Regeneration of Northern Hardwoods in the Northern Forest:
A Hubbard Brook Roundtable

Interview synthesis and catalyst for dialogue
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Prepared by Natalie Cleavitt, Alex Ding, Zoe Economos, Raeana Kiss, Isabella Kong, and Sarah Garlick

This report summarizes interviews conducted during February and early March with participants of a Hubbard Brook Roundtable on the regeneration of northern hardwoods, to be held on March 25, 2021. Please find the names and bios of all interview participants at the end of this report. We have attempted to record faithfully the comments that were shared with us and we acknowledge that our own biases may have slipped in as we made choices on what and how to report and synthesize what we have heard. The goal of this paper is to serve as a catalyst for discussion at the roundtable. Some quotations have been lightly edited for clarity. —NC, AD, ZE, RK, IK, and SG

1. **What do you see as the most important topics or issues related to regeneration of northern hardwoods that we should discuss with this group? What do you hope we accomplish with this dialogue?**

"The problem is regeneration and that it is not working."

"We don't have the species that we want to see growing. We don't have the diversity."

Nearly all interview participants expressed concern about the regeneration patterns they are seeing in the region and hope that this roundtable will highlight the importance of this issue and allow for an exchange of observations and experiences from practitioners and researchers from different sub-regions and sites — something that does not commonly happen. Many participants expressed interest in having a conversation about where the northern forest is headed in the future and how to take action now to promote desirable species.

We heard a range of different specific topics people wanted to discuss with the group, most prominently were issues related to beech and beech bark disease, deer browse, invasive plants and diseases, and climate change. Finally, we heard convergence about a need for more regional data about regeneration patterns and a need to develop a shared protocol for collecting those data.

"The issue of regeneration is multi-faceted; different people are more or less attuned to different aspects—invasive species, overpopulation of herbivores, land history issues, soil fertility issues. Understanding how these facets interact is a real problem."

"A combination of factors leads to poor-quality regeneration: light thinning practices, beech bark disease, deer browse, and the effects of acid rain."

"My biggest concern is the loss of desirable tree species. In southern parts of New Hampshire, red oak and sugar maple are being replaced with beech."

"The knowledge on regeneration techniques are from the past and those conditions from the past are long gone today."

"What is regenerating? Not just regenerating but recruiting into dominant positions in the canopy? … Our forests are changing for a bunch of different reasons: climate, disturbances, and how they are managed and treated."

"I always say you don't want to anger the beech because when you anger the beech you regenerate the beech. I think we've angered the beech through poor cutting practices. Lots of cuts are these overstory removal—people wanting to start a new crop of trees and I just don't think we've spent enough time thinking about the best silvicultural way to get from point A to point B."

"I think sugar maple regeneration is a huge concern across the board in New Hampshire. Our soils aren't as enriched as they are in places like Vermont, and it's a known issue amongst landowners and practitioners that if we try and even if we do regenerate sugar maple, it immediately gets browsed by deer. So, sugar maple regeneration, deer browse is a real concern, and beech hell—what we call beech hell as foresters. I feel like as practitioners we're always trying to manage beech, because it dominates whenever you put equipment in the ground and disrupt the forest ecosystem. It seems like beech always wins, and we're trying to regenerate other things: yellow birch, and sugar maple, and things like that."

"Which species are going to be able to thrive in the projected future climates?"

"Should we as a research and management community be more proactive about planting species of the future out there, or should we just let nature take its course?"

"The most important issue is controlling species composition. Beech has proliferated in northern hardwoods managed under single-tree systems, moderate-to-high density shelterwood systems, and partial harvests across the ecological site types where northern hardwoods could be expected to occur. [Leak's] work refining group/patch selection practices has given forest managers an important tool to address the question of getting the desirable regeneration that forest managers want—using an understanding of soil/site relationships and management systems."

2. **What are some of the regeneration patterns or trends you are seeing in this region (NH, ME, VT, or more broadly)? In your view, what factors are driving those patterns?**

Many participants talked about the fact that they are observing changing patterns in regeneration: *"We are no longer able to regenerate the diversity of trees we once could, using the same treatments."* Several participants talked about the "patchiness" of regeneration patterns on the landscape—the importance of site characteristics and past management leading to different results in different areas.

