Proceedings of the December 15, 2017

# Forest Ecosystem Monitoring Cooperative Conference

## *Beyond Communication: Advocating for Science and our Forests*

FEMC

Forest Ecosystem Monitoring Cooperative

Davis Center • University of Vermont • Burlington, VT, USA

# Forest Ecosystem Monitoring Cooperative

*Providing the information needed to understand, manage, and protect Vermont's forested ecosystems in a changing global environment.*

Established in 1990 and ratified in 1996 via a memorandum of understanding between the Vermont Agency of Natural Resources, the University of Vermont, and USDA Forest Service, the Forest Ecosystem Monitoring Cooperative (FEMC, formerly the Vermont Monitoring Cooperative) has been conducting and coordinating forest ecosystem monitoring efforts for twenty-seven years.

Originally designed to better coordinate and conduct long-term natural resource monitoring and research within two intensive research sites (Mount Mansfield State Forest, the Lye Brook Wilderness Area of the Green Mountain National Forest), FEMC efforts have since expanded to capture relevant forest ecosystem health work across the northeastern region with an expanding list of partners from Maine, Massachusetts, New Hampshire, New York, and beyond.

Today, the FEMC funding stems primarily from a partnership with the USDA Forest Service State & Private Forestry as part of the Cooperative Lands Forest Health Management Program. The majority of FEMC operations are handled by staff affiliated with the Rubenstein School of Environment and Natural Resources at the University of Vermont, the Vermont Department of Forests, Parks & Recreation in the Vermont Agency of Natural Resources, and the USDA Forest Service's Green Mountain National Forest. While FEMC funding primarily supports ongoing monitoring, outreach and data management, the bulk of FEMC activities are accomplished by "in kind" contributions provided by the larger collaborative network.

The current mission of the FEMC is to serve as a hub of forest ecosystem research and monitoring efforts across the region through improved understanding of long-term trends, annual conditions and interdisciplinary relationships of the physical, chemical and biological components of forested ecosystems. These proceedings highlight some of the FEMC activities aligned with this mission and demonstrate the potential of large collaborative networks to coordinate and disseminate the information needed to understand, protect and manage the health of forested ecosystems within a changing global environment.

Online at https://www.uvm.edu/femc/

FEMC Steering Committee and State Partnership Committees – https://www.uvm.edu/femc/cooperative/committees

FEMC staff – https://www.uvm.edu/femc/about/staff

VERMONT AGENCY OF NATURAL RESOURCES

The University of Vermont

USDA FOREST SERVICE

# Proceedings of the December 15, 2017 Forest Ecosystem Monitoring Cooperative Conference:

## Beyond Communication: Advocating for Science and our Forests

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Contributing Editors: Miriam Pendleton, John Truong, Alexandra Kosiba, James Duncan and Jennifer Pontius.

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# Introduction to the Proceedings

The Forest Ecosystem Monitoring Cooperative (FEMC) annual conference was held on December 15, 2017, at the Davis Center on the University of Vermont campus. This marked the 27th year of coordinated FEMC activities. The guiding theme of "**Beyond Communication: Advocating for Science and our Forests**" was chosen to help collaborators build capacity to communicate and market their work to a broader stakeholder audience.

The morning plenary session was led by Tad Segal who addressed the key frameworks and approaches used in advocating for science-based decision making. Effective communication in science-based decision making was broken down into four focus areas; the communication landscape, cognitive heuristics, the audience, and the motivation model. Following our keynote presentation, four experts in the world of science communication gave 5-minute flash-talks synthesizing their techniques and strategies for effective communication directed towards the many stakeholders our audience collaborate with professionally in their fields. Each speaker used their professional experiences with various audiences and gave succinct focused talks exploring effective communication strategies. Our morning speakers brought to light the importance of understanding your audience, remaining focused on your key message, and determining how your message will benefit your audience.

This year the afternoon was devoted to two concurrent sessions where 24 collaborators from across the region presented their most recent work, followed by five working group sessions on the topic of effective communication that were offered by members of the Cooperative.

These proceedings represent a combination of summaries of the plenary session talks written by FEMC staff, syntheses and outcomes from a series of afternoon working sessions, and the abstracts submitted by researchers to the concurrent sessions. Additional details, including videos and downloadable PowerPoints of presentations can be found on the meeting home page at: www.uvm.edu/femc/cooperative/conference/2017/content.

# Keynote Presentation

This year's keynote by **Tad Segal**, President and Founder of Outreach Strategies, addressed the key frameworks and approaches used in advocating for science-based decision making and maximizing communication impacts.

**Tad Segal** is a senior communications and advocacy strategist specializing in complex campaigns impacting public policy on sustainability issues at the domestic and international levels. He started Outreach Strategies in 2009 to focus on media, stakeholder engagement and international education campaigns to protect our air, land and water both in the U.S. and around the world.

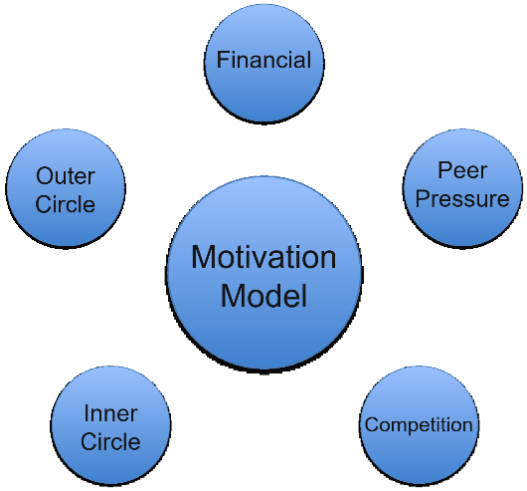
When advocating for the environment and for science-based decision making, one should consider four key areas: (1) the communication landscape, (2) cognitive heuristics and biases, (3) the target audience(s), (4) and what motivates them to take action.

The current communications landscape is highly politically polarized, low in trust, with both high media consolidation and self-reinforcing media selection technologies. This polarization is greater than at any time in recent history. Trust in institutions has declined precipitously, and there is a strong generational divide to this deterioration. Today there are only five companies controlling the majority of the nation's media. In rural areas, the access to multiple sources of information can be limited or non-existent.

According to the field of cognitive heuristics, our brains operate in different ways at different times, strongly influencing how a person ingests new information. The "halo effect" and "sequencing" are both examples of heuristics - mechanisms by which we extrapolate and determine our stance on a topic. Therefore, it is crucial that the topic is both relatable and direct. Understanding heuristics is more important today than in the past since they are reinforced by the current communication landscape. In environmental advocacy, it is important to **sequence the message**, make it **easy to comprehend**, and **know the audience**.

It is also important to consider how audience(s) engage with information. There are different types of audiences that require specifically tailored messages. One methodology to breaking down audience types is to place them into four categories (Architects, Influencers, Decision Makers and Implementers). Architects help design the intended change; Influencers do not have the power to make this change directly, but can influence those who do; Decision Makers have the power to make the proposed change; and Implementers can carry out the proposed change.

Why people make decisions to take action also matters greatly in designing communications campaigns. There are five main reasons people take action: financial considerations, peer pressure, competition, desire to help ourselves and people close to us, and a desire to help society at large. In advocating for science-based decision making, one should consider all these areas to create the most impactful campaign.

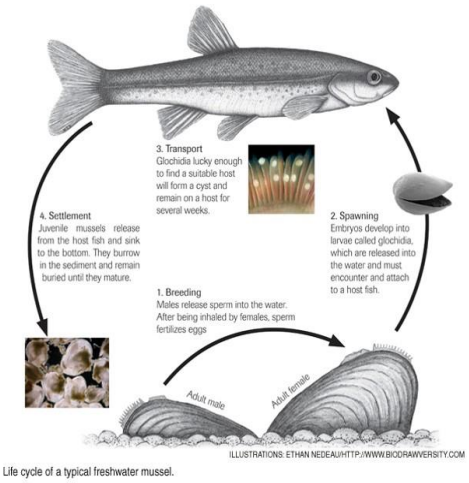



Considering these various factors when crafting messages and conducting outreach around environmental issues can help increase the effectiveness of our communication around environmental issues, whether advocating on a specific policy or attempting to communicate basic information to a non-technical audience. The ability to influence decisions and inject scientific knowledge into the policy-making process requires us as scientists to hone and utilize these tools.

# Effectively Communicating Science and Advocating for Forest Ecosystem Research

*This year's plenary focused on effectively communicating science and advocating for forest ecosystem research. Tad Segal, president and founder of Outreach Strategies LLC led the keynote presentation followed by four experts in the environmental field with personal experience in effective science communication*.

***The Short, Sweet and Engaging Story of Freshwater Mussels***
***Mark Ferguson**, Zoologist, Vermont Department of Fish and Wildlife*



Life cycle of a typical freshwater mussel.

**Life Cycle of a Typical Freshwater Mussel**

As Vermont's state Zoologist, Mark Ferguson is responsible for the protection and management of rare vertebrates and invertebrates. This task becomes increasingly challenging when you are trying to protect lesser known species. Mark, provided an example on how to draw in an audience on a topic that may not be commonly familiar to the everyday person. Mark gave a concise overview into the lifecycle of freshwater mussels more specifically, the initial steps in making a mussel.

Mark starts off his talk by informing the audience that *there are 18 different freshwater mussel species that occur in the state of Vermont, more than any other New England state*. This fact connects the subject of freshwater mussels to the audience, especially those living in Vermont. Mark then describes the techniques used by various mussels to breed. Generally, male mussels release sperm into the water until it encounters a female. The female mussel will inhale the sperm through their siphon. From there it will enter the gill pouches where it will fertilize the eggs and she will then produce her larvae.

Mussel at the larvae stage are in their parasitic state, something that is unique in bivalves. To survive they must attach themselves to a host fish. To accomplish this feat, female mussels have developed adaptations to lure in the right host. Mark provided an example through video where a lampmussel waved a fish-like mantle at an unsuspecting fish. As the fish attacked the fish-like mantle the mussel blasted her larvae in to the gills of the fish, a memorable visual that shows the amazing evolution of these simple creatures. To view the use of this modified lure visit https://www.youtube.com/watch?v=I0YTBj0WHkU.


*A female Yellow Lampmussel with a fish-like mantle used to lure in host fish.*

Understanding this initial process has allowed scientists to replicate them in the lab, resulting in young mussel that can be reintroduced to recover declining populations of mussel.

***So What? How to Grab and Hold People's Attention About Science?***
***Bridget Butler**, Principal, Bird Diva Consulting.*

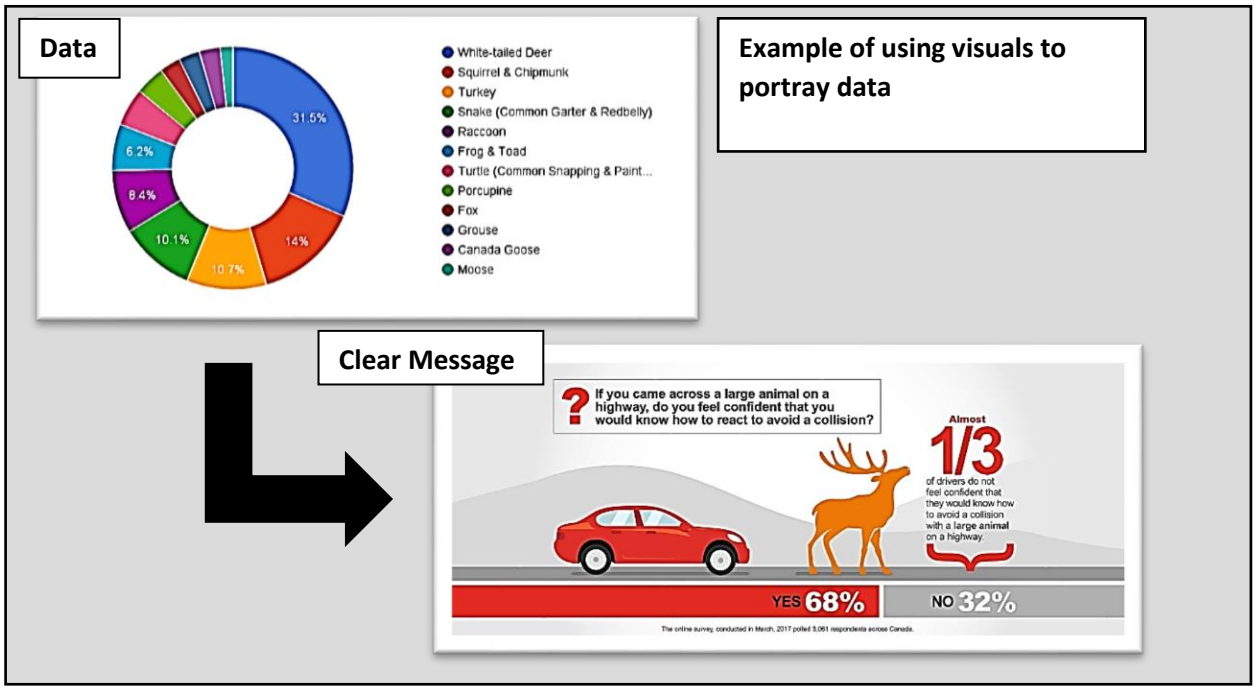
Scientists push their way through a great deal of obstacles to reach their next breakthrough. All that time and hard work and then they are faced with condensing all that information into something that is memorable and digestible to a broad audience.

Using her experience in bird conservation and the media, Bridget Butler provided insight into some of the strategies she uses to captivate her audience. Alluding to the eight second attention span of humans, Bridget leans on her "rule of fours". When presenting information it's important to break that information down into four bite-size pieces that your audience can walk away with. This forces you to narrow down the most important information, something that you can continuously refer back to during your interview or presentation so that your audience can walk away with at least four key points.

Knowing your audience is the next step. Understanding how they talk, what their interests are, and who they are will give you an edge by allowing you to mold your information to fit your audience. Eliminating jargon is one way that Bridget suggests can make your information easier to understand. When presenting information, get your point across through minimal text, bold fonts, and strong visuals that a person could look at briefly and walk away understanding the point you were trying to make.

Next, remember to give your audience something that they can relate to. Bridget mentions that your audience will always be asking themselves how your information can help them. When creating your four key points you want to keep your audience in mind. Review your key points and confirm that each point can benefit your audience in one way or another.

Finally, it's about the way you present that information that will create a lasting impression. Be confident and energetic when you present your findings. Learn to redirect your passion to the audience so that they too will pick it up.

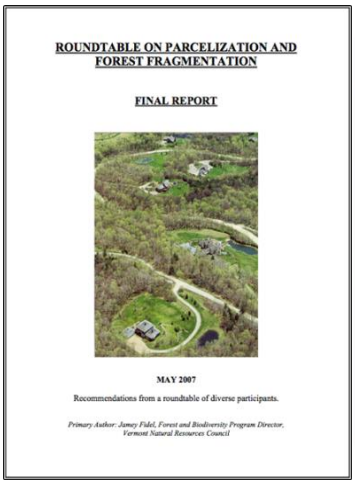


## *Reaching Decision Makers: Using Science to Inform Policy*

**Jamey Fidel**, General Counsel and Forest and Wildlife Program Director, Vermont Natural Resources Council

To effectively utilize science to inform policy, first begin with published peer-reviewed research that forms the foundation for the issue. This step is followed by awareness building, typically led by NGOs, government agencies, or academic institutions. From here, it helps to have a defining catalyst – such as an event or stakeholder process – to build momentum for the issue. Ideally, science will be fully integrated into final policy.

One notable example of this process was new policy on rivers and infrastructure development. The Rivers Program at the Vermont Agency of Natural Resources developed the science of fluvial-geomorphology in the state, recognizing that river positions are not static. Through this work, the staff demonstrated to state, regional, and local agencies that river corridors will move, and decisions about development and infrastructure need to consider this reality. As a result, this science was incorporated into local and regional planning, with many towns adopting stronger flood and erosion regulations. However, the defining catalyst was Hurricane Irene in 2011. The flooding resulting from this storm demonstrated the impacts of development on river corridors. Following this, new state regulations pertaining to river corridors and erosion hazard areas were adopted into policy.


ROUNDTABLE ON PARCELIZATION AND FOREST FRAGMENTATION

FINAL REPORT

MAY 2007

Recommendations from a roundtable of diverse participants.

