC. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C.T. (2014). *Co-Benefits of Carbon Standards Study, Part 1*. briefing with the USEPA. Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Yang, Y., R.D. Yanai, and R.D. Briggs (2014). *Detecting differences of tissue chemistry in four northern hardwoods tree species*. Ecological Society of America Annual Meeting. Sacramento, CA. Status = UNDER_REVIEW; Acknowledgement of Federal Support = Yes
- Wild, A.D., and R.D. Yanai (2014). *Do Nutrients Make Maple Sap Sweeter?*. New York Society of American Foresters. Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = Yes

- Wild, A.D., and R.D. Yanai. (2014). *Do soil nutrients make maple sap sweeter?*. Ecological Society of America Annual Meeting. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C. T (2014). *Effects of Changing Climate on the Structure and Function of the Northern Forest: Long-Term Measurements, Experiments and Future Model Projections from the Hubbard Brook Experimental Forest, NH, USA*. Environmental Seminar Series at the University of Tennessee Knoxville. Knoxville, TN. Status = OTHER; Acknowledgement of Federal Support = Yes
- Dong, Y. (2014). *Effects of Parent Material on Foliage Nutrients in Northern Hardwood Forest*. New York Society of Foresters. Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = No
- Sanders-Demott, R and PH Templer. (2014). *Effects of climate change across seasons on ecosystem nitrogen retention and carbon uptake by maple saplings..* 99th Annual Meeting of the Ecological Society of America. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Sanders-Demott R, R McNellis and PH Templer (2014). *Effects of climate change across seasons on phenology, root health and carbon uptake by maple saplings..* Hubbard Brook Annual Cooperators Meeting. North Woodstock, NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Templer PH, A Reinmann and J Susser. (2014). *Effects of winter climate change on aboveground productivity of northern forest ecosystems*. Hubbard Brook Annual Cooperators Meeting. North Woodstock, NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Campbell. J.L., Rustad, L.E., Adams, M.B., Brissette, J.C., Hollinger, D.Y., Kabrick, J.M., Kolka, R.K., Martin, M.E., Schuler, T.M., and Sebestyen, S.D. (2014). *Environmental sensor applications at experimental forests: The Smart Forest Network..* 99th Annual Meeting, Ecological Society of America. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Wild, A.D., and R.D. Yanai (2014). *First Signs of a Foliar Treatment Response in the Multiple Element Limitation in Northern Hardwood Forest Ecosystem Study*. Hubbard Brook Committee of Scientist Spring Meeting. Millbrook, NY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Fuss, C.B., Lovett, G.M., Goodale, C.L., Darby, B.A., Ollinger, S.V., Ouimette, A.P., Zhou, Z. (2014). *Forest age and the mineral soil nitrogen "bank": Borrowing and saving across time*. Hubbard Brook Annual Cooperators Meeting. Woodstock, NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Kaiser, S.A. T.S. Sillett, M.S. Webster. (2013). *Habitat-specific reproductive strategies in response to food supplementation increase male fitness in a songbird*. One Hundred and Thirty-first Meeting of the American Ornithologists' Union. Chicago, IL. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C.T. (2014). *Health Co-Benefits of Carbon Standards Air Quality and Health Benefits of the Carbon Standards Co-Benefits Stud*. Briefing: U.S. Environmental Protection Agency. Washington, DC. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C.T. (2014). *Health Co-Benefits of Carbon Standards Air Quality and Health Benefits of the Carbon Standards Co-Benefits Study*. Briefing given to the Office of

Management and Budget. Washington, DC. Status = OTHER; Acknowledgement of Federal Support = Yes

- Driscoll, C.T. (2014). *Health Co-Benefits of Carbon Standards Air Quality and Health Benefits of the Carbon Standards Co-Benefits Study*. Briefing: Council on Environmental Quality (CEQ). Washington, DC. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C.T. (2014). *Health Co-Benefits of Carbon Standards Air Quality and Health Benefits of the Carbon Standards Co-Benefits Study*. Briefing: Senator Carper's staff. Washington, DC. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C.T. (2014). *Health Co-Benefits of Carbon Standards Air Quality and Health Benefits of the Carbon Standards Co-Benefits Study*. briefing given to Senator Reid's staff. Washington, DC. Status = OTHER; Acknowledgement of Federal Support = Yes
- Rodenhouse, N. (2014). *How well do climate and ecosystem characteristics predict bird abundance at the landscape spatial scale?*. Annual Hubbard Brook Cooperators' Meeting. North Woodstock, NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Rodenhouse, N., Z. Zhou, M. Martin, S. Ollinger, and J. Battles. (2014). *How well do climate and ecosystem characteristics predict bird abundance at the landscape spatial scale?*. 2014 Annual Meeting of the Ecological Society of America. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Rodenhouse, N., Z. Zhou, M. Martin, S. Ollinger, and J. Battles. (2014). *How well do climate and ecosystem characteristics predict bird abundance at the landscape spatial scale?*. Northeastern Research Station, USDA Forest Service. Delaware, OH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Rodenhouse, N., Z. Zhou, M. Martin, S. Ollinger, and J. Battles (2014). *How well do climate and ecosystem characteristics predict bird abundance at the landscape spatial scale?*. Department of Wildlife Biology, Ohio State University,. Columbus, OH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Rodenhouse, N., Z. Zhou, M. Martin, S. Ollinger, and J. Battles. (2014). *How well do climate and ecosystem characteristics predict bird abundance at the landscape spatial scale?*. 2014 Annual Meeting of the Ecological Society of America. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Miller, C. M., H. Merrill, N.L. Rodenhouse, S. Kaiser, L. Neitmann. (2013). *Humans vs. digital recorders: alternative methods for surveying birds*. Annual Cooperators' Meeting, Hubbard Brook Ecosystem Study. North Woodstock, NH.. Status = OTHER; Acknowledgement of Federal Support = Yes
- Berton, R., Driscoll, C. T., Chandler, D. G. (2014). *Hydrologic Response of the Merrimack Watershed (NH-MA) to Variations in Sea Surface Temperature and Sea Level Pressure*. Graduate Research Symposium. Syracuse University, Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Berton, R., Driscoll, C. T., Chandler, D. G. (2014). *Hydrologic Response of the Merrimack Watershed (NH-MA) to Variations in Sea Surface Temperature and Sea Level Pressure*. Graduate Research Symposium. Syracuse University, Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = Yes

- Yanai, R.D. (2014). *Improving Environmental Monitoring with Uncertainty Analysis*. Catskill Environmental Research and Monitoring Conference. High-mountain, NY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Puntsag, T., Welker, J.M., Mitchell, M.J., Klein, E.S., Campbell, J.L. and Likens, E. (2014). *Long-term precipitation isotope ratios ($\delta^{18}O$, δ^2H , d -excess) in the northeast US reflect Atlantic Ocean warming and shifts in moisture sources..* American Geophysical Union, Fall Meeting. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Vadeboncoeur, M., Asbjornsen, H., Green, M., and Campbell, J. (2014). *Long-term trends in evapotranspiration in forested small catchments in the northeastern USA..* 2014 American Society of Agricultural and Biological Engineers Meeting, Evapotranspiration: Challenges in Measurement and Modeling from Leaf to the Landscape Scale and Beyond. Raleigh, NC. Status = OTHER; Acknowledgement of Federal Support = Yes
- Hallworth, M. T., T. S. Sillett, S. Van Wilgenburg, K. A. Hobson and P.P. Marra. (2014). *Migratory connectivity of a Neotropical migratory songbird revealed using archival light-level geolocators..* Symposium of Animal Movement and the Environment. Raleigh, NC. Status = OTHER; Acknowledgement of Federal Support = Yes
- Hallworth, M. T., T. S. Sillett, S. Van Wilgenburg, K. A. Hobson and P.P. Marra. (2014). *Migratory connectivity of a Neotropical migratory songbird revealed using archival light-level geolocators..* North America Congress for Conservation Biology. Missoula, MT. Status = OTHER; Acknowledgement of Federal Support = Yes
- Goodale, C.L. (2014). *Nitrogen and Climate Change*. BIOGEOMON 2014 Conference. Bayreuth, Germany. Status = OTHER; Acknowledgement of Federal Support = Yes
- See, C.R., M.C. Fisk, R.D. Yanai. (2014). *Nitrogen and phosphorus co-limitation in northern hardwood forests..* Ecological Society of America Annual Meeting. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- See, C.R., M.C. Fisk, R.D. Yanai. (2014). *Nitrogen and phosphorus co-limitation in northern hardwood forests..* Ecological Society of America Annual Meeting. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Asbjornsen H, L Rustad, PH Templer. (2014). *Northern Forest DroughtNet: A new framework to understand impacts of precipitation change on the Northern forest ecosystem..* American Geophysical Union. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Betts, M.G. (2012). *On species distributions*. Invited seminar, Portland State University Dept. of Biology. Portland, WA. Status = OTHER; Acknowledgement of Federal Support = No
- Illan, J.G, Thomas C.D, Betts M.G. (2012). *On the influence of climate change on bird distributions: Will the predictions come true?.* Department of Biology Workshop. The University of York. York, United Kingdom. Status = OTHER; Acknowledgement of Federal Support = No
- Yanai, R. (2014). *P-recycling and P-efficiency of ecosystems*. German Research Foundation's (DRG) Priority Research Programme SPP 1685 workshop "Ecosystem Nutrition: Forest Strategies for limited phosphorus resources". Freising, Munich, Germany. Status = OTHER; Acknowledgement of Federal Support = Yes