Key trends that were highlighted include the dominance of beech sprouts, challenges associated with regenerating sugar maple, particularly in New Hampshire, a notable reduction in yellow birch, and an increase in red maple. Participants noted a variety of influencing factors, including browse frequency (by deer or other species like moose), changing weather as a result of climate change (including fluctuating winters and drought), the presence of various invasive pests (including invasive earthworms), and site-specific soil fertility.

Many participants brought up the importance of the social context of management, particularly negative public perceptions about clearcutting, and the importance of market forces in driving management practices.

"Tree diversity is blocked."

"*Every now and again there will be a stand or two where clearcutting (one half-to-two-acre group cut) results in a beech thicket. There is a strong correlation in stands up until 1996 to 2005 but strongest between 1998 and 2002. ... We have one stand that sits directly adjacent to a clearcut from mid-to-late eighties. [The cut from the eighties] is regenerating primarily paper birch, but also a fair amount of white ash, not as much sugar maple, some red maple, and yellow birch. Adjacent to that, on the same ELT (ecological land type), so assume the same soils, [we have a clearcut] that has regenerated as a beech thicket—thick and ugly. What changed*?" refers to NH

"In the valleys, poor regeneration is driven by a history of high browse and invasive shrub layer (especially in the Connecticut River Valley). In the uplands (over 800 feet), the proliferation of American beech from impact of beech bark disease is the main driver of poor regeneration." refers to VT

"Acid rain in the context of sugar maple is a long term stressor because we remove the calcium from the soil and the natural process of returning that is very slow, through weathering. So we can see this persistent stress. And we've seen that clearly in the dynamics of the species. Regeneration is less robust, growth is slower and less robust, there's decline in the forest dominance, and their regeneration doesn't do as well."

"Beech competes with sugar maple, so in some ways both are suffering from long-term declines, which allows red spruce to get re-established in the forest or expand."

"I think some things that are driving some of the patterns are probably related to atmospheric deposition of chemicals, and nutrients in the soil, past industrial practices that may have depleted some soil nutrients."

"It's not easy to unwind the long-term effects of past management, because you have the forest on a trajectory."

"Lacking low-grade markets, lacking strong markets, limits our ability to economically practice."

"When it comes to forest management, loss of low grade markets is probably going to have the biggest effect on future forests of the Northeast, more than climate change."

"Hemlock woolly adelgid seems to kill all of the trees within a decade of being established. So we end up seeing this complete removal of these hemlock stands."

"Beech is overly dominant and appears to be expanding its range. The origins of glacial drift materials influence the occurrence of beech regionally—granitic soils where beech is an integral part of the landscape; schists and less-acidic soils where beech can become a greater component of regeneration through "light-touch" silvicultural practices—partial harvests, moderate-to-high density shelterwoods, and single-tree selection. Many of those decisions based on interpretations of what society might want—e.g., essentially closed canopy forested landscapes versus how do managers paint future forest landscapes to highlight the vibrant fall color schemes visitors to New England come to see—the reds, oranges, and yellows currently on the New England landscape."

3. What are some of the most common management objectives and practices related to tree regeneration on the landscape today?

We heard a range of different responses to this question. Many participants talked about broad objectives of increasing the compositional diversity and structure of the forest — we heard about a perceived need to

reduce the amount of landscape dominated by middle-aged hardwoods. We also heard interest in the objective of regenerating species that will be well-suited to future conditions — and questions about the degree to which these species should be actively promoted, for example by planting. Other specific objectives discussed include ash harvesting and recruitment in the face of the emerald ash borer, oak regeneration as a solution to the decline of other less-suitable species, browse management, and sugar maple retention. Participants noted the preponderance of "small disturbance silviculture" in the region including thinning, single-tree selection, and small gap formation. We also heard observations of increased interest, more recently, in patch clear-cuts and high grading.

"The management priorities are forest health. It's preventing massive loss, curbing the spread of pests and pathogens, and maintaining forest health because of the huge recreational value of northern hardwood forests. That's something from a Vermont perspective, it's a part of our tourism industry, to come and see the foliage."