*Primary Author: Jamey Fidel, Forest and Biodiversity Program Director, Vermont Natural Resources Council*


Another example of science to policy action was stronger attention to forest fragmentation and the role of coalitions. While ample research on the negative ecological and economic effects of fragmentation existed, awareness building was needed. Coalitions to advocate for stronger fragmentation policies were built and a statewide forest roundtable was held. The catalyst opportunity occurred when the Vermont Legislature asked the Vermont Agency of Natural Resources to draft reports on strategies to address fragmentation. Agency and expert testimony, lobbying and grassroots support resulted in new policies to minimize forest fragmentation Vermont-wide.

Both of these successful examples showcase the process in which science provides the foundation to policy. Indeed, testimony from scientists can help build credibility to the cause, assist in awareness building, and provide technical expertise. Integral to this effort is providing venues to share information and develop effective communication to shape policy.

***Science for Impact? Know your Audience***

**Julianna White**, University of Vermont Gund Institute for Environment, CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Julianna White is the program manager for the CGIAR research program; a small UVM research team that works on low emissions development in agriculture. The team conducts research and stakeholder engagement to develop agricultural options that decrease greenhouse gas emissions and increase carbon sequestration.

White depicts her communication strategies through the use of a three step process focused on the "impact pathway", a plan for extending the effects of the work and identifying the key next steps and stakeholders for further work. The first step is to engage "research users" who are the scientists or experts on the topic. This group is responsible for sending along their findings to the "next users" which are typically national research institutions and extension organizations. Lastly the research must be portrayed to the "end users" who are farmers. It is the responsibility of research organizations to utilize communication tools such as journal articles, reports, media outlets, and infographics to effectively communicate their findings to all stakeholders.

This process was demonstrated with a case study on nutrient management using optical sensors. The first step is to connect with the "research users". Fertilizer use has grown quickly in some countries and has become over-used in areas such as India and China leading to a decrease in profitability and an increase in greenhouse gas emissions and water pollution. Researchers in India and Mexico tested the use of handheld optical sensors and released a journal article showing how nutrient management sensors can help farmers calculate how much and what kind of fertilizers to use in the fields.


*CCAFS main target countries for low emmisions development in agriculture*

The next step is to bring the science to the "next users" or policy makers. In this case a feasibility analysis and case study were developed for investors, private sector leaders, extension organizations, and farm associations to show how these sensors have worked in certain areas and how they will work in other regions going forward. This step also requires reaching out to development organizations, farmer groups and cooperatives, and other people who work on the ground to get farmers using this new technology.

The last step is to move on to the "end users", the farmers. Farmers are innovative entrepreneurs that form a network with one another allowing them to share new technologies and techniques. CGIAR aids in this collaboration by providing clear communication messages and visuals that describe to farmers what they can use and how they can use them. The impact of utilizing these sensors is that farmers can increase productivity and profits while simultaneously decreasing $N_2O$ emissions and water pollution. Proper communication between scientists, policy makers, and farmers allow these technologies to be used on a large scale and have significant impacts on productivity and emissions.

***The Making of Outdoor Radio***

**Kent McFarland**, Sara Zahendra, Vermont Center for Ecostudies, and Chris Albertine, Vermont Public Radio (*Not presented during the flash-talk session but is available at* https://www.uvm.edu/femc/cooperative/conference/2017/content *)*

Kent McFarland discusses the importance of communicating science and natural history in a way that is both interesting and informative to the public. He is currently working on a program with Vermont Public Radio (VPR) called Outdoor Radio, which unites the sounds and science of nature in a monthly storytelling feature. In the early 20th century, Anna Comstock, the first female professor at Cornell University, and writer of *Nature Study in Hand*, started a natural history study among schools that progressed until the 1950s and 60s. These programs produced some of the greatest naturalists in history such as Aldo Leopold and Rachel Carson. Unfortunately during the 50s and 60s, natural history began to fade from curriculum and today natural history knowledge by the general public is at an all-time low. This disconnect between the public and the scientific community is what led to the creation of Outdoor Radio.

Although scientists are well versed in the details of their research, they often lack the ability to clearly pitch this information to the public, which leads to miscommunication and a lack of interest. Kent McFarland and his team faced these roadblocks before hooking up with storyteller Chris Albertine from VPR. Albertine relayed the importance of giving a story a clear beginning, middle, and an end. In order to give science a story, the content must entice people while simultaneously sneaking in important research. Randy Olson, a scientist and filmmaker describes the necessity of story writing to follow a certain formula including the words “and, but, therefore” in that order. This is depicted in McFarland’s story about salamanders and vernal pools below. Turning scientific findings into narrative writing can be difficult and frustrating, however it can also be an excellent tool to captivate the public and present important research. To learn more about VPR’s Outdoor Radio check out http://digital.vpr.net/programs/outdoor-radio#stream/0

*On a rainy night in April the salamander crawled from underground and then it went to a vernal pool and made it, but one scientist has found that vernal pools contain methyl mercury from atmospheric deposition and the salamanders are accumulating it in their bodies. Therefore, we have to find out if this harms the salamanders and if so can we lower emissions and clean up the vernal pools?*

*- Kent McFarland*

# Summary of Working Sessions

Session summaries were written with presenters and FEMC staff for the afternoon working sessions.

## *Can We Manage the Impacts of Climate Change on Sugar Maple and Maple Sugaring?*

*Organizer: Toni Lyn Morelli (DOI Northeast Climate Science Center; University of Massachusetts); generally led by the ACERnet team*

This working group focused on discussing management adaptations to negative impacts of climate change on sugar maple and maple syrup production. The participants included tribal members, small maple sugar producers, foresters and private forestry consultants that work with sugar producers, and researchers from the U.S. Forest Service, state agencies, and academia concerned with the impact of warmer weather on sugar maple populations. Participants were broken into three groups to discuss the major threats that sugar maples face from climate change, based on the initial group vote: warmer winters and springs, more weather variability, and more extreme weather events.

*From left to right: Alexander Bryan, David Lutz, Selena Ahmed, Joshua M. Rapp, Toni Lyn Morelli, and Ryan Huish*

Personal stories were shared concerning loss of quantity and quality of syrup production due to increasing temperatures, drought, false springs, and pest outbreaks. Perspectives from tribal members were particularly valuable. Concerns varied depending on whether the participant was from the southern (VA, NJ), central (Midwest, MA, VT, NH), or northern (Canada, northern Maine) part of the sugar maple range. After outlining the major management crises faced by sugar producers, participants discussed possible adaptations such as tapping in early January to catch any early sap flow, increasing forest diversity to increase resilience, and for tappers to allow regeneration among sugar bushes.

*Photo by Josh Rapp*

Sugar maple trees and producers face serious threats due to climate change and it is the responsibility of foresters, farmers, and researchers to adapt management strategies to combat these changes. Moreover, all groups stressed that more research is needed on the direct and indirect impacts of climate change and on the potential for adaptation and sustainable practices. And finally, when thinking about what maple sugaring should look like at the end of the century, participants described healthy, adapted trees in a diverse, functioning forest ecosystem, with maple syrup continuing as one of the many ecosystem services of the forests of the northeast and Midwest and mid-Atlantic, with more people with different perspectives involved and connected, working together.

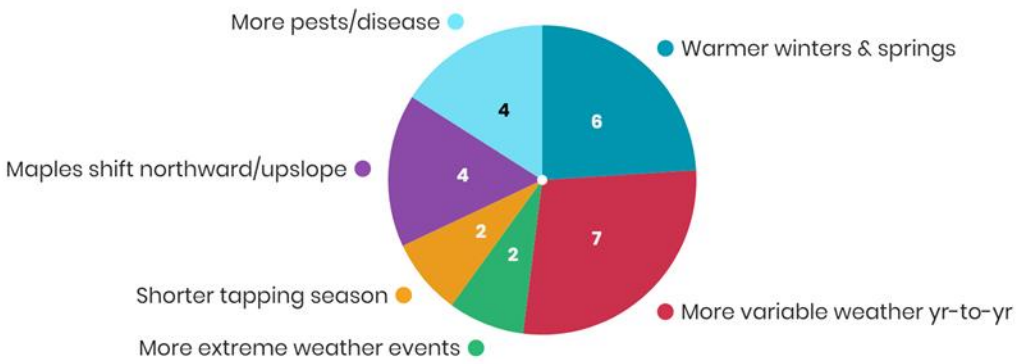
**General Session Notes:**

- Began by organizing into three groups: managers, researchers, producers
    - Composed of: Tribal members, small maple sugar producers, foresters that work with sugar producers, private forest consultants that work with sugar producers, as well as researchers from academia, state agencies, and the U.S. Forest Service concerned with the impact of warmer weather on sugar maple stands.
- Used an online/phone application (www.menti.com) to ask 3 open-ended questions to the group. As people responded with up to 3 words, those words would show up on the screen or get bigger if they were already there.
    - Q.1: What changes are you seeing in sugar maple stands and maple syrup that might be related to climate change?
        - Most popular responses: Earlier season, more variability, shorter season, quality, phenolics, yield, variable temperature
        - **Responses from 16 participants:**


    - Q.2: Related to syrup production or sugar maple management, what are you doing to respond to climate change?
        - Most popular responses: Research, invasive control, traditional ecological knowledge, tapping earlier, regeneration, healthy trees, adaptation.
        - **Responses from 22 participants:**


    - Q.3: What is your biggest concern related to sugar maple and maple sugaring?
        - Most popular responses: More variable weather, more extreme weather events, shorter tapping season, maples shift northward/ upslope, more pests/disease, warmer winters and springs

- **Responses from 25 participants:**




- Focus for the day: group discussions focused on the impacts of warmer winter/spring, more variable weather, and extreme weather on sugar maple production and stands
    - Each group (a mix of managers, researchers, producers) was assigned one of these categories to discuss

**Notes from Group Discussions**

| | Problems | Quality Concerns | Solutions |
|---|---|---|---|
| **Group 1: Warmer winter/spring**<br><br>Main Drawbacks: influence on pests, nutrient cycling, weather unpredictability | •More invasive earthworms→loss of leaf litter layer/beech dominance→lack of germination, faster cycling of nutrients<br>•No snow cover→more erosion→less litter→root damage<br>•Forest pests (e.g., forest tent caterpillar, gypsy moth)<br>•Summer drought→regeneration failure<br>•Problems with regeneration if some populations require low temperatures | •Fewer freeze/thaw cycles in southern locations<br>•Crown dieback→less leaves→less sugar<br>•High calcium magnesium soils leads to the best quality syrup<br>•Soil leaching from erosion and different forest stand makeup→less calcium magnesium soils.<br>•Warming→trees heal wound faster→shorter tapping season<br>•Warming earlier in spring→budburst or microbial activity can interfere with production<br>•Decreased sap quantity and quality<br>•Harder to manage without frozen ground for access<br>•Change in species composition might affect soils and thus taste | • Foresters and sugar maple producers must allow for regeneration to aid in adaptation of sugar maples to a warmer climate<br>• Tap early<br>• Tap other species – other maples, birch, beech<br>• Sanitary taps<br>• Vacuum tubing<br>• Prewarmers<br>• Smaller taps<br>• Disposable taps<br>• Pull taps earlier<br>• Fertilize<br>• Liming<br>• Homogenization of syrup<br>• Bulk production<br>• Consider different sites<br>• Deer management: wolves, doe hunting<br>• Manage invasive species, spraying<br>• Structural and species diversity, including more red maple and ash; Promote harvesting<br>• Note that the northern end of the sugar maple range is likely to benefit from warmer conditions<br>• Source seeds from farther south<br>• Maintain closed canopy |
| **Group 2: More variable weather** | •Increase in pest outbreaks<br>•Pressure changes are different in other species→requires vacuum tapping→no long term viability<br>•Warm weather near end of season can end season prematurely | •Increase in fungal and bacterial spread<br>•Shorter tapping season<br>•Less reliable tapping season | •Begin tapping earlier (i.e. January 1st) to catch a false spring<br>•Manage for pests and disease by avoiding monocultures<br>•Sanitize spouts regularly to lower the spread of fungal/bacterial disease<br>•Adapt to tapping other species |
| **Group 3: Extreme weather events**<br><br>Goal: cover false springs, ice storms, wind blow down, wildfire, flooding, drought, and other extreme weather patterns that damage maple populations | •Drought→ destroy an entire season's crop + "bud taste"<br>•False springs→leaf damage + more microbes in tap hole→disease and lower quality syrup<br>•Storms→Windthrow→kills trees + damages tubing systems (→loss of time/opportunity)<br>•Catastrophic wind events can reduce recruitment or even wipe out a population<br>•Flooding/Extreme Precipitation→Soil Erosion→leaf litter loss/leaching→little regeneration | •Early season= light syrup, less microbial activity<br>•Late season (or warmer weather conditions) =darker syrup, lower quality, high microbial activity. | •Tap earlier in season to avoid false springs→still risk a low yield<br>•Tap in fall<br>•Tap silver/black maple (but harder to heal; more brown)<br>•More work needs to be done to manage maple stands/ production to account for extreme weather<br>•Testing smaller tap holes to combat effects of increased microbial activity due to false springs<br>•Nanofiltration (i.e. reverse osmosis, raises the sugar content of low-sugar syrup by placing next to high-sugar syrup separated by permeable membrane; important in false spring years when sugar content is lower)Using "certification" status to achieve goals (example: To be deemed "certified organic", at least 25% of syrup must come from red maple) |

## *Climate Change and an Ecologically Functional Landscape: How Can We Plan For and Achieve Conservation Success?*

*Organizer: Bob Zaino (VT Fish and Wildlife), Eric Sorenson (VT Fish and Wildlife), and Liz Thompson (Vermont Land Trust)*

The primary goal of this session was to address difficulties with choosing high priority conservation areas, where the organizers looked for different ideas to sustain Vermont's biological diversity. The main focus of the session was maintaining, enhancing and conserving ecologically functional landscapes through cooperation with other agencies in the state and landowners. The difficulty of cooperating with many different types of people, organizations and institutions was one of the common themes of the conference. The biggest obstacle was conclusively taking different ideas, plans and organizations and building them into a coherent whole from which everybody benefits. Organizers also showed the attendees two maps from two different conservation agencies prioritizing different areas. One obstacle both agencies shared was that around 20% of land was prioritized. This was complicated by the challenge of choosing high and low priority areas, along with limited cooperation between the two organizations.

A major topic of discussion during the session was how to know if a landscape is self-adapting to climate change. The most common answer was that we need to know what "adapting" looks like. If the whole community changes, is that a success or failure? Some other discussion points included what to consider when choosing conservation areas – is it genetic diversity, ecosystem biodiversity or simply ecosystem services? Can monitoring help us recognize success or failure? One issue arising with monitoring is how to determine what to monitor when we do not know exactly what the outcomes of adaptation landscape will look like.

Lastly, coordination and communication is very important among different societal groups, with attendant challenges in how these groups take in and interpret information. Many landowners do agree and support land trusts when shown what a certain area, ecosystem or landscape does to their benefit. One of the ideas many attendants of the session agreed upon was that landowners will react positively if the conservation ideas and areas are zoomed in, town by town, street by street, showing landowners their very backyard and its position in saving Vermont's forests.

# *Informing Policy – Expert Testimony and Other Ways to Engage With Lawmakers*

*Organizer: Joanna Garton (Vermont Department of Forests, Parks, & Recreation)*

*Panelists:*
*David Mears (Director, Environmental Law Center, Vermont Law School)*
*Rebecca Ellis (Deputy Commissioner, Vermont Department of Environmental Conservation)*
*Neil Kamman (Senior Policy Advisor, Vermont Department of Environmental Conservation)*
*Jamey Fidel (General Counsel & Forest and Wildlife Program Director, Vermont Natural Resources Council)*

This session focused on how scientists can engage effectively with policy makers and understand how policy makers approach and think about issues. The organizer, Joanne Garton, posed several big questions to the panelists, who engaged in a discussion with the audience on these issues. The key themes that came up repeatedly were: **Know your audience; consider the timing; fine-tune the delivery; and balance advocacy and credibility.**

*From left to right: David Mears, Rebecca Ellis, Neil Kamman, and Jamey Fidel*

**Know your audience**

All panelists seemed to agree that scientific understanding and information are not the first and foremost concern to those making policy. This doesn't mean that they don't want to utilize science or include it, but there could be any number of higher-priority issues that override those concerns, such as landowner reactions, economic costs and government spending. In addition, policy makers may not be familiar with the science, which can prevent them from engaging. Showing up and expecting the science to speak for itself is generally not a viable tactic, and inserting scientific information into the policy making process entails hard work and stepping outside your comfort zone.