- Dong, Y., R.D. Yanai, M.C. Fisk, R. Briggs, M. Johnston (2014). *Parent material, N cycling, and foliar chemistry in northern hardwood forests.*. Ecological Society of America Annual Meeting. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = No
- Goswami S, Vadeboncoeur M, Collin E, Yanai R, Fisk M. (2014). *Poster: Contrasting root systems of two coexisting tree species in northern hardwood forest ecosystems.*. Annual meetings of the Ecological Society of America. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Hallworth, M. T., T. S. Sillett, S. Van Wilgenburg, K. Hobson and P. P. Marra. (2013). *Range-wide migratory connectivity revealed by archival light-level geolocators.* Annual Cooperators' Meeting, Hubbard Brook Ecosystem Study. North Woodstock, NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Driscoll, C. T. (2014). *Recovery of Acid Lakes in the Adirondack Region of New York: Model Projections under Different Scenarios of Emissions Controls.* LTER Mini-symposium. National Science Foundation, Arlington, VA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Sorensen P, PH Templer, A Finzi, P Groffman, M Fisk, L Christensen, and T Fahey. (2014). *Roots alter microbial response to winter climate change.*. Hubbard Brook Annual Cooperators Meeting. North Woodstock, NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Hallworth, M. T., T. S. Sillett, L. Rockwood, and P. P. Marra. (2014). *Seasonal interactions influence individuals and the population growth rate of a long distance migratory songbird.*. Seasonal interactions influence individuals and the population growth rate of a long distance migratory songbird.. Estes Park, CO. Status = OTHER; Acknowledgement of Federal Support = Yes
- Hallworth, M. T., T. S. Sillett, L. Rockwood, and P. P. Marra. (2014). *Seasonal interactions influence individuals and the population growth rate of a long distance migratory songbird.*. American Ornithologists Union.. Estes Park, CO. Status = PUBLISHED; Acknowledgement of Federal Support = Yes
- Sorensen PO, PH Templer and AC Finzi. (2014). *Soil temperature manipulation in winter vs. summer leads to different effects on growing season soil microbial activity in temperate hardwood forests.*. American Geophysical Union. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Yang Yang (2014). *Source of variability in tissue chemistry in northern hardwood species.*. New York Society of American Foresters. Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Muniz, A., and S.A. Kaiser. (2013). *Spatial and temporal variation in nest predation rates of a migratory songbird across an elevation gradient.* 20th Annual Conference of The Wildlife Society. Milwaukee, WI. Status = OTHER; Acknowledgement of Federal Support = Yes
- N. Lany, M. P. Ayres (2011). *Spring leaf phenology, insect abundance and the timing of breeding by birds in a North American temperate forest.*. American Geophysical Union Fall Meeting. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes
- Lany, N.K., M.P. Ayres, E. Stange, T.S. Sillett, N.L. Rodenhouse, R.T. Holmes (2013). *Spring leaf phenology, insect abundance, and the timing of breeding by*

the Black-throated Blue Warbler. New England Natural History Conference. Springfield, MA. Status = OTHER; Acknowledgement of Federal Support = Yes

- Yanai, R.D., Steven Hamburg, Matt Vadeboncoeur; Joel Blum, Mary Arthur, Paul Lilly (2014). *Sustainable Forest Harvest Requires Nutrient Supply from Soil Pools: Ecosystem Budgets for Second-Growth Northern Hardwoods in New Hampshire, USA.*. 24th IUFRO World Congress. Salt Lake City, UT. Status = OTHER; Acknowledgement of Federal Support = Yes
- Lany, N.K., M.P. Ayres. (2013). *Temperature and the balance of top-down and bottom-up interactions in a temperate hardwood forest.*. Seminar, Swedish University of Agricultural Sciences. Uppsala, Sweden. Status = OTHER; Acknowledgement of Federal Support = No
- Berton, R., Driscoll, C. T., Chandler, D. G (2014). *The Assessment of Climate and Anthropogenic Impacts on Watershed Hydrology: A Case Study of the Merrimack Watershed, NH-MA*. 3-Minute Thesis Competition. Syracuse University, Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Yang, Y. and R.D. Yanai. (2014). *The Importance of Measuring Mercury in Wood*. American Geophysical Union Fall Meeting. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Yanai, R.D. (2014). *The Importance of quantifying uncertainty in managing forests*. 24th IUFRO World Congress. Salt Lake City, UT. Status = OTHER; Acknowledgement of Federal Support = Yes
- Pourmokhtarian, A. (Invited Speaker), C.T. Driscoll, J.L. Campbell, K. Hayhoe, A.M.K. Stoner (2014). *The Influence of Downscaling Models and Observations on Future Hydrochemistry Responses of Forest Watersheds*. American Geophysical Union (AGU) 2014 Fall Meeting. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Berton, R., Shaw, S. B., Chandler, D. G., Driscoll, C. T. (2014). *The Prediction of Annual Discharge Due to Oceanic Indices Variations in the Northeastern United State*. New England Graduate Student Water Symposium. University of Massachusetts Amherst, Amherst, MA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Berton, R., Driscoll, C. T., Shaw, S. B., Chandler, D. G. (2014). *The Teleconnection of Merrimack Hydrology to AMO and NAO Oceanic Indices*. 51st Annual Hubbard Brook Cooperators' Meeting. Hubbard Brook, NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Berton, R., Driscoll, C. T., Chandler, D. G. (2014). *The Teleconnection of Streamflow Variations with Large-Scale Oceanic Variables in the Merrimack Watershed, NH-MA*. NUNAN Lecture & Research Day. Syracuse University, Syracuse, NY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Berton, R., Shaw, S. B., Chandler, D. G., Driscoll, C. T. (2014). *The Use of Oceanic Indices Variations Due to Climate Change to Predict Annual Discharge Variations in Northeastern United States*. American Geophysical Union Fall Meeting. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Pourmokhtarian, A., Driscoll, C.T., Campbell, J.L., Hayhoe, K., Stoner, A. (2014). *The influence of downscaling models and observations on future hydrochemistry responses of forest watersheds.*. American Geophysical Union, Fall Meeting. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

- Lany, N.K., M. P. Ayres, and J. M. Scriber. (2014). *Top-down vs. bottom-up is a function of temperature for forest Lepidoptera..* 2014 Annual Meeting of the Ecological Society of America. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Lany, N.K. and M. P. Ayres (2014). *Top-down vs. bottom-up is a function of temperature for forest Lepidoptera..* International Union of Forest Research Organizations 2014 World Congress. Salt Lake City, UT. Status = OTHER; Acknowledgement of Federal Support = Yes
- Lany, N.K., M. P. Ayres, and J. M. Scriber (2014). *Top-down vs. bottom-up is a function of temperature for forest Lepidoptera..* Annual Meeting of the Ecological Society of America. Sacramento, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes
- Betts, M.G. (2012). *Toward a behavioral global ecology.* Invited seminar, Texas Tech University. Lubbock, Texas. Status = PUBLISHED; Acknowledgement of Federal Support = No
- Yanai, R.D, P.J. Lilly, M.A. Arthur, K. Bae, S.P. Hamburg, C.R. Levine, M.A. Vadeboncoeur. (2014). *Uncertainty in accounting for carbon accumulation following forest harvesting..* American Geophysical Union Fall Meeting. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Frey, S.J.K, Rodenhouse, N.L., Sillett, S., Holmes, R.T., and Betts, M.G. (2012). *Ups and downs: Long-term songbird population trends across an elevational gradient in the Hubbard Brook Experimental Forest, NH.* Ecological Society of America Conference. Portland Oregon. Status = OTHER; Acknowledgement of Federal Support = Yes
- Frey, S.J.K, Rodenhouse, N.L., Sillett, S., Holmes, R.T., and Betts, M.G. (2012). *Ups and downs: Long-term songbird population trends across an elevational gradient in the Hubbard Brook Experimental Forest, NH.* North American Ornithological Congress. Vancouver, British Columbia. Status = OTHER; Acknowledgement of Federal Support = Yes
- Holmes, R.T. (2013). *Ups and downs: bird population trends across the Hubbard Brook valley.* Annual Cooperators' Meeting, Hubbard Brook Ecosystem Study. North Woodstock, NH. Status = OTHER; Acknowledgement of Federal Support = Yes

Inventions

Journals

- Bailey, S.W., Brousseau, P.A., McGuire, K.J., Ross, D.S. (2014). Influence of landscape position and transient water table on soil development and carbon distribution in a steep, headwater catchment.. *Geoderma*. 226-227 279. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.geoderma.2014.02.017
- Balaria, A., C.E. Johnson, and P.M. Groffman. (2014). Effects of calcium treatment on forest soil organic matter along an elevation gradient.. *Canadian Journal of Forest Research*. 44 969. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

- Battles, J.J., T J. Fahey, C.T. Driscoll, J.D. Blum, and C.E. Johnson (2014). Restoring soil calcium reverses forest decline.. *Environ. Sci. Technol. Lett.*. 1 15. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Bourgault, Rebecca R., Donald S. Ross and Scott W. Bailey (2014). Chemical and morphological distinctions between vertically and laterally developed spodic horizons at Hubbard Brook, NH. *Soil Science Society of America Journal*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.2136/sssaj2014.05.0190
- Burakowski, Elizabeth A. and Ollinger, Scott V. and Lepine, Lucie and Schaaf, Crystal B. and Wang, Zhuosen and Dibb, Jack E. and Hollinger, David Y. and Kim, JiHyun and Erb, Angel and Martin, Mary (2015). Spatial scaling of reflectance and surface albedo over a mixed-use, temperate forest landscape during snow-covered periods. *Remote Sensing of Environment*. 158 465--477. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.rse.2014.11.023
- Butnor, John R. and Campbell, John L. and Shanley, James B. and Zarnoch, Stanley (2014). Measuring soil frost depth in forest ecosystems with ground penetrating radar. *Agricultural and Forest Meteorology*. 192-193 121--131. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Bytnerowicz, Andrzej and Fenn, Mark and McNulty, Steven and Yuan, Fengming and Pourmokhtarian, Afshin and Driscoll, Charles and Meixner, Tom (2013). Chapter 16 - Interactive Effects of Air Pollution and Climate Change on Forest Ecosystems in the United States: Current Understanding and Future Scenarios. *In: Matyssek, R.; Clarke, N.; Cudlin, P.; Mikkelsen, T.N.; Tuovinen, J.-P.; Wieser, G.; Paoletti, E., eds. 2013. Developments in Environmental Science*. 13 333--369. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Campbell, John L. and Reinmann, Andrew B. and Templer, Pamela H. (2014). Soil Freezing Effects on Sources of Nitrogen and Carbon Leached During Snowmelt. *Soil Science Society of America Journal*. 78 (1), 297. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.2136/sssaj2013.06.0218
- Campbell, John L. and Soggi, Anne M. and Templer, Pamela H. (2014). Increased nitrogen leaching following soil freezing is due to decreased root uptake in a northern hardwood forest. *Global Change Biology*. 20 (8), 2663--2673. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gcb.12532
- Cawley, Kaelin M. and Campbell, John and Zwilling, Melissa and Jaffé, Rudolf (2014). Evaluation of forest disturbance legacy effects on dissolved organic matter characteristics in streams at the Hubbard Brook Experimental Forest, New Hampshire. *Aquatic Sciences*. 76 (4), 611--622. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s00027-014-0358-3
- Christenson, L. M. and Mitchell, M. J. and Groffman, P. M. and Lovett, G. M. (2014). Cascading Effects of Climate Change on Forest Ecosystems: Biogeochemical Links Between Trees and Moose in the Northeast {USA}. *Ecosystems*. 17 (3), 442--457. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s10021-013-9733-5