"In the northern forest compared with other regions, there is a strong reliance on silvicultural techniques: cutting practices, thinning, group selection, and being mindful of the seedbank. [This] seems to be the primary tool. But in other regions, there's more of a balance: work done with soil quality, fertilization, or active planting to achieve regeneration goals, as well as silvicultural techniques. Maybe we need to diversify the toolbox that's being used in this area."

"Because so much harvesting in the past has been rather thoughtless, a lot of our harvesting is reclamation. Trying to undo the silvicultural sins of the past."

"The loss of value in low-grade markets makes it very difficult to do effective silviculture. And it facilitates people making patch cuts. Sometimes patch cuts are okay; if they're the right seed conditions, patch cuts are okay. But often they're not the right seed conditions, and they're not done right. Usually they're too large, in my opinion. So you end up with a lot of birch regeneration, and it doesn't bode well, especially for paper birch, in a warming climate."

"So, I hate to even say it, but I'm trying to move oak into northern hardwoods as much as possible. I work on the edge where there is oak forest touching the northern forests and they overlap, so I can do that pretty effectively."

"[An important] thing is leaving as much wood standing in the forest as possible. Later harvests are better, there's no doubt about it. And sustainability is cutting as much as you grow, or no more than you grow. That's the definition of sustainable forestry. It's not always addressed that way, but it is. So you have to find a way to go through the forest and take certain trees and not a lot, and leave it to grow and just keep going."

"The improvement harvest that we're doing is moving from a heavily degraded stand and trying to improve the species composition and quality of the residual stand to get it set up for regeneration."

"Private conservation landowners are doing a lot of smaller disturbance harvesting, which is fine, but that results in one type of regeneration. Other private landowners who may not have conservation objectives are sometimes doing really large disturbances, but that could lead to high-grading and that's concerning."

"Everyone is talking about 'Oh, we can regenerate paper birch in this patch cut.' Well, you can, but is the paper birch really going to be okay in seventy years? I doubt it."

"Emerald ash borer prefers deep furrows of mature ash and cannot lay egg masses on smoother bark of young ash. The theory is that maybe if we regenerated it right now, while we have the opportunity, then the EAB population may eat itself out of a host and we may be able to maintain ash long-term."

"You could do a large aggressive cut without leaving seed trees and the stand will regenerate from the seed bank."

"The beginning and end stages of a tree's life is really important. Foresters often ignore this part and only focus on the middle part of a tree's life."

"Foresters don't need to use massive machinery, though this is generally the way it's done now."

"Multiple thinnings in a stand over time: it just pushes the problem forward."

"What they all do is they mow the understory. It makes their work easier, and it makes it look nicer. I think one of the big issues is the suburbanization of timber sales. Landowners want their land to look clean and uncluttered when the harvest is done, otherwise it's a mess. So you have an issue leaving slash in the forest, which is so important for regeneration. It will keep the deer from browsing off the species you want to grow, and it will just enrich the site. Leaving all the limbs on the forest floor, that's where the nutrients are."

"A slowly growing trend toward group/patch/clearcut options to deal with the beech regen problem. Using these silvicultural options on snow-free ground (where maternity roosting bats are not an issue) provides a variety of hardwood species regeneration that can outcompete beech. It does not eliminate beech from future stands—it just allows other species to thrive in managed stands as well. Moderate-to-high canopy residual stand treatments used to moderate any visual concerns does the opposite as has been demonstrated by the last 40 years of forest management."

4. **Are there any misconceptions that you want to see resolved? Are there things you wish managers or scientists better understood?**

A number of misconceptions were mentioned particularly with reference to how and why forestry is done. We heard concerns that the scientific community and the media are promoting low-impact forestry as the only "good" way to do forestry. "*The less trees cut, the better the forestry*." Some people mentioned that they felt that scientists aren't always aware of all the limitations that come with practicing forestry, including landowner demands and market limitations. We also heard remarks about the challenges translating forest research to practice, with some managers expressing perceptions that scientific knowledge often isn't relevant to their site-specific contexts, and scientists expressing perceptions that managers are sometimes resistant to changing practices.

