PROJECT SUMMARY

Overview: The main *objectives* of the Scenarios, Services, and Society (S^3) RCN are to synthesize existing science, catalyze new research, and produce science products to understand and advance sustainable land-use trajectories. The major *activities* of the S^3 RCN are to: (1) generate a suite of qualitative land-use scenarios co-developed by scientists and stakeholders that depict a range of possible future social, economic, and environmental realities for the study region; (2) simulate the land-use scenarios as they interact with multiple environmental stressors using existing modeling frameworks; (3) evaluate the simulated scenarios in terms of bundles of ecosystem services that are defined together with the stakeholders; and (4) share knowledge with broader audiences to advance sustainable land-use trajectories and enhance communities of practice in scenario-based sustainability science. The *methods* to be employed consist primarily of coordination activities and include: (1) Science and Stakeholder Workshops, (2) Open Technical Workshops to promote methods development and model coupling, (3) Synthesis and Writing Meetings, and (4) a Webinar Learning Series to foster knowledge exchange. *S^3 RCN Steering Committee*: David Foster (PI, Harvard University), Shere Abbott (Syracuse University), Mark Borsuk (Dartmouth College), Charles Driscoll (Syracuse University), Kathy Fallon Lambert (Harvard University), Robert Lilieholm (University of Maine), Taylor Ricketts (University of Vermont), Jonathan Thompson (University of Virginia), Angelica Zambrano (Smithsonian Institution, post doc).

Intellectual Merit: The proposed S^3 RCN will bring together scientists from diverse disciplines and across several major research initiatives to better understand the social-ecological drivers and consequences of land use as it interacts with multiple environmental stressors. As the world population approaches ten billion people, demands on Earth's finite land-base are growing and increasingly conflicting. Natural and managed landscapes are called upon to supply food and fiber, support climate change mitigation and adaptation, alleviate poverty, and support human well-being. Expanded knowledge to meet these demands has been hampered by a lack of synthesis and integration across scientific disciplines. The S^3 RCN will engage diverse stakeholders, synthesize existing data, and link existing models to develop and simulate future land-use scenarios and to analyze the consequences for different bundles of ecosystem services. In doing so, four fundamental sustainability science research challenges will be addressed: (1) linking qualitative scenarios with quantitative simulations, (2) evaluating interacting environmental stressors, (3) analyzing different bundles of ecosystem services, and (4) bridging scenarios-to-solutions. The *major expected benefit* of the S^3 RCN is the development of a novel, network-based framework for using participatory scenarios to understand and promote sustainable land-use trajectories in complex social-ecological systems. Importantly, the S^3 RCN activities reflect the co-mingling of research and practical application that is central to sustainability science.

Broader Impacts: The S^3 RCN will integrate broader impacts throughout its five-year duration. By including post-docs and students at all levels of the RCN, S^3 will contribute to STEM workforce development by offering direct experience in managing collaborative, transdisciplinary research networks. All students and post-docs will have the opportunity to lead workshops and working groups and to (co)author papers. The S^3 RCN will also provide training for scientists of all ranks in techniques of stakeholder engagement, linking science with action, and science communication. To increase its societal impact, the S^3 RCN will collaborate with Reos Partners to design workshop sessions for developing stakeholder-defined scenarios and for bridging scenarios to solutions. The S^3 RCN will also be a central activity of the recently established Science Policy Exchange (SPE), which is co-led by several S^3 Steering Committee members. This collaboration will result in policy-relevant communication products such as synoptic reports, case studies of iconic landscapes, and online visualization tools for decision makers. Finally, drawing on the extensive outreach expertise of the Harvard Forest and SPE, the S^3 products will be widely disseminated to journalists and decision makers through editorial board visits, press kits and teleconference(s), policy briefings, and presentations at policy and management conferences. S^3 will also work with collaborators to share lessons with communities of practice worldwide. Together these broader impacts will help deepen the scientific basis for critical land-use decisions for decades to come.

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*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

PROJECT DESCRIPTION

RCN-SEES: Integrating Land-Use Scenarios, Ecosystem Services, and Linkages to Society (Scenarios, Services, and Society - S^3)

A. Theme: *Integrating future scenarios, ecosystem services, and societal objectives to understand and advance sustainable land-use trajectories in complex social-ecological systems.*

Land use is a major component and driver of global change and is intimately connected with ecosystem structure and function, and with human well-being (Ojima et al. 1994, Foley et al. 2005, MA 2005). Natural and managed landscapes are called upon to supply food and fiber, support climate change mitigation and adaptation, alleviate poverty, and support human well-being. Forests, in particular, face competing demands for regulating, provisioning, and cultural services at local to global scales (FAO 2010, FAO-JRC 2012). Yet, the knowledge base for understanding and promoting sustainable land-use trajectories is highly fragmented and oftentimes isolated from its social context and from the human communities who represent the principle agents of change (Ojima et al. 1994, Cash et al. 2003). Scenarios provide a research tool for engaging stakeholders to envision alternative land use futures; for evaluating interactions between land use, climate change, and other global change factors; and for elucidating the consequences of different trajectories for ecosystem services in a manner that can inform sustainable land-use policy, planning, and stewardship.

The Scenarios, Services, and Society (S^3) RCN will create a transdisciplinary network of diverse scientists, stakeholders, and practitioners to address the organizing question: *What are the consequences of alternative land-use scenarios for bundles of ecosystem services and what are the implications for society?* The focus of the S^3 RCN will not be to conduct new research but to build bridges between "islands of solid knowledge" (Carpenter et al. 2009) to address four fundamental research challenges in sustainability science: (1) linking qualitative scenarios with quantitative simulations, (2) evaluating interacting environmental stressors, (3) analyzing different bundles of ecosystem services, and (4) bridging scenarios-to-solutions (Table 1).

To address these challenges, the S^3 RCN will coordinate *activities* among several major land use and sustainable development research initiatives (e.g., LTER, EPSCoR, NatCap, etc.) that are currently unconnected. Specifically, the S^3 RCN will work with social science practitioners and a network of diverse scientists and stakeholders to:

1. generate a suite of narrative land-use scenarios co-developed by scientists and stakeholders that depict a range of possible future social-economic and environmental realities for the study region;
2. simulate the land-use scenarios as they

Box 1: Terms (as used in the S^3 RCN proposal)

Bundles of ecosystem services – groups of ecosystems services that correspond to stakeholder objectives (Martin-Lopez et al. 2012).

Collaborators – a subset of stakeholders who have agreed to lend resources and time to the S^3 RCN.

Community of practice – a group with common interests that learns by interacting to share ideas, experiences, and knowledge.

EPSCoR - Experimental Program to Stimulate Competitive Research.

Facilitated dialogue – semi-structured discussions between scientists and stakeholders guided by a neutral facilitator to develop qualitative scenarios

Stakeholders – individuals who directly affect (e.g., policy makers) or are affected by land use decisions (e.g., landowners).

Learning journeys – field trips with 4-6 participants and a facilitator designed to achieve specific learning objectives through experience.

LTER – Long Term Ecological Research program.

NatCap – the Natural Capital project.

Prototyping sessions – interactive sessions in which scientists and stakeholders collaborate to identify land-use policies and actions that advance desired scenarios.

Scenarios – a set of plausible futures that incorporates internally consistent assumptions about major drivers, relationships, and constraints.

Social science practitioners – individuals who apply scientific theory to practice in the areas of stakeholder engagement, policy, and science communication.

Sustainable land-use trajectories – land-use patterns that meet growing development, food, and fiber demands while sustaining regulating services and livelihoods (World Bank 2006).

Transdisciplinary – a cross-sector, problem-oriented research approach that engages diverse stakeholders.

interact with multiple environmental stressors using existing modeling frameworks;
3. evaluate the simulated scenarios in terms of bundles of ecosystem services that are defined together with the stakeholders; and
4. share knowledge with broader audiences to advance sustainable land-use trajectories and enhance communities of practice in scenario-based sustainability science.

The S^3 RCN *outcomes* will include:
1. new research collaborations and a series of synthetic papers addressing critical sustainability science gaps,
2. improved scientific basis and decision-support methods for evaluating alternative land-use trajectories at the regional scale using scenarios and ecosystem services,
3. a comprehensive web-based, open-access scenarios research platform to further catalyze new research, and
4. innovative science communication products to distill the implications of S^3 RCN science for other researchers and for stakeholders involved in land-use policy, conservation, and management.
5. a place-based and network-based framework for using participatory scenarios to understand and promote sustainable land-use trajectories in complex social-ecological systems.

Table 1: Fundamental research challenges for scenario-based sustainability science.

Research Need	Description	Key Question	References
#1 – Linking qualitative scenarios and quantitative simulations	There is a need to more effectively translate qualitative scenarios into quantitative decision rules for landscape simulation models.	How can scientists collaborate with stakeholders to more effectively translate qualitative narratives into quantitative simulations?	Varho and Tapio 2013, Arciniegas and Janssen 2012, Price et al. 2012, McCloskey et al. 2011, Garb et al. 2008, Patel et al. 2007, Walz et al. 2007.
#2 - Evaluating interacting environmental stressors	The interactions among environmental stressors are strong, but are relatively understudied. Research focused on a single driver of change will miss key interactions and may even be misleading.	What are the interactive effects of land use and other dominant environmental stressors on forest processes and how does compounding uncertainty affect our ability to interpret these effects?	Reilly et al. 2012, Thompson et al. 2011, Ollinger et al. 2002, Aber et al. 2001, Albani et al. 2010.
#3 – Analyzing different bundles of ecosystem services	Most ecosystem services assessments have focused on the monetary value of regulating and provisioning services that are well-defined in the literature. However, stakeholder objectives and preferences are important drivers of land use change.	How can hierarchies of stakeholder objectives be used to define and analyze different bundles of ecosystem services?	Martin-Lopez et al. 2012, Raudsepp-Hearn et al. 2010, Cronan et al. 2010.
#4 – Bridging scenarios-to-solutions	While scenarios have become well-established as a means for exploring the consequences of highly uncertain changes in complex systems, evaluations suggest a divide exists between the development and use of scenarios in sustainability decisions.	How can the findings and insights developed from an integrated scenarios process inform and advance sustainable land-use trajectories?	Arciniegas and Janssen 2012, Tonn et al. 2006, Lorenzoni and Hulme 2009

B. Goals and Objectives: The *goal* of the S^3 RCN is to understand the drivers and consequences of alternative land-use scenarios and to advance sustainable land-use trajectories by synthesizing existing and catalyzing new research. The S^3 RCN will pursue the following *objectives*, which will also serve as the basis of our Assessment and Evaluation Plan (Table 3):
1. *Network objective* – create a diverse, transdisciplinary network of stakeholders, scientists, and practitioners to address fundamental challenges in scenarios-based sustainability science (Table 1).
2. *Science objective* – develop new knowledge about the sustainability and ecosystem service consequences of land-use decisions aggregated to the regional scale.

3. *Sustainability objective* – improve decision-support tools for landowners, government agencies, and non-governmental organizations interested in attaining more sustainable land-use trajectories.
4. *Education and training objective* – enhance education opportunities for graduate students and post-docs in transdisciplinary research projects with stakeholders; and provide advanced training for scientists of all ranks in stakeholder engagement, model coupling, and science communication.

C. Rationale: Human influences on ecosystems are intensifying and, in many regions, are irreversibly altering ecosystem structure, function, and services (Foley et al. 2005). Forests, in particular, face growing and competing demands. Over the past three centuries, forests worldwide have undergone extensive changes with the transition from wildlands to agriculture consuming 20% to 50% of previously forested lands (Turner et al. 1993, Matthews et al. 2000). In the U.S., forest conversion to developed uses is now the dominant land-cover transition (Drummond and Loveland 2010). The eastern U.S. alone experienced a 4.1% decline in total forest area between 1973 and 2000 (Drummond and Loveland 2010). Economic forecasts suggest that forest conversion, fragmentation, and perforation may result in a net loss of 10 million hectares of U.S. forestland by 2050 (Alig et al. 2003). Understanding the underlying drivers and social and economic processes that lead to land-use and land-cover (LULC) change in forested regions; the interactions of land use with other environmental stressors; and the trade-offs and consequences for different bundles of ecosystem services are pressing research challenges in sustainability science (Figure 1).

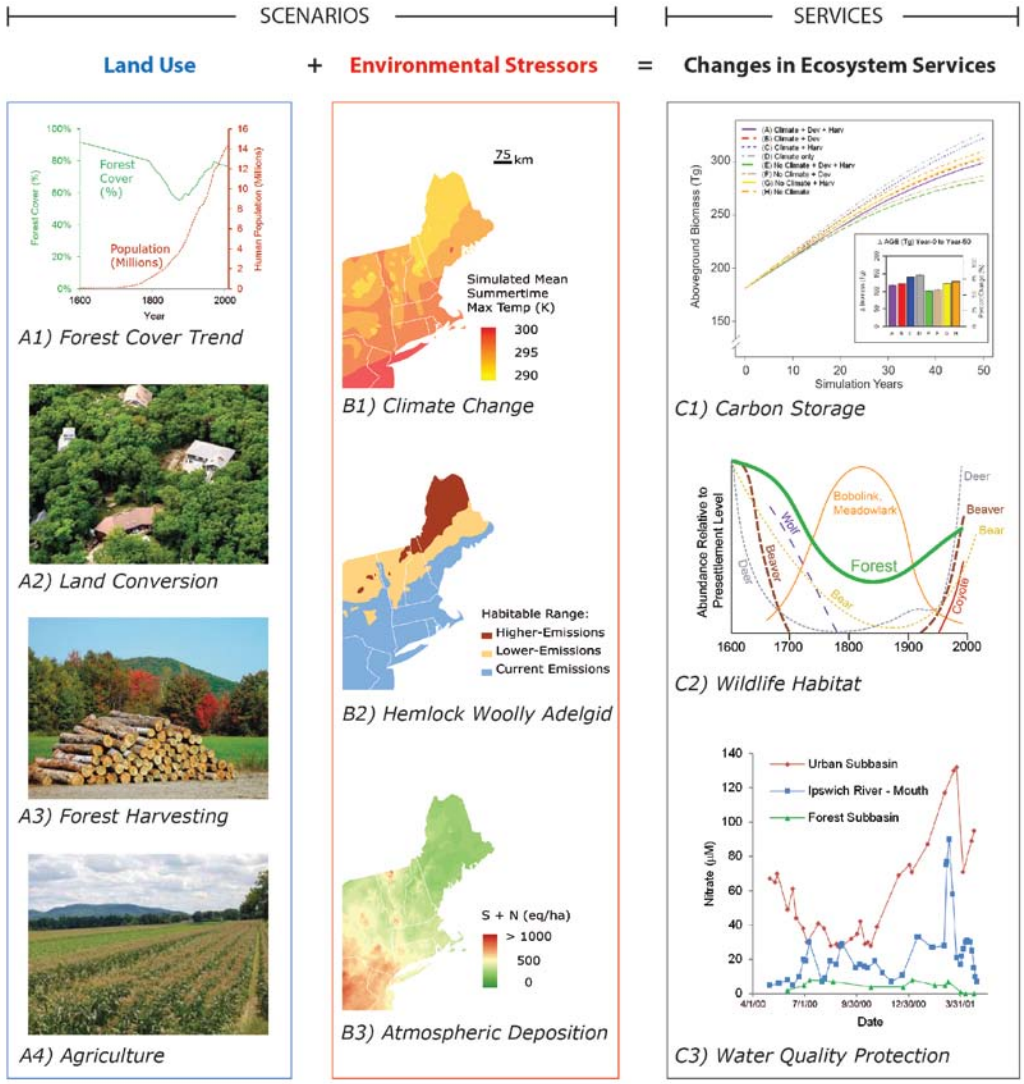
Land-use practices and land-cover change in forested regions occur not in isolation, but in combination with other environmental stressors. For example, consider the myriad interactions between forest land-use decisions and climate change: Warmer temperatures and are changing tree establishment and productivity (McMahon et al. 2010; Ettinger et al. 2011), which may alter silvicultural options. New markets are opening for woody biomass, in part to meet a demand for reducing consumption of fossil fuels. Alternatively, forest carbon markets are incentivizing conservation. What's more, climate change is expected to drive new patterns of human migration as warmer regions and coastal zones become less hospitable (Reuveny 2007). And these are but a few examples. Indeed, climate change as it interacts with other environmental stressors, such as fire, atmospheric deposition and pests and pathogens, can further compound the direct effects on forests of land-use practices and land-cover change. Consequently, to develop and evaluate alternative scenarios, it is necessary to understand the direct and indirect interactions between land use and regionally relevant environmental stressors.