**Consider the timing**

Panelists described two types of conditions for inserting science into the policy making process. The first is slow and steady – the science can be ready and waiting, but it takes a lot of diligence to work directly with stakeholders, meeting them where they are, and helping build a consensus on a policy goal. On the other hand, there are times when the right message about the right topic can be immediately impactful, such as mercury regulation, because you have the right communication materials and the public is paying attention. Because you don't know which situation you will find yourself in, advocating early and often is key.

**Fine-tune the delivery**

Meeting people where they are means having the right materials. A legislator may remember just one slide of a 30-slide presentation, and it likely won't be the one with a graph on it. Go into testimony with a goal and stay committed to communicating that goal and the science that supports it, rather than trying to explain the entire context of the issue. Providing good similes and metaphors that capture the crux of the issue will be more effective than explaining the science behind the issue. An example was describing phosphorous in water as nails you're using to build a shed. You need some nails (nutrients) to build a shed (maintain aquatic organisms) but too many nails (e.g. too much phosphorous), and you build too many sheds (algae), and you will eventually reach a point where you cannot accommodate all of them in your yard (lake). Case studies also provide a way to use concrete examples firmly based on data and science to tell a more compelling story, and can keep scientists on firmer ground.

**Balance advocacy and credibility**

The norms of scientists and their engagement in policy-making seems to be shifting – advocating for particular policies might have been unthinkable for a scientist 15 years ago, but that is changing. Maintaining consistency is a key way to maintain credibility when providing testimony on multiple issues, and acknowledging the tension of being a scientist advocating for a particular policy can help diffuse the potential risk of that act. Scientists are trained to avoid stating things with certainty because of the nature of the scientific method, which can undercut the ability of the public to believe scientists – being assertive with language is something that is needed in this sphere to balance with all the other interests lobbying on a given issue.

## *Media Training for Scholars: Getting News Coverage for Science*

*Organizer: Basil Waugh (Gund Institute for Environment, University of Vermont)*

Basil Waugh, Communications Director for the Gund Institute for Environment began the session on getting media coverage by asking the audience to share their personal experiences with media. This led to stories about the difficulties of translating and condensing stories into consumable media for a broad audience and the many techniques and strategies they have found interviewers use to manipulate stories.

Basil then took the group to the initial contact point with the media. Imagine yourself working at your desk when your phone rings. It's some media entity and they want to interview you, now what do you do? Basil emphasizes not to panic. Find out the who, what, and why they are contacting you. Get off the phone and *then* decide whether their media outlet suits your needs. If you've decided yes, the next step is to prepare yourself before committing to an interview.

The main way to prepare yourself is to stay informed about the subject at hand and insist that you are taking the interview in a setting that prioritizes your comfort. The most important thing to remember is that you are limited in terms of time and the amount of detail you can include. Create three key messages and practice staying on those three messages despite the path taken by the interviewer. Practice deflecting the conversation back to your main key message to ensure the audience will walk away understanding your message.

Although you cannot predict exactly what questions will be asked, you can always anticipate a set of questions that may come up. Basil explained that common interview questions fall into the following categories; the softball questions that are basic and non-technical (e.g. "*Were there any surprising findings*?"), the hardball questions, and questions off the record. The audience was reminded to be cautious of "off the record" questions as those are asked while you assume the interview has ended, which is false. It's best to assume that anything said between you and the interviewer could potentially be used regardless of what the interviewer says.

The group was then equipped with a set of phrases that would allow them to maintain control of the interview, phrases such as "That's an interesting question but the most important issue is...", "Let me start off by saying...", "There are many important opinions on this issue but what the science says is...". Remember, you are the expert on the subject matter. Steer the conversation so that your audience understands your key messages.

Proper navigation of the media can be a great benefit towards increasing the impacts of your research by advancing public understanding. Using the media can lead to many opportunities that would otherwise go unnoticed if you had not broadcasted your work. Though these benefits are invaluable, Basil states that opportunities will come - never feel like you have only one and go into something in which you are unprepared.

Once we learned how to work the interview process, Basil walked us through the steps of making the news. First, be aware of the current topics in the news by researching the news itself. Review journal publications that are related to your own professional interests. Second, monitor your project milestones and find ways to connect them to global events, making your story relevant on the larger scale. Lastly, it's important to remember the media is a business and they are looking for the next big story that puts them above their

competitors. Review your story and pick the portions that you believe would be of interest to the media's audience.

The main takeaway from Basil's working session is that we all can agree media can be intimidating, but when you are prepared and confident it can lead to more opportunities to further extend your mission and the impact of your work.

## *Stakeholder Engagement in Research and Results*

*Organizer: Julianna White (University of Vermont Gund Institute for the Environment, CGIAR Research Program on Climate Change, Agriculture and Food Security) and Bridget Butler (Principal, BirdDiva Consulting)*

The working session had two goals, identifying stakeholders and identifying strategies. Julianna's organization is working to reduce agricultural emissions of greenhouse gases in the developing world and Bridget is working to conserve habitat in Vermont, but both need to make the case to non-scientists that what they are proposing makes sense to local communities.

Julianna targets what audience she is speaking to and tailors her information to that audience. The information is grounded on peer-reviewed papers, which are in turn based on data, but not all audiences need a scientific paper. To reach different audiences CGIAR makes different products ranging from YouTube videos to synopses for government ministries. They also support "young experts" who receive training, and work with stakeholders in developing evidence-based policies and methodologies to the extent possible.

Bridget "maps" the public's values by *listening* then develops messages by chunking information into understandable pieces. Four is the magic number for human memory and retrieval of information. She outlined how to make your work understandable in no more than four aspects, then chunk each of those aspects into no more than four pieces of supporting information. She showed examples from her own conservation work on how to do this before the group put theory into practice with a messaging exercise based on their own work.

# Contributed Abstracts

There were 24 talks contributed to the conference, presented between two sessions throughout the day. In the morning there were three concurrent sessions. The sessions were *Engaging Stakeholders and Influencing Forest Policy* moderated by Alexandra Kosiba, *Water Quality and Assessment Across Scales* moderated by Ismar Biberovic, and *Trends and Patterns in Wildlife and Fisheries* moderated by Carolyn Loeb. In the afternoon session of talks there were three concurrent sessions. The concurrent sessions were *Forest Ecology and Silviculture* moderated by Alexandra Kosiba, *Environmental Change and Long-Term Monitoring* moderated by Christian Schorn, and *Can We Manage the Impacts of Climate Change on Sugar Maple and Maple Sugaring* moderated by Toni Lyn Morelli. Below are the abstracts submitted for these talks, including author affiliation. The presenting authors name is in bold type.

## *Imported Forest Pests: Science applied to policy*

**Gary M. Lovett**[1]

[1] Cary Institute of Ecosystem Studies

The forests of the Northeast have been subjected to repeated invasions of forests insects and pathogens imported through global trade. This is part of larger problem of forest pest invasion that affects the whole country. We convened a group of experts to assess the ecological and economic impacts of forest pests and policy options for preventing the importation of new pests. This presentation will discuss the findings of this study and subsequent activities to put these policies into action.

# *Bridging the gap between invasive species research and management: Challenges and solutions in New York State*

**Carrie Brown-Lima**[1]

[1]New York Invasive Species Research Institute


The body of scientific knowledge on invasive species has been rapidly growing concurrently with the introduction and spread of new invasive species. Despite the increasing availability of new information and technology there continues to be a disconnect between research and management that can hinder the understanding and application of new solutions to invasive species challenges. In an effort to address this divide, New York State has established the New York Invasive Species Research Institute (NYISRI) based at Cornell University. NYISRI has the mission to communicate and coordinate invasive species research to help prevent and manage the impact of invasive species in New York State and beyond. The institute partners with New York's eight Partnerships for Regional Invasive Species Management (PRISMs), iMap Invasives database, Department of Environmental Conservation, Office of Parks, Recreation and Historic Preservation and many researchers across disciplines who are willing to devote their expertise to improve invasive species management on the ground. This presentation will provide an overview of the comprehensive approach to address invasive species in New York State including the programs and activities that NYISRI is promoting in an effort to bridge the gap between invasive species research and management in New York State. It will also give insight on how recent research and innovations should influence the way we think about and manage invasive species moving forward.

# *Charting a future for research on the Northern Forest: NSRC partnerships to sustain forest research*

**William B. Bowden**[1]

[1]Rubenstein School of Environment and Natural Resources. University of Vermont


**NSRC Partnerships**

Since its inception in 2001 the Northeastern States Research Cooperative (NSRC) has supported cross-disciplinary, collaborative research in the Northern Forest, a 26-million acre working landscape that is home to more than two million residents and stretches from eastern Maine through New Hampshire and Vermont and into northern New York. A central component of the program has been the importance of the Northern Forest to society and the need for research activities to have relevance and benefit to the people who live within its boundaries, work with its resources, use its products, visit it, and care about it. As directed by the public law that created it, the NSRC has been a competitive grant program for research on the Northern Forest region, jointly directed through the USDA Forest Service Northern Research Station, the University of Vermont, the University of New Hampshire, the University of Maine, and the SUNY College for Environmental Science and Forestry. Between 2001 and 2015 the NSRC has funded 279 completed projects with an additional 43 ongoing projects. These projects have been awarded to 176 individual researchers at 53 unique institutions, organizations, and agencies. The research has ranged over 14 core research interest areas, with the most important interest areas in (1) Forest Management & Productivity; (2) Atmospheric Pollution; (3) Forest Health & Invasive Species; and (4) Climate Change. The NSRC has successfully met its mission for over 15 years. But in recent years it has become apparent that the NSRC needs to re-envision its future. As a consequence, we are taking the 2017-18 year to reimagine what the NSRC might be. In the initial phases of this effort we have reached out to the stakeholder and researcher communities in the Northern Forest region to seek their advice and input. We are currently preparing a retrospective Business Report for the Forest Service, which will summarize the achievements of the NSRC over the last 17 years and in January 2018 we are planning a facilitated workshop to develop a strategic vision for the future. This is a transition that the FEMC has already successfully negotiated. As we consider how the NSRC might change in the future and what it might do and become, it has become clear that closer partnership with the FEMC could be beneficial to both organizations. In this presentation we will explore these benefits and seek input from the meeting participants to help us identify a future path that will best serve the Northern Forest communities and the resources that we all value.

# *Effective communication with a municipal audience*

**Jens C. Hilke[1],** Monica Przyperhart[1]

[1] Vermont Fish and Wildlife Department

Vermont Fish & Wildlife Department staff work with all 251 VT Municipalities and Regional Planning Commissions to provide technical assistance on conservation planning for VT's fish, wildlife & habitats. Because 81% of VT is in private ownership and individual towns have land use planning & regulatory authority, we believe technical assistance is an effective approach to influence land use decisions made by municipalities, and this job is critical for the Department to achieve its mission of the conservation of all of Vermont's fish, wildlife and plant species, related habitats and natural communities.

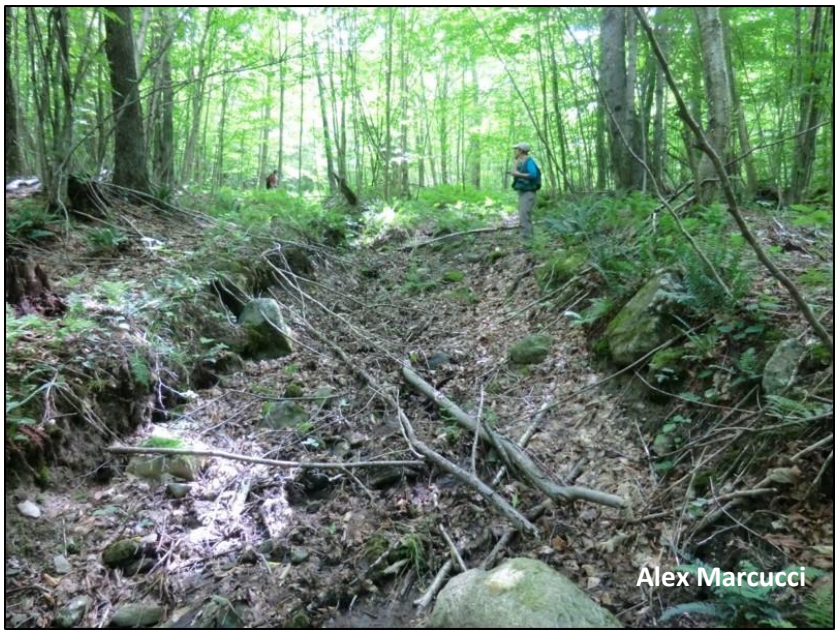

Over the last ten years, Department staff have constantly worked to improve messaging for the municipal audience so that we can better advocate for fish & wildlife resources. This involves interpreting the full suite of natural heritage elements from the landscape scale (interior forest blocks, habitat connectivity, etc.) to natural communities and fine filter elements like vernal pools, rare & endangered species, and wetlands. Recently, Department staff developed a messaging triangle to ensure consistency in our approach while still maintaining the flexibility to address locally important resources and issues. The three points of this triangle represent the three main messages that we want all audiences to hear: Your place is important, this landscape is changing, and you have a range of options for moving forward. No matter what the topic of a presentation, these three messages are embedded in the content, and we can pivot from one to the next. Our goal is to also maintain a central message for every conversation we have with the public: The health of our ecology, economy, and community are intricately linked. Even when explaining complex scientific concepts, we strive to incorporate this messaging triangle into all of our work.

As the Agency has developed Vermont Conservation Design and presented it on the BioFinder website and in the text of a soon to be released publication titled Mapping Vermont's Natural Heritage (a mapping and conservation guide for land use planners), staff continue to wrestle with the most effective language to express difficult concepts, such as landscape scale, the importance of coarse-filter conservation, and the nuances of bringing each heritage element into the land use planning framework. While the scientific process should attempt to avoid value judgments or at least acknowledge them ahead of time, effective communication to this audience is intimately involved with the community values of each town and the individuals in the room. We strive to present this material in an effective way, connecting with community values and local understanding while empowering local decision makers to choose the way forward with a range of options, from non-regulatory to regulatory tools. We have found the messaging triangle to be an effective tool for achieving these goals.

# *Using LiDar to map eroded forest roads in the Lake Champlain Basin, Vermont*

**Sean MacFaden[1],** Jarlath O'Neil-Dunne[1], Mary Nealon[2], Alexandra Marucci[2]

[1] University of Vermont, Spatial Analysis Laboratory
[2] Bear Creek Environmental, LLC




Phosphorus pollution in Lake Champlain reduces water quality, degrades wildlife habitat, and compromises recreational activities such as swimming, boating, and fishing, Urban land uses and agriculture are known to be the primary sources of this pollution, but some of it could emanate from eroded logging roads and skid paths in managed forests. Most of these features are unmapped, so the magnitude and distribution of pollution from logging roads are unknown. Accordingly, this project explored methods for mapping forest roads in the Lake Champlain Basin and identifying segments likely to be eroded. Roads were mapped using a combination of LiDAR-derived surface models and automated feature extraction techniques in two sections of the Basin: Rutland County and the Upper Missisquoi Watershed. Eroded sites were then identified by examining gully depth and a stream power index derived from flow potential and slope. Field verification data for both study sites indicated that extensive networks of roads and trails were only partially mapped because some road segments were topographically indistinguishable from adjacent terrain. The resolution of the input LiDAR affected the capture rate, with 51% of field-verified roads mapped in Rutland County (0.7-m LiDAR) and 38% in the Upper Missisquoi Watershed (1.6-m LiDAR). However, the field data also showed that the most heavily-eroded sites were captured by automated modeling, suggesting that a LiDAR-based approach is useful to pollution estimation even when comprehensive networks cannot be effectively delineated. Future work should focus on improved capture of forest roads and field-based estimation of phosphorus loading from specific road types and site conditions.

# *Dealing with Non-Detects: Using censored environmental data wisely*

**Rebecca M. Harvey[1], Phillip Jones[1], Heather Pembrook[1], Jim Kellogg[1]**

[1]Vermont Department of Environmental Conservation, Watershed Management Division

Scientists working with long term monitoring programs and historic data sets are often faced with the question of how to deal with censored data; in this case, data below the detection limit. The most common approach is to substitute the value with an arbitrary fraction of the detection limit (i.e. half the detection limit). Although they have been historically accepted, these substitution methods introduce significant biases to long term data sets, making trend detection all but impossible. Further, statistical analyses become more complicated as method detection limits change over time. Results below the detection limit (the "less thans") are still valuable data points that contribute meaningful information to long term data sets. So, we're still faced with the question of how to treat censored data? In this talk, I will present a few useful approaches to handling "less thans", based in part on the percent of censored values in the data set. This discussion will be presented within the context of Vermont's long-term acid lake monitoring data set, which contains both censored data and moving detection limits.