- Cleavitt, Natalie L. and Battles, John J. and Fahey, Timothy J. and Blum, Joel D. (2014). Determinants of survival over 7 years for a natural cohort of sugar maple seedlings in a northern hardwood forest. *Canadian Journal of Forest Research*. 44 (9), 1112--1121. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1139/cjfr-2014-0177
- Cline, Mason H. and Strong, Allan M. and Sillett, T. Scott and Rodenhouse, Nicholas L. and Holmes, Richard T. (2013). Correlates and Consequences of Breeding Dispersal in a Migratory Songbird. *The Auk*. 130 (4), 742--752. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1525/auk.2013.12244
- Creed, I.F., Spargo, A.T., Jones, J., Buttle, J., Adams, M., Beall, F., Booth, E., Campbell, J., Clow, D., Elder, K., Green, M.B., Grimm, N.B., Miniati, C., Ramlal, P., Saha, A., Sebestyen, S., Spittlehouse, D., Sterling, S., Williams, M.W., Winkler, R., and Yao, H. (2014). Changing forest water yields in response to climate warming: Results from long-term experimental watershed sites across North America.. *Global Change Biology*. 20 (10), 3209. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gcb.12615
- Dib, A., C.E. Johnson, C.T. Driscoll, T.J. Fahey, and K. Hayhoe (2014). Simulating effects of changing climate and CO₂ emissions on soil carbon pools at the Hubbard Brook Experimental Forest.. *Global Change Biology*. 20 1645. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Dib, Alain E. and Johnson, Chris E. and Driscoll, Charles T. and Fahey, Timothy J. and Hayhoe, Katharine (2014). Simulating effects of changing climate and {CO₂} emissions on soil carbon pools at the Hubbard Brook experimental forest. *Global Change Biology*. 20 (5), 1643--1656. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gcb.12436
- Durán, Jorge and Morse, Jennifer L. and Groffman, Peter M. and Campbell, John L. and Christenson, Lynn M. and Driscoll, Charles T. and Fahey, Timothy J. and Fisk, Melany C. and Mitchell, Myron J. and Templer, Pamela H. (2014). Winter climate change affects growing-season soil microbial biomass and activity in northern hardwood forests. *Global Change Biology*. 20 (11), 3568--3577. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gcb.12624
- Dybzinski, Ray and Farris, Caroline E. and Ollinger, Scott and Pacala, Stephen W. (2013). Interspecific vs intraspecific patterns in leaf nitrogen of forest trees across nitrogen availability gradients. *The New Phytologist*. 200 (1), 112--121. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/nph.12353
- Fisk MC, Ratliff TJ, Goswami S, Yanai RD. (2014). Synergistic soil response to nitrogen plus phosphorus fertilization in hardwood forests.. *Biogeochemistry*. 118 195. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Fisk MC, Santangelo S, Minick KJ. (2015). Carbon mineralization is promoted by phosphorus and reduced by nitrogen addition in the organic horizon of northern hardwood forests.. *Biology and Biochemistry*. 81 212. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.soilbio.2014.11.022

- Fisk, Melany and Santangelo, Sharon and Minick, Kevan (2015). Carbon mineralization is promoted by phosphorus and reduced by nitrogen addition in the organic horizon of northern hardwood forests. *Soil Biology and Biochemistry*. 81 212--218. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.soilbio.2014.11.022
- Fisk, Melany C. and Ratliff, Tera J. and Goswami, Shinjini and Yanai, Ruth D. (2014). Synergistic soil response to nitrogen plus phosphorus fertilization in hardwood forests. *Biogeochemistry*. 118 (1-3), 195--204. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s10533-013-9918-1
- Friedl, Mark A. and Gray, Josh M. and Melaas, Eli K. and Richardson, Andrew D. and Hufkens, Koen and Keenan, Trevor F. and Bailey, Amey and O'Keefe, John (2014). A tale of two springs: using recent climate anomalies to characterize the sensitivity of temperate forest phenology to climate change. *Environmental Research Letters*. 9 (5), 054006. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1088/1748-9326/9/5/054006
- Gannon, John P. and Bailey, Scott W. and McGuire, Kevin J. (2014). Organizing groundwater regimes and response thresholds by soils: A framework for understanding runoff generation in a headwater catchment. *Water Resources Research*. n/a--n/a. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/2014WR015498
- Gillin, C.P., Bailey, S.W., McGuire, K.J. and Gannon, J.P. (2014). Mapping of hypopedologic spatial patterns in a steep headwater catchment. *Soil Science Society of America Journal*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.2136/sssaj2014.05.0189
- Johnson, Chris E. and Driscoll, Charles T. and Blum, Joel D. and Fahey, Timothy J. and Battles, John J. (2014). Soil Chemical Dynamics after Calcium Silicate Addition to a Northern Hardwood Forest. *Soil Science Society of America Journal*. 78 (4), 1458. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.2136/sssaj2014.03.0114
- Johnson, Chris E. and Siccama, Thomas G. and Denny, Ellen G. and Koppers, Mary Margaret and Vogt, Daniel J. (2014). In situ decomposition of northern hardwood tree boles: decay rates and nutrient dynamics in wood and bark. *Canadian Journal of Forest Research*. 44 (12), 1515--1524. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1139/cjfr-2014-0221
- Kampichler, Christian and Angeler, David G. and Holmes, Richard T. and Leito, Aivar and Svensson, Sören and van der Jeugd, Henk P. and Wesolowski, Tomasz (2014). Temporal dynamics of bird community composition: an analysis of baseline conditions from long-term data. *Oecologia*. 175 (4), 1301--1313. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s00442-014-2979-6
- Keenan, T.F., J. Gray, M.A. Friedl, M. Toomey, G. Bohrer, D.Y. Hollinger, J.W. Munger, J. O'Keefe, H.P. Schmid, I. Sue Wing, B. Yang, and A.D. Richardson. (2014). Net carbon uptake has increased through warming-induced changes in temperate forest phenology. *Nature Climate Change*. 4 598--604. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1038/NCLIMATE2253

- Kulkarni, Madhura V. and Burgin, Amy J. and Groffman, Peter M. and Yavitt, Joseph B. (2014). Direct flux and 15N tracer methods for measuring denitrification in forest soils. *Biogeochemistry*. 117 (2-3), 359--373. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s10533-013-9876-7
- Kulkarni, Madhura V. and Groffman, Peter M. and Yavitt, Joseph B. and Goodale, Christine L. (2014). Complex controls of denitrification at ecosystem, landscape and regional scales in northern hardwood forests. *Ecological Modelling*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.ecolmodel.2014.03.010
- Levine, Carrie R., Ruth D. Yanai, Gregory G. Lampman, Douglas A. Burns, Charles T. Driscoll, Gregory B. Lawrence, Jason A. Lynch, and Nina Schoch. (2014). Evaluating the Efficiency of Environmental Monitoring Programs.. *Ecological Indicators*. 39 (April), 94. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1016/j.ecolind.2013.12.010
- Lindenmayer, D.B., Blair, D., McBurney, L., Banks, S.C., Stein, J.A.R., Hobbs, R.J., Likens, G.E. and Franklin, J.F. (2014). Principles and practices for biodiversity conservation and restoration forestry: a 30 year case study on the Victorian montane ash forests and the critically endangered Leadbeater's Possum. *Australian Zoologist*. 36 441--460. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Lindenmayer, David B. and Banks, Sam C. and Laurance, William F. and Franklin, Jerry F. and Likens, Gene E. (2014). Broad Decline of Populations of Large Old Trees. *Conservation Letters*. 7 (1), 72--73. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/conl.12079
- Lindenmayer, David B. and Barton, Philip S. and Lane, Peter W. and Westgate, Martin J. and McBurney, Lachlan and Blair, David and Gibbons, Philip and Likens, Gene E. (2014). An Empirical Assessment and Comparison of Species-Based and Habitat-Based Surrogates: A Case Study of Forest Vertebrates and Large Old Trees. *PLoS ONE*. 9 (2), e89807. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pone.0089807
- Lindenmayer, David B. and Laurance, William F. and Franklin, Jerry F. and Likens, Gene E. and Banks, Sam C. and Blanchard, Wade and Gibbons, Philip and Ikin, Karen and Blair, David and McBurney, Lachlan and Manning, Adrian D. and Stein, John A.R. (2014). New Policies for Old Trees: Averting a Global Crisis in a Keystone Ecological Structure. *Conservation Letters*. 7 (1), 61--69. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/conl.12013
- McGuire, Kevin J. and Torgersen, Christian E. and Likens, Gene E. and Buso, Donald C. and Lowe, Winsor H. and Bailey, Scott W. (2014). Network analysis reveals multiscale controls on streamwater chemistry. *Proceedings of the National Academy of Sciences*. 111 (19), 7030--7035. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1073/pnas.1404820111
- Migliavacca, Mirco and Reichstein, Markus and Richardson, Andrew D. and Mahecha, Miguel D. and Cremonese, Edoardo and Delpierre, Nicolas and Galvagno, Marta and Law, Beverly E. and Wohlfahrt, Georg and Andrew Black, T. and Carvalhais, Nuno and Ceccherini, Guido and Chen, Jiquan and Gobron, Nadine and Koffi, Ernest and William