"*Science, foundational science, is focused on broader landscapes; but broad landscape suggestions aren't going to work for every site*."

"*Scientists produce information and expect the managers to find the insights. It is hard for managers to find what is important."*

"The managers seem to be sometimes not particularly amenable to change, when our understanding changes. You know, 'this seems to work; why would I change what I'm doing?' So they have a little bit of resistance to change."

"I want everybody to understand that for forest managers in general, our ultimate goal is to improve the forest, despite the misconception that all we care about is cutting the forest down. We've dedicated our lives to a profession of growing forests and yet there's this vision that we don't care about the forest. That's a huge misconception."

"I would like to see less of a dichotomy between preserving the forest and working in the forest. I'm on the board of directors for a successful land trust and I see a lot of the members of the trust be absolute preservationists—they don't want to see anything happen. I think [we need] a little more latitude in that regard so that we can do gentle work in the woods and make things grow well. They just want to make trails everywhere, you know. And if you have trails all through the forest, you're not going to have bears in the trees. You're not going to have neotropical songbirds in the trees. There's a lot of things that you don't have if there's constantly people walking around in the forest, talking."

"I'd like to see people getting engaged with the fact that the wood has to come from someplace. And I sound so industrial saying that, it bothers me, but it has to come from someplace, because you cannot satisfy the demand. No matter how much timber goes through these markets, it's always more, more, more. And it's going to come from someplace. So either it's going to come from someplace where it's carefully managed and well-thought out, or it's going to come from someplace where it gets torn apart."

"One of the largest misconceptions is that everyone seems to feel that they have to use this massive machinery now. And it's become how it's done. And it doesn't have to be how it's done."

"The importance of forest product markets, I think, is lost by academia and portions of the general public."

"We need to be more mindful of soil/site differences, and the effects on regen species composition."

5. **What information about regeneration needs to be exchanged among scientists, managers, foresters, and other decision makers?**

We heard convergence on two key topics in the answers to this question: (1) information and ideas about future forests — what we want future forests to look like and how to manage toward that future; and (2) information and ideas about how to measure and track regeneration across the landscape. We also heard people comment on the importance of fostering this exchange.

"I wish forest managers and scientists had a tighter ecosystem — like the public health community, as a model."

"We need on-the-ground site visits with handouts. On-the-ground sessions on granitic, schist, and less acidic drift are important outreach and training efforts. Soil/site relationships are best seen on-the-ground."

"The sin of the scientists is that they produce information and they sort of just say, "here it is" and produce a journal article or something, and expect the managers to kind of figure out the insights from that."

"Land managers and foresters: they're the pulse out there of what's going on. How do we monitor the pulse of what they're seeing when it comes to regeneration?"

"What don't we know that we really need to know to either understand the problem or develop tools for response?"

"I hope to come together and all agree that more objective and refined regen information is needed to appropriately judge what level of management or lack thereof is needed in the future."

"We need a monitoring protocol to be developed. Something that is easy and uniform and comparable across states."

"There are big policy questions related to the trajectory of the forest in terms of carbon sequestration. If we see all invasives and super browsed and undesirables, do we do a reboot shelterwood to try to fix? Or just leave it degraded? What are the long-term carbon implications 200 years from now?"

"What are some things that we should be doing, here in the Northern Forest, to leave a fully functioning forested ecosystem for the next 100 years? [...] The time to make some of those decisions...is probably now."

"[The way the forest is composed] hasn't always been that way. If you look back at the records of what the forest was like back when the European settlers first came to this region, and before there was a lot of forest utilization, and land-clearing for agriculture, and then regrowth after agricultural abandonment, there's been a lot of changes in the last 200 years. ... There's a shifting baseline. Should we be trying to regenerate what's there now? We have to think about all the changes that have gone on in the last 200 years. ... Is this really what the land is most capable of?"

"I think it's important that there's a meeting of the minds so that guidelines could be put out by scientists and they can be very exact in how they're expected to be implemented, but the reality is we're limited on the ground by a million different factors that make it that it's always imperfect for us to apply things, to apply knowledge."