**Vermont Acid Lakes**

# *High-frequency water quality measurements reveal differences in storm hysteresis and loading in relation to land cover and seasonality*

**Matthew C.H. Vaughan[1,2]**, William B. Bowden[1], James B. Shanley[3], Andrew Vermilyea[4], Ryan Sleeper[1], Art J. Gold[5], Soni M. Pradhanang[5], Delphis F. Levia[6], Alan S. Andres[6], Francois Birgand[7], Andrew W. Schroth[1]

[1]University of Vermont
[2]Lake Champlain Basin Program
[3]US Geological Survey
[4]Castleton University
[5]University of Rhode Island
[6]University of Delaware
[7]North Carolina State University

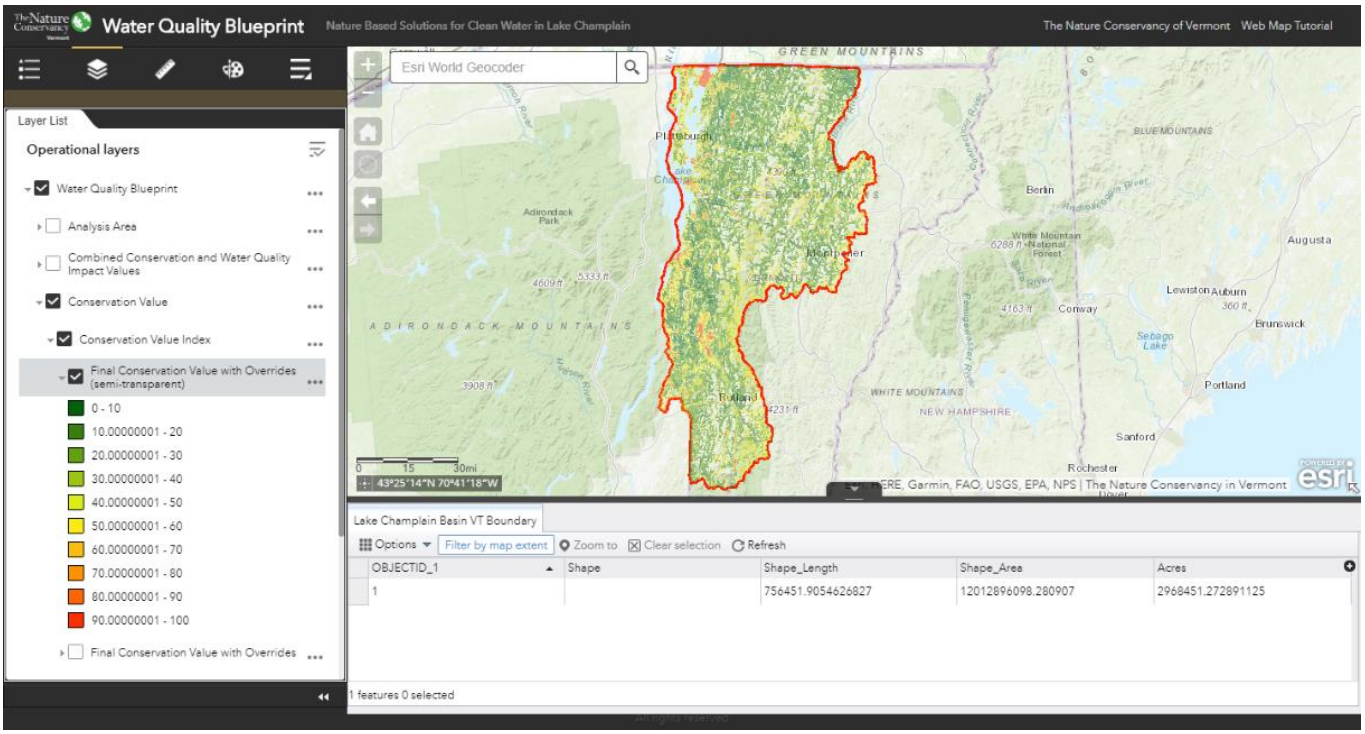
Storm events dominate riverine loads of dissolved organic carbon (DOC) and nitrate and are expected to increase in frequency and intensity in many regions due to climate change. We deployed three high-frequency (15 min) in situ absorbance spectrophotometers to monitor DOC and nitrate concentration for 126 storms in three watersheds with agricultural, urban, and forested land use/land cover in the Lake Champlain Basin. We examined intrastorm hysteresis and the influences of seasonality, storm size, and dominant land use/land cover on storm DOC and nitrate loads. DOC hysteresis was generally anticlockwise at all sites, indicating distal and plentiful sources for all three streams despite varied DOC character and sources. Nitrate hysteresis was generally clockwise for urban and forested sites, but anticlockwise for the agricultural site, indicating an exhaustible, proximal source of nitrate in the urban and forested sites, and more distal and plentiful sources of nitrate in the agricultural site. The agricultural site had significantly higher storm nitrate yield per water yield and higher storm DOC yield per water yield than the urban or forested sites. Seasonal effects were important for storm nitrate yield in all three watersheds and farm management practices likely caused complex interactions with seasonality at the agricultural site. Hysteresis indices did not improve predictions of storm nitrate yields at any site. We discuss key lessons from using high-frequency in situ optical water quality sensors.

# *Water Quality Blueprint – Nature-based solutions for clean water in Lake Champlain*

**Dan Farrell**[1], Rose Paul[1], Ann Ingerson[1], Shayne Jaquith[1]

[1]The Nature Conservancy of Vermont

Natural systems are increasingly considered to be cost-effective solutions to water quality problems, providing multiple ecological co-benefits. The Water Quality Blueprint is a publicly accessible online tool designed to help watershed managers and conservation practitioners make use of natural and restorable areas to achieve water quality and conservation goals in the Vermont portion of the Lake Champlain Basin. It includes two independent prioritizations of floodplains and other areas associated with rivers, lakes and wetlands: a map layer that highlights natural assets that would benefit from protection and restoration (Conservation Value) and a map layer that highlights locations that are impaired, at risk of impairment or that may attenuate sources of pollution (Water Quality Impact Value). These prioritizations are raster-based, weighted combinations of multiple component datasets that represent important habitats, natural processes, and impairments. The component datasets, as well as other supporting datasets, are included in the web-map to help users understand patterns related to ecology, pollution, restoration potential, and fluvial processes at the site, watershed, and basin scales. The results of the Water Quality Blueprint have been incorporated into the Clean Water Roadmap for Vermont, an online tool designed to support the VTDEC's efforts to reduce phosphorous pollution in the Lake Champlain Basin.



# *An overview of ongoing moose mortality and productivity research in northern Vermont*

**Jacob R, Debow**[1, 2], Cedric Alexander[1], James D. Murdoch[2], Matthew Witten

[1]Vemont Fish and Wildlife Department
[2]Rubenstein School of Environment and Natural Resources, University of Vermont
[3]US Geological Survey Vermont Cooperative Fish and Wildlife Research Unity

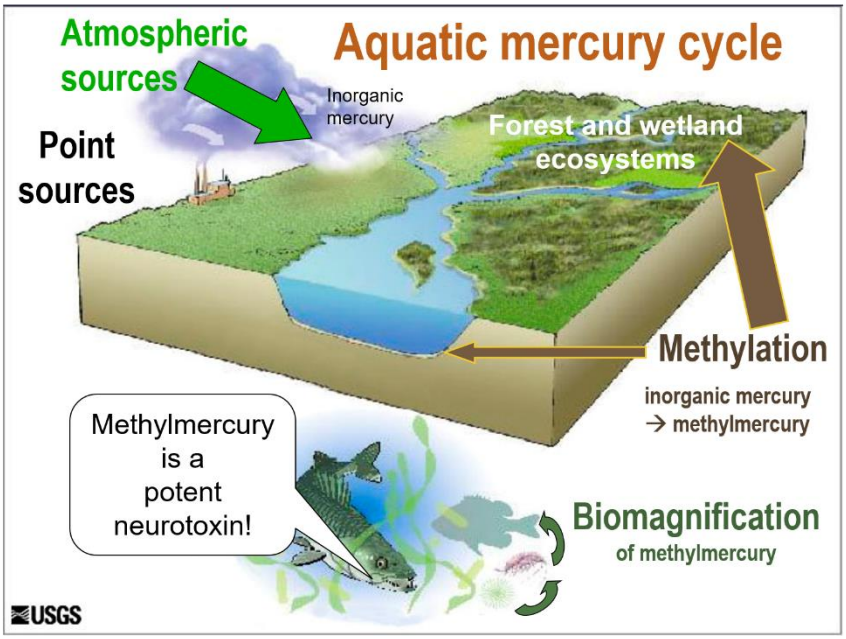
Current moose (*Alces alces*) research in Maine and New Hampshire identified 3 consecutive years (2014-2016) of winter tick (*Dermacentor albipictus*) epizootics causing >70% annual calf mortality (March-April). Tick indices on harvested bull moose in northeastern Vermont have consistently been lower than study areas in New Hampshire and western Maine. Although winter tick epizootics were considered relatively rare in Vermont, decreasing carcass weights and ovulation rates of Vermont cows indicate tick levels are still high enough to cause the current observed population decline. In response, the State of Vermont initiated a 3-year study similar to those in New Hampshire and Maine to investigate the population characteristics of Vermont's northeastern population. These 3 state research projects are linked geographically, occurring in similarly managed, private commercial forestland that is the core of moose habitat in the northeastern United States. In January 2017, a total of 60 moose (30 calves and 30 adult cows) were captured and fitted with GPS radio-collars to monitor winter calf mortality and adult productivity in northeastern Vermont. Calf mortality from March to April was 40% (12 of 30). Dead calves displayed overt signs of severe winter tick infestation, namely heavy tick loads, substantial weight loss (22.26kg-48.76kg) and musculature atrophy, and edema; histological studies of tissue samples are ongoing. Winter mortality of adult cows was 10% (3 of 30) and is considered normal. Productivity of yearling and adult cows was measured by direct observation from May to August with efforts focused on pregnant cows (n = 19) in the collared population. The calving rate was 50% (15 of 30) and 79% (15 of 19) of known pregnancies. Calf survival was 62% (10 of 16 including one set of twins) through mid-July putting total productivity at 33% (10 of 30). Capture of an additional 35 moose is planned for January 2018.

# *A regional investigation of mercury in small mid-trophic fishes and predatory games fishes of streams in the northeastern United States*

**Karen Riva Murray**[1], Peter VanMetre[2], James Coles[3]

[1]US Geological Survey, New York Water Science Center, Troy, NY
[2]US Geological Survey, Texas Water Science Center, Austin, TX
[3]US Geological Survey, New England Water Science Center, Northborough, MA

Fish-tissue mercury (Hg) concentrations exceed human health advisory levels and wildlife guidelines in water bodies throughout the northeastern United States. Mercury concentrations in small, mid-trophic level invertivorous fishes and in predatory game fishes of this region's streams were assessed during the summer of 2016 as part of the Northeast Stream Quality Assessment (NESQA), a multi-stressor study conducted by the USGS National Water-Quality Program. The objectives of the fish mercury investigation were to document stream-fish Hg concentrations throughout the region and to describe the environmental factors associated with observed spatial patterns across the region. Streams were located in urban, agricultural, and forested watersheds, and represented a variety of potential mercury sources. Total mercury (THg), assumed to be primarily methylmercury (MeHg), was analyzed in fish tissue collected from 91 streams. Small-bodied, mid-trophic, invertivorous fishes were collected from nearly every site, and game fish samples were collected from 54 of the sites. The most commonly collected mid-trophic level fishes collected were Blacknose Dace (*Rhinichthys atratulus*, 61 sites), Longnose Dace (*Rhinichthys cataractae*, 22 sites), and Creek Chub (*Semotilus atromaculatus*, 22 sites). These samples consisted of single-species composites of whole specimens. The most commonly collected game fish samples were salmonids (collected from 26 sites) and centrarchids (collected from 21 sites; mainly Micropterus and Lepomis species). Multiple mid-trophic level species and game fish species were collected at many sites, to facilitate spatial comparisons across the region. Fish and periphyton samples also were analyzed for nitrogen stable isotopes (15N) to provide estimates of base-adjusted trophic position (i.e. by adjusting fish 15N for differences among sites in base nitrogen signature). Fish Hg concentrations will be compared with human-health and wildlife-health guideline levels, and will be analyzed in relation to stream physical data (such as stage, temperature), water quality data (including pH and concentrations of dissolved organic carbon, sulfate, THg and MeHg), bed sediment THg, landscape characteristics, and food web characteristics (based on periphyton, macroinvertebrate, and fish community sampling data) to document factors affecting mercury bioaccumulation in stream-resident fish across the Northeastern United States.



# *Eastern ribbonsnakes and common gartersnakes in Vermont*

**James Andrews**[1,2]

[1]The Vermont Reptile and Amphibian Atlas
[2]The University of Vermont

The Eastern Ribbonsnake (*Thamnophis sauritus*) and the Common Gartersnake (*Thamnophis sirtalis*) are very similar in appearance and often confused, but once the appropriate field marks are learned, they are easy to tell apart in the field. The Eastern Ribbonsnake has a state heritage rank of S2, is a high priority species of greatest conservation need (SGCN) and is very limited in distribution within Vermont. The Common Gartersnake has a state heritage rank of S5 and is by far the most abundant and widespread snake in Vermont. Although historically reported from Grand Isle County and Shelburne Pond, the Eastern Ribbonsnake has not been documented from anywhere north of Rutland County in many decades. I will discuss the differences in appearance and habitat of these two species as well as historic and recent records. My hope is to generate more reports of Eastern Ribbonsnake in order to develop a better understanding of its current range and conservation status within Vermont.

**Gartersnake** **Ribbonsnake**

# *From Vermont to the Dominican Republic: Factors driving variation in apparent survival of Bicknell's Thrush on the breeding and wintering grounds*

**Jason M. Hill[1],** John Lloyd[1], Kent P. McFarland[1], and Chris C. Rimmer[1]

[1]Vermont Center for Ecostudies


To effectively conserve migratory species, we must understand the factors that drive year-round variation in demographic processes. Despite their status as a high conservation priority, fundamental questions remain regarding the processes that drive Bicknell's Thrush (*Catharus bicknelli*) populations. Bicknell's Thrush is a migratory songbird whose breeding range in the U.S. is restricted to chronically-disturbed montane forests of Balsam Fir (*Abies balsamea*) and spruce (*Picea spp.*) in four northeastern states. Bicknell's Thrush has one of the smallest breeding populations (~71,000) of North American passerines, 95% of the population occurs above 805 m, and >50% of that population occurs on just three public lands: White Mountain National Forest (NH and ME), Baxter State Park (ME), and the High Peaks Wilderness Area (NY). The majority of Bicknell's Thrushes are believed to overwinter in the Dominican Republic.

Using Cormack-Jolly-Seber (CJS) models, in a Bayesian framework, we explored how weather (including hurricanes), habitat loss and disturbance on the breeding and wintering grounds drive variation in apparent survival of adult Bicknell's Thrush. We used 15 years (2001-2015) of Bicknell's Thrush capture-mark-recapture data from Mt. Mansfield, Vermont. Variation in apparent survival was best explained by above-average temperature on the breeding grounds (May-July) in Vermont. Bicknell's Thrush were less likely to return to Mt. Mansfield following relatively warm breeding seasons. Apparent survivorship is driven by true mortality and permanent movement away from capture-recapture sites. Therefore, one possible explanation of this finding is that nesting success may be negatively affected by above-average temperatures, which in turn decreases adult site fidelity.