Against a backdrop of human-accelerated environmental change, the 300 million hectares of forestland in the U.S. generate ecosystem services that provide products (e.g., timber and wood fuel; MA 2005), regulate ecosystem processes (e.g., climate regulation, water regulation, and purification, and air quality regulation; MA 2005), and generate cultural benefits (e.g., serenity, health, and aesthetics; MA 2005). Forests are increasingly called upon to help mitigate or adapt to these changes while also undergoing conversion and fragmentation, by residential and commercial development (Stein et al. 2005, Millar et al. 2007, Drummond and Loveland 2010); and intensified harvesting (Alig and Butler 2002). For the last century, most land-use decisions, policies, and management strategies have supported provisioning services at the expense of both regulating and cultural services (Martin-Lopez et al. 2012, Carpenter et al. 2006, DeFries et al. 2004). Yet regulating services are associated with the resilience of social-ecological systems to disturbances of various kinds (Carpenter et al. 2006). In order to promote sustainable land-use trajectories amidst competing land-use demands, it is necessary both to better understand land-use drivers and to develop improved methodologies for evaluating the aggregate, unforeseen effects of land-use decisions at a regional scale. Using New England as a model system, the S^3 RCN will synthesize existing data and catalyze new land-use research to develop and analyze land-use *scenarios* as they interact with environmental stressors*,* evaluate the consequences and trade-offs for ecosystem *services,* and distill the implications for *society*.

New England represents an ideal laboratory for synthesizing current knowledge regarding the connections between land-use decisions and the sustainability of different bundles of ecosystem services. More than

80% of New England's landscape is classified as forestland, a remarkable return to forest from its agriculture-dominated past (Foster 1992). Though, after 150 years of reforestation, the trend has reversed and a second wave of deforestation is occurring with all six New England states resulting in a net loss in forestland from its peak in 1980 (Foster et al. 2010). Most forestland in New England is privately owned, with small-parcel woodlot owners, intermixed with large, once-industrial, holdings in the north now held by TIMOs (Timber Investment Management Organizations) and REITs (Real Estate Investment Trusts). The instability of TIMO/REIT land ownership and aging landowner demographics has increased risks of parcelization and conversion (Lilieholm et al. 2010). Across New England, parcel sizes are decreasing resulting in a social and physical fragmentation that is changing the mix of ecosystem services and the management, development, and public access trends in the region (Lilieholm 2007, Wiersma 2009).

Figure 1: Land Use, Environmental Stressors, and Consequences for Ecosystem Services in New England's Forested Landscape.



Land-use practices and land-cover change associated with agriculture and development have transformed the New England landscape through time (A1 from Foster et al. 2010). Land-use effects in the region are compounded by intensifying and interacting environmental stressors (B1, from Hayhoe et al. 2008; B2, from Frumhoff et al. 2007; B3, from NADP 2013). Sustainability consequences of historic change and future scenarios can be analyzed in terms of changes in ecosystem services that are vital to society (C1, from Thompson et al. 2011; C2, from Foster et al. 2002; C3, from Williams et al. 2005).

The proximate causes of land-use and land-cover change in New England's forests are similar to those across the eastern US: residential sprawl from urban cores (DeNormandie and Corcoran 2009); amenity development around lakes and recreation areas (Klyza and Trombulak 1994, White et al. 2009); and harvesting and clearing associated with renewable energy development such as woody biomass (Manomet 2010), wind development (UCS 2007), and hydropower transmission lines (SPNHF 2011). In northern New England and New York there are currently 16 wood pellet facilities that collectively process 1.2 million metric tons of woody biomass annually (Biomass Magazine, 2012). In Maine, chip harvests increased by 250% from 2000 to 2007 (Benjamin 2010). Stakeholders across the region are grappling with decisions about shifting conservation priorities in the face of climate change (Anderson et al. 2012), harvesting guidelines for woody biomass energy (Walker et al. 2010), forest management geared to carbon markets (Fletcher et al. 2009), timber harvesting in response to pests (Foster and Orwig 2006), large-scale restoration of farmland for regional food systems (Donahue et al. in prep), and others. By using regional scenarios it is possible to elucidate otherwise unforeseen interactions of alternative land-use futures with a range of environmental stressors (e.g., climate change, pests and pathogens, and atmospheric pollution) and to evaluate tradeoffs for different bundles of ecosystem services and the regulating, provisioning, and cultural benefits they provide. As New England faces a second opportunity to determine the fate of its forests (Foster et al. 2010), it is a historically significant and poignant time to convene scientists, stakeholders from across the region to share perspectives, knowledge, data, and models to envision and analyze a suite of future scenarios for the region that can motivate and inform land-use decisions over the next several decades.

The S^3 RCN network will facilitate forward-looking synthesis and modeling in the complex social-ecological system of the New England landscape to address our four research challenges in scenario-based sustainability science (Table 1). In addition to the recruitment of diverse stakeholders and scientists, partnerships with well-established social science practitioners are central to our S^3 RCN approach. Specifically, we will work with Reos Partners to design and help implement the group-process design, stakeholder engagement, and scenario development components of the network. Reos Partners is a social innovation consultancy that has designed and facilitated many effective scenario processes including scenarios for the future of energy in North America and for reconciliation in South Africa. We will draw on the experience and expertise of Steering Committee member, Kathy Fallon Lambert to lead the policy outreach and science communication components of the network. Lambert directs the Science Policy Exchange (SPE). The SPE, initiated and led in part by the Harvard Forest, is a consortium of research institutions dedicated to increasing the influence of ecological science in environmental decision making.

Research Challenge #1: Linking Qualitative Scenarios with Quantitative Simulations

*...actual construction of scenarios, and developing techniques for the task, remain at the heart of the scenarios literature (*Varho and Tapio 2013).

Land use and climate change are examples of sustainability challenges that involve many diverse stakeholders responding to rapidly changing socio-economic conditions. The direct participation of diverse stakeholders in the research process is important in systems with such a high degree of inherent complexity (Patel et al. 2007). Participation of stakeholders can also increase the impact of sustainability science on environmental outcomes by helping to ensure transparency, credibility, and salience (Cash et al. 2003, Clark et al. 2006). Moreover, the resulting social learning can expand the capacity of participants (Johnson et al. 2012), and promote the use of science in decision making (Patel et al. 2007).

Past analyses have shown that forecasting future land use based on historical trends nearly always fails because it cannot account for the nonlinear dynamics, reciprocal feedbacks, biological legacies, time lags, heterogeneity, and surprises, that are the hallmarks of complex social-ecological systems (cf. Pontius et al. 2008, Liu et al. 2007). In the face of such irreducible uncertainty, scenarios provide a means of exploring how the future may unfold given different human actions (Xiang and Clarke 2003, Nassauer and Corry 2004, Gomben at al. 2012).

Integrating qualitative scenarios with quantitative simulations represents a major challenge in the development and analysis of land-use scenarios (Patel et al. 2007, Walz et al. 2007, Garb et al. 2008). Alcamo (2001), in his work crafting the Millennium Assessment scenarios, referred to this work as the challenge of integrating "story and simulation". Participatory scenario development results in qualitative narratives that describe a range of alternative futures. Oftentimes the narratives are translated by scientists into quantitative models without the direct engagement of the stakeholders, compromising the utility, transparency and legitimacy of the results (Alcamo 2001, Cash et al. 2003, Parson 2008). Efforts have been made to engage stakeholders in the linking of qualitative scenarios and quantitative simulations using Bayesian Belief Networks (McCloskey et al. 2011), decision trees (Thompson et al. 2011), and other technical approaches. However, research teams have reported considerable difficulty using these highly technical techniques with stakeholders (personal communication R. Lilieholm, J. Thompson, T. Spies). This challenge has led to calls for expanding approaches for linking qualitative and quantitative land-use scenarios in a transparent and reproducible manner (Patel et al. 2007, Carpenter et al. 2009).

To address this research challenge, we will draw on existing research and the knowledge of the S^3 RCN Network (Table 2) to assess the strengths and weaknesses of different methods for linking qualitative scenarios and quantitative simulations. By comparing techniques that have already been tested in different projects and landscapes, and by iterating directly with stakeholders, we will improve current methods and translate the qualitative scenarios into quantitative decision rules for simulation. The decision rules will specify the type, amount, and spatial allocation of land-cover changes and land-use practices.

Research Challenge #2: Evaluating Multiple Environmental Stressors

Global change involves the simultaneous and rapid alteration of several key environmental parameters that control the dynamics of forests (Aber et al. 2001).

The capacity of ecosystems to deliver services to society changes in response to land use *in combination with* other environmental stressors. Quantitative simulations of the land-use scenarios must, then, accurately model the impacts of multiple interacting environmental stressors. This poses a challenge to disciplinary scientists who, when simulating land-use change are accustomed to modeling individual or, at most, a pair of processes at a time (e.g., Ollinger et al. 1998, Aber et al. 2001, Albani et al. 2010, Thompson et al. 2012). Understanding how interactions between land use and these environmental stressors affect forest structure, function, and associated ecosystem services requires a place-based, multi-model approach (Reilly et al. 2012) that is lacking in most scenario studies (Cash and Moser 2000).

In the temperate forest ecosystems of New England, climate change, atmospheric deposition, and forest pests and pathogens have been identified as major environmental stressors that interact with land use in forested landscapes (Wargo and Auclair 2000, Foster and Aber 2004). To address the research challenge of evaluating interacting environmental stressors, the S^3 RCN will host a workshop, support a working group, and provide a specific application (i.e., land use in the forests of New England) for linking existing models of land use, pests and pathogens, climate, and biogeochemistry. The S^3 RCN Steering Committee and Core Network (Table 2) include scientists with extensive skills and publishing records in these research areas. However, the lack of a mechanism for bringing these separate research communities together has hampered the integration of these models at watershed to regional scales. Differences in input parameterizations and model assumptions constrain scientists from synthesizing information derived from different scales and modeling platforms (Urban 2005). However, great strides toward meta-model analysis can be made when modelers coordinate input parameters and explicitly state their objectives and assumptions (Sturtevant et al. 2007).

By bringing together scientists from diverse disciplines, the S^3 RCN will provide a collaborative venue for comparing and coupling environmental change models. Specifically, the S^3 RCN will use the LANDIS-II landscape simulation framework (Scheller et al. 2007; Scheller and Mladenoff 2005) to integrate forest ecosystem processes (i.e. succession, establishment, dispersal and natural disturbance) with land-use change scenarios, pest and pathogen scenarios, and existing downscaled climate projections

for select Inter-governmental Panel on Climate Change (IPCC) emissions scenarios (Hayhoe et al. 2008). The LANDIS-II results will then be integrated with scenarios of atmospheric deposition using the established PnET model (both the BGC and CN versions; Aber and Federer 1992, Aber et al. 1997) intensively studied watersheds in the region, such as the Hubbard Brook Experimental Forest in New Hampshire, and, as feasible, for the region. The outputs from the suite of models will be used as inputs to InVEST (Integrated Valuation of Ecosystem Services and Trade-offs; Daily et al. 2009, Goldstein et al. 2012) and other tools to analyze changes in ecosystem services.

Research Challenge #3: Defining and Analyzing Different Bundles of Ecosystem Services

New methodologies need to be developed to derive the value of the ecosystem configurations that deliver different bundles of services (Carpenter et al. 2009).

Assessment and valuation of ecosystem services is widely used in global assessments to understand and quantify trade-offs associated with different land-use management and policy decisions (cf. Costanza et al. 1997). Ecosystem services have been the cornerstone of influential scenario-based assessments of how ecosystems and benefits to society change under different development and land-use change futures (MA 2005). However, there is a growing recognition, however, that the quantification of ecosystem services has not translated into conservation and policy gains as anticipated, due in part to the lack of institutional structures, legal mechanisms, and robust ecosystem service markets needed to provide incentives that can influence land use decisions (Daily and Matson 2008, Carpenter et al. 2009, Daily et al. 2009, Goldstein et al. 2012). This disconnection has led to calls for better understanding the relationships between ecosystem services and human well-being (Carpenter et al. 2009), and for expanding methodologies to define and evaluate different "bundles of services" (see Box 1) that take into account social preferences and stakeholder objectives (Martin-Lopez et al. 2012).

To address this research challenge we will draw on the skills of the social scientists in the S^3RCN Steering Committee (see Table 2), convene workshops and support working groups, to elicit stakeholder objectives and define a unique set of ecosystem services. Specifically, we will collaborate with stakeholders to construct comprehensive *objectives hierarchy* (Keeney 1988). The upper levels of the hierarchy represent general objectives (such as "Maintain Regulating Services"), and the lower levels of the hierarchy will contain more detailed elements (such as "Maintain Water Quality"). After constructing the objectives hierarchy, we will work with stakeholders to ascribe measurable attributes to the detailed, lower-level, objectives. These then provide a basis for evaluating changes in the fulfillment of these stakeholder objectives (or, services) under different land-use scenarios. For example, if small non-industrial private landowners identify "maintain privacy" and "improve aesthetics" as important objectives for owning and managing land in New England (Markowski-Lindsay et al. 2012), it is possible to ask what are the attributes that characterize those objectives (e.g., distance from roads, forest stand density) and then analyze how those attributes would change under various land-use scenarios. Analyzing the simulated scenarios in terms of these stakeholder-defined bundles of services will strengthen the relevance and impact of ecosystem service assessments for land-use policy and stewardship.

Research Challenge #4: Bridging Scenarios-to-Solutions

[There exists] a perceived social divide between scenario developers and scenario users. Scenarios are shaped, or seen to be shaped, entirely on one side of the divide and then taken up, or not, by decision-makers on the other (Garb et al. 2008).

Linking knowledge with action to promote a transition to sustainability is a well-articulated challenge in sustainability science (NRC 1999, Cash and Clark 2001, Cash et al. 2003, Garb et al. 2008). Another common challenge identified in reviews of scenarios research is effective communication and dissemination of assumptions, results, and implications to scenario users (Shell 1998, Parson et al. 2007, Garb et al. 2008). Several published examples exist for negotiating these challenges, including ones forged by members of the S^3 RCN Steering Committee (Driscoll et al. 2011, Driscoll et al. 2012). These and other examples note that successful integration of science with policy and conservation entails:

continuous stakeholder-researcher engagement (Driscoll et al. 2011), elicitation of stakeholder objectives and policy-relevant questions (Keeney et al. 1990), synthesis of fragmented knowledge (Clark 2009), and deliberate attention to knowledge exchange (Driscoll et al. 2012, Driscoll et al. 2011, McNie 2007).

To address this research challenge, we will engage high-level decision makers as stakeholders throughout the project and will dedicate a workshop, several webinars, and science communication products to linking knowledge with action. This will include convening a policy prototyping session in the final S^3 RCN "scenarios-to-solutions" workshop (sensu, Shell 1998). To overcome communication barriers, the S^3 RCN will collaborate with the SPE (see Broader Impacts) to develop science communication products throughout the five-year initiative. Finally, we will enhance communities of practice by sharing the experience and knowledge gained from the S^3 RCN with colleagues and organizations working on sustainable development challenges around the world (see Broader Impacts).