Munger, J. and Perez-Priego, Oscar and Robustelli, Monica and Tomelleri, Enrico and Cescatti, Alessandro (2015). Influence of physiological phenology on the seasonal pattern of ecosystem respiration in deciduous forests. *Global Change Biology*. 21 (1), 363--376. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gcb.12671

- Morse, J. L. and Werner, S. F. and Gillin, C. P. and Goodale, C. L. and Bailey, S. W. and McGuire, K. J. and Groffman, P. M. (2014). Searching for biogeochemical hot spots in three dimensions: Soil C and N cycling in hydrogeologic settings in a northern hardwood forest. *Journal of Geophysical Research: Biogeosciences*. 119 (8), 2013JG002589. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/2013JG002589
- Morse, Jennifer L. and Durán, Jorge and Beall, Fred and Enanga, Eric M. and Creed, Irena F. and Fernandez, Ivan and Groffman, Peter M. (2014). Soil denitrification fluxes from three northeastern North American forests across a range of nitrogen deposition. *Oecologia*. 1--11. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s00442-014-3117-1
- Ollinger S.V., P.B. Reich, S. Frolking, L.C. Lepine, D.Y. Hollinger, and A.D. Richardson. (2013). Nitrogen cycling, forest canopy reflectance, and emergent properties of ecosystems.. *Proceedings of the National Academy of Sciences of the United States of America*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1073/pnas.1304176110
- Ollinger S.V., P.B. Reich, S. Frolking, L.C. Lepine, D.Y. Hollinger, and A.D. Richardson. (2013). Nitrogen cycling, forest canopy reflectance, and emergent properties of ecosystems.. *Proceedings of the National Academy of Sciences*. . Status = PUBLISHED; Acknowledgment of Federal Support = No ; Peer Reviewed = Yes ; DOI: 10.1073/pnas.1304176110
- Smith, Val H. and Dodds, Walter K. and Havens, Karl E. and Engstrom, Daniel R. and Paerl, Hans W. and Moss, Brian and Likens, Gene E. (2014). Comment: Cultural eutrophication of natural lakes in the United States is real and widespread. *Limnology and Oceanography*. 59 (6), 2217--2225. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.4319/lo.2014.59.6.2217
- Sullivan, Franklin B. and Ollinger, Scott V. and Martin, Mary E. and Ducey, Mark J. and Lepine, Lucie C. and Wicklein, Haley F. (2013). Foliar nitrogen in relation to plant traits and reflectance properties of New Hampshire forests. *Canadian Journal of Forest Research*. 43 (1), 18--27. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1139/cjfr-2012-0324
- Tonitto, Christina and Goodale, Christine L. and Weiss, Marissa S. and Frey, Serita D. and Ollinger, Scott V. (2013). The effect of nitrogen addition on soil organic matter dynamics: a model analysis of the Harvard Forest Chronic Nitrogen Amendment Study and soil carbon response to anthropogenic N deposition. *Biogeochemistry*. 117 (2-3), 431--454. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s10533-013-9887-4
- Toomey, Michael and Friedl, Mark and Frolking, Steve and Hufkens, Koen and Klosterman, Stephen and Sonnentag, Oliver and Baldocchi, Dennis and Bernacchi, Carl and Biraud, Sebastien and Bohrer, Gil and Brzostek, Edward and Burns, Sean P. and Coursolle, Carole and Hollinger, David Y. and Margolis, Hank A. and McCaughey, Harry

and Monson, Russell K. and Munger, J. William and Pallardy, Stephen and Phillips, Richard P. and Torn, Margaret and Wharton, Sonia and Zeri, Marcello and Richardson, Andrew (2014). Greenness indices from digital cameras predict the timing and seasonal dynamics of canopy-scale photosynthesis. *Ecological Applications*. 25 99--115. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; ISSN: 1051-0761

- Vadeboncoeur, Matthew A. and Hamburg, Steven P. and Yanai, Ruth D. and Blum, Joel D. (2014). Rates of sustainable forest harvest depend on rotation length and weathering of soil minerals. *Forest Ecology and Management*. 318 194--205. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.foreco.2014.01.012
- Wexler, Sarah K. and Goodale, Christine L. and McGuire, Kevin J. and Bailey, Scott W. and Groffman, Peter M. (2014). Isotopic signals of summer denitrification in a northern hardwood forested catchment. *Proceedings of the National Academy of Sciences*. 111 (46), 16413--16418. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1073/pnas.1404321111
- Yanai, R.D., N. Tokuchi, J.L. Campbell, M.B. Green, E. Matsuzaki, S.N. Laseter, C.L. Brown, A.S. Bailey, P. Lyons, C.R. Levine, D.C. Buso, G.E. Likens, J. Knoepp, K. Fukushima. (2014). Sources of uncertainty in estimating stream solute export from headwater catchments at three sites.. *Hydrological Processes*.. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/hyp.10265
- Yu, Xue and Driscoll, Charles T. and Warby, Richard A. F. and Montesdeoca, Mario and Johnson, Chris E. (2014). Soil mercury and its response to atmospheric mercury deposition across the northeastern United States. *Ecological Applications*. 24 (4), 812--822. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1890/13-0212.1
- Zipkin, Elise F. and Sillett, T. Scott and Grant, Evan H. Campbell and Chandler, Richard B. and Royle, J. Andrew (2014). Inferences about population dynamics from count data using multistate models: a comparison to capture–recapture approaches. *Ecology and Evolution*. 4 (4), 417--426. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/ece3.942

Licenses

Other Products

Other Publications

- Likens, G. E. and L. O. Hedin. (2014). *F. Herbert Bormann 1922-1912: A Biographical Memoir*.. Biographical Memoirs are brief biographies of deceased National Academy of Sciences members, written by those who knew them or their work. These biographies provide personal and scholarly views of America’s most distinguished researchers and a biographical history of U.S. science. Bormann memoir available at <http://www.nasonline.org/publications/biographical-memoirs/memoir-pdfs/bormann-f-herbert.pdf>. Status = PUBLISHED; Acknowledgement of Federal Support = No

- Likens, G.E. (2014). *The ecosystem approach for understanding and resolving environmental problems..* In: Blue Planet Prize book.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Patents

Technologies or Techniques

Thesis/Dissertations

- Yang, Yang.. . *Sources of variability in tissue chemistry in northern hardwood species..* (2015). SUNY College of Environmental Science and Forestry. Acknowledgement of Federal Support = Yes
- Gannon, J.P.. *A Hydropedological Approach to Describing Runoff Generation, Lateral Podzolization, and Spatial and Temporal Patterns of {DOC} in a Headwater Catchment..* (2014). Virginia Tech. Acknowledgement of Federal Support = Yes
- Pourmokhtarian, Afshin.. *Biogeochemical Modeling of the Response of Forest Watersheds in the Northeastern U.S. to Future Climate Change. Ph.D. Thesis.* (2013). Syracuse University. Acknowledgement of Federal Support = Yes
- Diggs, Franklin M.. *Contrasting mycorrhizal guilds through the soil profile..* (2014). SUNY College of Environmental Science and Forestry. Acknowledgement of Federal Support = Yes
- Dong, Yi. *Effects of rock-derived nutrients on N cycling in northern hardwood forest.* (2014). {SUNY} College of Environmental Science and Forestry. Acknowledgement of Federal Support = Yes
- Dong, Yi.. *Effects of rock-derived nutrients on N cycling in northern hardwood forest..* (2014). SUNY College of Environmental Science and Forestry. Acknowledgement of Federal Support = Yes
- Lany, Nina. *Effects of temperature on species interactions in northern hardwood forests.* (2014). Dartmouth College. Acknowledgement of Federal Support = Yes
- Reinmann, Andrew. *Effects of winter climate change on carbon and nitrogen losses from temperate forest ecosystems.* (2014). Boston University. Acknowledgement of Federal Support = Yes
- Fuss, Colin. *Hydrochemical Dynamics Under Differing Winter Climate Regimes at the Hubbard Brook Experiment Forest.* (2014). Syracuse. Acknowledgement of Federal Support = Yes
- Bourgault, R.. *Hydropedology of podzols at Hubbard Brook, New Hampshire.* (2014). University of Vermont. Acknowledgement of Federal Support = Yes
- Lee, M.. *Impact of Diffuse Radiation Measurements on Modeling Carbon Budgets: A Model-Data Fusion Experiment at Bartlett Experimental Forest. Undergraduate Thesis..* (2013). Harvard University. Acknowledgement of Federal Support = Yes
- McDonald, Michael. *Multitrophic Interactions: Moose Herbivory Affects Nest Site Selection. M.S. Thesis, Wildlife Science, The University of Vermont, Burlington, Vermont..* (2013). University of Vermont. Acknowledgement of Federal Support = Yes

- van Doorn, Natalie S.. *Patterns and Process of Forest Growth: the Role of Neighborhood Dynamics and Tree Demography in a Northern Hardwood Forest*. (2014). University of California, Berkeley. Acknowledgement of Federal Support = Yes
- Dib, Alain E.. *Simulating Effects of a Changing Climate and Higher CO2 Emissions on Soil Carbon Pools at the Hubbard Brook Experimental Forest Using CENTURY and RothC*. M.S. Thesis. (2012). Syracuse University. Acknowledgement of Federal Support = Yes
- Hallworth, Michael. *The influence of migratory connectivity and seasonal interactions on individual- and population-level dynamics of a long distance migratory songbird*.. (2014). George Mason University. Acknowledgement of Federal Support = Yes
- Burakowski, Elizabeth. *Winter climate impacts of historical deforestation in New England*. (2014). University of New Hampshire. Acknowledgement of Federal Support = Yes
- E. Burakowski.. *Winter climate impacts of historical deforestation in New England*.. (2014). University of New Hampshire. Acknowledgement of Federal Support = Yes

Websites

- *Bird population and community studies at HBEF*
<http://www.hubbardbrook.org/research/animals/bird/holmes-intro03.htm>

An introduction to our ongoing research projects in bird population and communities studies at HBEF.