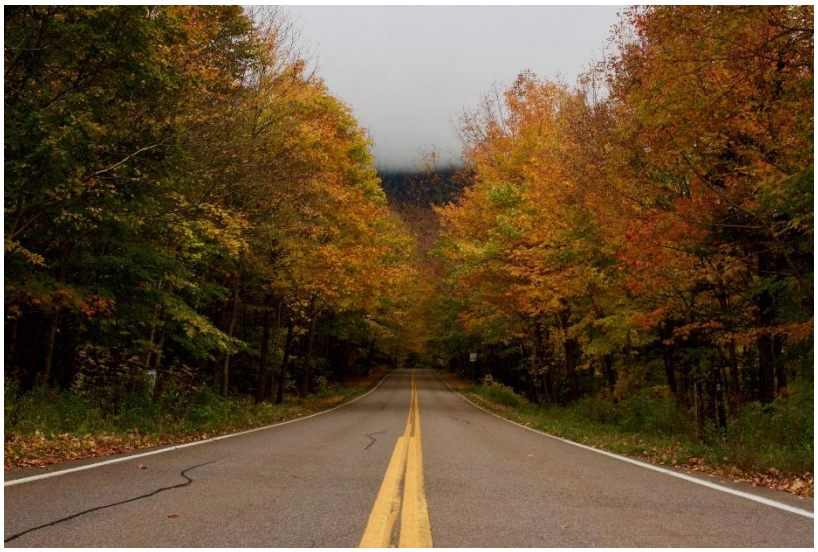
Surprisingly, annual deforestation rates in the Dominican Republic were not a strong predictor of Bicknell's Thrush apparent survival. Further, our results suggested that tropical storms and hurricanes were not associated with direct mortality of overwintering adult thrushes. Rather, our results indicated a delayed one-year boost in apparent survival following major storm system passage. Storms moving near or over the Dominican Republic during winter likely created areas of blowdown and disturbance. These areas of disturbance may result in improved foraging opportunities for thrushes in subsequent years.

Our results suggest that Bicknell's Thrush populations are driven by processes on both the breeding and wintering grounds. These findings illuminate numerous future avenues of research that may provide insight into the mechanisms driving Bicknell's Thrush inter-annual variation in abundance and survivorship.

# *How weather and other factors influence fall leaf color displays*

**Paul G. Shaberg**[1]

[1] USDA Forest Service



Vistas of colorful fall foliage hold tremendous public and media interest, and associated tourism is estimated to add billions of dollars to the regional economy each year. This natural spectacle of diverse leaf coloration is based on the physiology of leaf pigments. There are three primary pigments in tree leaves - green chlorophyll and yellow carotenoid pigments that are in leaves all growing season, and red anthocyanins that are newly produced in the leaves of some species (e.g., maples, ash, red oak, etc.) during autumn. The initial change in color associated with fall color development is the fading of chlorophyll to reveal yellow carotenoids that were always there but had been masked by green. This process is triggered by reductions in day length, but is greatly hastened by exposure to environmental stresses (e.g., drought or seasonal low temperatures) that can speed leaf senescence. Environmental stress is also associated with the production of anthocyanin pigments in the fall. Anthocyanins serve as protective compounds that may help leaves stay on trees longer and allow for greater sugar and nutrient resorption prior to leaf fall. Greater resource recovery from leaves before they abscise may benefit tree health and productivity in later growing seasons. The specific timing and intensity of leaf color displays depends on the interplay of environmental triggers that either speed up (e.g., drought and low temperatures) or slow down (e.g., ample precipitation and mild temperatures) chlorophyll breakdown and anthocyanin production. Several examples of how these processes can play out across the landscape will be provided.

# *Regional spatiotemporal patterns of forest disturbance using aerial detection surveys*

**Alexandra M. Kosiba[1,2],** Garrett W. Meigs[1,3,4], James A. Duncan[1,2], Jennifer A. Pontius[1,2,5], William S. Keeton[1,3], and Emma R. Tait[1,2]

[1]University of Vermont, Rubenstein School of Environment and Natural Resources, Burlington, VT
[2]Forest Ecosystem Monitoring Cooperative, South Burlington, VT
[3]University of Vermont, Gund Institute for Environment, Burlington, VT
[4]Oregon State University, College of Forestry, Corvallis, OR
[5]USDA Forest Service, Northern Research Station, Burlington, VT


Forest disturbances have significant influences on forest ecosystem composition, structure, and function, as well as carbon sequestration and other important ecosystem services. Recognizing the importance of monitoring forest disturbances, federal and state agencies in the United States (US) have conducted annual aerial detection surveys (ADS) to quantify the spatial extent and severity of forest disturbances. Although geospatial data have been collected for decades, they have not been compiled across the northeastern US to investigate interannual and cumulative disturbance patterns. Using 17 years of ADS data (2000-2016), a new disturbance mapping portal (the "Northeastern Forest Health Atlas") was created to investigate forest disturbances in New England and New York. Using this newly compiled database, we examined the spatiotemporal patterns of disturbance.

Our analysis indicated that approximately 11.0 million ha of forestlands in the study region (10%) have experienced at least one disturbance event over the 17-year period, averaging (+/-SE) 647,425 +/- 215,482 ha (3.4% +/- 1.1% of forestland) year-1. While there were no detectable temporal trends in total annual disturbance or relative amount of disturbance by agent, we found that some coastal ecoregions experienced higher disturbance rates than others (e.g., Acadian Plains and Hills and Atlantic Coastal Pine Barrens). Insects caused the greatest amount of mapped disturbance (8,097,969 ha), and a relatively small number of non-native introduced insects (19 species) were responsible for half of this damage. Within the region, we detected several "hotspots" with multiple disturbance events, with some of these experiencing as many as 12 years of disturbance in the 17-year record. Repeated disturbance by insects often co-occurred with other causal agents (typically abiotic), indicating that secondary stressors are important drivers of forest decline. Because climate change may alter the types, intensities, and frequencies of forest disturbance, quantifying baseline, historical patterns is critical for detecting shifts in disturbance dynamics and developing adaptive management alternatives.

# *Windstorm and salvage harvest in northern mixed deciduous forests change forest structure, but not plant community diversity or richness*

**Sarah Pears[1],** Kimberly Wallin[1, 2], Timothy Work[3]

[1]Rubenstein School of Environment and Natural Resources, University of Vermont, Burlington, VT
[2]USDA Forest Service Northern Research Station, Burlington, VT
[3]Departement des Sciences Biologiques, Universite Du Quebec, Montreal QC

Windstorms are the most important ecological disturbance in northeastern United States forests due to their frequency and intensity, and the severity of tree destruction they cause. In the wake of a windstorm that damages forest stands managers may salvage harvest, logging damaged trees to recover economic, recreational, aesthetic, or other values threatened by the destruction of existing forest conditions; however, ecological outcomes of post-windstorm salvage harvest in northern mixed deciduous forests are not well understood. We investigated impacts of a 2010 windstorm and subsequent salvage harvest in Vermont on forest structure and plant community. Data collected in 2014 indicates that forest structure was significantly different among stands that were not windthrown or recently harvested (reference), unharvested windthrown stands (windthrown), and salvage-harvested windthrown stands (salvaged). Reference and salvaged sites had significantly lower coarse woody debris abundance than windthrown sites; there was no difference in coarse woody debris abundance between control and harvested sites. Live tree basal area was significantly higher in control sites than both windthrown and salvaged sites. We found no significant differences in dead tree basal area between control sites and windthrown or salvaged sites, although dead tree basal area was lower in salvaged sites than windthrown sites with marginal significance. Plant community diversity, calculated as Shannon-Wiener diversity indices, and species richness were not different among treatments, although some individual plant species were favored by disturbance. These findings provide forest managers with clear evidence of short-term outcomes of post-windstorm salvage harvest in mixed deciduous forests.

# *Seventy years of northern hardwood silviculture: Long-term compositional and structural evolution after repeated group selection*

**Nicole S. Rogers**[1], Anthony W. D'Amato[1], W.B. Leak[2]

[1]University of Vermont, Rubenstein School of the Environment and Natural Resources
[2]USDA Forest Service Northern Research Station

Group selection is a widely applied uneven-aged management approach for northern hardwood forests in northeastern North America. Previous work has demonstrated that repeated application of group selection can provide diverse forest structure and composition, particularly an increased component of mid-tolerant species, relative to single-tree selection; however, outcomes from this approach have generally been discussed at the stand level and over short time frames. As such, there is limited understanding of within group dynamics and development over time.

Continuous application of group selection has occurred since the late 1930s at the US Forest Service Bartlett Experimental Forest in the White Mountains of New Hampshire providing a unique opportunity to examine the long-term impacts of group selection on forest structural and compositional conditions. In particular, mapping of historic group openings allowed for characterization of the evolution of individual cohorts in terms of changes in species composition, structure, and recruitment over extended time periods. Results synthesize over 70 years of measurements and demonstrate that behavior of individual cohorts follows patterns of development exhibited by even-aged stands, including early dominance by intolerant and mid-tolerant species. Additionally, analysis highlights emergent stand-level properties in terms of size structures and compositional conditions that are critical for landowners to consider as they weigh the benefits of applying this approach over long time frames. This is particularly important in the context of long-term forest dynamics and future uncertainty in environmental and management conditions.

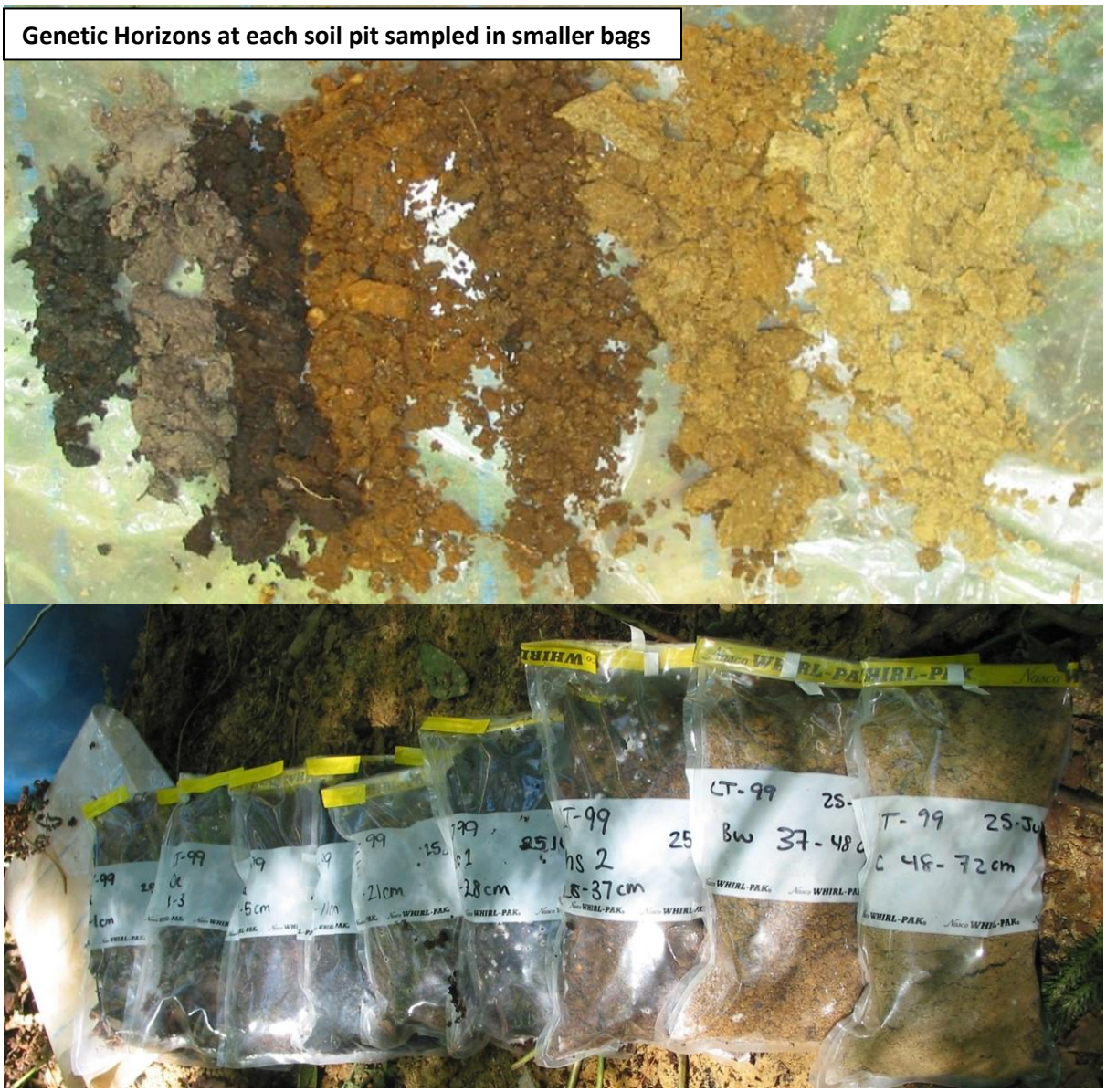
# *Update on Vermont long-term soil monitoring project*

**Thomas Villars**[1, 2], Don Ross[1, 2]

[1]USDA Natural Resources Conservation Service
[2]University of Vermont

The Vermont Long-term Soil Monitoring Project was founded in 1998. Initial sampling was done at each site in 2000, and 5 year incremental soil sampling was begun in 2002. Follow-up sampling has been carried out in 2007, 2012, and in 2017. This talk presents a brief overview of the project and highlights what has been learned in the nearly 20 year timespan of the project. It also will offer reflections on the challenges and opportunities facing the project in the future.

**Genetic Horizons at each soil pit sampled in smaller bags**

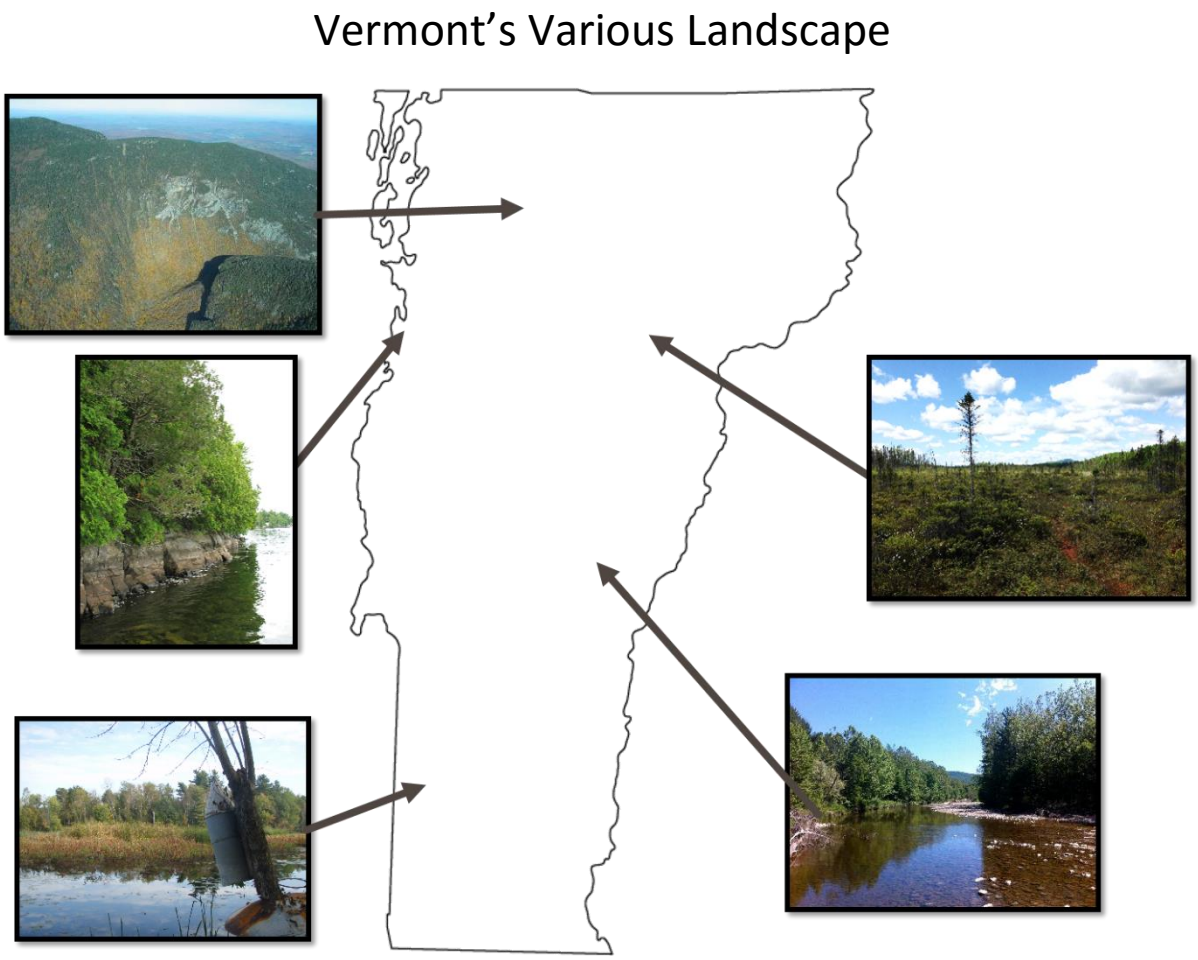


# *Ridges. Valleys, bedrock & soil: Using the physical landscape to conserve species in a changing climate*

**Bob Zaino[1],** Liz Thompson[2]

[1]Vermont Fish and Wildlife Department
[2]Vermont Land Trust

The physical landscape - the underlying "stage" of the natural landscape - plays a critical role in the expression of biological diversity. With climate change expected to scramble familiar species-habitat associations and rearrange natural communities, conserving diversity in the physical landscape will be increasingly important. Vermont Conservation Design, a comprehensive plan for an ecologically functional landscape, applied a new approach to incorporating physical features in conservation planning. By representing the full diversity of topography, aspect, elevation, and geology as part of a connected natural landscape, the design helps maximize opportunities for species to shift ranges and find suitable new settings in a changing climate. This can serve as a practical and efficient way to plan for long-term conservation of biological diversity.