D. Research Coordination Activities

General Description and Major Activities: The S^3 RCN will coordinate activities with several currently unconnected major research initiatives (e.g., LTER, EPSCoR, NatCap, etc.) dedicated to understanding sustainable land use in New England to:

1. generate a suite of narrative land-use scenarios co-developed by scientists and stakeholders that depict a range of possible future social-economic and environmental realities for the study region;
2. simulate the land-use scenarios as they interact with multiple environmental stressors using existing modeling frameworks;
3. evaluate the simulated scenarios in terms of bundles of ecosystem services that are defined together with the stakeholders; and
4. share knowledge with broader audiences through webinars and science communication products.

The S^3 RCN activities parallel the four research challenges it seeks to address, as described herein and depicted in Figure 2. The S^3 RCN is a time-limited five year initiative that will produce a set of shared environmental change scenarios and supporting land cover/land use simulations which will be harnessed by diverse researchers and practitioners in the region and beyond. As such, it is not intended to promote a long-term network in need of sustained funding but rather is designed as a 5-year networked activity to catalyze new research and new collaborations that will have on-going benefit (Figure 3). The major S^3 RCN activities will include: Science & Stakeholder Workshops, Open Technical Workshops, Synthesis & Writing Meetings, a Webinar Learning Series, and Science Communication and Outreach. Note, while not described in detail below, there will be two broadcasts of the Webinar Learning Series each year based on researcher and stakeholder information needs.

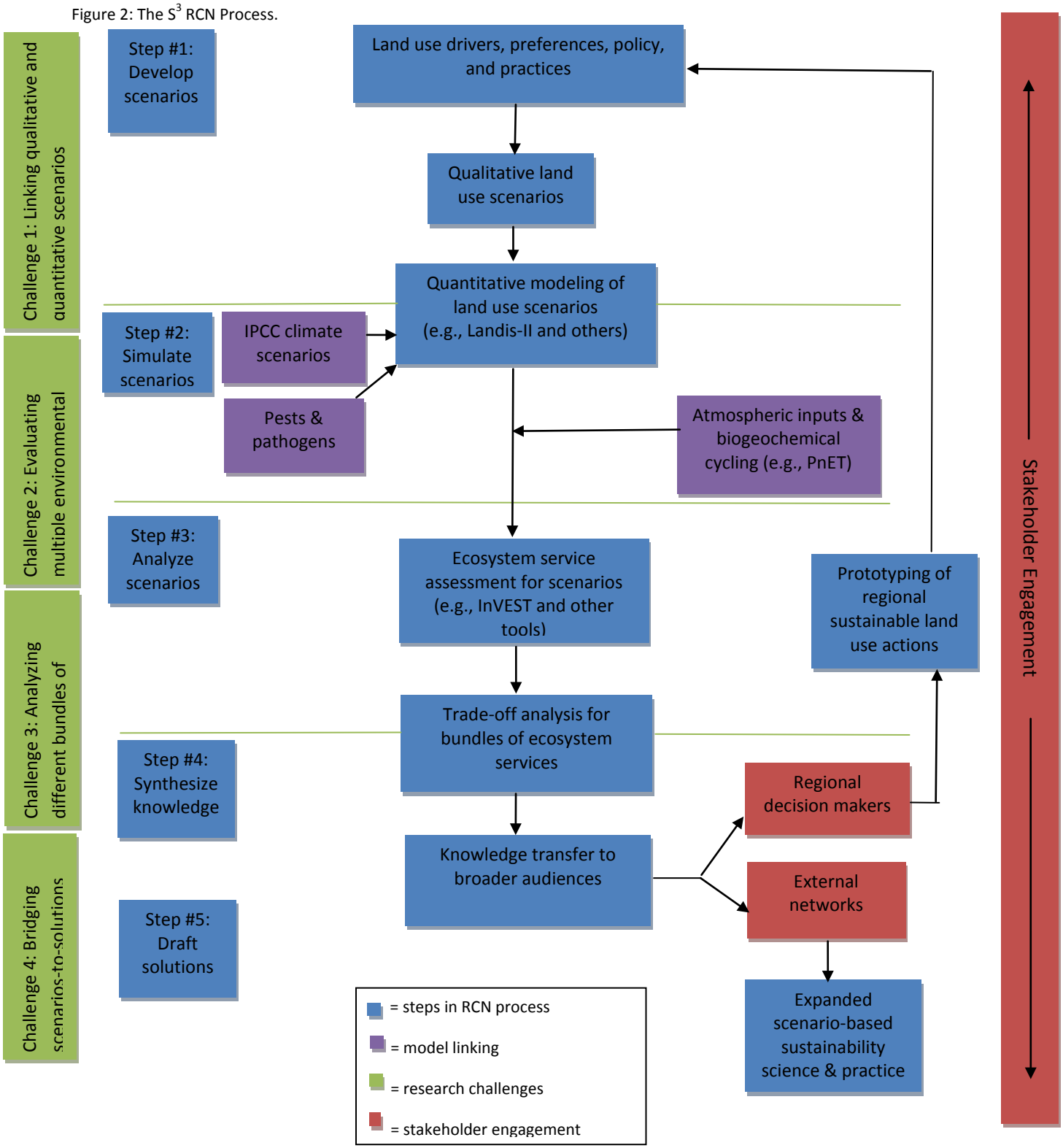
Year 1: Network Creation/Research Challenge #1 - Linking Qualitative Scenarios and Quantitative Simulations

Process Design. The use of scenarios gained attention through private sector efforts, most notably the Shell Scenarios work (Wack 1985). Yet, there are few examples where the research community has reached-out and engaged social science practitioners from the private sector to draw on their years of experience in crafting and applying scenarios. The S^3 RCN will diversify traditional research collaborations by engaging Reos Partners to help design and execute a scenarios process for landscape change in New England. The scenario design process will begin with interviews of S^3 RCN Steering Committee and the Core Network to design the process by which scientists and stakeholders will collaborate as equal partners to envision and analyze alternative scenarios of the future.

Science & Stakeholder Workshop #1. The purpose of the workshop will be to collaborate with stakeholders to define drivers and proximate causes of land use, resulting in a set coherent narrative land-use scenarios. This will be a 3-day workshop with approximately thirty scientists, and stakeholders. Ample time will be dedicated to establishing a shared view of the landscape and its challenges. This will include facilitated dialogue, learning journeys, and field trips into New England forests.

Science Communication and Outreach. In Year 1, we will design a series of science communication products to translate S[3] RCN findings for broader audiences (see Broader Impacts). Also in Year 1, we will create the S[3] RCN project website to facilitate social networking across the diverse network and share final scenario narratives, descriptions of story and simulation approaches, and opportunities to participate in the future.

Figure 2: The S[3] RCN Process.



Year 2: Research Challenges #1 & #2 - Qualitative and Quantitative Scenarios/Evaluating Interacting Environmental Stressors

Science & Stakeholder Workshop #2. The purpose of this workshop is to work with stakeholders to translate the scenario narratives into quantitative simulations. The landscape model LANDIS-II, which has already been applied within the region, will be used to simulate forest succession and disturbance dynamics as well as land use and land cover change for each of the scenarios over 50 years. The simulation process will incorporate existing downscaled IPCC climate projections for the region (Hayhoe et al. 2008). It is anticipated that interactions and feedbacks with pests and pathogens and atmospheric deposition of sulfur and nitrogen will be a weak link in the simulation process. A separate Open Technical Workshop will be organized to focus on this need.

Open Technical Workshop #1. The purpose of Open Technical Workshop #1 is to bring together modelers from different disciplines to collaborate on a model framework for integrating land use, climate change, forest pests and pathogens, and atmospheric deposition. The 1.5-day workshop will convene regional experts to identify common parameter sets (e.g. common climate projections), common spatial and temporal scales, and land-use change scenarios with a goal of linking existing models and fostering new synthetic collaborations.

Science Communication & Outreach. In Year 2, we will develop the open-access web-based research platform to further facilitate collaborative research by providing access to our qualitative scenarios and quantitative simulations.

Year 3: Research Challenge #3 - Defining and Analyzing Different Bundles of Ecosystem Services

*Science & Stakeholder Workshop #3.*The Year 3 workshop will focus on analyzing how ecosystem services change under different land-use and environmental change scenarios. We will collaborate with stakeholders to define bundles of services that correspond to stakeholder objectives. We will apply existing models, such as InVEST, to analyze the consequences of the simulated scenarios in terms of the different bundles of services. It is anticipated that modeling new stakeholder services will be a weak link in the analysis process. A separate Open Technical Workshop will be convened to address this need.

Open Technical Workshop #2. The purpose of Open Technical workshop #2 is to explore methods for evaluating stakeholder-defined services that are not included in existing models. Specific attention will also be given to methods for evaluating tradeoffs between regulating, and provisioning and cultural services. The S^3 RCN will convene a 1.5-day workshop to provide a venue for collaboration that will lead new programming scripts or modules for existing models.

Science Communication and Outreach. In Year 3, we will develop additional website capacity to share scenario simulations and the stakeholder-defined ecosystem services with researchers beyond S^3.

Year 4: Synthesis and Writing

Synthesis & Writing Meetings #1. The purpose of the Synthesis & Writing meetings is to provide a venue for collaborating on synthetic, interdisciplinary publications. Over the course of the workshops and coordinating conference calls organized by the Steering Committee, scientists will have the opportunity to form working groups. Funds will be made available to support these working groups for synthesis and writing in Years 4 and 5. We anticipate that the working groups will produce peer-reviewed papers related to each of the four research challenges suitable for a special issue of a prominent journal.

Science Communication and Outreach. Titles and draft abstracts for the working group papers will be posted on the S^3 RCN website in Year 4. This will facilitate connections with the broader scientific community and provide an open process for potential co-authors to contribute to the development and writing of these papers.

Year 5: Research Challenge #4 – Bridging Scenarios to Solutions

Science & Stakeholder Workshop #4 – The final Science & Stakeholder Workshop will be held in Year 5. This will be a 2-day event focused on distilling and sharing the results from the scenario simulation and ecosystem service analysis. We will challenge scientists to communicate their most salient findings through TED-style talks. We will offer a science communication training session to assist the scientists with the preparation of the presentations. On the second day, we will host a scenario-to-solutions session co-led with social science practitioners and stakeholders. The intent of this session will be to draft land-use policy and stewardship prototypes that could shift land-use trajectories toward a more sustainable future. The prototyping session will be modeled after a similar effort convened by the Climate Development Knowledge Network to produce prototype ideas for climate-compatible development.

Synthesis & Writing Meetings #2. Following the same format as Year 4, the second round of Synthesis & Writing Meetings will be held. It is anticipated that participants will bring draft papers that have been evolving since Year 4 and will emerge from this second meeting with final draft manuscripts.

Science Communication and Outreach. Outputs for Year 5 will include the S^3 RCN work products, datasets, and data layers used throughout the project; and documentation of our process and workshops. We will finalize science communication products that translate the S^3 RCN findings for broader audiences based on the design outlined in Year 1 (see Broader Impacts).

Figure 3: S3 RCN Timeline.

Activity	Year 1	Year 2	Year 3	Year 4	Year 5
Stakeholder & Science Workshop	■	■	■		■
Open Technical Workshop		■	■		
Synthesis & Writing Meetings			■	■	
Assessment activities		■	■		■
Products (website, papers, reports)	■	■	■	■	■

E. Expected Benefits: The integrated S^3 RCN approach described above will yield important benefits for science, including:

1. New collaborations and newly catalyzed research. Many of the participating scientists have worked in New England for years and are part of well-developed but unconnected research programs focused on scenarios and ecosystem services (e.g., LTER, EPSCoR, NatCap). However, most have never formally collaborated or worked across their respective disciplinary divides.
2. An expanded framework for scenarios research in complex social-ecological systems. The framework will incorporate decision science, a multi-model approach for simulating interactions between multiple stressors, analysis of new bundles of services, and linkages between scenarios and solutions.
3. New and adapted models for understanding interactive stressors specific to the New England landscape and for analyzing new bundles of ecosystems services defined by stakeholders.
4. A strong research legacy of open-source datasets, scenario simulations tailored to New England's landscape, and data layers for on-going use and research by others.
5. Publication of multiple interdisciplinary papers on land use and environmental change in social-ecological systems suitable for a special issue in a major journal.

F. Management & Coordination Plan: The S^3 RCN will have a transparent management structure with well-defined roles for RCN Steering Committee members. Coordination of the S^3 RCN will be undertaken with attention to inclusivity, collaboration, scientific productivity, and rigorous assessment.

Leadership Structure: David Foster, Director of the Harvard Forest, is the *Principle Investigator* for the S^3 RCN. His relevant research and experience include two decades of leadership of the HF LTER Program,

Co-director with Billie Turner of the Integrated Land Change Science and Tropical Deforestation Project in the Southern Yucatán, and co-director with Chuck Redman of the Agricultural Transitions Cross-LTER CHN project. Foster will Chair the S^3 RCN Steering Committee, be the primary science leader of the Science & Stakeholder Workshops, serve as the primary guide for science and synthesis activities in the RCN, co-author one or more synthesis papers, and be responsible for preparing annual and final reports to NSF.

Table 2: S^3 RCN Steering Committee and Core Network Members.

Discipline & name		Affiliation	Major research initiatives & expertise in research challenges (1-4)
Ecological sciences	David Foster* PI	Harvard Forest, Harvard University	PI - Harvard Forest LTER V with focus on scenarios; land use history and human interactions; LTER Executive Committee; NEON Committee Chair; Challenges 1,2,4
	Jonathan Thompson*	University of Virginia/Smithsonian	LTER Future Scenario Working Group Chair; Mid Atlantic NEON Core; Oregon Coastal Landscape Analysis and Modeling Study; Massachusetts Forest Scenarios; Challenges 1,2,3
	Scott Ollinger	UNH, Institute for the Study of Earth, Oceans and Space	Co-PI Hubbard Brook LTER; New Hampshire EPSCoR for Ecosystems and Society; NEON Board of Directors; Challenges 2,3
	Bill Keeton	University of Vermont (UVM)	Chair UVM Forestry; PI NSF: Wood Bioenergy and Water Sustainability; Challenges 2,3
	Spencer Meyer[±]	University of Maine	Maine EPSCoR Sustainability Solutions Initiative; Challenges 1,4
	Eben Broadbent[Δ]	Smithsonian Institution	Harvard Forest LTER Post Doc; integrating human-environment interactions through geospatial analysis; Challenges 2,3
Social sciences	Angelica Almeyda Zambrano* [Δ]	Smithsonian Institution	Ruffolo Doctoral Fellow in Sustainability Science at Harvard; land use impacts of development policies; Infrastructure Change, Human Agency, and Resilience; Challenges 1,3
	Taylor Ricketts*	UVM, Gund Institute for Ecological Economics	Director of Gund; Principal at Natural Capital Project; Convening Lead Author for the Millennium Ecosystem Assessment; Challenges 1,3
	Rob Lilieholm*	University of Maine	Giddings Professor of Forest Policy; Maine EPSCoR Sustainability Solutions Initiative; Program Leader, Conservation Lands and Public Values, Ctr for Research on Sustainable Forests; Challenges 1,3,4
	Shere Abbott*	Syracuse University	Vice President for Sustainability Initiatives, University Prof. of Sustainability Science and Policy; former Associate Director for Environment, Office of Science & Technology Policy; Challenges 1,4
	Dave Kittredge	UMass, Amherst	Massachusetts Extension Forester; USDA Family Forest Research Center; PI NSF-CHN Shifting Land Uses and Forest Conservation; Challenges 1,3
	Michelle Johnson[±]	University of Maine	Maine EPSCoR Sustainability Solutions Initiative; Challenges 1,4
Engineering	Charles Driscoll*	Syracuse University	University Prof. of Environmental Systems Engineering; Co-PI HBR LTER; atmospheric deposition; biogeochemical cycling and modeling; Challenges 2,3
	Mark Borsuk*	Dartmouth College, Thayer School of Engineering	Decision theory; integrated systems modeling and management; uncertainty analysis, risk assessment; Challenges 1,3,4
Social science practitioners	Kathy Fallon Lambert*	Harvard Forest, Harvard University	Co-developed HBRF Science Links Program; HF Wildlands and Woodlands Initiative; Director – Science Policy Exchange; Challenges 1,4
	Joe McCarron	Reos Partners	Founding partner of Reos; scenario development, facilitation, group-process design; Challenges 1,4
Collaborators	Joe Short	Northern Forest Center	Directs public policy, biomass energy and ecosystem services programs for non-governmental organization (NGO) focused on conservation and economic development; Challenges 1-4
	Bob Perschel	New England Forestry Foundation	Executive director of NGO focused on forestry and conservation; Challenges 1-4
	Emily Bateson	Highstead	Conservation Director of NGO focused on regional forest conservation; Challenges 1-4
	Keith Ross	LandVest	Senior advisor with private sector real estate company; Challenges 1-4
	Erika Rowland	Wildlife Conservation Society (WCS)	Works on issues of climate change in the North America program of WCS, links scenario science with management; Challenge 4
	Emily McKenzie	World Wildlife Fund (WWF)	Manages Natural Capital Project at WWF and leads NatCap's work at the science-policy interface; Challenge 4

* = Steering Committee member, [±] = graduate student, [Δ] = post-doctoral fellow

In addition to the PI, there will be two designated *RCN Coordinators* who will meet monthly.