- *Hubbard Brook Research Foundation Education Programs*
<http://hubbardbrookfoundation.org/education-programs-at-hubbard-brook-an-overview/>

The Hubbard Brook Research Foundation hosts a dynamic website with teaching resources developed with support of the LTER Schoolyard program and the USDA-Forest Service. It contains data activities developed by our RET teachers, mock-NECAP exams developed with our partner schools, and teaching guides on acid rain and migratory birds. Contents of the website are promoted at state-wide and regional science teacher conferences and through our various partnerships with teacher professional development organizations.

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Participants/Organizations

Research Experience for Undergraduates (REU) funding

Form of REU funding support:

REU supplement

How many REU applications were received during this reporting period?

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

10

REU Comments:

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Fahey, Timothy	PD/PI	1
Driscoll, Charles	Co PD/PI	2
Bailey, Scott	Co-Investigator	3
Battles, John	Co-Investigator	2
Blum, Joel	Co-Investigator	1
Campbell, John	Co-Investigator	6
Fisk, Melany	Co-Investigator	3
Goodale, Christine	Co-Investigator	1
Groffman, Peter	Co-Investigator	1
Johnson, Chris	Co-Investigator	2
Likens, Gene	Co-Investigator	2
McGuire, Kevin	Co-Investigator	2
Mitchell, Myron	Co-Investigator	1
Ollinger, Scott	Co-Investigator	0
Pruyn, Michele	Co-Investigator	1
Richardson, Andrew	Co-Investigator	1
Rodenhouse, Nicholas	Co-Investigator	2
Yanai, Ruth	Co-Investigator	1
Abrams, Mary Ann	K-12 Teacher	1
Dumont, Peter	K-12 Teacher	1
Aubrecht, Donald	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Chen, Min	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Keenan, Trevor	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Zhou, Zaixing	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Cleavitt, Natalie	Other Professional	6
Garlick, Sarah	Other Professional	6
Lovett, Gary	Other Professional	1
Martin, Mary	Other Professional	5
Pardo, Linda	Other Professional	2
Templer, Pamela	Other Professional	1

Name	Most Senior Project Role	Nearest Person Month Worked
Wilson, Geoff	Other Professional	12
Wilson, Jackie	Other Professional	6
Ard, Gabrielle	Technician	1
Burns, Margaret	Technician	3
Buso, Donald	Technician	6
Engelman, Heather	Technician	1
Glick, Nicholas	Technician	7
Grunzel, David	Technician	3
Guida, Timothy	Technician	3
Heinz, Alexis	Technician	2
Irish, Amanda	Technician	3
Koppers, Mary Margaret	Technician	6
Kotovich, Nikolas	Technician	3
Martel, Lisa	Technician	3
Montesdeoca, Mario	Technician	2
O'Neill, William	Technician	1
Rice, Michael	Technician	3
Savides, Kimberley	Technician	3
Thorne, Trischa	Technician	4
Gleason, Jamie	Staff Scientist (doctoral level)	1
Lepine, Lucie	Staff Scientist (doctoral level)	1
Bayer, Clarice`	Graduate Student (research assistant)	4
Blumstein, Megan	Graduate Student (research assistant)	2
Burakowski, Elizabeth	Graduate Student (research assistant)	1
Fuss, Colin	Graduate Student (research assistant)	1
Gannon, John	Graduate Student (research assistant)	5
Goswami, Shinjini	Graduate Student (research assistant)	6
Hadley, Sarah	Graduate Student (research assistant)	1
Lany, Nina	Graduate Student (research assistant)	1
Patterson, Owen	Graduate Student (research assistant)	2
Pourmokhtarian, Afshin	Graduate Student (research assistant)	1
Puntsag, Tamir	Graduate Student (research assistant)	2
Shan, Shan	Graduate Student (research assistant)	4
Yang, Yang	Graduate Student (research assistant)	1
Magill, Alison	Non-Student Research Assistant	1
Shao, Shuai	Non-Student Research Assistant	6
Babel, Hannah	Undergraduate Student	2
Collin, Erin	Undergraduate Student	1
Donovan, Edward	Undergraduate Student	1

Name	Most Senior Project Role	Nearest Person Month Worked
Dowhaniuk, Nicholas	Undergraduate Student	1
Emerson, Janelle	Undergraduate Student	1
Forlini, Dominic	Undergraduate Student	2
Geromini, Sarah	Undergraduate Student	1
Grentzer, Michael	Undergraduate Student	3
Hastings, Leah	Undergraduate Student	1
Hernandez, Nathaniel	Undergraduate Student	2
Higginson, Charlotte	Undergraduate Student	3
Jardine, Kelsey	Undergraduate Student	1
Kellner, James	Undergraduate Student	3
McCandless, Catherine	Undergraduate Student	2
McClure, Amelia	Undergraduate Student	3
McQuillan, Mary Elizabeth	Undergraduate Student	3
Minicucci, Leona	Undergraduate Student	1
Montague, Madeline	Undergraduate Student	3
Morrison, Zepher	Undergraduate Student	1
Schiera, James	Undergraduate Student	1
Shephard, Noah	Undergraduate Student	3
Tamargo, Katelyn	Undergraduate Student	1
Thomson, Kathryn	Undergraduate Student	1
Becerra, Briana	Research Experience for Undergraduates (REU) Participant	3
Floro, Kelly	Research Experience for Undergraduates (REU) Participant	3
Gunn, Cailene	Research Experience for Undergraduates (REU) Participant	3
Hernandez, Jessica	Research Experience for Undergraduates (REU) Participant	3
Jarrett, Jamal	Research Experience for Undergraduates (REU) Participant	3
Jones, Jarred	Research Experience for Undergraduates (REU) Participant	3
Morgan, David	Research Experience for Undergraduates (REU) Participant	3
Poling, Benjamin	Research Experience for Undergraduates (REU) Participant	3
Suttenberg, Stephanie	Research Experience for Undergraduates (REU) Participant	3
Weeks, Josiah	Research Experience for Undergraduates (REU) Participant	3

Full details of individuals who have worked on the project:

Timothy J Fahey

Email: tjf5@cornell.edu

Most Senior Project Role: PD/PI

Nearest Person Month Worked: 1

Contribution to the Project: Fahey is project Principal Investigator.

Funding Support: Home institution.

International Collaboration: No

International Travel: No

Charles T Driscoll

Email: ctdrisco@syr.edu

Most Senior Project Role: Co PD/PI

Nearest Person Month Worked: 2

Contribution to the Project: Designs and coordinates project, works with students and technicians.

Funding Support: none

International Collaboration: No

International Travel: No

Scott W Bailey

Email: swbailey@plymouth.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 3

Contribution to the Project: Dr. Bailey is the lead researcher and field coordinator on the hydrogeology study, which examines feedbacks between hydrology, soil characteristics, and catchment biogeochemistry in the reference watershed. He has been responsible for soil and geochemical characterization in the reference watershed. 2 graduate students on the project successfully defended in Spring 2014.

Funding Support: USFS-Northern Research Station

International Collaboration: No

International Travel: No

John J Battles

Email: jbattles@berkeley.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 2

Contribution to the Project: Co-lead scientist for long-term monitoring of primary productivity, forest composition, and tree demography.

Funding Support: this award.

International Collaboration: No

International Travel: No

Joel D Blum

Email: jdblum@umich.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Contributed to several journal papers, supervised lab analyses, contributed to field sampling.

Funding Support: no salary support from this project; paid by home institution.

International Collaboration: No

International Travel: No

John L Campbell

Email: jlcampbell@fs.fed.us

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 6

Contribution to the Project: Campbell conducts research on biogeochemistry and hydrology. Help maintain the long-term hydrometeorological record.

Funding Support: US Forest Service

International Collaboration: No

International Travel: No

Melany Fisk

Email: fiskmc@miamioh.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 3

Contribution to the Project: Melany Fisk's research focuses on nutrient cycling and soil organisms. She is involved in studies of winter climate and snowpack controls of carbon and nitrogen processing, and of plant-microbe processes that mediate interactions among different nutrients (calcium, nitrogen, phosphorus).

Funding Support: partial support from this grant towards research.

International Collaboration: No

International Travel: No

Christine Goodale

Email: clg33@cornell.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: worked on data and manuscripts pertaining to stable isotopes of N in soil and streamwater.

Funding Support: this grant and a former NSF award (DEB-0919131).

International Collaboration: No

International Travel: No

Peter Mark Groffman

Email: groffmanP@caryinstitute.org

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Peter leads long-term monitoring of soil microbial biomass and activity, winter climate change and nitrogen gas flux research.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Chris Johnson

Email: cejohns@syr.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 2

Contribution to the Project: Research on soil biogeochemistry; supervision of students and technician.

Funding Support: this grant.

International Collaboration: Yes, australia

International Travel: No

Gene E Likens

Email: LikensG@ecostudies.org

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 2

Contribution to the Project: Overall project supervision, ecosystem and biogeochemical research on forest, stream and lake ecosystems of the Hubbard Brook Valley.

Funding Support: salary from home institution

International Collaboration: No

International Travel: No

Kevin J McGuire

Email: kevin.mcguire@vt.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 2

Contribution to the Project: • Dr. McGuire is the main researcher on the process hydrology portion of the project that relates to the hydrology study, which examines feedbacks between hydrology, soil characteristics, and catchment biogeochemistry in the reference watershed, WS3.
• Manages a subaward and was the primary advisor to 1 graduate student on the project in 2014.

Funding Support: This grant and NSF EAR 1014507.