# *Evaluating trends and environmental drivers of sugar maple and red oak growth in the state of Vermont*

**Rebecca L. Stern[1],** Paul G. Shaberg[2], Chris F. Hansen[1], Paula F. Murakami[3], Shelly A. Rayback[4], Gary J. Hawley[1]

[1]Rubenstein School of Environment and Natural Resources, University of Vermont, Burlington, VT, USA
[2]USDA Forest Service, Burlington, VT, USA
[3]USDA Forest Service, South Burlington, VT, USA
[4]Department of Geography, University of Vermont, Burlington, VT USA

Understanding how tree species in the Northern Forest have responded to anthropogenic factors such as climate change and pollution inputs in the past is critical for future ecological management, because experimental evidence indicates that these factors can significantly alter the health and productivity of some tree species. As part of a larger dendrochronology project examining how the woody growth of major tree species in the Northern Forest has changed over the last century, Northern red oak (*Quercus rubra L.*) and sugar maple (*Acer saccharum Marsh.*) growth is being examined to better understand the main drivers of productivity in these important species. Northern red oak is sparse yet widely distributed throughout the forest ecosystems of Vermont (VT), however, its habitat suitability and abundance are projected to increase as temperatures rise. Sugar maple, a major component of the northern hardwood forest, has exhibited declines in crown health and growth in recent decades-a trajectory that could threaten tourism, sugaring and other industries within the state.

We are quantifying changes in annual xylem increment growth of dominant and codominant red oak and sugar maple trees at multiple sites across different latitudes, aspects, and elevations throughout VT using standard dendrochronological techniques. Relative growth trends are being related to local- and elevationally-adjusted climate data (e.g., temperature and precipitation), regional and global climate indices and datasets (e.g., Standardized Precipitation-Evapotranspiration Index), and other environmental data (e.g., pollution inputs of sulfur and nitrogen) to assess their influence on species-specific productivity. Our final product will be models of growth based on the individual and/or interacting variables that best explain historical growth for each species. These models will inform projections of future growth assuming modeled changes in environmental growth drivers.

# *Factors affecting use of climate change science and decision support tools for forest management in Vermont*

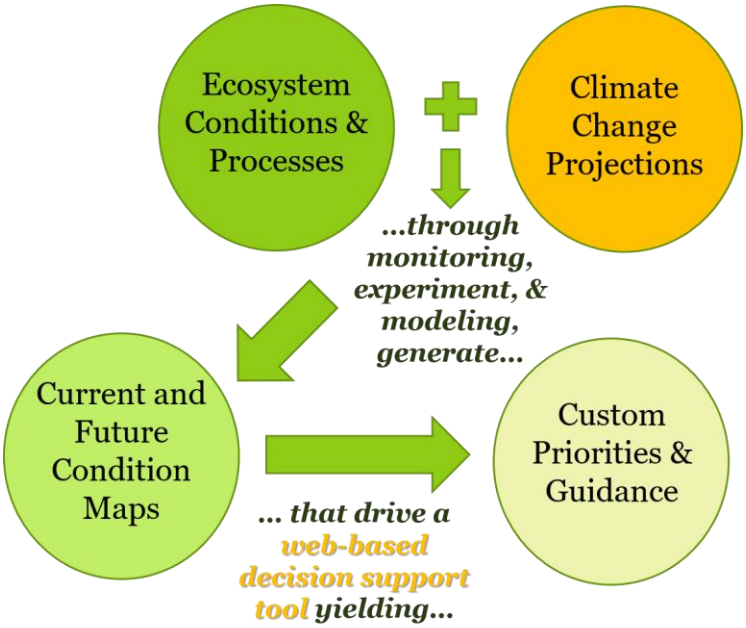
**Clare Ginger**[1], William Valliere[1], James Duncan[2]

[1]University of Vermont Rubenstein School of Environment and Natural Resources
[2]Forest Ecosystem Monitoring Cooperative

The US Forest Service has identified climate change as an important driver of landscape change, and a source of risk for forests and grasslands in the US. The Forest Health and Climate Research Group in the Rubenstein School at the University of Vermont is gathering data and developing models to assess the impacts of climate change on forest ecosystem health in the state of Vermont. In consultation with stakeholder groups, we are integrating these data into a spatially-structured decision support tool for forest management.

In this presentation, we ask: What are potential uses for climate change data and decision support tools in forest management decisions in Vermont? How do these vary by type of user? What factors may affect the use of climate change data and decision support tools? How do these vary by type of user?

**Conceptual Overview of Decision Tool**




To address these questions, we draw on information from transcripts of meetings with 18 individuals from 13 organizations (federal and state agencies, non-profit organizations, county foresters) in the state of Vermont, and selected organizational documents. We coded these materials for key themes related to potential uses of data and tools, and for factors affecting use of the tool. This presentation provides a comparative assessment among types of organizations related to these themes. It also considers how potential users of the data and tools can contribute to the development of tools. Finally, it reflects on the institutional context of the overall project and how it relates to the capacity to generate and provide data about climate change and related trends in forest health for use in forest management decisions.

# *Finding the sweet spot: Climate optimum for maple syrup production*

**Joshua Rapp[1,2],** David A. Lutz[3], Ryan D. Huish[4], Boris Dufour[5], Selena Ahmed[6], Toni Lyn Morelli[1,7], Kristina A. Stinson[1]

[1]Department of Environmental Conservation, University of Massachusetts Amherst
[2]Harvard Forest, Harvard University
[3]Environmental Studies Program, Dartmouth College
[4]Department of Natural Sciences, University of Virginia's College at Wise
[5]University du Quebec Chicoutimi
[6]Department of Health and Human Development, Montana State University
[7]United States Geological Survey

Maple sap collected for maple syrup production only flows when freezing temperatures are followed by a thaw. Since temperature fluctuations are most frequent in the fall and spring, maple syrup producers tap trees at these times, although mostly commonly in the spring when sap sugar content is higher. While the conditions that support daily sap flow have been studied at individual sites and are relatively well understood, the relationships between climate conditions (i.e. monthly average temperatures) and the tapping season over the entire range of sugar maple has not been described. Knowing how the timing and length of the tapping season, overall season-long sap flow, and sap sugar content are related to monthly mean climates would be useful for forecasting the maple syrup season at lead times of a few months to decades since monthly averages can be more reliably forecast at these time scales than daily weather fluctuations.

ACERnet (Acer Climate and Socio-Ecological Research Network) is collecting data at sites across the geographic range of sugar maple to describe the tapping season response to climate. At each of six sites ranging from sugar maples southern range limit in Virginia to its northern range in Quebec we have monitored sap flow and sugar content for up to 6 years. We used this data to describe climate responses for several metrics of tapping season timing, duration, and quality, and then used these relationships to create projections of the tapping season at the sample sites in the future. Here we report on these results, explore whether there is a climate optimum for maple syrup projection, and discuss how maple syrup production may change across the region of production in the future.

# *Climate effects on maple phytochemistry and producer perceptions and responses*

**Selena Ahmed[1], David Lutz[2],** Joshua Rapp[5], Ryan Huish[3], Boris Dufour[6], Debra Kraner, Toni Morelli[4], Autumn Brunelle, Kristina Stinson[5]

[1]Food and Health Lab, Montana State University
[2]Dartmouth College
[3]University of Virginia's College at Wise
[4]USGS - Northeast Climate Science Center
[5]University of Massachusetts Amherst
[6]University du Quebec Chicoutimi

Global environmental change is impacting forest and agricultural systems around the world and is presenting both challenges and opportunities for producer livelihoods, food resources, and consumer wellbeing. While studies have shown the impact of climate change on crop yields, research is needed to elucidate the effects of climate change on crop quality. This study uses sugar maple as a study system to examine the effects of global environmental change on crop quality and associated producer perceptions and responses. Specifically, we examine the influence of weather variables on maple sap quality as measured by phytochemicals in the eastern range of sugar maple in North America. These findings are presented alongside perceptions elicited through surveys with maple producers on climate change and its effects on the sugar maple system including sap quality. Lastly, findings are presented on maple producer responses to various climate scenarios.

# *What sap with that? A look at how Native Americans are adapting to climate change and maple sap production*

**Autumn Brunelle**[1], Selena Ahmed[2], Joshua Rapp[3], Aaron Ellis, David Lutz[4]

[1]Acer Climate and Socio-Ecological Research Network (ACERnet)
[2]Food and Health Lab, Montana State University
[3]University of Massachusetts Amherst
[4]Dartmouth College

Native American tribes in the midwestern and northeastern United States use maple syrup to continue cultural practices, and traditional teachings. Both Western and Non-Western cultures are discovering that sugar maple health is declining, and the tapping season has become more sporadic. Focus groups and one-on-one interviews with representatives from various tribes show that Native Americans are adapting to climate change in ways that are different from Western thought. Native Americans are practicing new ways to manage natural resources by considering their traditional belief of living with nature and concentrating on long-term solutions. Focusing on other culturally significant, sap producing species is one way that Native Americans are adapting. In Western culture, interviews show that businesses respond in ways that maximize profits over the short term by turning to advanced technology and redesigning products. Ultimately, Western response is panic whereas Native Americans are choosing to accept what nature has given them.

# *Ziizabokdoke: A cultural tradition of sugar making for one Midwestern tribe and seven generations of change*

**Bonnie Ekdahl[1], Alex Bryan[1]**

[1]Saginaw Chippewa Tribe

Ziizabokdoke, or making maple sugar, has been an enduring cultural tradition among Native Americans for countless generations. In fact, the colonists learned the art of sugar making from the natives! For one member of a tribe in the center of Michigan's Lower Peninsula, ziizabokdoke continues to be not only common practice, but a way of life that brings together the whole community. In this presentation, a sugarer from the Saginaw Chippewa Indian Tribe describes the traditional tools and practices that she and her ancestors have used and engaged in for generations, the annual celebrations she hosts with her family to honor the sugarbush and mark the sugaring season, the natural " signals" she relies on to cue steps along the tapping process, and how her product gets distributed amongst members of her tribe and its versatile utility – beyond a sweetener! Additionally, she will share a personal account of how ziizabokdoke has changed over recent generations, and concerns for the future of ziizabokdoke and the health of the sugar maple, as well as journaling she is doing to monitor these changes. The talk will conclude with an exploration of " seven generations" of change through the eyes of long-term weather records and climate models, including changes in the timing and duration of the traditional tapping season, as well as the predictability of the optimal tapping date, the conditions of previous seasons leading up to the tapping season that influence sap quality, and the timing of those natural signals that this native tapper depends on throughout the season.

# Image and Photo Credits

## *Cover Photo*

Blooming plant. 2017. Photo by John Truong, FEMC.

## *Introduction*

Tad Segal, keynote presentation. 2017. Photo by John Truong, FEMC.

## *Plenary Sessions*

**All photos from speaker presentations with the following exceptions:**

**The Short, Sweet and Engaging Story of Freshwater Mussels**

Yellow Lampmussel. March 14, 2016. Photo by Jeffrey Cole, USGS. Accessed from https://www.usgs.gov/media/images/yellow-lampmussel.

"Bridget Butler, Bird Diva" by Jack Rowell. Accessed from www.nature-museum.org (https://www.nature-museum.org/upcoming-events/2017/4/27/talk-bridget-butler-the-bird-diva)

Jamey Fidel. Photo by A. Blake Gardner. Accessed from Vermont Natural Resources Council website (http://vnrc.org/about-vnrc/staff/)

Julianna White. Accessed from Gund Institute for Environment, University of Vermont website (https://www.uvm.edu/gund/profiles/julianna-white)

Kent McFarland. 2017. Photo by John Truong, FEMC.

## *Summary of Working Sessions*

***Can we Manage the Impacts of Climate Change on Sugar Maple and Maple Sugaring?***

20120221-DSCF5263.jpg. February 21, 2012. Photo by Josh Rapp. Accessed from Flickr (https://www.flickr.com/photos/151875405@N07/32647049331/in/album-72157676438576404/) with consent on 01/09/2018.

20150328-IMG_0432.jpg. March 28, 2015. Photo by Josh Rapp, Accessed from Flickr (https://www.flickr.com/photos/151875405@N07/32617090882/in/album-72157676438576404/) with consent on 01/09/2018.

***Climate change and an ecologically functional landscape: How can we plan for and achieve conservation success?***

Trail in Hemlocks. 2017. Photo by John Truong, FEMC.

***Informing Policy – Expert testimony and Other ways to Engage with Lawmakers***

Panelists from Session. 2017. Jim Duncan, FEMC.

***Media Training for Scholars: Getting news coverage for science***

Basil Waugh Portrait. Accessed from Gund Institute for Environment, University of Vermont website (https://www.uvm.edu/gund/profiles/basil-waugh).

## *Contributed Abstracts Session*

**All photos from speaker presentations with the following exceptions:**

***How weather and other factors influence fall leaf color displays***

Fall on Notch Road, Stowe, Vermont. 2017. John Truong, FEMC.

***Imported Forest Pests: Science applied to policy***

Forest Tent Caterpillar on Branch. 2017. Kelsey Hamm.

***Bridging the Gap between Invasive Species Research and Management: Challenges and solutions in New York State***

NYISRI logo. 2015. Cornell University (www.nyisri.org).

***High-frequency water quality measurements reveal differences in storm hysteresis and loading in relation to land cover and seasonality***

Lake Champlain during storm. 2017. John Truong, FEMC.

***From Vermont to the Dominican Republic: Factors driving variation in apparent survival of Bicknell's Thrush on the breeding and wintering grounds***

Bicknell's Thrush Portrait. 2016. Kent McFarland.

***Windstorm and salvage harvest in northern mixed deciduous forests change forest structure, but not plant community diversity or richness***

Stanley Park. Photo by Hobvias Sudoneigh accessed from Flickr (https://www.flickr.com/photos/striatic/362062517) and licensed under Creative Commons BY 2.0 license (https://creativecommons.org/licenses/by/2.0/).

***Finding the sweet spot: Climate optimum for maple syrup production***

Maple Sap. Photo by eliudrosales accessed from Flickr (https://www.flickr.com/photos/29271939@N02/13292226944) and licensed under Creative Commons BY 2.0 license (https://creativecommons.org/licenses/by-nc-nd/2.0/).

***Climate effects on maple phytochemistry and producer perceptions and responses***

Sap Buckets. Photo by Brad Smith accessed from Flickr (https://www.flickr.com/photos/57402879@N00/426731051) and licensed under Creative Commons BY 2.0 license (https://creativecommons.org/licenses/by-nc/2.0/).

***What sap with that? A look at how Native Americans are adapting to climate change and maple sap production***

Little Maple Syrup Factories. Photo by David Marvin from Flickr (https://www.flickr.com/photos/74418101@N02/32584168464) and licensed under Creative Commons BY 2.0 license (https://creativecommons.org/licenses/by-nc-nd/2.0/).