6. **What questions do you have for (other) land managers and foresters? What questions do you have for (other) forest scientists?**

Questions for managers:
"I want to hear from other foresters about the need for site prep—which is not always done. How you control American beech—control undesirable species—to ensure you have good regen coming in."

"Sometimes we do apply herbicide or pesticides, and is that something that other folks are doing to impact their regeneration?"

"Are there new guidelines for dealing with seed years, soil disturbances, and just straight silvicultural practices? Are there recommendations that are changing because of climate, soil degradation, and even markets?"

"I think that we're grappling with sizes to make our openings to regenerate what we want to regenerate, and grappling with how to time things with seed years, and how important that is, and how to deal with deer browse and beech."

"People want to know what the trends really are, what's really happening on the ground."

"How well do you evaluate soil/site differences prior to harvest? Critical to understanding what to do where."

To forest managers, from scientists:
"What are you worried about? What factors do you think are driving recruitment or will drive recruitment in the future?"

"What's crucial from a management perspective is to list all your targets, all your goals. What do you want from these forests? What are the amenities they want?...not all these goals are mutually attainable."

"Why aren't soil tests utilized in forests, and how can we promote that?"

Questions for both scientists and managers:
"Why is it harder to regenerate sugar maple on some sites than others? With sites that have a lot of sugar maple: what drives that regeneration and proliferation? Is it past management, soil quality, competing vegetation?"

"What are the conditions that, once you get seeds, lead to effective recruitment?"

"What realistically should we, forest managers, be doing and seeking as an image of the northern forest, based on the current issues we're facing?"

For scientists:
"For scientists, I think I need more detailed soils information. I need soils information that tells me the pH of the soil six inches beneath the ground, a foot beneath the ground. That's available, but it's not readily available. And I need more correlation about which trees will thrive on which soil types. Again, that's available, but it's crude. I mean, the soil is everything. It all comes from the soil, all terrestrial life. So I think we need really in-depth soils analysis. And it needs to be made right there, so it's easily available, so I don't have to do research to find it every time. That's what I need from scientists."

"It would be interesting to hear what is on the horizon as far as insects and disease that maybe hasn't reached us yet."

"We hear things from Hubbard Brook Experimental Forest and then we hear a different set of information from Bartlett Experimental Forest. So it's curious to us as practitioners, why are there these differences and should we explore those a little more deeply?"

7. **Do you have ideas for what the outputs of this roundtable should look like and where they should be shared?**

Participants agreed that it was important to share this discussion with a wider audience and we heard a number of ideas about how to do so, including working with cooperative extension and producing an article for an applied journal, Journal of Forestry, Northern Woodlands, Forestry News for Foresters newsletter, or general technical reports. Participants also expressed the importance of continuing to share knowledge and the need for guidance for practitioners on specific topics. Ideas included:

- A webinar on keys to success with regenerating different types of stands.
- A weekly or monthly email with information that is useful on the ground would be welcome. *How can we stay engaged and continue the work?*
- Best management practices guide on working with beech and emerald ash borer.

- Researchers regularly visiting forests and working with practitioners to understand the practical aspects of their research: *"Don't just publish and move on."*
- A new research agenda, practice agenda, or shared research-practice agenda. "*Consensus on key needs and key people to be involved."*
- Something concrete to be used such as threshold numbers or monitoring protocols that are easy and provide data: Important to be uniform so it is comparable across states

We heard a broader interest in the research and practice community coming together to communicate to private landowners and the general public about these issues. Possible approaches include storytelling, social media or podcasts/video, and using songbird habitat to convey the importance of regeneration and diversity.

"I'd like to see it get into the eyes of people who aren't fascinated by it."

"Reports by themselves can often just be a report and then they sit on a shelf somewhere."

"General technical reports can be really powerful to influence federal land managers."

"How do we get these insights into social media?...if you're thinking about regeneration and you're thinking about making lasting change, we influence the people who will be making decisions in the next generation."

"The public at large is fighting us because they don't like the image of what it's gonna take to get [a healthy forest], so something that would resonate with the public so that they feel confident, or have more confidence understanding how forest management needs to be."

"I like the idea of producing something that's really accessible for people who are putting forestry on the ground."