International Collaboration: No

International Travel: Yes, luxembourg - 0 years, 0 months, 4 days

Myron James Mitchell

Email: Mitchell@syr.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: In the past year in conjunction with my Ph.D. student Tamir Puntsag we are examining the stable isotopes of water with particular emphasis on precipitation and streams.. We have sampled precipitation and stream samples for the archives and have analyzed the stable isotopes of hydrogen and oxygen in water. We have done over 2000 isotopic analyses using the facilities at the University of Alaska-Anchorage. We have begun synthesizing these data and are working on a manuscript of these results.

Funding Support: This grant.

International Collaboration: Yes, mongolia

International Travel: Yes, japan - 0 years, 0 months, 7 days

Scott Ollinger

Email: scott.ollinger@unh.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 0

Contribution to the Project: Carbon and nitrogen cycling, remote sensing and ecosystem modeling.

Funding Support: Other.

International Collaboration: No

International Travel: No

Michele Lynn Pruyn

Email: mlpruyn@plymouth.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Serves as PI for the HBEF REU project. Mentor to undergraduate participants. Work with the co-PIs, to run the programming, review submissions, etc. Conduct research with undergrads and graduate student.

Funding Support: home institution support.

International Collaboration: No

International Travel: No

Andrew Richardson

Email: arichardson@oeb.harvard.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Dr. Richardson managed CO₂ flux measurements at Bartlett Experimental Forest; supervised undergraduates and postdocs conducting empirical and model-data fusion analyses of Bartlett Data.

Funding Support: Funded through Harvard faculty position.

International Collaboration: Yes, australia
International Travel: No

Nicholas Rodenhouse

Email: nrodenho@wellesley.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 2

Contribution to the Project: Nick leads/manages the study of heterotrophs: sampling of birds, salamander, insects, mammals to produce the data and models needed develop a landscape demography for heterotrophs.

Funding Support: Home institution.

International Collaboration: Yes, poland
International Travel: No

Ruth Yanai

Email: rdyanai@syr.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Ruth coordinates the MELNHE project (Multiple Element Limitation in Northern Hardwood Ecosystems), which was proposed as an activity of the Hubbard Brook LTER. 2014 was the fourth year of treatment of N, P, and Ca in stands of different ages at Hubbard Brook, Jeffers Brook, and Bartlett Experimental Forests. Uncertainty analysis was another theme of the HBR LTER. This effort has since been funded as a Research Coordination Network called QUEST (Quantifying Uncertainty in Ecosystem Studies), led by Yanai and other HBR researchers (Mark Green and John Campbell) as well as researchers at other institutions.

Funding Support: partial from this grant.

International Collaboration: Yes, germany

International Travel: Yes, germany - 0 years, 0 months, 3 days; germany - 0 years, 0 months, 6 days

Mary Ann Abrams

Email: m_abrams@sau9.org

Most Senior Project Role: K-12 Teacher

Nearest Person Month Worked: 1

Contribution to the Project: Mary Ann was a Research Experience for Teachers participant and worked on a project investigating the effects of silvicultural treatments on small mammal populations.

Funding Support: Research Experience for Teachers.

International Collaboration: No

International Travel: No

Peter Dumont

Email: pdumont@sau4.org

Most Senior Project Role: K-12 Teacher

Nearest Person Month Worked: 1

Contribution to the Project: Peter is a high-school science teacher and participated in our Research Experience for Teachers program. He worked on a project investigating the effects of salamanders on streamwater chemistry.

Funding Support: RET

International Collaboration: No

International Travel: No

Donald Aubrecht

Email: aubrecht@oeb.harvard.edu

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 1

Contribution to the Project: Donald assisted with field maintenance of instruments and CO2 flux system at Bartlett.

Funding Support: Also funded through other NSF support.

International Collaboration: No

International Travel: No

Min Chen

Email: minchen@fas.harvard.edu

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 2

Contribution to the Project: conducted model-data fusion analysis of Bartlett flux data.

Funding Support: Funded for this work through grants from NOAA and DOE.

International Collaboration: No

International Travel: No

Trevor Keenan

Email: trevor.keenan@mq.edu.au

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 1

Contribution to the Project: Trevor analyzed CO₂ flux data from Bartlett and long-term phenology data from Hubbard Brook.

Funding Support: Funded through Australian fellowship.

International Collaboration: Yes, australia

International Travel: No

Zaixing Zhou

Email: zaixingzhou@gmail.com

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 1

Contribution to the Project: Enhancements to PnET ecosystem models model, simulation of NPP for the HB valley and validation against valley-wide plot measurements.

Funding Support: this grant and other.

International Collaboration: No

International Travel: No

Natalie L Cleavitt

Email: nlc4@cornell.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 6

Contribution to the Project: Dr. Cleavitt oversees the tree survey crew and runs several other long-term plant ecology projects. She conducts the collection of fine litter, coarse woody debris and leaves for foliar chemistry. This season she mentored two REU students. She curates the long-term vegetation data sets. She takes full part in data analysis and paper writing. She is also author of “Seeking the Wolf Tree”, the schoolyard book for Hubbard Brook, which is currently being illustrated.

Funding Support: this award and Cornell University.

International Collaboration: No

International Travel: No

Sarah Garlick

Email: sarahgarlick@gmail.com

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 6

Contribution to the Project: Sarah is the Director of Science Policy and Outreach for the Hubbard Brook Research Foundation and directs the site’s Forest Science Dialogs project

Funding Support: NSF Award #DRL 1322871

International Collaboration: No

International Travel: No

Gary Lovett

Email: lovettg@caryinstitute.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Lovett is chair of the Hubbard Brook Committee of Scientists, the organization that runs the HB Ecosystem Study.

Funding Support: Home institution

International Collaboration: No

International Travel: No

Mary Martin

Email: mary.martin@unh.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 5

Contribution to the Project: Information management

Funding Support: this grant.

International Collaboration: No

International Travel: No

Linda H Pardo

Email: lpardo@fs.fed.us

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 2

Contribution to the Project: technician supervision, study design, methods development, data qa/qc and analysis.

Funding Support: US Forest Service.

International Collaboration: No

International Travel: No

Pamela Templer

Email: ptempler@bu.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: I am an ecosystem ecologist and forest ecologist. I manage projects related to plant nutrient uptake, canopy and soil carbon fluxes, as well as soil nitrogen cycling measurements in the laboratory and field. I am an elected member of the Scientific Coordinating Committee and am on the Board of Trustees for the Hubbard Brook Research Foundation. I support graduate students working at Hubbard Brook.

Funding Support: NSF LTER grant, along with funds from a NSF CAREER grant, and a grant from NOAA and NASA>

International Collaboration: No

International Travel: No

Geoff Wilson

Email: gwilson@hbresearchfoundation.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 12

Contribution to the Project: Geoff is the Director of Facilities and Programs for the Hubbard Brook Research Foundation and oversees the K-12 education programs, coordinates the REU and RET programs, and participates in other education and outreach activities on behalf of the site. In addition, he manages the seasonal housing and lab facilities.

Funding Support: sLTER.

International Collaboration: No

International Travel: No

Jackie Wilson

Email: jwilson@hbresearchfoundation.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 6

Contribution to the Project: Jackie is an educational associate for the Hubbard Brook Research Foundation and is very involved with the K-12 education for the site, including lesson development and participation in a state-wide teacher professional development team.

Funding Support: sLTER

International Collaboration: No

International Travel: No

Gabrielle Ard

Email: gard@syr.edu

Most Senior Project Role: Technician

Nearest Person Month Worked: 1

Contribution to the Project: Gabrielle is analyzing patterns of phosphorus in soil water and stream water.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Margaret Burns

Email: burnsm@caryinstitute.org

Most Senior Project Role: Technician

Nearest Person Month Worked: 3

Contribution to the Project: Field, laboratory and data analysis.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Donald C Buso

Email: dbuso@worldpath.net

Most Senior Project Role: Technician

Nearest Person Month Worked: 6

Contribution to the Project: Manager of Field Studies and Data Management at Hubbard Brook Experimental Forest under supervision of Gene E. Likens.

Funding Support: supported by this grant.

International Collaboration: No

International Travel: No

Heather Engelman

Email: forestecology@esf.edu

Most Senior Project Role: Technician

Nearest Person Month Worked: 1

Contribution to the Project: Heather takes care of the bulk of the lab paperwork and maintains project information on the ESF websites. She also supports manuscript, poster and grant preparation.

Funding Support: SUNY-ESF.

International Collaboration: No

International Travel: No

Nicholas Glick

Email: nblick@syr.edu

Most Senior Project Role: Technician

Nearest Person Month Worked: 7

Contribution to the Project: Sampling and analysis of soil solution and stream samples.

Funding Support: this grant.

International Collaboration: No

International Travel: No

David P Grunzel

Email: dagrunz@gmail.com

Most Senior Project Role: Technician

Nearest Person Month Worked: 3

Contribution to the Project: assisted teams with banding of oven birds and the oven bird demography project

Funding Support: this grant.

International Collaboration: No

International Travel: No

Timothy A Guida

Email: timothyguida@gmail.com

Most Senior Project Role: Technician

Nearest Person Month Worked: 3

Contribution to the Project: Conducted point-counts of birds and assisted with arthropod and vegetation sampling.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Alexis Kristan Heinz

Email: akh24@cornell.edu

Most Senior Project Role: Technician

Nearest Person Month Worked: 2

Contribution to the Project: Alexis is the lab manager for Fahey's lab at Cornell University; she

provides laboratory assistance for this project.

Funding Support: this award.

International Collaboration: No

International Travel: No

Amanda Irish

Email: irishA@caryinstitute.org

Most Senior Project Role: Technician

Nearest Person Month Worked: 3

Contribution to the Project: Role: Field, laboratory and data analysis.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Mary Margaret Koppers

Email: mmkoppers@syr.edu

Most Senior Project Role: Technician

Nearest Person Month Worked: 6

Contribution to the Project: Mary Margaret Koppers is a technician examining soil chemistry at Syracuse University.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Nikolas I Kotovich

Email: nkotovic@uvm.edu

Most Senior Project Role: Technician

Nearest Person Month Worked: 3

Contribution to the Project: Conducted point-counts of birds and assisted with arthropod and vegetation sampling.