*Providing the information needed to understand, manage, and protect the region's forested ecosystems in a changing global environment*

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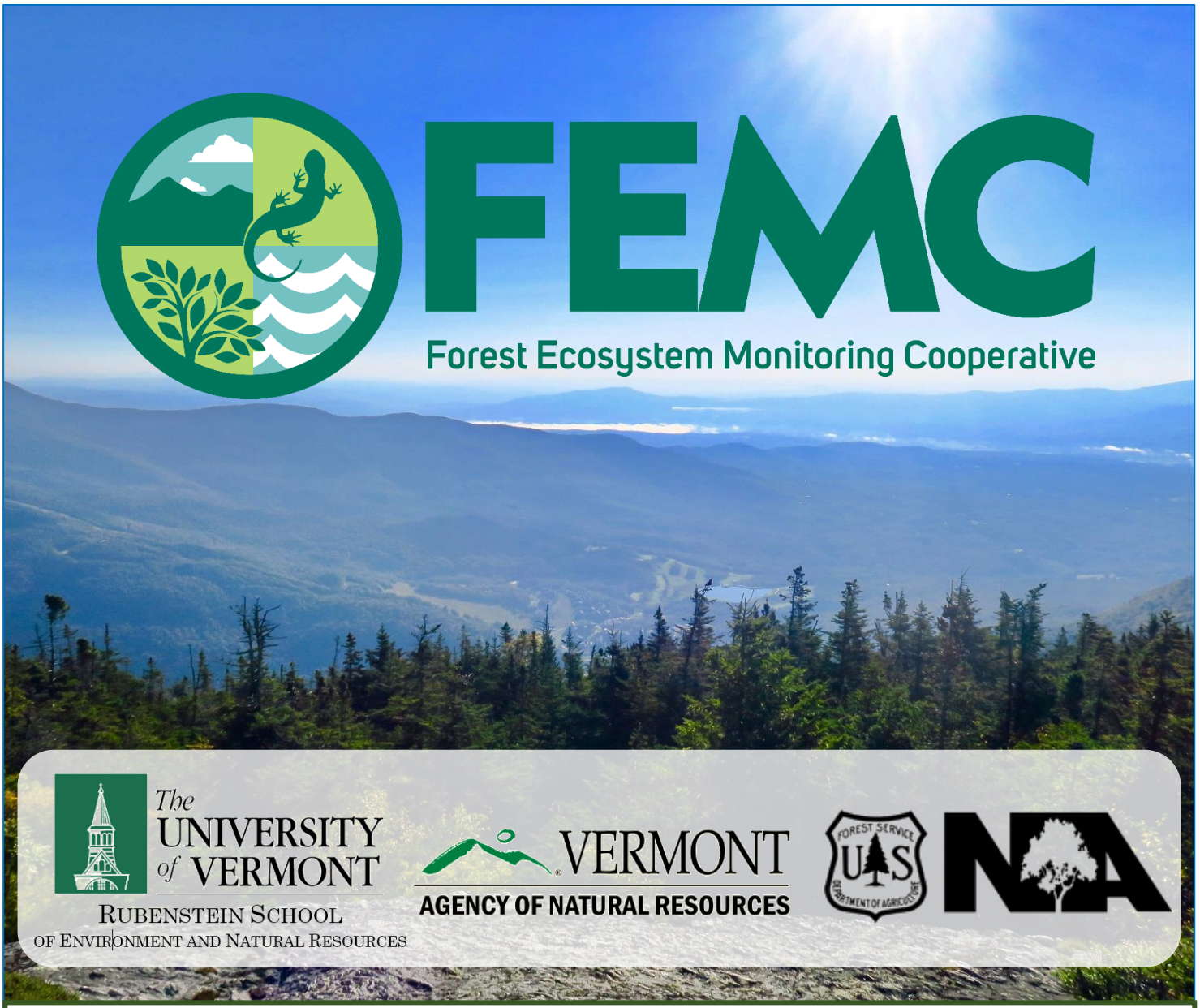
# Appendix: Agenda for 2017 Conference

For informational purposes, the agenda from the conference is reproduced on the following page. It is also available online at https://www.uvm.edu/femc/cooperative/conference/2017/agenda




## 2017 Forest Ecosystem Monitoring Cooperative Conference

# Beyond Communication: Advocating for Science and our Forests

**December 15, 2017 – Davis Center – University of Vermont**

# About the Forest Ecosystem Monitoring Cooperative

For over 25 years, the Forest Ecosystem Monitoring Cooperative (formerly the Vermont Monitoring Cooperative) has brought together practitioners from a range of disciplines and institutions to work together on monitoring and assessing forested ecosystems. The result is one of the largest and longest consistent records of forest ecosystem health in the country.

The primary mission of the FEMC is to "**is to serve the northeast temperate forest region through improved understanding of long-term trends, annual conditions, and interdisciplinary relationships of the physical, chemical, and biological components of forested ecosystems.**"

## *The History of the Forest Ecosystem Monitoring Cooperative*

Established in 1990 as a partnership among the USDA Forest Service, the State of Vermont Agency of Natural Resources and The University of Vermont (UVM), the mission of the Forest Ecosystem Monitoring Cooperative (FEMC) mirrors and builds upon the priorities of these partners and their counterparts in the larger region. The FEMC serves as a hub to facilitate collaboration among federal, state, non-profit, professional and academic institutions towards ongoing monitoring of forested ecosystems across the region and an improved understanding of forested ecosystems in light of the many threats they face. In May 2017, the Cooperative changed its name from the Vermont Monitoring Cooperative as new state partners began participating in the FEMC. The cooperative now includes significant partnerships in Maine, Massachusetts, New Hampshire and New York.

## *The Services of the Forest Ecosystem Monitoring Cooperative*

The FEMC staff supports the activities of a much larger network of actively engaged collaborators across governmental, academic, research and non-profit organizations. FEMC staff work with these collaborators to provide:

- Coordination and facilitation of monitoring and research activities across organizations, disciplines and state boundaries;
- Data support including: retrieval, archive, management, sharing, analysis and synthesis;
- Coordination and support of long-term ecosystem monitoring;
- Yearly syntheses of key ecosystem components, providing up-to-date assessments of current forest condition as well as long-term trends;
- An annual conference where ecosystem professionals come together for a day of sharing, learning and networking across disciplinary and organizational boundaries.

## *Getting Involved with the Forest Ecosystem Monitoring Cooperative*

Interested in getting involved? The FEMC has numerous committees and activities that could use your support, and we would love to hear from you! Contact Jim Duncan (james.duncan@uvm.edu) if you would like to learn more.

# About the 2017 Conference

This year, the theme for the conference is:

***Beyond Communication: Advocating for Science and our Forests***

2017 marks the 27th year of the Monitoring Cooperative and its first year as the Forest Ecosystem Monitoring Cooperative! This year's conference promises to deliver a dynamic array of talks and workshops designed to help collaborators build capacity to communicate and market their work to a broader stakeholder audience. This conference will help participants develop messages and share information in such a way that the public sees the value of forest ecosystem monitoring and research in our region and its relevance to their lives.

A **special thank you to our Conference Facilitators** Emily Drew, Alexandra Kosiba, Carolyn Loeb and Christian Schorn for their help in moderating our contributed talks sessions.

## Schedule at a glance

| | |
|---|---|
| 9:00 – 9:20 | Welcome |
| 9:20 – 10:00 | Keynote Presentation: Communicating for Impact |
| 10:00 – 10:25 | Successful Science Communication Flash Talks |
| 10:50-12:10 | Contributed Talks Session 1 |
| 12:10 – 1:20 | Lunch |
| 1:20 – 2:40 | Contributed Talks Session 2 |
| 3:00 – 4:30 | Working Groups |
| 4:30 – 5:30 | Poster Session and Social Hour |

# News from the Cooperative in 2017

**Forest Indicators Dashboard** giving easy-to-use scores and trends in nearly 20 key datasets to quickly summarize how our forests are doing https://www.uvm.edu/femc/indicators

**Regional expansion continues** with new state committee meetings and ongoing partner projects

**Northeastern Forest Health Atlas**, providing access to mapped disturbance data and field research dating back to 1918 for a 5-state region https://www.uvm.edu/femc/forest-health-atlas

**Building the best data management portal**, including additional features, data-driven applications, and member status in the DataONE network.

**Updates on 2016 data and long-term trends** in the FEMC Long-term Monitoring update, and expansion to other states with the FEMC Regional Monitoring Update https://www.uvm.edu/femc/products/long_term_update

**Increasing staff capacity** with Ali Kosiba as Project Coordinator, Mike Finnegan as Database/Web Developer and John Truong as Project/Field Coordinator

# Just a sample! Check out more of our work this year at the registration desk.

2017 was a busy year for FEMC, including work on both expanding the Cooperative membership and also developing new tools and analyses to improve assessment of forest ecosystem condition. Some highlights:

Cover Photo – “Mountain top” by John Truong

# Beyond Communication: Advocating for Science and our Forests

**9:00 to 5:30, December 15, 2017**

**Davis Center -- University of Vermont -- Burlington, VT**

## Agenda

**8:15 – 9:00** **Registration and Coffee** *(Livak Fireplace Lounge. Coffee and poster setup in Sugar/Silver Maple)*

**9:00 – 9:20** **Introduction and Welcome** *(Sugar/Silver Maple)*

**9:20 – 10:00** **Communicating for Impact – Keynote Presentation** *(Sugar/Silver Maple)*

**Tad Segal**, President and Founder of Outreach Strategies
Tad Segal is a senior communications and advocacy strategist specializing in complex campaigns impacting public policy on sustainability issues at the domestic and international levels. As a mission-driven organization, Outreach Strategies is engaged in some of the most exciting and innovative integrated media, stakeholder engagement and international education campaigns to protect our air, land and water both in the U.S. and around the world. With deep experience in a variety of environments, including large coalitions, agency, corporate and government settings, he specializes in complex communications campaigns that impact public policy on sustainability issues. His keynote will address the key frameworks and approaches used in advocating for science-based decision making.

**10:00 – 10:25** **Successful Science Communication** *(Sugar/Silver Maple)*

*5-minute flash talks demonstrating effective communication strategies and campaigns*

**The Short, Sweet and Engaging Story of Freshwater Mussels**
Mark Ferguson, Zoologist, Vermont Department of Fish and Wildlife

**So What? How to Grab & Hold People's Attention About Science**
Bridget Butler, Principal, Bird Diva Consulting

***Reaching Decision Makers: Using Science to Inform Policy***
Jamey Fidel, *General Counsel and Forest and Wildlife Program Director, Vermont Natural Resources Council*

***Science for impact? Know your audience***
Julianna White, University of Vermont Gund Institute for Environment, CGIAR Research Program on Climate Change, Agriculture and Food Security

**The Making of Outdoor Radio** Kent McFarland and Sara Zahendra (Vermont Center for Ecostudies) and Chris Albertine (Vermont Public Radio)

## 10:25 – 10:50 Plenary Wrap Up and Coffee Break *(Sugar/Silver Maple)*

## 10:50 – 12:10 Contributed Talks 1 *(Rooms listed below)*

*Learn about new and ongoing research, monitoring, conservation and outreach initiatives related to the forested ecosystem through several concurrent sessions of presentations.*

Abstracts are available at the registration desk.

### Contributed Talks Session 1 Schedule

| Time | Engaging Stakeholders and Influencing Forest Policy<br>*Moderator:* Alexandra Kosiba<br>*Room*: Silver Maple | Water Quality Assessments Across Scales<br>*Moderator*: Emily Drew<br>*Room*: Frank Livak | Trends and Patterns in Wildlife and Fisheries<br>*Moderator*: Carolyn Loeb<br>*Room*: Mildred Livak |
|---|---|---|---|
| **10:50 to 11:10** | Imported Forest Pests: Science Applied to Policy<br>*Gary M. Lovett* | Using LiDAR to Map Eroded Forest Roads in the Lake Champlain Basin, Vermont<br>*Sean MacFaden* | Eastern Ribbonsnakes and Common Gartersnakes in Vermont: One Rare and One Abundant<br>*Jim Andrews* |
| **11:10 to 11:30** | Bridging the Gap between Invasive Species Research and Management: Challenges and solutions in New York State<br>*Carrie Brown-Lima* | Dealing with Non-Detects: Using Censored Environmental Data Wisely<br>*Rebecca M. Harvey* | An Overview of Ongoing Moose Mortality and Productivity Research in Northern Vermont.<br>*Jacob R. DeBow* |
| **11:30 to 11:50** | The NSRC and FEMC as partners for a better future in the Northern Forest Lands<br>*William B. Bowden* | High-frequency water quality measurements reveal differences in storm hysteresis and loading in relation to land cover and seasonality<br>*Matthew C.H. Vaughan* | A Regional Investigation of Mercury in Small Mid-trophic Fishes and Predatory Game Fishes of Streams in the Northeastern United States<br>*Karen Riva Murray* |
| **11:50 to 12:10** | Effective Communication with a Municipal Audience<br>*Jens Hilke* | Water Quality Blueprint - Nature-Based Solutions for Clean Water in Lake Champlain<br>*Dan Farrell* | From Vermont to the Dominican Republic: factors driving variation in apparent survival of Bicknell's Thrush on the breeding and wintering grounds<br>*Jason M. Hill* |

## 12:10 – 1:20 Lunch *(Sugar/Silver Maple)*

## 1:20 – 2:40 Contributed Talks 2 *(Rooms listed below)*

Abstracts are available at the registration desk.

SPECIAL TRACK This track of talks connects to a working session and special collection of posters throughout the afternoon.

### Contributed Talks Session 2 Schedule

| Time | Forest Ecology and Silviculture<br>*Moderator:* Alexandra Kosiba<br>*Room*: Mildred Livak | Environmental Change and Long-Term Monitoring<br>*Moderator*: Christian Schorn<br>*Room*: Jost | SPECIAL TRACK Can We Manage the Impacts of Climate Change on Sugar Maple and Maple Sugaring?<br>*Moderator*: Toni Lyn Morelli<br>*Room*: Frank Livak |
|---|---|---|---|
| **1:20 to 1:40** | How weather and other factors influence fall leaf color displays<br>*Paul G. Schaberg* | Update on Vermont Long-term Soil Monitoring Project<br>*Thomas Villars, Don Ross* | Finding the sweet spot: Climate optimum for maple syrup production<br>*Joshua Rapp* |
| **1:40 to 2:00** | Regional spatiotemporal patterns of forest disturbance using aerial detection surveys<br>*Alexandra M. Kosiba* | Evaluating trends and environmental drivers of sugar maple and red oak growth in the state of Vermont<br>*Rebecca L. Stern* | Climate Effects on Maple Phytochemistry and Producer Perceptions and Responses<br>*Selena Ahmed and David Lutz* |
| **2:00 to 2:20** | Windstorm and salvage harvest in northern mixed deciduous forests change forest structure, but not plant community diversity or richness.<br>*Sarah Pears* | Ridges, Valleys, Bedrock & Soil: Using the Physical Landscape to Conserve Species in a Changing Climate<br>*Bob Zaino and Liz Thompson* | What Sap with That?: A look at how Native Americans are Adapting to Climate Change and Maple Sap Production.<br>*Autumn Brunelle* |
| **2:20 to 2:40** | Seventy years of northern hardwood silviculture: long-term compositional and structural evolution after repeated group selection<br>*Nicole S. Rogers* | Factors Affecting Use of Climate Change Science and Decision Support Tools for Forest Management in Vermont<br>*Clare Ginger* | Ziizabokdoke: A cultural tradition of sugar making for one Midwestern tribe and seven generations of change<br>*Bonnie Ekdahl and Alex Bryan* |

## 2:40 – 3:00 Coffee Break *(Silver Maple)*

## 3:00 – 4:30 Workshops *(Rooms listed below)*

*Revisit the science communication and advocacy topics from the morning plenary to learn more techniques, hone skills or learn from experts in the field. Descriptions of sessions can be found below.*

**SPECIAL TRACK** Can We Manage the Impacts of Climate Change on Sugar Maple and Maple Sugaring?
*Organizer*: Toni Lyn Morelli, DOI Northeast Climate Science Center and University of Massachusetts
*Room*: Frank Livak Ballroom

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Climate Change and an Ecologically Functional Landscape: How Can We Plan for and Achieve Conservation Success?
*Organizers*: Bob Zaino (Vermont Fish and Wildlife), Eric Sorenson (Vermont Fish and Wildlife), and Liz Thompson (Vermont Land Trust)
*Room*: Sugar Maple Ballroom

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Informing policy: How scientists can engage with lawmakers
*Roundtable Participants:* Rebecca Ellis, Jamey Fidel, Neil Kamman, David Mears
*Organizer*: Joanne Garton, Vermont Department of Forests, Parks and Recreation
*Room*: Jost Foundation Room

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Media Training for Scholars: Getting News Coverage for Science
*Organizer*: Basil Waugh, Gund Institute for the Environment, University of Vermont
*Room*: Chittenden Bank Room

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Stakeholder Engagement in Research and Results
*Organizers*: Julianna White (Gund Institute for Environment and CGIAR) and Bridget Butler (Bird Diva Consulting)
*Room*: Williams Family Room

## 4:30 – 5:30 Poster Session and Social *(Silver Maple)*

*Enjoy conversation and over 28 posters and demonstrations at the end of the day. Poster titles are listed at the end of the agenda.*

**SPECIAL TRACK** Includes posters in the special track "Can We Manage the Impacts of Climate Change on Sugar Maple and Maple Sugaring?"