"I definitely agree with publishing a paper and things as well, but taking that and putting it into some kind of workshop or field manual would be good."

8. Is there anything else you would like to share about these topics?

"Remote sensing may also become useful for forest inventory. I'm interested in this area."

"I think we have to get it to the forestry community so people really know that large old hardwoods should just be left on site. They should not be harvested."

"It's harder to regenerate softwood, so we should regenerate softwood wherever we can. The hardwood will grow up through the softwood, and then it'll grow into beautiful trees, because the softwoods shade the boles and then they grow beautifully clear and tall. So softwoods should be used as an aid in the regeneration of hardwoods."

"What happens during these early phases is that we don't track them very well, and it ends up determining the future of the forest. Because if you think about it, it's really important in forest ecosystems who gets there first."

"It's a really tricky time to be a forester, and underscoring the importance of what they're doing and the issues that they face, whether it be regeneration or something else, is a huge part of this story."

"We need to be emotional about future forests."

Participant Bios:

Scott Bailey is a research scientist for the USDA Forest Service at the Northern Research Station in New Hampshire. He has worked with the Hubbard Brook Experimental Forest, with a primary focus on sugar maple regeneration. His primary interests are soil and water quality issues. As a "geo-ecologist," he works to understand geologic structure in reference to how it affects current forest health and composition.

John Battles has been studying northern forests for his entire career as a scientist, and he seeks to understand forest dynamics and disturbances. He works on the community and individual population level, studying how different drivers of change affect the forests.

Roger Boyer is a forester on the White Mountain National Forest. He works with the land with sustainability goals in mind, including sustainable timber harvest, wildlife habitat diversity, structural diversity, and species compositional diversity. He and his team have an acute awareness of the balance between sustainable recreational use and ecological importance.

Nat Cleavitt is a Research Associate at Cornell University and has studied tree regeneration mainly in unharvested forests both at Hubbard Brook Experimental Forest and on Society for the Protection of New Hampshire Forests properties. She worked at Hubbard Brook as an undergraduate in the 1990s and came back to Hubbard Brook as a postdoc in 2002. Still there.

Anthony D'Amato is a professor and the Director of the Forestry Program at the University of Vermont. He works on evaluating the effectiveness of silvicultural practices in forested areas in Vermont. He is involved specifically in training researchers how to best harvest a forest with societal objectives in mind. He also works on researching the influence of plant interactions on tree growth.

Kevin Evans is the Director of Woodlands Operations for Dartmouth College, where he has been managing about 40+ thousand acres of timberland in the northern forest for about 35 years now. Dartmouth Second College Grant lands are about 55% northern hardwoods. Kevin estimates about 7500 cords of wood harvested a year and about 800 acres treated per year. "We have been managing this property for 214 years and managed it on a sustainable basis, mostly single tree selection, for the past 30 years—mostly single tree, uneven-aged management. I've been in northern hardwoods trying to regenerate them for a long time."

Ben Farina is a silviculturist in the Pemi ranger district of the White Mountain National Forest. He plans harvest projects, writes prescriptions, does the marking and also the post-harvest site preparation, which is most relevant to forest regeneration.

Andrew Fast is the Forest Industry Specialist for UNH Cooperative Extension. A big part of what he does is provide research-based information to help people make informed decisions. For the ten years before this position, Andrew was the country forester for several counties. He describes having a vested interest in everything from the land all the way up through industry.

Alexandra Kosiba is the state climate forester for Vermont and helps guide forest management under a changing climate. She has experience working with forest inventory data and is involved in a project compiling regeneration data from different states to make them comparable to better look at regeneration over a wider scale. Her interests lie in using data to answer questions about regeneration patterns.