1. *Science Coordinator*: Jonathan Thompson is a Research Assistant Professor at University of Virginia and a Research Ecologist at the Smithsonian Institution Conservation Biology Institute. His relevant research and experience include: scenario development, landscape simulations across multi-owner landscapes, and forest policy analysis. As S^3 RCN *Science Coordinator* he will reach out to scientific community to participate in network, recruit the participation of postdocs, and coordinate special issue/special section, co-lead workshops, and assist with website development and maintenance.
2. *Network Coordinator:* Kathy Fallon Lambert will bring project management, policy engagement, and science communication theory and experience to the S^3 RCN. The S^3 RCN partnership with the SPE will build on Lambert's past successes including the Hubbard Brook Research Foundation (HBRF) Science Links projects and the Harvard Forest Wildlands and Woodlands initiative. As S^3 *Network Coordinator* she will lead the engagement of stakeholders for policy impact, coordinate science communication, implement diversity and assessment plans, oversee the website, and lead broader impact activities.
3. Research Assistant: Thompson and Lambert will be assisted by a Research Assistant who will assist with workshop and webinar logistics, working group support, and website maintenance.

Facilitator and Group Process Designer: Joe McCarron is a Partner at Reos Partners and a social science practitioner. McCarron will be responsible for the group-process design, learning journeys and other social technologies for stakeholder engagement, workshop agenda development and facilitation, workshop logistics, and the design and execution of the prototyping session at final workshop.

Steering Committee. The S^3 RCN Steering Committee includes the Chair (Foster), the S^3 RCN coordinators (Thompson and Lambert), and representatives from across the major disciplines of ecology, engineering, decision science, economics, and policy. The Steering Committee represents different academic ranks; genders, ethnicities, and sectors (below and Table 2). Steering Committee members will meet by videoconference two times per year, lead workshop sessions, lead and participate in ad hoc working groups, and author papers together with other members of the network.

Core Network and Collaborators. To augment the Steering Committee, we have recruited additional scientists and collaborators as members of the Core Network (Table 2). Members of the Core Network will attend the RCN workshops and participate or lead ad hoc working groups to develop synthetic papers. The collaborators will help facilitate outreach and exchange with stakeholders in New England and beyond. To identify and select the S^3 RCN Core Network, Foster, Lambert, and Thompson held in-person meetings with sustainability focused EPSCoR programs at Universities of Maine, New Hampshire, and Vermont; and with Gund Institute of Ecological Economics at UVM. We also drew from participant lists from scenarios workshops held at Harvard Forest in 2009, 2011, and 2012.

Post-doc and Student Involvement. In addition to offering a position for a post-doc to serve as full and equal members of the Steering Committee (Angelica Almeyda Zambrano), we named several post-docs, graduates students, and research interns to the S^3 RCN Core Network (Table 2). In addition, up to four post-docs, five graduate students, and two research assistants who are already funded through separate research projects will receive full travel and participant support costs for each Science & Stakeholder Workshop. Working groups that apply for funding will be evaluated for inclusion of post-docs and graduate students. We will coordinate with Aaron Ellison, REU Program Director at Harvard Forest, to develop opportunities for undergraduates through the Harvard Forest REU program.

Allocation of Funds. We will establish formal mechanisms to ensure fair and equitable allocation of group resources. For example, all S^3 RCN participants will be eligible to receive full travel and participant costs by reimbursement regardless of their rank. The Steering Committee will also provide stipends for 2-4 individuals per workshop who have been asked to take on additional tasks and responsibilities to develop content and lead sessions within the workshop. In addition, anyone who has participated in the S^3 RCN

workshops can request funds to organize Synthesis & Writing meetings. These requests will be reviewed by Steering Committee with an emphasis on expertise and diversity.

Data and Information Access. We will provide free and open access to data and products generated through the S^3 RCN activities. Archiving and access will follow the Harvard Forest LTER data management plan (see Data Management Plan). A central tenet of this project is to make the scenario narratives and quantitative representations widely available to others to foster additional analysis.

External Network Collaboration. The S^3 RCN is dedicated to contributing to a broader community of practice in scenarios and ecosystem service valuation beyond the Northeast. Through a collaborator with the Wildlife Conservation Society, the findings and "lessons learned" from the S^3 RCN will be shared with course developers for the U.S. Fish and Wildlife Service's National Conservation Training Center. Collaborating with the World Wildlife Fund Natural Capital Project, we will also disseminate the findings and lessons to stakeholders using scenarios for sustainable development around the globe. To reach scientific networks, S^3 RCN members will give presentations, posters, and submit abstracts for LTER All Scientists Meetings, NEON annual meetings, Ecological Society of America (ESA) annual meetings, and meetings of other scientific societies. We will also distribute S^3 RCN program description and opportunity announcements through these networks and through CHANS-Net (the International Network of Research on Coupled Human and Natural Systems).

Network recruitment process. Stakeholder diversity in New England notably includes tribal interests (Judd 1997) and socio-economic diversity (Lilieholm 2007). Prior to the first workshop, recruitment for diverse participation will be undertaken and will include distribution of network information and participation opportunities via email announcements to (1) ESA's Strategies for Ecology Education, Diversity, and Sustainability (SEEDS); (2) the National Alliance for Doctoral Studies in Mathematical Sciences; (3) the Alliance for Building Faculty Diversity in the Mathematical Sciences; (4) LTER Network; and (5) an extensive list of thousands of institutions developed by the Research Experience for Undergraduates program at Harvard Forest, which has a strong record of attracting applications from underrepresented groups. Core Network members include representatives from a wide variety of organizational settings include academia, non-governmental conservation and economic development organizations, government and industry. All Science & Stakeholder Workshops are intended to bring researchers together with stakeholders and decision makers from diverse institutions public, civil society, and policy (Table 2), including many serving "Distressed and Underserved" census tracts.

G. Diversity Plan: Members of Steering Committee, Core Network, and workshop participants will include representatives from the public, private, and civil society sectors; as well as individual landowners who are stakeholders in land policy, conservation, and management decisions. The Steering Committee and Core Network reflects solid gender, rank, and institutional diversity, and we will seek additional gender, racial/ethnic, and socio-economic diversity and participation from under-represented groups in the expanded network as described below. We anticipate that all of the specific steps described below will facilitate collaborations with new researchers, post-docs, graduate students, and undergraduates.

H. Assessment & Evaluation Plan: The assessment and evaluation of the S^3 RCN will be based on the stated objectives for the initiative as described on page 1. For each objective there are assessment questions, metrics and data sources (Table 3). The assessment will be undertaken in two phases: a formative assessment to monitor and provide feedback to the Steering Committee regarding progress on each objective that can be used to modify future activities, and a summative assessment undertaken at the end of the project to evaluate results.

I. Broader Impacts: Consistent with the fundamental tenets of sustainability science, the S^3 RCN will integrate broader impacts throughout its five-year duration (Kates et al. 2001). The S^3 RCN broader impacts fall into two main categories: STEM workforce training and broader societal impact. The S^3 RCN will support the development of a diverse globally competitive STEM (science, technology, and mathematics) workforce by providing training for at least 5 graduate students and post-docs in regional-

scale, transdisciplinary collaborative research projects. We will also provide the opportunity for one post-doc to serve on the Steering Committee, for several post-docs and graduate students to serve on the Core Network, and for undergraduate REUs at the Harvard Forest to participate in the RCN. Throughout the RCN recruitments process, special attention will be given to full participation by women, persons with disabilities, and underrepresented groups in STEM. All students and post-docs will have the opportunity to lead workshop sessions and working groups and to (co)author papers for journal submission. We will also provide training for participating scientists of all ranks in techniques for stakeholder engagement, linking science with action, and science communication. Such efforts will improve partnerships between academia and the private, civil, and government sectors.

Expanding organizational capacity to address sustainability challenges and developing enduring reciprocal relationships with diverse stakeholders are fundamental to the S^3 RCN. Such outcomes will have broader societal impacts on science, policy and sustainable resource management in New England and beyond. To this end, we will collaborate with Reos Partners to design and facilitate a meaningful and productive science-stakeholder process. The Reos collaboration will include facilitated dialogue and learning journeys for developing stakeholder-defined scenarios and dedicated workshops sessions for bridging scenarios to solutions. The S^3 RCN will also be a central activity of the recently established SPE, which is co-led by several S^3 Steering Committee members. The SPE collaboration will result in policy-relevant communication products such as synoptic reports, case studies of iconic landscapes, and online visualization tools for decision makers. Drawing on the extensive outreach expertise of the Harvard Forest and the SPE, the S^3 products will be widely disseminated to journalists and decision makers through editorial board visits, press kits and teleconference(s), policy briefings, and presentations at non-research conferences aimed at addressing land-use challenges. The S^3 RCN will also work with. Specifically, we will partner with World Wildlife Fund's Natural Capital Project and Wildlife Conservation Society and other collaborators to coordinate webinar and training opportunities that share S^3 findings with decision makers to improve the application of scenarios and ecosystem service assessment in policy and conservation decisions worldwide. Together these broader impacts will help deepen the scientific basis for critical land-use decisions for decades to come.

Table 3: Assessment Plan.

Objective	Assessment Question	Formative & Summative Metrics	Data Sources
Network objective	Are we forging a diverse, transdisciplinary network that is catalyzing new research?	Year 2 & 5 – configuration of network compared to initial configuration; number of participants by group (e.g., underrepresented groups, major disciplines, academic rank, sector).	Workshop and webinar participant lists, workshop surveys, social network analysis.
Science objective	Is the network advancing the four fundamental research challenges?	Year 3 & 5 - new journal submissions and published articles in the four areas, presentations at scientific and other meetings, abstracts submitted, development and sharing of new datasets.	Document reviews, steering committee meetings, website/data page visitation reports, annual reports, science citation index.
Sustainability objective	Are the stated objectives or information needs of stakeholders addressed in the research or outreach materials and did the findings inform policy decisions?	Year 3 & 5 - content of new journal submissions and presentations, policy and conservation recommendations, forest management plans, media coverage.	Document reviews, stakeholder interviews and surveys, participant lists for workshops and webinars, Google News searches, website analytics.

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Thompson, J.R., A. Weik, F.J. Swanson, S.R. Carpenter, N. Fresco, T. Hollingsworth, T.A. Spies, D.R. Foster. 2012. Scenario Studies as a Synthetic and Integrative Research Activity for Long-Term Ecological Research. BioScience, 62(4), 367–376. doi:10.1525/bio.2012.62.4.8.

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Xiang, W. N., and K. C. Clarke. 2003. The use of scenarios in land-use planning. Environment and Planning B: Planning and Design 30:885–909.

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Professional Preparation:

Connecticut College, Magna cum Laude (Botany)	B.A.	1977
University of Minnesota (Ecology)	M.S.	1981
University of Minnesota (Ecology)	Ph.D.	1983

Appointments:

1990 - present	Director of the Harvard Forest, Harvard University
1983 - 1990	Professor, Harvard University

Products: (Five relevant and five additional):

Foster, D. R., Oswald, W. W., Faison, E. K., Doughty, E. D. and Hansen, B. C. S. 2006. A climatic driver for abrupt mid-Holocene vegetation dynamics and the hemlock decline in New England*. *Ecology* 87:2959-2966.

Lindbladh, M. and **Foster**, D. R. 2010. Dynamics of long-lived foundation species: the history *Quercus* in south Scandinavia*. *Journal of Ecology* 98:1330-1345.

Orwig, D. A., Cobb, R. C., D'Amato, A. W., Kizlinski, M. L. and **Foster**, D. R. 2008. Multi-year ecosystem response to hemlock woolly adelgid infestation in southern New England Forests*. *Canadian Journal of Forest Research* 38:834-843.

Oswald, W. W., **Foster**, D. R., Doughty, E. D. and Faison, E. K. 2009. A record of Lateglacial and early Holocene environmental and ecological change from southwestern Connecticut, USA*. *Journal of Quaternary Science* 24:553-556.

Parshall, T. and **Foster**, D. R. 2002. Fire on the New England landscape: regional and temporal variation, cultural and environmental controls. *Journal of Biogeography* 29:1305-1317.

Albani, M., Moorcroft, P. R., Ellison, A. M., Orwig, D. A. and **Foster**, D. R. 2010. Predicting the impact of hemlock Woolly Adelgid on carbon dynamics of Eastern U.S. forests*. *Canadian Journal of Forest Research* 40:119-133.

Busby, P. E., Canham, C. D., Motzkin, G. and **Foster**, D. R. 2009. Forest response to chronic hurricane disturbance in coastal New England*. *Journal of Vegetation Science* 20:487-497.

D'Amato, A. W., Orwig, D. A. and **Foster**, D. R. 2008. The Influence of Successional Processes and Disturbance on the structure of Tsuga canadensis Forests*. *Ecological Applications* 18:1182-1199.

Foster, D. R., Donahue, B., Kittredge, D. B., Motzkin, G., Hall, B., Turner, B. L. and Chilton, E. 2008. New England's Forest Landscape. Ecological Legacies and Conservation Patterns Shaped by Agrarian History*. In: Redman, C. L. and Foster, D. R., *Agrarian Landscapes in Transition*, Oxford University Press, Inc., New York, N. Y.

Foster, D. R. and Orwig, D. A. 2006. Pre-emptive and salvage harvesting of New England forests: when doing nothing is a viable alternative*. *Conservation Biology* 20:959-970.