Funding Support: this grant.

International Collaboration: No
International Travel: No

Lisa Martel
Email: martelL@caryinstitute.org
Most Senior Project Role: Technician
Nearest Person Month Worked: 3

Contribution to the Project: Role: Field, laboratory and data analysis.

Funding Support: this grant.

International Collaboration: No
International Travel: No

Mario Montesdeoca
Email: mmontesd@syr.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 2

Contribution to the Project: Mario Montesdeoca supervises laboratory activities at Syracuse University, Department of Civil Engineering.

Funding Support: paid by employer.

International Collaboration: No
International Travel: No

William O'Neill
Email: wfoneill160@msn.com
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Bill contributed to manuscript support this year, particularly preparing graphics.

Funding Support: this project and support from SUNY-ESF.

International Collaboration: No
International Travel: No

Michael Rice

Email: mjrice03@syr.edu

Most Senior Project Role: Technician

Nearest Person Month Worked: 3

Contribution to the Project: Sampling and analysis of soil solution and stream samples.

Funding Support: from this grant.

International Collaboration: No

International Travel: No

Kimberley S Savides

Email: kim.savides@gmail.com

Most Senior Project Role: Technician

Nearest Person Month Worked: 3

Contribution to the Project: Conducted point-counts of birds and assisted with arthropod and vegetation sampling.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Trischa B Thorne

Email: trischa.b.thorne@gmail.com

Most Senior Project Role: Technician

Nearest Person Month Worked: 4

Contribution to the Project: Crew leader; assisted plot teams with data collection; organized data entry and proofing, etc.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Jamie D Gleason

Email: jdgleaso@umich.edu

Most Senior Project Role: Staff Scientist (doctoral level)

Nearest Person Month Worked: 1

Contribution to the Project: Performed lab analysis

Funding Support: other funding.

International Collaboration: No

International Travel: No

Lucie Lepine

Email: lucie.lepine@unh.edu

Most Senior Project Role: Staff Scientist (doctoral level)

Nearest Person Month Worked: 1

Contribution to the Project: Remote sensing using high spectral resolution aircraft data. Preparation of spatial data layers for modeling.

Funding Support: this grant and home institution.

International Collaboration: No

International Travel: No

Clarice` Bayer

Email: clarice.bayer@umontana.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 4

Contribution to the Project: Claire Bayer is a Ph.D. candidate, University of Montana. Food Web Complexity and Retentiveness in Low Productivity Environments. Ph.D. Dissertation in progress, University of Montana, Missoula, MT

Funding Support: this grant.

International Collaboration: No

International Travel: No

Megan Blumstein

Email: blumstein@fas.harvard.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 2

Contribution to the Project: conducted model-data fusion analysis of Bartlett flux data.

Funding Support: Funded by NSF Doctoral Fellowship.

International Collaboration: No

International Travel: No

Elizabeth Burakowski

Email: elizabeth.burakowski@gmail.com

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 1

Contribution to the Project: Remote sensing, albedo, ecosystem-climate interactions.

Funding Support: Other

International Collaboration: No

International Travel: No

Colin Fuss

Email: cfuss@syr.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 1

Contribution to the Project: Colin Fuss is studying the long term soil solution and stream chemistry patterns at Syracuse University.

Funding Support: No.

International Collaboration: No

International Travel: No

John P Gannon

Email: jpgannon@vt.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 5

Contribution to the Project: Mr. Gannon analyzed groundwater and soil water data to show how hydrologic influences lead to distinct variation in soil morphological expression. He completed his dissertation and published 1 refereed journal paper.

Funding Support: This grant and NSF EAR 1014507

International Collaboration: No

International Travel: No

Shinjini Goswami

Email: goswams@miamioh.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 6

Contribution to the Project: Shinjini Goswami is a graduate student at Miami University studying nitrogen and phosphorus limitation in forests.

Funding Support: Partially supported by this project.

International Collaboration: No

International Travel: No

Sarah J.K. Hadley

Email: Sarah.Frey@oregonstate.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 1

Contribution to the Project: Focusing on avian distribution and abundance. Effects of climate, vegetation and conspecifics on the landscape pattern and dynamics of forest birds. Ph.D. Dissertation, in progress. Oregon State University, Corvallis, OR

Funding Support: this project.

International Collaboration: No

International Travel: No

Nina Lany

Email: nina.k.lany@dartmouth.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 1

Contribution to the Project: Nina Lany (PhD candidate, Dartmouth College) and Dr. Matthew Ayres (Dartmouth College) are testing the hypothesis that inter-annual variation in foliar nitrogen content can generate the large fluctuations in caterpillar abundance observed in the HBEF. Temperature dependence of species interactions in a northern hardwood forest. Ph.D. Dissertation

in progress, Dartmouth College, Hanover, NH.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Owen Patterson

Email: patteroe@miamioh.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 2

Contribution to the Project: Owen Patterson is a graduate student at Miami University studying nutrient limitation of microbial activity.

Funding Support: Partially supported by this project

International Collaboration: No

International Travel: No

Afshin Pourmokhtarian

Email: apourmok@syr.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 1

Contribution to the Project: Afshin Pourmokhtarian is a Ph.D. student with Charles Driscoll in the Department of Civil and Environmental Engineering at Syracuse University. He is working on climate change effects on soil and stream chemistry.

Funding Support: none from this grant.

International Collaboration: No

International Travel: No

Tamir Puntsag

Email: tpuntsag@syr.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 2

Contribution to the Project: Along with Myron Mitchell at SNY ESF, in the past year Tamir Puntsag has been examining the stable isotopes of water with particular emphasis on precipitation and streams. Sampled precipitation samples for the archives and analyzed the stable isotopes of

hydrogen and oxygen in water. Completed over 2000 isotopic analyses using the facilities at the University of Alaska-Anchorage, and have begun synthesizing these data and working on a manuscript of these results.

Funding Support: Fulbright Fellowship and NSF LTER project.

International Collaboration: No

International Travel: Yes, japan - 0 years, 0 months, 7 days

Shan Shan

Email: shans@miamioh.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 4

Contribution to the Project: Shan Shan is a graduate student at Miami University studying interactions of nutrient limitation and rhizosphere microbial processes.

Funding Support: Partially supported by this project.

International Collaboration: No

International Travel: No

Yang Yang

Email: yyang100@syr.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 1

Contribution to the Project: Yang Yang processed litter samples and data. In addition to his thesis project, which involves samples collected from Hubbard Brook and other sites, he is preparing a paper on litterfall uncertainty.

Funding Support: graduate teaching assistant (chemistry) through Syracuse University.

International Collaboration: No

International Travel: No

Alison Magill

Email: a.magill@unh.edu

Most Senior Project Role: Non-Student Research Assistant

Nearest Person Month Worked: 1

Contribution to the Project: Assist Information Manager with data package preparation for

LTER-NIS and development and update HBR data packages.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Shuai Shao

Email: sshao@syr.edu

Most Senior Project Role: Non-Student Research Assistant

Nearest Person Month Worked: 6

Contribution to the Project: Shuai Shao is conducting research on the analysis of soil water and stream water to a calcium silicate watershed treatment.

Funding Support: none from this grant.

International Collaboration: No

International Travel: No

Hannah Babel

Email: babelhr@miamioh.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 2

Contribution to the Project: Hannah Babel is an undergraduate at Miami University studying microbial nutrient pools.

Funding Support: this project.

International Collaboration: No

International Travel: No

Erin Collin

Email: collineg@miamioh.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Erin Collin is an undergraduate at Miami University studying tree seedling responses to nutrients.

Funding Support: Partially supported by this project.

International Collaboration: No

International Travel: No

Edward Donovan

Email: ejw42@wildcats.unh.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Scanned historical charts and recorded data from charts.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Nicholas Dowhaniuk

Email: nsp6@wildcats.unh.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: HBR GIS dataset updates.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Janelle Emerson

Email: jeemerson@mail.plymouth.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Assisted with salamander sampling, maintained experimental stream pools.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Dominic Forlini

Email: forlinda@miamioh.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 2

Contribution to the Project: Dominic Forlini is an undergraduate at Miami University studying controls of soil microbial respiration.

Funding Support: this project.

International Collaboration: No

International Travel: No

Sarah Geromini

Email: sdy53@wildcats.unh.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Developing new datasets from meteorological chart archive.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Michael Grentzer

Email: grentzmf@miamioh.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 3

Contribution to the Project: Michael Grentzer is an undergraduate at Miami University studying microbial processes in the rhizosphere.

Funding Support: Partially supported by this project.

International Collaboration: No

International Travel: No

Leah Hastings

Email: l.hastings94@gmail.com

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Developing new datasets from meteorological chart archive.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Nathaniel Hernandez

Email: natcatcher@comcast.net

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 2

Contribution to the Project: Conducted point-counts of birds valley-wide.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Charlotte Higginson

Email: ceh262@cornell.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 3

Contribution to the Project: Charlie served as one of our field crew members for tree measurements including the 30-yr re-measure of Watershed 5, the 20-yr re-measure of the Bowl RNA, tree and soil work relating to the windstorm of 2 Jun 2013, and other field tasks.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Kelsey Jardine

Email: krjardin@syr.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: laboratory analyses of soils.

Funding Support: this grant.

International Collaboration: No

International Travel: No

James Kellner

Email: jlk338@cornell.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 3

Contribution to the Project: Jamie served as one of our field crew members for tree measurements including the 30-yr re-measure of Watershed 5, the 20-yr re-measure of the Bowl RNA, tree and soil work relating to the windstorm of 2 Jun 2013, and other field tasks.

Funding Support: LTER (this grant)

International Collaboration: No

International Travel: No

Catherine McCandless

Email: cmccandl@wellesley.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 2

Contribution to the Project: assisted with data entry, verification and analysis during the academic year.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Amelia R McClure

Email: amclure@wellesley.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 3

Contribution to the Project: Assisted with arthropod field experiments, sampling and sorting of samples.