# Working Group Descriptions

SPECIAL TRACK **Can We Manage the Impacts of Climate Change on Sugar Maple and Maple Sugaring?**

**Organizer:** Toni Lyn Morelli, DOI Northeast Climate Science Center and University of Massachusetts

This special track of talks, posters, discussion, and scenario planning throughout the afternoon will bring together researchers and collaborators from state and federal agencies, tribal partners, and private industry (including you!) from around the region to learn and discuss "Can We Manage the Impacts of Climate Change on Sugar Maple and Maple Sugaring?". The tapping of maple trees is a cultural touchstone for many people in the northeast and Midwest and Native American tribes have collected and boiled down sap for centuries. Because the tapping season is dependent on weather conditions, there is concern about the sustainability of maple sugaring as climate changes throughout the region. In addition, Northern Hardwood species like sugar maple are expected to contract their range northward eventually. In spite of this, maple syrup production is increasing rapidly, with demand rising as more people appreciate this natural sweetener. The ACERnet team of researchers from across the US and Canada will present on research earlier in the afternoon that has been funded through the Department of Interior Northeast Climate Science Center to address the impact of climate change on syrup quality, tapping timing, and maple distribution. Informed by the needs of state and federal resource managers, tribal groups, and other maple syrup producers, the research team has analyzed how climate variation and climate change is impacting the chemical composition of sap throughout the northeast region. They will also present on climate change adaptation options, including the potential use of less climate-sensitive red maples as alternatives to sugar maple.

This Working Group session will discuss climate adaptation options, for managers and producers to share insights and strategies, and to use scenario planning to brainstorm on what maple sugaring will look like in the future.

Following the working session, we will have a Poster session focused on the impacts of climate change on the culture and ecology of sugar maple - relevant contributions welcome.

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## Climate Change and an Ecologically Functional Landscape: How Can We Plan For and Achieve Conservation Success?

**Organizer:** Bob Zaino (Vermont Fish and Wildlife Department), Eric Sorenson (Vermont Fish and Wildlife Department), and Liz Thompson (Vermont Land Trust)

In 2015, the Vermont Fish and Wildlife Department and Vermont Land Trust produced "Vermont Conservation Design: Maintaining and Enhancing an Ecologically Functional Landscape." This effort identified the highest priority forest blocks, and surface waters and riparian areas needed to sustain the state's biological diversity into the future. We'd like to use this work, and other recent regional conservation planning efforts as a jumping off point for a wide-ranging discussion about the science and implementation of conservation planning. Questions include: Is the concept of an ecologically functional landscape the right one for dealing with climate change adaptation and evolution? How do we know if a landscape is self-adapting to climate change, and when do we intervene in species migration and natural community dynamics? What types of monitoring and assessment are needed to recognize success? How do we take dispersed conservation ideas, plans, and organizations and build towards a coherent whole? And, even if the science is right, how do we get large-scale conservation done? How do we overcome societal constraints? How can we use scientific conservation planning efforts to create a positive vision of people living within an ecologically functional landscape?

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# Working Group Descriptions Continued

## Informing Policy – expert testimony and other ways to engage with lawmakers

**Organizer:** Rebecca Ellis, Jamey Fidel, Joanne Garton, Neil Kamman, David Mears

Join a diverse group of environmental leaders and decision makers to explore how and why science informs policy in today's information-rich government. This discussion will mine the experiences of our roundtable participants as public officials, environmental advocates, legislators, and educators, touching upon the varied techniques and strategies that successfully communicate important research findings to broad audiences.

**Panelists:**

**Rebecca Ellis**, Deputy Commissioner, Vermont Department of Environmental Conservation
**Jamey Fidel**, General Counsel & Forest and Wildlife Program Director, Vermont Natural Resources Council
**Neil Kamman**, Senior Policy Advisor, Vermont Department of Environmental Conservation
**David Mears**, Director, Environmental Law Center, Vermont Law School

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## Media Training for Scholars: Getting News Coverage for Science

**Organizer:** Basil Waugh, Gund Institute for the Environment, University of Vermont

Garnering news coverage for your scientific efforts can amplify the impact and recognition of your work. Tailored for researchers, this media training presentation will help scholars and scientists to understand 1) what makes news, 2) key elements of successful media outreach, 3) and how to stay in control of interactions with journalists.

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## Stakeholder Engagement in Research and Results

**Organizer:** Julianna White and Bridget Butler

After discussing successful examples of engaging the public in our results, participants will examine how to 1) involve stakeholders in their own research (stakeholder mapping, planning for involvement) and 2) engage stakeholders with research results (verbal and visual messages, strategies). This will be an interactive session; participants will share ideas, provide feedback, and hone messages.

# Poster Titles and Presenters

***Abstracts available online -*** *https://www.uvm.edu/femc/cooperative/conference/2017/agenda*

**SPECIAL TRACK** (Re)expansion of the maple syrup industry in New England: projecting where the taps will be in a changing environment
Presenter: Joshua Rapp, *Harvard Forest*

An Investigation of Nutritional Effects On Beech Bark Disease Causal Organisms
Presenter: Gretchen Lasser, *Department of Forest and Natural Resources Management, SUNY-ESF*

**SPECIAL TRACK** Assessing a strategy of climate change adaptation for maple syrup producers in the Southern Appalachians: Diversification of maple species as sap sources.
Presenter: Ryan Huish, *The University of Virginia's College at Wise*

**SPECIAL TRACK** Battle of the Babies: Beech Interference with Maple Regeneration
Presenter: Daniel S. Hong, *SUNY-ESF*

Citizen Science in Action: 15 Years of the LaRosa Partnership Program
Presenter: Elijah Schumacher/ Jim Kellogg, *DEC WSMD*

Earthworm Cocoons: The Cryptic Side of Invasive Earthworm Populations
Presenter: Maryam Nouri-Aiin, *Department of Plant and Soil Science, University of Vermont*

Effects of Human Visitation on Mammals as Detected by Trail Cameras in Colchester, Vermont
Presenter: Jade Jarvis, *Biology Student Saint Michael's College*

**SPECIAL TRACK** Effects of Long-Term Nutrient Addition on Acer saccharum Sap Flow
Presenter: Alexandrea Rice, *SUNY ESF, 1 Forestry Drive, Syracuse, NY 13210*

Effects of woody shrub and tree density on species richness and habitat preference
Presenter: Alyssa Valentyn, *Saint Michael's College*

Forest Health Indicators Dashboard: Assessing the condition of forested ecosystems
Presenter: Jennifer Pontius, *RSENR University of Vermont and USFS Northern Research Station*

**SPECIAL TRACK** Future distribution of sugar-maple dominated forests on the Green Mountain National Forest under climate change
Presenter: Anthony W. D'Amato, *University of Vermont, Rubenstein School of Environment and Natural Resources; Department of Interior Northeast Climate Science Center*

Hydraulic safety margins and air-seeding thresholds in roots, trunks, branches, and petioles of four northern hardwood trees
Presenter: Brett A. Huggett, *Bates College*

Is gene flow extensive and inhibiting adaptation of red spruce (Picea rubens) along an elevational gradient?
Presenter: Brittany M. Verrico, *Dept. of Plant Biology, University of Vermont, Burlington, Vermont, USA*

**SPECIAL TRACK** Maple syrup in a changing climate
Presenter: Joshua Rapp, *Harvard Forest*

Monitoring the Health of Vermont's Forests: Long-Term Trends and Natural Communities
Presenter: Caroline Drayton, Forest Ecosystem Monitoring Cooperative, RSENR

## Poster Titles and Presenters Continued

Northeast Forest Information Source (NEFIS): A New, Open-Access, Online Portal for Research Related to the Northern Forest
Presenter: Meg Fergusson, *Center for Research on Sustainable Forests (CRSF) at the University of Maine*

Northeastern States Research Cooperative: Research Project Impacts
Presenter: Shari Halik, *University of Vermont*

ourVTwoods.org Outreach Display
Presenter: Kate Forrer, *UVM Extension*

Putting an Ear to the Ground: Monitoring the Impacts of Climate Change on Working Forests
Presenter: Jennifer Hushaw, *Applied Forest Scientist, Climate Services Program, Manomet, Inc.*

**SPECIAL TRACK** Qualitative Contributions to Climate Adaptation: Living History and Knowledge of the Sugar Maple
Presenter: Lena Wilson, Allissa Stutte, Devon Brock-Montgomery, *Red Cliff and Bad River Bands of Lake Superior Chippewa*

Soil Nutrients Effect on Fall Leaf Retention in Northern Hardwood Forests.
Presenter: Madison Morley, *State University of New York College of Environmental Science and Forestry*

**SPECIAL TRACK** Specific leaf area and amino acids vary within sugar maple canopies and across fertilization treatments
Presenter: Alexander, *SUNY-ESF*

The "Future Forests Geo-visualization and Decision Support Tool": Linking science and management in a geospatial, mutli-criteria structured decision support framework
Presenter: Jennifer Pontius, *UVM and USFS NRS*

The effect of acid-mine drainage on the diversity of sensitive species of macroinvertebrates in two branches of a Vermont stream
Presenter: Mariah J. Witas, *Saint Michael's College*

The Nature Conservancy Dam Screening Tool
Presenter: Shayne Jaquith, *The Nature Conservancy*

**SPECIAL TRACK** The Northeast Climate Science Center: Improving the way climate science informs resource management
Presenter: Toni Lyn Morelli, *U.S. Geological Survey, Department of Interior Northeast Climate Science Center*

The Power of Collaboration: Building Relationships and Fostering Public Support
Presenter: Elizabeth Spinney, *Vermont Department of Forests, Parks & Recreation*

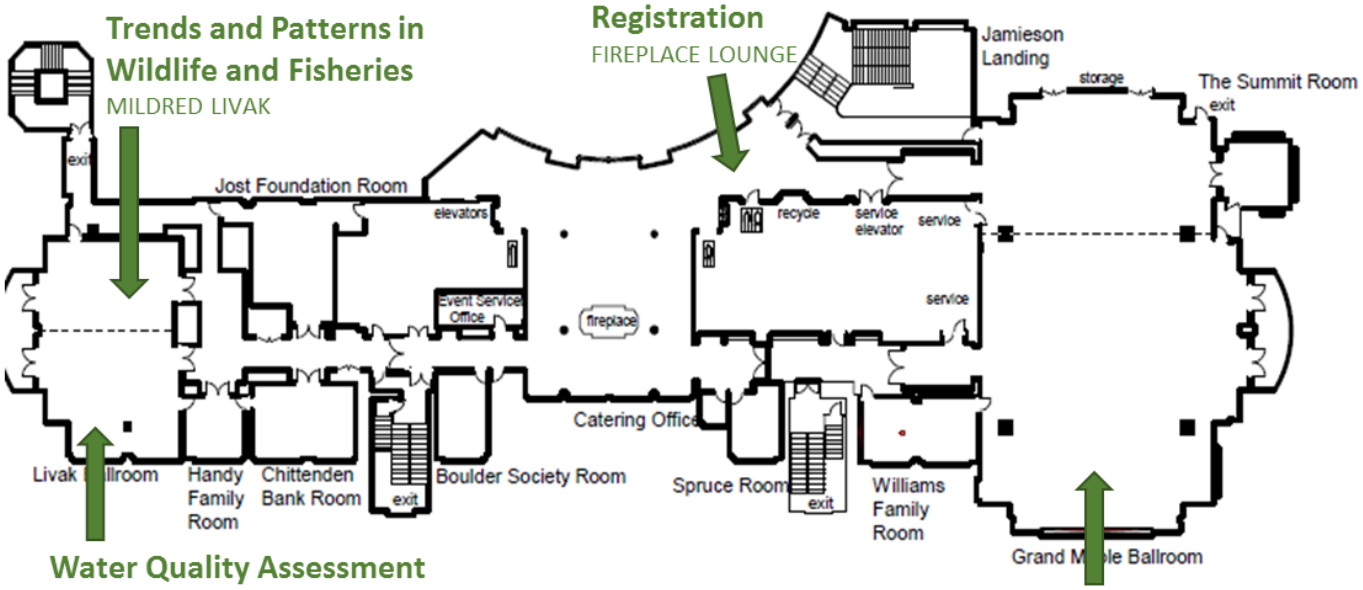
Water Quality Blueprint - Nature-Based Solutions for Clean Water in Lake Champlain
Presenter: Dan Farrell, *The Nature Conservancy of Vermont*

Xylem-vessel networks and drought resistance in northern hardwood trees

Presenter: Jay Wason, *Yale School of Forestry & Environmental Studies*

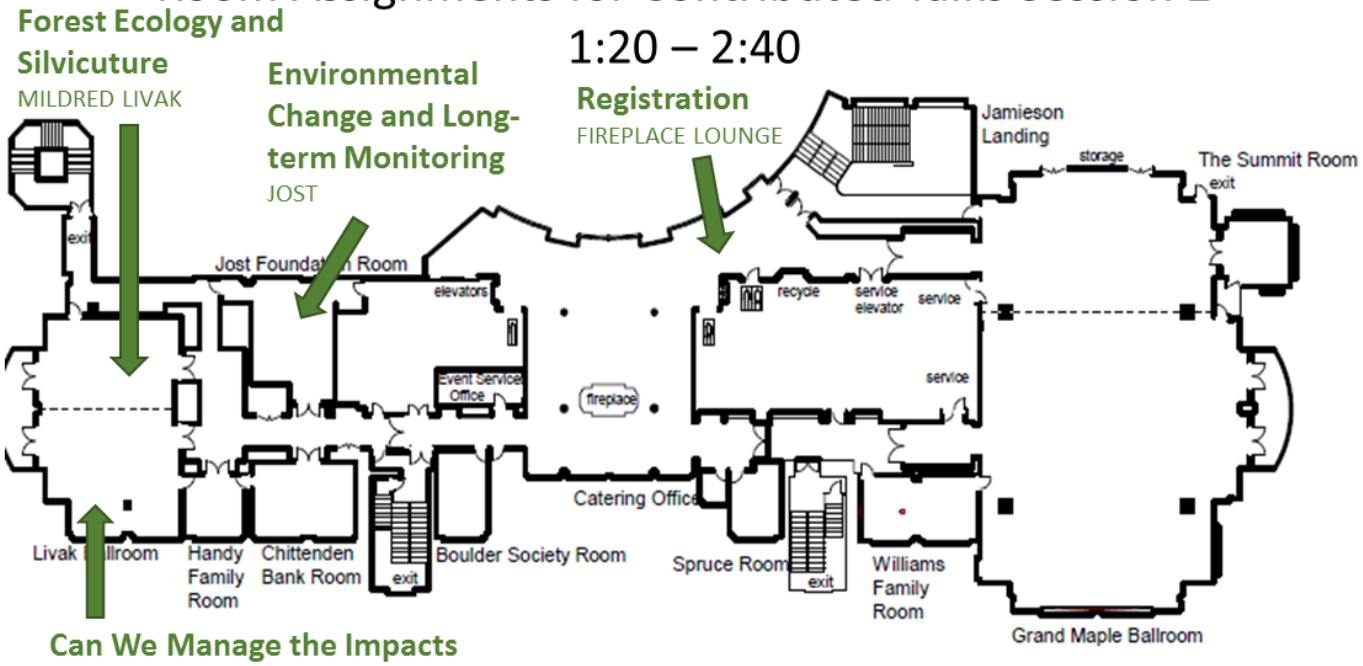
# Room Assignments for Contributed Talks Session 1

## 10:50 – 12:10




# Room Assignments for Contributed Talks Session 2

## 1:20 – 2:40



# Room Assignments for Working Groups and Poster Session
# 3:00 – 5:30