*http://harvardforest.fas.harvard.edu/publications.html

Synergistic Activity:

National Science Foundation LTER Program - Executive Committee (1995-1999; 2009-)
Harvard University - Director of the Graduate Program in Forest Biology (1985-)
Trustees of Reservations – Board of Directors (2009-)
The Nature Conservancy Board of Directors (2006-)
National Ecological Observation Network – Committee Chair; Design Consortium (2004-)

Sherburne "Shere" B. Abbott

Vice President for Sustainability Initiatives
University Professor of Sustainability Science and Policy
Syracuse University

Professional Preparation

Goucher College	Biology	A.B. - 1977
Yale University, School of Forestry and Environmental Studies	Environmental Science and Natural Resource Policy	M.F.S. - 1984

- Dodge Fellow in Human – Animal Ecology at Yale University

Appointments

June 2011-Present **Syracuse University**
- Vice President for Sustainability Initiatives
- University Professor of Sustainability Science and Policy

2009-2011 **Executive Office of the President, Office of Science and Technology Policy**
- Associate Director for Environment (Senate confirmed)

2005-2009 **University of Texas at Austin, Office of the Executive Vice-President and Provost**
- Director of Center for Science and Practice of Sustainability
- Faculty, College of Liberal Arts

2003-2005 **American Association for the Advancement of Science**
- Chief International Officer

2001-2003 Consultant on environmental science and sustainable development for private foundations, the World Bank, the Brookings Institution, and other non-governmental organizations

1984-2001 **National Academies' National Research Council**
- Executive Director of the Board on Sustainable Development
- Director of the Board on International Organizations and Programs
- Director of the Polar Research Board

U.S. Marine Mammal Commission
- Assistant Scientific Program Director

Products

Board on Sustainable Development, National Research Council. 1999. *Our Common Journey: A Transition Toward Sustainability.* 384 pp., National Academy Press, Washington, D.C.

Abbott, S.B., and W.S. Benninghoff. 1990. "Orientation of environmental change studies to the conservation of Antarctic ecosystems". In: *Antarctic Ecosystems: Ecological Change and Conservation*, ed by K.R. Kerry and G. Hempel. Pp 394-403. Springer-Verlag Berlin Heidelberg, Germany.

Synergistic Activities

(2012 – present) Executive Committee, New York Working Group on Sustainability Education

(October 17-19, 2012) Invited Participant, NSF Workshop on "Best Practices for Integrating Social Sciences in Sustainability Research and Education" University of Chicago, Chicago, IL

(January 2012) Invited Participant, National Climate Assessment ECO-BIO-ES Workshop, The Gordon and Betty Moore Foundation, Palo Alto, CA.

(June 14, 2011) Convened and Chaired US-International Women in Science Dialogue at the White House, Washington, D.C.

Collaborators & Other Affiliations

No collaborators and other affiliations

Biographical Sketch - Mark E. Borsuk

(a) Professional Preparation

Princeton University	Civil Engineering and Operations Research	BSE, 1995
Duke University	Statistics and Decision Sciences	MS, 2001
Duke University	Environmental Science and Policy	PhD, 2001
Swiss Federal Institute of Environmental Science and Technology	Systems Analysis, Integrated Assessment and Modeling	Post-Doc, 2001-2003

(b) Appointments

2007 - present	Assistant Professor, Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire, USA
2010 - present	Summer Guest Investigator, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, USA
2006 - 2007	Research Assistant Professor, Department of Biological Sciences, Dartmouth College, Hanover, New Hampshire, USA
2004 - 2005	Research Group Leader, Integrated Modeling and Decision Analysis, Department of Systems Analysis, Integrated Assessment and Modeling, Swiss Federal Institute for Environmental Science and Technology (EAWAG), Dübendorf, Switzerland
2001 - 2003	Post-Doctoral Researcher, EAWAG, Dübendorf, Switzerland
1997	Director, Governor's Working Group on Water Quality, Raleigh, North Carolina, USA
1995 - 1996	Engineering Associate, ENVIRON Corporation, Princeton, New Jersey, USA

(c) Products

Related to the proposed project:

Gerst, M. D., P. Wang, and M. E. Borsuk. 2013. Discovering plausible energy and economic futures under global change using multidimensional scenario discovery. Environmental Modelling & Software, dx.doi.org/10.1016/j.envsoft.2012.09.001

Borsuk, M. E., S. Schweizer, and P. Reichert. 2012. A Bayesian network model for integrative river rehabilitation planning and management. Integrated Environmental Assessment & Management. 8: 462–472.

Gerst, M. D., R. B. Howarth, M.E. Borsuk. 2010. Accounting for the risk of extreme outcomes in an integrated assessment of climate change. Energy Policy 38: 4540–4548.

Reichert, P. and M. E. Borsuk. 2005. Does high forecast uncertainty preclude effective decision support? Environmental Modelling & Software. 20: 991-1001

Hostmann, M., B. Truffer, P. Reichert and M. E. Borsuk. 2005. Stakeholder values in decision support for river rehabilitation. Archiv für Hydrobiologie (Large Rivers Supplement 15) 155: 491-506.

Other publications:

Tomassini, L., R. Knutti, G.-K. Plattner, D. van Vuuren, T. F. Stocker, R. B. Howarth, and M. E. Borsuk. 2010. Uncertainty and risk in climate projections for the 21st century: comparing mitigation to non-intervention scenarios. Climatic Change 103: 399–422.

Reichert, P., M. E. Borsuk, M. Hostmann, S. Schweizer, C. Spörri, K. Tockner and B. Truffer. 2007. Concepts of decision support for river rehabilitation. Environmental Modelling & Software 22: 188-201.

Turaga, R. M. R., R. B. Howarth, and M. E. Borsuk. 2010. Pro-environmental behavior: Rational choice meets moral motivation. Annals of the New York Academy of Sciences 1185: 211-224.

Borsuk, M. E., R. T. Clemen, L. A. Maguire, and K. H. Reckhow. 2001. Stakeholder values and scientific modeling in the Neuse River watershed. Group Decision & Negotiation 10: 355-373.

(d) Synergistic Activities

Community Engagement Core Leader, Dartmouth Superfund Research Program (2011-present)

Editorial Board: Environmental Modelling & Software (2008-present)

Member, U.S. EPA Science Advisory Board, Expert Elicitation Advisory Panel (2009)

Development, documentation, and distribution of the Neuse Estuary Bayesian Ecological Response Network (Neu-BERN), an integrative model to help policy makers determine the maximum allowable load (TMDL) of nitrogen to the Neuse Estuary that would meet ecological and water quality objectives (www.lumina.com/case-studies/neuse-estuary)

Development, documentation, and training of the Integrative River Rehabilitation Model (IRRM), a decision analytic model for evaluating the effects of alternative river restoration strategies on ecological and economic endpoints (www.eawag.ch/forschung/siam/software/irrm/index_EN)

Charles T. Driscoll, Ph.D. Syracuse University, Department of Civil and Environmental Engineering, 151 Link Hall, Syracuse, NY 13244; 315-443-3434; ctdrisco@syr.edu

PROFESSIONAL PREPARATION

University of Maine	Civil Engineering	B.S. 1974
Cornell University	Environmental Engineering	M.S. 1976
Cornell University	Environmental Engineering	Ph.D. 1980

APPOINTMENTS

2001-present University Professor of Environmental Systems Engineering, SU;
2001-2003 Interim Chair, Dept. of Civil and Env. Eng., SU;
1999-present Director, Center for Environmental Systems Engineering, SU;
2006 Visiting Scientist, Department of Environmental Science, Univ. of Virginia;
1993-2001 Distinguished Professor of Civil and Env. Eng., SU;
1987-1988 Visiting Scientist, Institute of Ecosystem Studies;
1985-1993 Professor, Dept. of Civil and Env. Eng.;
1983-1985 Associate Professor, Dept. of Civil and Env. Eng.;
1979-1983 Assistant Professor, Dept. of Civil and Env. Eng., SU

RELEVANT PRODUCTS (FROM OVER 370 PEER-REVIEWED PUBLICATIONS)

Driscoll, C. T., G. B. Lawrence, A. J. Bulger, T. J. Butler, C. S. Cronan, C. Eagar, K. F. Lambert, G. E. Likens, J. L. Stoddard, and K. C. Weathers. 2001. Acidic deposition in the northeastern United States: Sources and inputs, ecosystem effects, and management strategies. BioScience **51**:180-198.

Driscoll, C. T., D. Whitall, J. Aber, E. Boyer, M. Castro, C. Cronan, C. L. Goodale, P. Groffman, C. Hopkinson, K. Lambert, G. Lawrence, and S. Ollinger. 2003. Nitrogen pollution in the northeastern United States: Sources, effects, and management options. BioScience **53**:357-374.

Gbondo-Tugbawa, S. S., C. T. Driscoll, J. D. Aber, and G. E. Likens. 2001. Evaluation of an integrated biogeochemical model (PnET-BGC) at a northern hardwood forest ecosystem. Water Resources Research **37**:1057-1070.

Pourmokhtarian, A., C. T. Driscoll, J. L. Campbell, and K. Hayhoe. 2012. Modeling potential hydrochemical responses to climate change and rising CO_2 at the Hubbard Brook Experimental Forest using a dynamic biogeochemical model (PnET-BGC). Water Resources Research **48, W07514**:13pp.

Raciti, S. M., T. J. Fahey, R. Q. Thomas, P. B. Woodbury, C. T. Driscoll, F. J. Carranti, D. R. Foster, P. S. Gwyther, B. R. Hall, S. P. Hamburg, J. C. Jenkins, C. Neill, B. W. Peery, E. E. Quigley, R. Sherman, M. A. Vadeboncoeur, D. A. Weinstein, and G. Wilson. 2012. Local-scale carbon budgets and mitigation opportunities for the northeastern United States. BioScience **62**:23-38.

RELATED SIGNIFICANT PRODUCTS

Chen, L. and C. T. Driscoll. 2005. Regional application of an integrated biogeochemical model to northern New England and Maine. Ecological Applications **15**:1783-1797.

Gbondo-Tugbawa, S. S. and C. T. Driscoll. 2003. Factors controlling long-term changes in soil pools of exchangeable basic cations and stream acid neutralizing capacity in a northern hardwood forest ecosystem. Biogeochemistry **63**:161-185.

Wu, W. and C. T. Driscoll. 2009. Application of the PnET-BGC – an integrated biogeochemical model – to assess the surface water ANC recovery in the Adirondack region of New York under three multi-pollutant proposals. Journal of Hydrology **378**:299-312.

SYNERGISTIC ACTIVITIES

The research program of Dr. Driscoll has several synergistic activities: 1) Dr. Driscoll's research is an important component in the educational activities of undergraduate and graduate students at SU through independent research experience; 2) Data sets and summaries resulting from his research are available to other researchers through the world wide web (e.g., www.hubbardbrook.org; www.ourlake.org); 3) Dr.

Driscoll teaches undergraduate/graduate classes in biogeochemistry and environmental sustainability. Some of the lecture material for those classes is developed from his research program. Students are required to conduct a project in which they analyze biogeochemical, energy, population and land cover data; 4) Dr. Driscoll routinely participates in public forums, provides briefings for state and federal government staff, and non-government organizations and lectures on environmental problems/issues. These activities are an outgrowth of his scholarly work; and 5) Dr. Driscoll is routinely asked to provide expert advice to industry and government agencies as a result of his research experience.

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PROFESSIONAL PREPARATION

Dartmouth College (Sociology and Environmental Studies)	A.B.	1990
Yale University School of Forestry and Environmental Studies (Forest Science)	M.F.S.	1992

APPOINTMENTS

2010 – present	Harvard Forest - Science & Policy Integration Project Director
2008 - 2010	Dartmouth College, Sustainability Manager
2004 – present	Ecologic: Analysis & Communications – Principle
1996 – 2004	Hubbard Brook Research Foundation - Executive Director

PRODUCTS (five relevant and five additional)

Driscoll, C.T., **K.F. Lambert**, F.S. Chapin, III, D. Nowak, T. Spies, F. Swanson, D.B. Kittredge, Jr., C.M. Hart. Science and Society: The Role of Long-Term Studies in Environmental Stewardship. BioScience. 62(4): 354-367.

Driscoll, C.T., **K.F. Lambert**, K.C. Weathers. 2011. Integrating Science and Practice: A Case Study of the Hubbard Brook Research Foundation Science Links Program. BioScience. 61(10):791-801.

Foster, D.R., B.M. Donahue, D.B. Kittredge**, K.F. Lambert**, M.L. Hunter, B.R. Hall, L.C. Irland, R.J. Lilieholm, D.A. Orwig, A.W. D'Amato, E.A. Colburn, J.R. Thompson, J.N. Levitt, A.M. Ellison, W.S. Keeton, J.D. Aber, C.V. Cogbill, C.T. Driscoll, T.J. Fahey. C.M. Hart. 2010. Wildlands and Woodlands: A Vision for the New England Landscape. Harvard Forest, Harvard University. 36 pp.

Levitt, J.N. and **K.F. Lambert**. 2006. Report on the Wildlands and Woodlands Conservation Finance Roundtable. A research publication of the Program on Conservation Innovation, Harvard Forest, Harvard University. 57 pp.

Driscoll, C.T., D. Whitall, J. Aber, E. Boyer, M. Castro, C. Cronan, C. Goodale, P. Groffman, C. Hopkinson, **K.F. Lambert**, G. Lawrence, and S. Ollinger. 2003. Nitrogen Pollution in the Northeastern United States: Sources, Effects, and Management Options. BioScience. 53(4): 357-374.

Driscoll, C.T., G.B. Lawrence, A.J. Bulger, T.J. Butler, C.S. Cronan, C. Eagar, **K.F. Lambert**, G.E. Likens, J.L. Stoddard and K.C. Weathers. 2001. Acidic Deposition in the Northeastern United States: Sources and Inputs, Ecosystem Effects, and Management Strategies. BioScience. 51(3):180-198.

Driscoll, C.T., Y-J. Han, C. Chen, D. Evers, **K.F. Lambert**, T. Holsen, N. Kamman, and R. Munson. 2007. Mercury Contamination in Remote Forest and Aquatic Ecosystems in the Northeastern U.S.: Sources, Transformations and Management Options. BioScience. 57(1):17-28.

Evers, D.C., Y-J Han, C.T. Driscoll, N.C. Kamman, M.W. Goodale, **K.F. Lambert**, T.M. Holsen, T.M. Holsen, C.Y. Chen, T.A. Clair, and T. Butler. 2007. Biological Mercury Hotspots in the Northeastern U.S. and Southeastern Canada. BioScience. 57(1):29-43.

Driscoll, C.T., D. Whitall, J. Aber, E. Boyer, M. Castro, C. Cronan, C. Goodale, P. Groffman, C. Hopkinson, **K.F. Lambert**, G. Lawrence, and S. Ollinger. 2003. Nitrogen Pollution: from the Sources to the Sea. Hubbard Brook Research Foundation. Science Links Publication vol. 1, no. 2.

Driscoll, C.T., G.B. Lawrence, A.J. Bulger, T.J. Butler, C.S. Cronan, C. Eagar, **K.F. Lambert**, G.E. Likens, J.L. Stoddard and K.C. Weathers. 2001. Acid Rain Revisited: advances in scientific understanding since the passage of the 1970 and 1990 Clean Air Act Amendments. Hubbard Brook Research Foundation. Science Links Publication. Vol.1, no.1.

SYNERGISTIC ACTIVITIES

NSF LTER Program Ad Hoc Communication Committee (2010)
NEON Education Committee – DSECC - Public Education and Engagement (2010 – present)
Biodiversity Research Institute – Board member (2008-2010)
Switzer Environmental Fellows Network (1991 - present)
Leopold Schepp Fellow (1991 - present)

Robert J. Lilieholm

Professional Preparation

Utah State University, Logan	Forest Management	B.S. 1983
Louisiana State University, Baton Rouge	Forest Ecology	M.S. 1985
University of California, Berkeley	Wildland Resource Science	Ph.D. 1988

Appointments

E.L. Giddings Associate Professor of Forest Policy, School of Forest Resources, University of Maine (2006 to present)
Associate Professor, Department of Environment & Society, USU (2003-2006)
Associate Professor, Department of Forest Resources, USU (1994-2003)
Assistant Professor, Department of Forest Resources, USU (1988-1994)

Five Related Products

Jansujwicz, J., A.J.K. Calhoun, J.E. Leahy, and R.J. Lilieholm. 2013. Using Framing Theory with Mixed Methods to Develop a Private Landowner Typology. Society and Natural Resources (in press).