Bill Leak began work with the Northeastern Forest Experiment Station in 1956. After several years working on nursery stocking questions in Vermont, Bill's research efforts have focused on: 1) New England ecological site classification (soil-site relationships); 2) site-related silvicultural practices that work on the New England forested landscape—particularly group/patch selection; and 3) the ecological aspects of New England northern hardwoods—successional trends and time-to-climax; old-growth characteristics; elevational distribution, tree migration trends, and regeneration dynamics—all in relation to site characteristics. Bill has shared this accumulated understanding over the years through hundreds of workshops, field tours, and field visits with federal, state, private, and industrial forest managers across New England in addition to his publication record. Bill's additional efforts to better understand the role of heavier disturbance (e.g., even-aged clearcuts) in regenerating northern hardwoods has been a key tool in managing northern hardwoods for ephemeral early-successional habitat for neotropical migratory songbirds. Bill cannot attend the roundtable discussion but submitted responses to the interview questions via email.

Lynn Levine has been a consulting forester for 42 years. She was the first female consulting forester in the Northeast and worked towards making licensing required for foresters. She has specifically been involved in addressing issues that arise from deer browsing in forested areas in Windham County in Vermont and started her own forestry consulting business, Forest Care.

Amanda Mahaffey works in Brunswick, Maine for the Forest Stewards Guild, a non-profit based in Santa Fe, New Mexico. While a licensed forester, she also works in outreach and translating science into practice through listening sessions and field workshops to empower decision makers in taking action to promote positive change.

Jackie Matthes is an ecologist and a professor at Wellesley College. Her research interests include how forests are responding and adapting to insects, pathogens, and climate change. She moved to Massachusetts in 2014 and has been involved in the Hubbard Brook Ecosystem Study since around that time, including studying red oak regeneration.

Tim Morton lives in southeast Vermont and has lived in Vermont all his life. He started in private forestry and has been a state forester since 1987. The first 16 years of his career in state forestry he was a county forester advising private landowners and then became state forester in charge of management on state lands and permitting for harvests on private land.

Dave Patrick is the Executive Director for the Center for Adirondack Biodiversity at Paul Smith's College and the Director of Conservation Programs for the Nature Conservancy in New Hampshire. He is currently working on addressing the drivers of climate change and researching ways to sequester carbon more efficiently. He is interested in helping people adapt to climate change using climate solutions.

Steven Roberge is the extension forestry specialist for the University of New Hampshire Cooperative Extension. He works with private landowners to provide education and resources to guide decision making, as well as consulting foresters to educate and train them using science from organizations such as Hubbard Brook. He co-founded an initiative looking at restoration forestry by regenerating degraded stands to rehabilitate forests.

Sean Ross is the Director of Forestry Operations for the Lyme Timber Company. He is responsible for developing long term forest management plans, ownership objectives, overseeing teams on the ground, and ensuring sustainable returns on investment that are in compliance with forest certifications and conservation easements.

Matt Sampson has worked as a forester for the past twenty years. He is also the Northeast regional director for the Forestland group, where he oversees management activities.

Daniel Stepanauskas is a forester who has been working in the White Mountains for 39 years. He primarily engages in silviculture and tries to grow the largest trees possible to keep the right species on the right site. He does work for municipalities, corporations, and private landowners.

Jeff Tilley is a USDA forest program manager and forest silviculturist for the Green Mountain and Finger Lakes forest regions in Vermont and New York. He works on managing budgets for the program and provides support and expertise for land management in Vermont. He also works specifically on natural regeneration implanting.

Wendy Weisiger is the Managing Forester for the Society for the Protection of New Hampshire Forests, the third-largest landowner and oldest land trust in New Hampshire. The Forest Society manages land for forestry, recreation, and habitat by practicing timber harvest and silviculture. She inventories, writes plans and prescriptions, and implements harvests along with consulting foresters.

Aaron Weiskittel is a professor of Forest Biometrics and Modeling at the University of Maine. He is also the Director for UMaine's Center for Research on Sustainable Forests, which is a 50-year old cooperative forestry research unit dedicated to funding and outreach related to applied forestry issues. His research and work have spanned a wide breadth, from directly interfacing with land managers to tackle logistical issues and create predictive decision-support tools, to studying wide-ranging regenerative patterns within the northeastern forests.

Chris Woodall is a scientist for the USDA Forest Service. He currently works on the Forest Inventory Program which includes tree regeneration inventory. He has interests in using national regeneration inventory data to better understand concerns for managers and how other people's findings can inform how we analyze this data. He brings a unique perspective from previous work with ponderosa pine in the western US.