Funding Support: this grant.

International Collaboration: No
International Travel: No

Mary Elizabeth McQuillan
Email: mcquill23@gmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: conducted salamander and aquatic insect surveys, set up and maintained experimental stream pools.

Funding Support: this grant.

International Collaboration: No
International Travel: No

Leona Minicucci
Email: lminicucci@mail.plymouth.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: updating k-12 educational webpages/HB virtual tour.

Funding Support: this grant.

International Collaboration: No
International Travel: No

Madeline Montague
Email: msm297@cornell.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Maddie served as one of our field crew members for tree measurements including the 30-yr re-measure of Watershed 5, the 20-yr re-measure of the Bowl RNA, tree and soil work relating to the windstorm of 2 Jun 2013, and other field tasks.

Funding Support: this grant.

International Collaboration: No
International Travel: No

Zepher Morrison

Email: 7greensoccermonkey@gmail.com

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Assisted with salamander sampling, maintained experimental stream pools.

Funding Support: this grant.

International Collaboration: No

International Travel: No

James Schiera

Email: jtschier@syr.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 1

Contribution to the Project: Field sampling of soils.

Funding Support: this grant.

International Collaboration: No

International Travel: No

Noah Shephard

Email: ns628@cornell.edu

Most Senior Project Role: Undergraduate Student

Nearest Person Month Worked: 3

Contribution to the Project: Noah was a returning crew member. This year he served again as one of our field crew members for tree measurements including the 30-yr re-measure of Watershed 5, the 20-yr re-measure of the Bowl RNA, tree and soil work relating to the windstorm of 2 Jun 2013, and other field tasks.

Funding Support: this award.

International Collaboration: No

International Travel: No

Katelyn Tamargo

Email: kmtamarg@syr.edu

Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: laboratory analyses of soils.

Funding Support: this grant.

International Collaboration: No
International Travel: No

Kathryn Thomson
Email: kpb39@wildcats.unh.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Developing new datasets from meteorological chart archive.

Funding Support: this grant.

International Collaboration: No
International Travel: No

Briana Becerra
Email: brbecerra@csumb.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 3

Contribution to the Project: Bri conducted a project comparing the seedling layer and seedling environment between 30-yr (Watershed 5) and reference 100-yr old forest and three elevation classes. Her project contributes to our growing studies of the seedling layer at HBEF and to the summary of 30-yr changes in Watershed 5. Bri presented the results of her project through an oral presentation at the HBRF-REU conference and at a poster at the larger UROC conference.

Funding Support: REU site grant DEB # 1156844

International Collaboration: No
International Travel: No
Year of schooling completed: Sophomore
Home Institution: California State University Monterey Bay
Government fiscal year(s) was this REU participant supported: 2014

Kelly Floro

Email: kfloro@gmu.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 3

Contribution to the Project: Kelly investigated the permeability of the C soil horizon to water and found more variability than has been generally assumed.

Funding Support: REU site grant DEB # 1156844

International Collaboration: No

International Travel: No

Year of schooling completed: Sophomore

Home Institution: George Mason University

Government fiscal year(s) was this REU participant supported: 2014

Cailene Gunn

Email: cgunn@bates.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 3

Contribution to the Project: Cailene developed and tested an alternative method to lysimetry for soil water extraction.

Funding Support: REU site grant DEB # 1156844

International Collaboration: No

International Travel: No

Year of schooling completed: Sophomore

Home Institution: Bates College

Government fiscal year(s) was this REU participant supported: 2014

Jessica Hernandez

Email: jh0d2011@mymail.pomona.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 3

Contribution to the Project: Jessica worked on a project investigating the dispersal and homing behavior of *Gyrinophilus porphyriticus* across two freshwater predation regimes.

Funding Support: REU site grant DEB # 1156844

International Collaboration: No

International Travel: No

Year of schooling completed: Junior
Home Institution: Pomona College
Government fiscal year(s) was this REU participant supported: 2014

Jamal Jarrett

Email: malj999@gmail.com

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 3

Contribution to the Project: Jamal tested a technique utilizing dendrochronology and whirl counts on suppressed red spruce trees to gain insights into the canopy disturbance history of the reference watershed at Hubbard Brook.

Funding Support: REU site grant DEB # 1156844

International Collaboration: No

International Travel: No

Year of schooling completed: Other

Home Institution: Tennessee State University

Government fiscal year(s) was this REU participant supported: 2014

Jarred Jones

Email: joneja09@gettysburg.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 3

Contribution to the Project: Jarred investigated the disturbance history of the reference watershed at Hubbard Brook using dendrochronology and remote sensing techniques.

Funding Support: REU site grant DEB # 1156844

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: Gettysburg College

Government fiscal year(s) was this REU participant supported: 2014

David Morgan

Email: djmorgan@plymouth.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 3

Contribution to the Project: David investigated the atmospheric and environmental conditions responsible for extreme streamflow at Hubbard Brook.

Funding Support: REU through this award.

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: Plymouth State University

Government fiscal year(s) was this REU participant supported: 2014

Benjamin Poling

Email: btp5187@vt.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 3

Contribution to the Project: Ben conducted a project comparing the soil drainage features of trees that had been tipped-up or snapped during the windstorm of 2 Jun 2013. Ben learned to characterize soil pits at HBEF with particular emphasis on details important to drainage. His data builds a larger effort to document the relationship between soil characteristics and mode of tree damage during the 2 Jun 2013 windstorm at HBEF. Ben presented the results of his project through an oral presentation at the HBRF-REU conference.

Funding Support: REU site grant DEB # 1156844

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: Virginia Polytechnic Institute and State University

Government fiscal year(s) was this REU participant supported: 2014

Stephanie Suttentberg

Email: slsuttent@syr.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 3

Contribution to the Project: Stephanie investigated the abundance of snails, a calcium sensitive species, on forest stands of different ages and nutrient status. Leaf and litter sorting, coordinating schedules with students on related projects. She served on our summer crew with REU support (from HB LTER via Cornell).

Funding Support: REU through this grant.

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: SUNY ESF
Government fiscal year(s) was this REU participant supported: 2014

Josiah Weeks

Email: jdweeks@plymouth.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 3

Contribution to the Project: Josiah worked on a project investigating reciprocal subsidies between land and stream ecosystems.

Funding Support: REU site grant DEB # 1156844

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Plymouth State University
Government fiscal year(s) was this REU participant supported: 2014

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
Hubbard Brook Research Foundation	Other Organizations (foreign or domestic)	Woodstock, NY
Plymouth State University	School or School Systems	New Hampshire

Full details of organizations that have been involved as partners:

Hubbard Brook Research Foundation

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Woodstock, NY

Partner's Contribution to the Project:

Facilities
Collaborative Research

More Detail on Partner and Contribution:

Plymouth State University

Organization Type: School or School Systems

Organization Location: New Hampshire

Partner's Contribution to the Project:

Facilities

Collaborative Research

More Detail on Partner and Contribution:

Have other collaborators or contacts been involved? Yes

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Impacts

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

Research in the Hubbard Brook LTER program seeks a better basic understanding of the discipline of ecosystem biology, especially biogeochemistry and energy flow. Our long-term measurements of a suite of large-scale experiments has contributed to refined understanding of the interactions between ecological processes and biogeochemical cycles. A suite of simulation modeling studies allows us to synthesize understanding at regional scales and in future scenarios of environmental change. Our studies of energy flow through the complex herbivore and detrital food webs integrates knowledge across sub-disciplinary lines including vegetation dynamics, microbial ecology and heterotrophy population dynamics

What is the impact on other disciplines?

Beyond the core disciplines of ecosystem biology and biogeochemistry, the HBR LTER Program contributes to allied research disciplines in the physical and biological sciences. Our work attracts the interest of geochemists and physical hydrologists as well as that of molecular and cell biologists. The continuity of standardized and well-documented data collection is a hallmark of the HBR LTER; this aspect of the long-term studies at our site provides an internationally recognized benchmark for many disciplines of field-oriented research.

What is the impact on the development of human resources?

The Hubbard Brook LTER Project makes an active effort to develop human resources at many stages of development, from K-12 through post-doctoral. Through our educational and research activities numerous students and technicians have advanced their capacity for addressing the

environmental problems that face 21st Century society. A continuous stream of researchers has been nurtured in the HBR LTER, eventually to reach prominent positions in academic, governmental and private sector institutions. We have encouraged the participation of females and minorities in our project through recruitment at our participating Universities and throughout the world.

What is the impact on physical resources that form infrastructure?

During the past year we continued to improve the physical infrastructure at HBR in two ways: 1) we expanded our realtime environmental sensor network, and 2) we expanded the capacity of our physical sample archive.

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?

The website for Hubbard Brook (<http://hubbardbrook.org>) is now hosted on a server at the University of NH, providing local control of the system to the HBR-IM. The physical location of this server is at the Research Computing and Instrumentation (RCI) Center, in a climate controlled environment, with emergency power. RCI provides system administration, upgrades, backups, helpdesk support, and expertise for special projects as needed. Changes to the website now take place on a separate development server, providing a platform for developing/testing new datasets, metadata, changes in webpage functionality, etc. A mirror of this webserver will be established at the LNO, providing offsite redundancy, and failover capability.

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

Society is confronted with difficult choices about the degree of pollution abatement that is necessary to achieve desirable outcomes in terms of environmental quality. The long-term data sets from HBR-LTER provide among the best objective information available on which to base judgments about the threats of pollution to forest health, soil and water quality, and about the effectiveness of pollution abatement efforts in reducing those threats. Temporal trends can be evaluated against the backdrop of natural variation in reference and manipulated catchments, providing both parameter values and validation data for predictive models. Cost-effective environmental protection depends upon using these models to project the benefits of particular pollution abatement strategies. Hubbard Brook is a cornerstone of such efforts.

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Changes/Problems

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.