Meyer, S.R., M.L. Johnson, and R.J. Lilieholm. 2012. Landscape Conservation in the United States: Evolution and Innovation across the Urban-Rural Interface. Pages 225- 258 in W. Zipper, D.N. Laband, and B.G. Lockaby, eds., Urban-Rural Interfaces: Linking People and Nature. Jointly published by the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. 332 pages.

Gomben, P.C., R.J. Lilieholm, and M. Gonzalez-Guillen. 2012. Impact of Demographic Trends on Future Development Patterns and the Loss of Open Space in the California Mojave Desert. Environmental Management 49(2):305-324.

McCloskey, J.T., R.J. Lilieholm, and C.S. Cronan. 2011. Using Bayesian Belief Networks to Identify Future Compatibilities and Conflicts between Development and Landscape Conservation. Landscape and Urban Planning 101(2011):190-203.

Cronan, C.S., R.J. Lilieholm, J. Tremblay and T. Glidden. 2010. A Retrospective Assessment of Land Conservation Patterns in Maine based on Spatial Analysis of Ecological and Socio-economic Indicators. Environmental Management 45(5):1076-1095.

Five Other Significant Products

Whitesell, S., R.J. Lilieholm, and T.L. Sharik. 2010. A Global Survey of Tropical Biological Field Stations. Pages 5-14 in BioScience Topics in Biological Field Stations, University of California Press (ISBN 978-0-9817130-4-5). 72 pages.

Lilieholm, R.J., L.C. Irland, and J.M. Hagan. 2010. Changing Socio-economic Conditions for Private Woodland Protection. Pages 67-98 in S.C. Trombulak and R.F. Baldwin, eds., Landscape-scale Conservation Planning. Springer-Verlag, New York, NY. 427 pages.

Lilieholm, R.J., and W.P. Weatherly. 2010. Kibale Forest Wild Coffee: Challenges to Market-based Conservation in Africa. Conservation Biology 24(4):924-930.

Lilieholm, R.J. 2007. Forging a Common Vision for Maine's North Woods. Maine Policy Review 16(2):12-25.

Fausold, C.F., and R.J. Lilieholm. 1999. The Economic Value of Open Space: A Review and Synthesis. Environmental Management 23(3):307-320.

Synergistic Activities

Program Leader, Conservation Lands and Public Values, Center for Research on Sustainable Forests. http://crsf.umaine.edu/research-programs/conservation/

Program Director, Acadian Internship in Regional Conservation and Stewardship. Six-week internship at Acadia National Park working with local NGOs on conservation initiatives for U.S and international students. http://www.sercinstitute.org/research/acadian-internships

Nationally-recognized research on undergraduate enrollment trends in natural resources. http://digitalcommons.usu.edu/cuenr/9thBiennial/Keynote/1/

NSF-funded Gnu Landscapes project, partnerships and collaborations in and around Kenyan protected areas. http://www.nrel.colostate.edu/projects/gnu/outreach.php

G. Peirce and Florence Pitts-Webber Outstanding Forestry Teacher Award in 2010.

BIOGRAPHICAL SKETCH 1/6/13

Taylor Henry Ricketts
Gund Institute for Ecological Economics
University of Vermont
617 Main Street
Burlington, VT 05401

(802) 656-7796 phone
(802) 656-2995 fax
taylor.ricketts@uvm.org

I. Professional Preparation

Dartmouth College	Earth Sciences	B.A.	1991
Stanford University	Biology	Ph.D.	2000
Stanford University	Biology	Post-doc	2000-2002

II. Professional Appointments

2011 – present Professor, Rubenstein School for Environment and Natural Resources, University of Vermont
2011 – present Director, Gund Institute for Ecological Economics, University of Vermont
2008 – 2011 Managing Director, Conservation Science Program, WWF – USA
2002 – 2008 Director, Conservation Science Program, WWF – USA
2003 – 2011 Adjunct Assistant Professor, University of Maryland, Biology and Graduate Program in Conservation Biology

III. Products

(i) Five Most Closely Related to the Proposed Project

Kareiva, P., H. Tallis, **T.H. Ricketts**, G.C. Daily, & S. Polasky, eds. (2011). *Natural capital: Theory and practice of mapping ecosystem services*. Oxford University Press, Oxford, UK.

Naidoo, R., A. Balmford, R. Costanza, B. Fisher, R.E. Green, B. Lehner, T.R. Malcolm, **T.H. Ricketts** (2008). Global mapping of ecosystem services and conservation priorities. *Proceedings of the National Academy of Sciences – US.* 105: 9495-9500.

Ricketts, T.H., J. Regetz, I. Steffan-Dewenter, S. A. Cunningham, et al. (2007). Landscape effects on crop pollination services: Are there general patterns?. *Ecology Letters* 11:499-515.

Naidoo, R. and **T.H. Ricketts** (2006). Mapping economic costs and benefits of conservation. *PLoS Biology* 4(11):e360.

Ricketts, T.H., G.C. Daily, P.R. Ehrlich, and C. Michener. 2004. Economic value of tropical forest to coffee production. *Proceedings of the National Academy of Sciences – US.* 101(34):12579-12582.

(ii) Five Other Significant

Imhoff, M.L., L. Bounoua, **T.H. Ricketts**, C. Loucks, R. Harriss, W. T. Lawrence (2004) Global patterns in human consumption of net primary production. *Nature* 429:870-873.

Ricketts, T.H., E. Dinerstein, T. Boucher, T.M. Brooks, et al. (2005). Pinpointing and preventing imminent extinctions. *Proceedings of the National Academy of Sciences – US* 102:18497-18501.

Ricketts, T.H., B. Soares-Filho, G. A. B. da Fonseca, D. Nepstad, et al. (2010).

Indigenous Lands, Protected Areas, and Slowing Climate Change. *PLoS Biology* 8:3 e10000331

Ricketts, T.H. 2001. The matrix matters: effective isolation in fragmented landscapes. *American Naturalist* 158(1):87-99.

Grand, J., M.P. Cummings, T. Rebelo, **T.H. Ricketts**, M.C. Neel (2007). Biased data reduce efficiency and effectiveness of conservation reserve networks. *Ecology Letters* **10**:364-374.

IV. Synergistic Activities

2012 – present Advisory Council, RFF Center for Management of Ecological Wealth
2012 – present Science Advisory Board, WWF, Luc Hoffmann Institute
2008 – 2012 Science Advisory Board, NCEAS (Chair 2010-2011)
2005 – 2012 Associate Editor, *Frontiers in Ecology and Evolution*
2004 – present Founder of WWF's *Kathryn Fuller Fund for Nature*, which sponsors doctoral and post-doc fellowships, seminars, and symposia in conservation science.

JONATHAN R. THOMPSON
Department of Environmental Sciences
University of Virginia
Charlottesville, VA 22903
E-mail: jrt6q@virginia.edu

Professional Preparation:

University of Massachusetts (Natural Resources)	B.S.	1999
Oregon State University (Forest Policy)	M.S.	2004
Oregon State University (Forest Ecology)	Ph.D.	2008
Harvard University – Harvard Forest	Post-doc	2008-2009

Appointments:

2011 – present	Research Assistant Professor, University of Virginia
2009 – present	Research Ecologist, Smithsonian Institution
2009 – present	Associate, Harvard University, Harvard Forest

Five Related Products:

Thompson, J. R., A. Wiek, F. Swanson, S. Carpenter, N. Fresco, T. Hollingsworth, T. Spies, D. R. Foster. 2012. Scenario studies as a synthetic and integrative research activity for long term ecological research. *BioScience.* 62(4)367-376

Thompson, J. R., D.R. Foster, R. Scheller, and D. B. Kittredge. 2011. The influence of land use and climate change on forest biomass and composition in Massachusetts, USA. *Ecological Applications*. 21 (7) 2425-2444.

Thompson J. R., S. Duncan, K. N. Johnson 2009. Is there potential for the historical range of variability to guide conservation given the social range of variability? *Ecology and Society.* 14(1): 18

Orwig, D., **J. R. Thompson**, N. Povak, M. Manner, D. Niebyl, D. R. Foster. 2012. A foundation tree at the precipice: Tsuga canadensis health following the arrival of Adelges tsugae in central New England. *Ecosphere*. *3(1)p10*

Thompson, J. R., K. N. Johnson, M. Lennette, T. A. Spies, and P. Bettinger. 2006. Historical disturbance regimes as a reference for forest policy in a multi-owner province: a simulation experiment. *Canadian Journal of Forest Research* 36:401-417.

Five Additional Products:

Thompson J. R. T. A. Spies. and L. Ganio. 2007. Reburn severity in managed and unmanaged vegetation in a large wildfire. *Proceedings of the National Academy of Sciences* 104:10743-10748.

Foster, D. R., B. Donahue, D. Kittredge, K. Fallon-Lambert, M. Hunter, B. Hall, L. Irland, R. Lilieholm, D. Orwig, A. D'Amato, E. Colburn, **J. R. Thompson**, J. Levitt, A. Ellison, W. Keeton, J. Aber, C. Cogbill, C. Driscoll, T. Fahey, and C. Hart. 2010. Wildland and Woodlands: A Forest Vision for New England. Harvard University Press. Cambridge, MA. ISBN: 978-1-4507-0603-250500

Thompson J. R. and T. A. Spies. 2010. Factors associated with crown damage following recurring mixed-severity wildfires and post-fire management. *Landscape Ecology.* 25:775-789

Thompson J. R., T. A. Spies, and K. Olsen. 2011. Canopy damage to conifer plantations within a mixed-severity wildfire varies with stand age. *Forest Ecology and Management.* 262:355-360.

Halofsky J., D. Donato, D. Hibbs, J. Campbell, M. Cannon, J. Fontaine, **J. R. Thompson**, R.G. Anthony, B.T. Bormann, L.J. Kayes, B.E. Law, D.L. Peterson, and T.A. Spies. 2011. Mixed severity fire regimes: Lessons from the Klamath-Siskiyou Ecoregion. *Ecosphere.* 2(40)

Synergistic Activity:

Board Member for "The LANDIS-II Project Foundation" A non-profit (501c3) organization dedicated maintenance and advancement the LANDIS-II landscape ecology simulation framework (2012 – present)

LTER -- Future Scenarios of Landscape Change Working Group, Co-Chair. (2008- present)

Smithsonian Institution -- Climate and Carbon Working Group, Member. (2009- present)

Wildlife Society – Interactions between climate and land use change working group (2011 – present)

ESA Ecosphere, Subject Matter Editor (2010- present)

Angélica M. Almeyda Zambrano
Conservation Ecology Center
Smithsonian Conservation Biology Institute
1500 Remount Road, Front Royal, VA 22630

540.635.6549
540.635.6506 (fax)
AlmeydaA@si.edu

Professional Preparation:

Universidad Nacional Agraria La Molina (Forest Sciences)	B.S.	1999
University of Florida (Latin American Studies)	M.S.	2004
Stanford University (Anthropological Sciences)	Ph.D.	2012

Appointments:

2012 - present	Postdoctoral Fellow, Smithsonian Conservation Biology Institute
2011 - 2012	Doctoral Fellow, Sustainability Science Program, Harvard University

Products: (Five relevant and five additional):

Almeyda Zambrano AM, EN Broadbent, M Schmink, SG Perz, and GP Asner. 2010. Deforestation drivers in Southwest Amazonia: comparing smallholder farmers in Iñapari, Peru, and Assis Brasil, Brazil. *Conservation and Society* 8(3): 157-170.

Perz SG and AM **Almeyda Zambrano**. 2010. A Tri-Partite framework of forest dynamics: hierarchy, panarchy and heterarchy in the study of secondary growth. In *Reforesting landscapes, linking pattern and process*, Harini Nagendra and Jane Southworth, 10:59-84. Landscape Series. New York: Springer.

Oliveira PJC, GP Asner, DE Knapp, AM **Almeyda Zambrano**, R Galván-Gildemeister, S Keene, RF Raybin, and RC Smith. 2007. Land-use allocation protects the Peruvian Amazon. *Science* 317(5842): 1233-6.

Broadbent EN, AM **Almeyda Zambrano**, R Dirzo, WH Durham, L Driscoll, P Gallagher, R Salters, JS, A Colmenares and S Randolph. 2012. The effect of land use change and ecotourism on biodiversity: a study of Manuel Antonio, Costa Rica, from 1985-2008. *Landscape Ecology* 27:731-744.

Almeyda Zambrano AM, EN Broadbent, and WH Durham. 2010. Social and environmental effects of ecotourism in the Osa Peninsula of Costa Rica: the Lapa Rios case. *Journal of Ecotourism* 9(1): 62-83.

Almeyda Zambrano AM, EN Broadbent, MS Wyman, and WH Durham. 2010. Ecotourism Impacts in the Nicoya Peninsula, Cost Rica. *International Journal of Tourism Research* 12:803-819.

Smith RC, D Pinedo, PM Summers, and AM **Almeyda Zambrano**. 2001. Tropical Rhythms and Collective Action: community-based fisheries management in the face of Amazonian unpredictability. *IDS Bulletin* 32(4): 36-46.

Duchelle AE, AM **Almeyda Zambrano**, S Wunder, J Börner, KA Kainer. *In review*. Livelihoods and conservation in smallholder-managed forests in Southwestern Amazonia: the role of Brazil Nut. *World Development*

Synergistic Activity:

CIFOR's Poverty and Environment Network - Partner (2006-2012)

CURRENT AND PENDING SUPPORT

David R. Foster

Dr. Foster, as Director of Harvard Forest, serves as PI on the proposal and grants listed below. Please note that it is the policy of The Faculty of Arts and Sciences (FAS) at Harvard University that researchers who do not receive salary support from a specific grant should not make quantifiable commitments of effort in the grant proposal, unless explicitly required by sponsor policy. Therefore, commitments of effort are indicated only in proportion to salary support received from any given grant.

Current:

Project/Proposal Title: LTER-IV: Integrated studies of the drivers, dynamics, and consequences of landscape change in New England
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Awarded: $5,385,455
Starting Date: 10/1/2006
Ending Date: 09/30/2013
Person Months per Year Committed to Project: *Please see explanation above.*

Project/Proposal Title: Predicting regional allergy hotspots in future climate scenarios
Source of Support: Environmental Protection Agency
Project Location: Harvard Forest
Total Amount Awarded: $898,634
Starting Date: 09/01/2009
Ending Date: 08/31/2013
Person Months per Year Committed to Project: *Please see explanation above.*

Project/Proposal Title: Collaborative Research and NEON: PalEON - a PaleoEcological Observatory Network to assess terrestrial ecosystem models
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Awarded: $65,790
Starting Date: 05/01/2011
Ending Date: 04/30/2013
Person Months per Year Committed to Project: *Please see explanation above.*

Project/Proposal Title: Collaborative Research: Digitization TCN: Mobilizing New England Vascular Plant Specimen Data to Track Environmental Changes
Source of Support: National Science Foundation
Total Amount Awarded: $13,399
Starting Date: 07/01/2012
Ending Date: 06/30/2016
Person Months per Year Committee to Project: *Please see explanation above.*

Project/Proposal Title: HFR LTER V: New Science, Synthesis, Scholarship, and Strategic Vision for Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Awarded: $5,879,997
Starting Date: 01/01/2013

Ending Date: 12/31/2018
Person Months per Year Committed to Project: *Please see explanation above*.

Project/Proposal Title: FSML: Walk-up towers for research, education, communication, and outreach at the Harvard Forest
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Awarded: $347,764
Starting Date: 06/01/2012
Ending Date: 05/31/2014
Person Months per Year Committed to Project: *Please see explanation above*.

Project/Proposal Title: Operation of the Harvard Forest Core Site in the AmeriFlux Network Management Project (ANMP)
Source of Support: Department of Energy via Lawrence Berkeley National Lab
Project Location: Harvard Forest
Total Amount Requested: $115,818 Harvard only
Starting Date: 10/01/2012
Ending Date: 09/30/2015
Person Months per Year Committee to Project: n/a

Project/Proposal Title: CNH-Ex: Shifting Land Use and Forest Conservation: Understanding the Coupling of Social and Ecological Processes along Urban-to-Rural Gradients
Source of Support: National Science Foundation - SubContract from Boston University
Total Amount Requested: $31,169 Harvard only
Starting Date: 09/01/2012
Ending Date: 08/31/2015
Person Months per Year Committee to Project: n/a

Pending:

This Project/Proposal Title: RCN-SEES: Scenarios, Services, and Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Requested: $749,659
Starting Date: 11/1/2013
Ending Date: 10/31/2018
Person Months per Year Committed to Project: n/a

Project/Proposal Title: A Center for Coastal Nutrient Management in Woods Hole
Source of Support: Environmental Protection Agency - SubContract from Marine Biological Laboratory
Project Location: Harvard Forest
Total Amount Requested: $125,004 Harvard only
Starting Date: 09/01/2013
Ending Date: 08/31/2017
Person Months per Year Committed to Project: n/a

Project/Proposal Title: Invasive Species, Forest Disturbance and the Carbon Cycle: The Effect of the Hemlock Woolly Adelgid on Local- to Regional-Scale Carbon Flux Following Ecosystem

Reorganization
Source of Support: Department of Energy
Project Location: Harvard Forest
Total Amount Requested: $ 460,296
Starting Date: 6/1/2013
Ending Date: 5/31/2016
Person Months per Year Committed to Project: n/a

CURRENT AND PENDING SUPPORT

Sherburne "Shere" B. Abbott

Pending:

This Proposal Title: RCN-SEES: Scenarios, Services, and Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Requested: $749,659
Starting Date: 11/1/2013
Ending Date: 10/31/2018
Person Months per Year Committed to Project: 0
Principal Investigator: David Foster

Mark Borsuk

Current and Pending Support

Current:
Proposal Title: A multi-level, agent-based model for identifying the factors that enable or constrain international climate change negotiations
Source of Support: National Science Foundation
Project Location: Hanover, NH
Total Amount Requested: $700,000
Starting Date: 05/01/2010
Ending Date: 04/30/2013
Person Months per Year Committed to Project: 1 Academic
Principal Investigator: Mark Borsuk

Proposal Title: Bayesian network modeling of gene-environment interactions and cancer susceptibility
Source of Support: NIH, Center of Biomedical Research Excellence (COBRE)
Project Location: Hanover, NH
Total Amount Requested: $1,647,511
Starting Date: 09/01/2011
Ending Date: 08/31/2016
Person Months per Year Committed to Project: 4.5 Academic, 1.5 Summer
Principal Investigator: Jason Moore

Proposal Title: Interactions among climate, land use, ecosystem services and society
Source of Support: NSF, EPSCoR
Project Location: Hanover, NH
Total Amount Requested: $ 1,321,391
Starting Date: 08/01/2011
Ending Date: 07/31/2016
Person Months per Year Committed to Project: 1 Summer
Principal Investigator: Richard Howarth

Proposal Title: Asynchronous mitosis in multinucleate cells
Source of Support: NIH
Project Location: Hanover, NH
Total Amount Requested: $ 1,425,083
Starting Date: 08/01/2010
Ending Date: 07/31/2015
Person Months per Year Committed to Project: 0.5 Summer
Principal Investigator: Amy Gladfelter

Pending:

This Proposal Title: RCN-SEES: Scenarios, Services, and Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Requested: $749,659
Starting Date: 11/1/2013
Ending Date: 10/31/2018

Person Months per Year Committed to Project: 0
Principal Investigator: David Foster

Proposal Title: Interdependence and Prospects for Resilience of Integrated Energy Food Systems
Source of Support: NSF
Project Location: Hanover, NH
Total Amount Requested: $1,465,769
Starting Date: 7/1/2013
Ending Date: 6/30/2016
Person Months per Year Committed to Project: 0.5 Summer
Principal Investigator: Anne Kapuscinski

Proposal Title: Coastal SEES (Track 1), Collaborative: Oligotrophication in Coastal Salt Ponds and their Mesocosm Analogs: The Mercury Response
Source of Support: NSF
Project Location: Hanover, NH
Total Amount Requested: $99,081
Starting Date: 05/1/2013
Ending Date: 04/30/2015
Person Months per Year Committed to Project: 1 Summer
Principal Investigator: Mark Borsuk

Proposal Title: Sector-specific climate policy as a catalyst for a low carbon future: insights from agent-based modeling and surveys of firm decision-making
Source of Support: NSF
Project Location: Hanover, NH
Total Amount Requested: $659,479
Starting Date: 09/1/2013
Ending Date: 08/31/2016
Person Months per Year Committed to Project: 1 Summer
Principal Investigator: Mark Borsuk

Proposal Title: Partnering with the Celiac Community to Understand Arsenic Exposure From Food
Source of Support: NIH
Project Location: Hanover, NH
Total Amount Requested: $2,476,606
Starting Date: 01/01/2014
Ending Date: 12/31/2018
Person Months per Year Committed to Project: 1 Summer
Principal Investigator: Brian Jackson

Project title: Dartmouth Toxic Metals Superfund Research Program
Source of Support: NIEHS/NIH
Location: Hanover, NH
Total Amount Requested: $ 17.4 million
Starting Date: 04/01/2013
Ending Date: 03/31/2018
Person Months per Year Committed to Project: 1 Academic
Principal Investigator: Bruce Stanton

Current/Pending Support for Charles Driscoll

Awarded

PI Name:	Driscoll, Charles T Jr.
Co-PI:	Charles Driscoll
Title:	*Land-Atmosphere Dynamics of Mercury and Ecological Implications for Adirondack Forest Ecosystems*
Sponsor Name:	New York State Energy Research and Development Authority
Project Period:	7/1/2008 - 4/30/2013
Total Sponsor Costs:	$440,093
Location of Project:	Syracuse University

Person-Mos/Year committed to the project: Cal: 0 Acad: 0.425 Sumr: 0

Awarded

PI Name:	Driscoll, Charles T Jr.
Co-PI:	Charles Driscoll
Title:	*Application of a Dynamic Watershed Biogeochemical Model (PnET-BGC) to Evaluate the Recovery of Sensitive Aquatic Resources at Great Smoky Mountains National Park from the Effects of Acidic Deposition*
Sponsor Name:	National Park Service/Department of the Interior
Project Period:	9/25/2009 - 8/31/2014
Total Sponsor Costs:	$150,000
Location of Project:	Syracuse University

Person-Mos/Year committed to the project: Cal: 0 Acad: 0 Sumr: 0

Awarded

PI Name:	Johnson, Chris E
Co-PI:	Charles Driscoll
Title:	*Response of Acidified Soils and Associated Surface Waters to Reduced Atmospheric Acid Inputs & Calcium Mitigation Strategies*
Sponsor Name:	New York State Energy Research and Development Authority
Project Period:	8/11/2009 - 8/10/2013
Total Sponsor Costs:	$249,997
Location of Project:	Syracuse University

Person-Mos/Year committed to the project: Cal: 0 Acad: 0.25 Sumr: 0

Awarded

PI Name:	Driscoll, Charles T Jr.
Co-PI:	Charles Driscoll
Title:	*Long-Term Ecological Research at the Hubbard Brook Experimental Forest*
Sponsor Name:	Cornell University
Project Period:	2/1/2011 - 7/31/2013
Total Sponsor Costs:	$393,801
Location of Project:	Syracuse University

Person-Mos/Year committed to the project: Cal: 0 Acad: 0 Sumr: 0.17

Awarded
PI Name: Driscoll, Charles T Jr.
Co-PI: Charles Driscoll
Title: *New York State Acid Lakes TMDLs*
Sponsor Name: Battelle
Project Period: 2/4/2011 - 5/5/2013
Total Sponsor Costs: $128,266
Location of Project: Syracuse University
Person-Mos/Year committed to the project: Cal: 0 Acad: 0.13 Sumr: 0.38

Awarded
PI Name: Driscoll, Charles T Jr.
Co-PI: Charles Driscoll
Title: *Postdoctoral Fellowship in Biology*
Sponsor Name: National Science Foundation
Project Period: 9/1/2011 - 8/31/2014
Total Sponsor Costs: $15,000
Location of Project: Syracuse University
Person-Mos/Year committed to the project: Cal: 0 Acad: 0 Sumr: 0

Pending this Project/Proposal Title
PI Name: Foster, David R.
Co-PI: Charles Driscoll
Title: *RCN-SEES: Scenarios, Services, and Society*
Sponsor Name: National Science Foundation
Project Period: 11/1/2013 - 10/31/2018
Total Sponsor Costs: $749,659
Location of Project: Harvard Forest
Person-Mos/Year committed to the project: 0

Pending
PI Name: Liddy, Elizabeth D
Co-PI: Charles Driscoll
Title: *Scientific Computing to Illuminate Dark Scientific Data*
Sponsor Name: National Science Foundation
Project Period: 7/1/2013 - 6/30/2018
Total Sponsor Costs: $9,742,865
Location of Project: Syracuse University
Person-Mos/Year committed to the project: Cal: 0 Acad: 0.19 Sumr: 0.51

Pending
PI Name: Driscoll, Charles T Jr.
Co-PI: Charles Driscoll

Title: *The Dynamics of Mercury and Methyl-Mercury in fresh Water Environments at the Coast of Israel*
Sponsor Name: United States-Israel Binational Science Foundation
Project Period: 10/1/2013 - 9/30/2017
Total Sponsor Costs: $1
Location of Project: Syracuse University
Person-Mos/Year committed to the project: Cal: 0 Acad: 0 Sumr: 0

Pending
PI Name: Driscoll, Charles T Jr.
Co-PI: Charles Driscoll
Title: *Evaluation of Biomass Harvesting Regimes on Nutrient Depletion Using a Forest Ecosystem Model*
Sponsor Name: Northeastern States Research Consortium
Project Period: 8/16/2013 - 8/15/2015
Total Sponsor Costs: $100,000
Location of Project: Syracuse University
Person-Mos/Year committed to the project: Cal: 0 Acad: 0 Sumr: 0

Pending
PI Name: Driscoll, Charles T Jr.
Co-PI: Charles Driscoll
Title: *Mercury and Organic Carbon Dynamics in Northern Forest Streams*
Sponsor Name: Northeastern States Research Consortium
Project Period: 8/16/2013 - 8/15/2015
Total Sponsor Costs: $71,572
Location of Project: Syracuse University
Person-Mos/Year committed to the project: Cal: 0 Acad: 0 Sumr: 0

Pending
PI Name: Driscoll, Charles T Jr.
Title: *Critical Zone Processes in an Urban Environment*
Sponsor Name: SUNY Research Foundation
Project Period: 1/1/2014 – 12/31/2018
Total Sponsor Costs: $2,162,684
Location of Project: Syracuse University
Person-Mos/Year committed to the project: Cal: 0 Acad: 0.46 Sumr: 0.138

Pending
PI Name: Call, Douglas F
Co-PI: Driscoll, Charles
Title: *Electrode-Based Remediation of Mercury Contaminated Sediments*
Sponsor Name: National Science Foundation
Project Period: 8/16/13 – 8/15/16
Total Sponsor Costs: $328,662

Location of Project: Syracuse University
Person-Mos/Year committed to the project: Cal: 0 Acad: 0 Sumr: 0

CURRENT AND PENDING SUPPORT

Kathy Fallon Lambert

Current:

Project/Proposal Title: HFR LTER V: New Science, Synthesis, Scholarship, and Strategic Vision for Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Awarded: $5,879,997
Starting Date: 01/01/2013
Ending Date: 12/31/2018
Person Months per Year Committed to Project: 1.7
Principal Investigator: David Foster

Project/Proposal Title: Northeast Science and Policy Consortium
Source of Support: Hubbard Brook Research Foundation
Project Location: Harvard Forest
Total Amount Awarded: $28,500
Starting Date: 05/01/2012
Ending Date: 04/30/2013
Person Months per Year Committed to Project: 2.4
Principal Investigator: David Foster

Project/Proposal Title: The Wildlands and Woodlands Initiative: Vision to Action
Source of Support: Jessie B. Cox Charitable Trust
Project Location: Harvard Forest
Total Amount Awarded: $70,000
Starting Date: 07/01/2012
Ending Date: 06/30/2013
Person Months per Year Committed to Project: 2.0
Principal Investigator: David Foster

Pending:

This Project/Proposal Title: RCN-SEES: Scenarios, Services, and Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Requested: $749,659
Starting Date: 11/1/2013
Ending Date: 10/31/2018
Person Months per Year Committed to Project: 2.4
Principal Investigator: David Foster

Project/Proposal Title: Wildlands and Woodlands. Translating the Vision into Sustained and Strategic Activities
Source of Support: Highstead Foundation, Inc.
Project Location: Harvard Forest
Total Amount Requested: $90,000

Starting Date: 01/01/2013
Ending Date: 12/31/2013
Person Months per Year Committed to Project: 3.25
Principal Investigator: David Foster

Project/Proposal Title: Introduced Forest Insects and Pathogens: Scientific Synthesis
and Policy and Management Solutions
Source of Support: U.S. Dept. of Agriculture—subcontract from Cary Institute of Ecosystem Studies
Total Amount Requested: $20,000 Harvard Only
Starting Date: 06/01/2013
Ending Date: 05/31/2015
Person Months per Year Committed to Project: .7
Principal Investigator: David Foster, HU; Gary Lovett, Cary Institute

Project/Proposal Title: A Center for Coastal Nutrient Management in Woods Hole
Source of Support: Environmental Protection Agency - Subcontract from Marine Biological Laboratory
Project Location: Harvard Forest
Total Amount Requested: $125,004 Harvard only
Starting Date: 09/01/2013
Ending Date: 08/31/2017
Person Months per Year Committed to Project: 1.5
Principal Investigator: David Foster, HU; Chris Neil, MBL

CURRENT AND PENDING SUPPORT

Robert John Lilieholm

CURRENT:

Proposal Title: Fragmentation in the Kitengela Ecosystem and Implications for Ungulates in Nairobi National Park, Kenya
Source of Support: National Science Foundation
Project Location: University of Maine, Orono
Total Amount Requested: $680,000
Starting Date: 09/01/2009
Ending Date: 08/31/2013
Person Months per Year Committed to Project: 0.25
Principal Investigator: Randall Boone

Proposal Title: The Maine Center for Sustainability Solutions
Source of Support: National Science Foundation
Project Location: University of Maine, Orono
Total Amount Requested: $20 million
Starting Date: 07/01/2009
Ending Date: 06/30/2014
Person Months per Year Committed to Project: 0.50
Principal Investigator: Mike Eckhart

Proposal Title: Potential Impacts of Alternative Future Land Uses on Forest Management and Potential Wood Supply across Maine
Source of Support: Northern States Research Cooperative (USFS)
Project Location: University of Maine, Orono
Total Amount Requested: $61,500
Starting Date: 07/01/2012
Ending Date: 06/30/2015
Person Months per Year Committed to Project: 0.25
Principal Investigator: Spencer Meyer

Proposal Title: Improving Emerald Ash Borer Monitoring and Management Prioritization
Source of Support: USDA Forest Service
Project Location: University of Maine, Orono
Total Amount Requested: $182,000
Starting Date: 10/01/2011
Ending Date: 09/30/2014
Person Months per Year Committed to Project: 0.25
Principal Investigator: William Livingston

Proposal Title: The Maine Futures Community Mapper: Fostering Economic Growth and Healthy Landscapes for Maine's Communities
Source of Support: Sewall Foundation
Project Location: University of Maine, Orono
Total Amount Requested: $40,000
Starting Date: 07/01/2012
Ending Date: 06/30/2013
Person Months per Year Committed to Project: 0.25

Principal Investigator: Spencer Meyer

PENDING

This Proposal Title: RCN-SEES: Scenarios, Services, and Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Requested: $749,659
Starting Date: 11/1/2013
Ending Date: 10/31/2018
Person Months per Year Committed to Project: 0
Principal Investigator: David Foster

Proposal Title: ISEA - Initiative for Sustainable Energy Advancement (Round 2 - AAAS submission for the next UMaine EPSCoR)
Source of Support: National Science Foundation
Project Location: University of Maine, Orono
Total Amount Requested: $20 million
Starting Date: 07/01/2014
Ending Date: 6/30/2019
Person Months per Year Committed to Project: 0.50
Principal Investigator: Johnathon Rubin

Proposal Title: An Integrated Watershed Approach to Changing Private Well Owners' Behaviors to Protect Drinking Water Quality
Source of Support: US EPA
Project Location: University of Maine, Orono
Total Amount Requested: $280,000
Starting Date: 07/01/2013
Ending Date: 6/30/2016
Person Months per Year Committed to Project: 0.25
Principal Investigator: John Peckenham

Taylor Henry Ricketts

Current and Pending Support

Current:
Proposal Title: Developing Sustainable Pollination Strategies for US Specialty Crops
Source of Support: U.S. Dept. of Agriculture
Project Location: Burlington, VT
Total Amount Requested: $90,123.00
Starting Date: 09/01/2012
Ending Date: 08/31/2017
Person Months per Year Committed to Project: Acad: 1.0 Sumr: 0.5
Principal Investigator: Rufus Isaacs

Proposal Title: Health & Ecosystems: Analysis of Linkages
Source of Support: Wildlife Conservation Society
Project Location: Burlington, VT
Total Amount Requested: $305,744.00
Starting Date: 03/01/2012
Ending Date: 12/31/2014
Person Months per Year Committed to Project: Acad: 0.5
Principal Investigator: Steve Osofsky - WCS

Proposal Title: Evaluating relationships among human health and welfare, ecological condition and natural resources governance
Source of Support: National Socio-Environmental Synthesis Center
Project Location: Annapolis, MD
Total Amount Requested: $100,000.00
Starting Date: 10/01/2012
Ending Date: 12/31/2014
Person Months per Year Committed to Project: N/A
Principal Investigator: Brendan Fisher & Taylor Ricketts

Proposal Title: Adaptation to Climate Change in the Lake Champlain Basin: New Understanding Through Complex Systems Modeling
Source of Support: EPSCoR / National Science Foundation
Project Location: Burlington, VT
Total Amount Requested: $20,000,000.00
Starting Date: 09/01/2011
Ending Date: 08/31/2016
Person Months per Year Committed to Project: Sumr: 1.0
Principal Investigator: Judith Van Houten

Proposal Title: CHN-RCN: Fostering Community and Ecosystem Resilience Through the Development of Place-based Research, Practice, and Education Networks
Source of Support: National Science Foundation
Project Location: Vermont, South Carolina, and Puerto Rico
Total Amount Requested: $500,000.00
Starting Date: 07/01/2013

Ending Date: 06/30/2018
Person Months per Year Committed to Project: Acad: 0.5
Principal Investigator: Deane Wang

Pending:

This Proposal Title: RCN-SEES: Scenarios, Services, and Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Requested: $749,659
Starting Date: 11/1/2013
Ending Date: 10/31/2018
Person Months per Year Committed to Project: N/A
Principal Investigator: David Foster

Jonathan R. Thompson

Current and Pending Support

Current:
Proposal Title: Harvard Forest LTER V: New Science, Synthesis, Scholarship, and Strategic Vision for Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount: $5,879,997 (Smithsonian sub award $420K)
Starting Date: 01/01/2013
Ending Date: 12/31/2018
Person Months per Year Committed to Project: 3 months
Principal Investigator: David Foster

Proposal Title: Integrating traditional knowledge and modern forest science toward resilient tribal management
Source of Support: Smithsonian Grand Challenge Award
Project Location: Smithsonian/Menominee Tribal College
Total Amount: $220,000
Starting Date: 9/01/2012
Ending Date: 9/01/2014
Person Months per Year Committed to Project: 2 months
Principal Investigator: Jonathan Thompson

Pending:

This Proposal
Proposal Title: RCN-SEES: Scenarios, Services, and Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Requested: $749,659
Starting Date: 11/1/2013
Ending Date: 10/31/2018
Person Months per Year Committed to Project: 0
Principal Investigator: David Foster

Proposal Title: Assessing evidence for a climate induced biome shift
Source of Support: National Science Foundation
Project Location: University of Virginia
Total Amount Requested: NA (no budget at pre-proposal stage)
Person Months per Year Committed to Project: 2 months
Principal Investigator: Jonathan Thompson

CURRENT AND PENDING SUPPORT

Angélica Almeyda Zambrano

Pending:

This Proposal Title: RCN-SEES: Scenarios, Services, and Society
Source of Support: National Science Foundation
Project Location: Harvard Forest
Total Amount Requested: $749,659
Starting Date: 11/1/2013
Ending Date: 10/31/2018
Person Months per Year Committed to Project: 0
Principal Investigator: David Foster

Facilities, Equipment, and Other Resources

Facilities and Equipment: The S^3 RCN does not have any specialized facilities and equipment needs. The dominant facilities use will be for meetings. Several workshops will be held at the Harvard Forest (described below). Other workshops will be held in conference centers at venues throughout New England.

The 1200-ha Harvard Forest has operated as Harvard University's main ecological research and educational facility since 1907. The Harvard Forest provides a complete base for research in forest, ecosystem and historical ecology and biosphere-atmosphere interactions. Since 1988, when the Forest became a National Science Foundation Long Term Ecological Research (LTER) site, the Forest has seen phenomenal growth in scientists, educators, students, collaborators, research and education programs, and laboratory, computing, archival, teaching, and housing facilities. The Harvard Forest is also the core site for the Northeast domain of the National Ecological Observatory Network (NEON).

Harvard Forest has considerable on-site facilities to accommodate the needs of the S^3 RCN. There are offices and meeting spaces for groups of 5 to 125 people in Shaler Hall; overnight accommodations in University-owned housing for up to 50 people in single, double, and triple rooms; dining facilities for 40; computational and GIS resources; and a complete herbarium of the local flora.

Equipment: An optical fiber circuit (100 Mbps) connects the Forest to Harvard University and the Internet. Wired and wireless network access is available in all offices and labs and in some residences. A new field wireless network (jointly managed by the Forest and Harvard Network Operations) provides high-speed Internet access to major experimental sites across the 400-ha Prospect Hill Tract. Scientific data from all projects are documented and posted on the Harvard Forest website within two years of collection. Harvard Forest holds an educational site-license for Adobe Connect which will be used for the S^3 RCN webinars.

Other Resources: David Foster, Director of the Harvard Forest, is the *Principle Investigator* for the S^3 RCN. His relevant research and experience include two decades of leadership of the HF LTER Program, Co-director with Billie Turner of the Integrated Land Change Science and Tropical Deforestation Project in the Southern Yucatán, and co-director with Chuck Redman of the Agricultural Transitions Cross-LTER CHN project. Foster will Chair the S^3 RCN Steering Committee, be the primary science leader of the Science & Stakeholder Workshops, serve as the primary guide for science and synthesis activities in the RCN, co-author one or more synthesis papers, and be responsible for preparing annual and final reports to NSF. No funds are requested in this proposal.

Dr. Foster, as Director of Harvard Forest, serves as PI on this. Please note that it is the policy of The Faculty of Arts and Sciences (FAS) at Harvard University that researchers who do not receive salary support from a specific grant should not make quantifiable commitments of effort in the grant proposal, unless explicitly required by sponsor policy. Therefore, commitments of effort are indicated only in proportion to salary support received from any given grant.

Data Management Plan

The data generated by this project (including observational, theoretical, and model-generated data) will be submitted within two years of collection to the Information Manager at the Harvard Forest (HF) for permanent archiving and online distribution through the HF Information Management System.

HF Information Management System: The HF Information Management System (IMS) is designed to store and deliver digital information (data and metadata) resulting from scientific research at the Harvard Forest. In its current form it includes most data collected over the last 25 years as well as selected data from earlier studies recorded in the HF Archives. Datasets include both long-term and short-term field measurements as well as historical, paleoecological, and modeling studies. As a general rule, datasets are included in the IMS if they support a publication or are deemed to have long-term scientific value, regardless of the source of funding.

The online Data Archive (http://harvardforest.fas.harvard.edu/data-archive) provides direct links to data and metadata for each project. Metadata are encoded in EML (Ecological Metadata Language; http://knb.ecoinformatics.org/software/eml/) and managed with eXist (an open source native XML database; http://exist.sourceforge.net/). Datasets can be browsed by ID number, title, keyword, taxon, location name, research topic, study type, LTER core area, and project status; and searched by investigator, keyword, taxon, and date. Updates to the EML metadata are harvested weekly to the LTER Network Data Catalog (Metacat) which provides additional search capabilities (https://metacat.lternet.edu/das/lter/index.jsp).

Data files can be downloaded directly from the Data Archive. Tabular data are stored as comma-delimited text files. Spatial data are stored as ArcView or Idrisi files.

An online Research Project Application, which includes a mandatory data management plan, must be submitted annually for every new and continuing research project at the Forest. Individual scientists prepare their own data and metadata files, which are checked, reformatted, and posted by the Information Manager and HF technical staff. Primary responsibility for quality control rests with the individual scientist. Data submissions are posted as received. A systematic update of the Data Archive is performed each spring in conjunction with the annual Harvard Forest Ecology Symposium.

Policy for Submission of Data: The Harvard Forest endorses the LTER Network Data Access Policy (http://www.lternet.edu/data/netpolicy.html) which states that research data must be made available online within two years of collection and no later than publication of the main findings.

The following guidelines must be followed for all research projects at Harvard Forest:

1. A Research Project Application (including a data management plan) must be submitted by the Principal Investigator at the start of a new project and annually thereafter until the project is completed.
2. Data and metadata must be submitted to the Information Manager within two years of collection for inclusion in the online Data Archive. Exceptions to this rule (other than student projects) must be approved by the HF Director.
3. Primary responsibility for data completeness and integrity (quality control) rests with the project Principal Investigator.

Policy for Use of Data: Harvard Forest online data are freely available for downloading and subsequent use. Prospective users are asked to identify themselves so that we may track dataset usage for our sponsoring agencies. The online metadata for each dataset includes citation information as well as the following use statement:

Postdoctoral Mentoring Plan

There are no postdoctoral researchers funded by this proposal.

Highstead

127 Lonetown Road
P.O. Box 1097
Redding, CT 06875-1097

203 938 8809
203 938 0343 fax

February 22, 2013

To: NSF RCN Program

Fr: Emily M. Bateson

By signing below (or transmitting electronically), I acknowledge that I am listed as a collaborator on this RCN proposal, entitled "Evaluating Land Use Scenarios, Ecosystem Services, and Linkages to Society" with David R. Foster as the Principal Investigator.

I agree to undertake the tasks assigned to me or my organization, as described in the project description of the proposal, and I commit to provide or make available the resources specified therein.

Signed:

Organization: Highstead, 127 Lonetown Road, Redding, CT 06875

Date: February 22, 2013

LandVest®

Distinctive Properties - Real Estate Consulting & Appraisal - Forestry Consulting
TEN POST OFFICE SQUARE, BOSTON, MASSACHUSETTS 02109

REGIONAL OFFICES

Two Monument Square
Portland, ME 04101
Telephone 207 774-8518
Fax 207 774-5845

22 Bayview Street
P.O. Box 1262
Camden, ME 04843
Telephone 207 236-3543
Fax 207 236-2172

4A Tracy Road
P.O. Box 1068
Northeast Harbor, ME 04662
Telephone 207 276-3840
Fax 207 276-3837

186 College Street
Burlington, VT 05401
Telephone 802 660-2900
Fax 802 660-2543

One The Green
Woodstock, VT 05091
Telephone 802 457-4977
Fax 802 457-9021

19 South Summer Street
P.O. Box 1056
Martha's Vineyard
Edgartown, MA 02539
Telephone 508 627-3757
Fax 508 627-7044

16 Centre Street
Concord, NH 03301
Telephone 603 228-2020
Fax 603 226-4391

To: NSF RCN Program

From: Keith Ross, Senior Adviser, LandVest, Inc.

By signing below (or transmitting electronically), I acknowledge that I am listed as a collaborator on this RCN proposal, entitled "Evaluating Land Use Scenarios, Ecosystem Services, and Linkages to Society" with David R. Foster as the Principal Investigator.

I agree to undertake the tasks assigned to me or my organization, as described in the project description of the proposal, and I commit to provide or make available the resources specified therein.

Signed: _____

Organization: LANDVEST, INC

Date: 2/12/13

WWF-UK
Registered office
Panda House, Weyside Park
Godalming, Surrey, GU7
1XR

Tel: +44 (0)1483 426444
Fax: +44 (0)1483 426409
info@wwf.org.uk
wwf.org.uk

9 February 2013

To: NSF RCN Program

From: EMILY MCKENZIE, NATURAL CAPITAL ADVISER AND MANAGER – NATURAL CAPITAL PROJECT, WWF

By signing below (or transmitting electronically), I acknowledge that I am listed as a collaborator on this RCN proposal, entitled "Evaluating Land Use Scenarios, Ecosystem Services, and Linkages to Society" with David R. Foster as the Principal Investigator.
I agree to undertake the tasks assigned to me or my organization, as described in the project description of the proposal, and I commit to provide or make available the resources specified therein.

Signed: 

Organization: WWF and the Natural Capital Project

Date: 9 February 2013

New England
Forestry Foundation

Conserving New England's forests since 1944

To: NSF RCN Program

From: Robert Perschel, Executive Director, New England Forestry Foundation

By signing below (or transmitting electronically), I acknowledge that I am listed as a collaborator on this RCN proposal, entitled "Evaluating Land Use Scenarios, Ecosystem Services, and Linkages to Society" with David R. Foster as the Principal Investigator. I agree to undertake the tasks assigned to me or my organization, as described in the project description of the proposal, and I commit to provide or make available the resources specified therein.

Signed: Bob Perschel
Organization: New England Forestry Foundation
Date: February 12, 2012

32 Foster Street • P.O. Box 1346 • Littleton, MA 01460 • 978-952-6856
www.newenglandforestry.org

Northern Forest Center
Thriving Communities & Healthy Forests

To: NSF RCN Program
From: ___Joe Short_____

By signing below (or transmitting electronically), I acknowledge that I am listed as a collaborator on this RCN proposal, entitled "Evaluating Land Use Scenarios, Ecosystem Services, and Linkages to Society" with David R. Foster as the Principal Investigator. I agree to undertake the tasks assigned to me or my organization, as described in the project description of the proposal, and I commit to provide or make available the resources specified therein.

Signed: ___ Joseph Short _____
Organization: ____Northern Forest Center_____
Date: __February 8, 2013_____

Wildlife Conservation Society
North America Program
301 N. Willson Avenue
Bozeman, MT 59715 • (406) 522-9333

To: NSF RCN Program

From: Erika L. Rowland, Conservation Scientist/Climate Change Ecologist

By signing below (or transmitting electronically), I acknowledge that I am listed as a collaborator on this RCN proposal, entitled "Evaluating Land Use Scenarios, Ecosystem Services, and Linkages to Society" with David R. Foster as the Principal Investigator.

I agree to undertake the tasks assigned to me or my organization, as described in the project description of the proposal, and I commit to provide or make available the resources specified therein.

Signed: Erika L. Rowland
Organization: Wildlife Conservation Society
Date: February 12, 2013