EMERGING TRENDS
Five Themes of the Northern Hardwood Conference

In August 2023, the NHRI hosted a dynamic 3-day conference in Fredericton focusing on the management of northern hardwood forests. In the early planning stages of the **Northern Hardwood Conference**, careful consideration was given to decide on the program theme. The overarching theme of "leveraging technology and digitalization of the value chain" was chosen initially, but we wanted our audience to know this was not solely a technology conference. Silviculture research, hardwood management, climate change, and wildlife and ecological management are all central to northern hardwoods management. As one example, without research on technology and climate change, we wouldn't have improvements in our management of hardwoods, ecology, or wildlife. It is all connected.

On day 1 of the conference, we hosted three concurrent workshops; option 1 was a series of technology workshops, option 2 an industry showcase and lightning research round, and option three was a hands-on silviculture mix.

Day 2 featured multiple concurrent sessions for a full scientific conference day. There was a mix of all five themes with presenters representing the scientific community and industry alike. In fact, the comment we heard most was that participants wished they did not have to choose one presentation over another.

Day 3 was a full field day where we explored the NHRI silviculture prescription system at multiple recent harvest sites and saw technology demonstrations during a great lunch break.

The following five articles, presented by five of our researchers/partners, feature some highlights for each theme and how they connect to northern hardwoods and our work. At the end of each article, we summarize the emerging priorities, research gaps, and further challenges facing northern hardwoods management from what we learned of the presentations as well as feedback from the **post-conference survey**.

EMERGING TRENDS
Five Themes of the Northern Hardwood Conference

TECHNOLOGY

by Bastien Vandendaele, Researcher at NHRI

The conference showcased technology as one of its central themes, exploring various subjects during engaging workshops, enlightening scientific sessions, and an engaging field day. The event was a resounding success, drawing attention to the imperative need for the forestry sector to embrace digitalization to effectively tackle the forthcoming challenges, optimize resource management, and ensure sustainable practices. One common theme was the need for standardization of data and systems to meet a forestry business perspective. As outlined during the presentation delivered by Jason Killam, Chief Forester at J.D. Irving, Ltd., data and systems have to be aligned with management objectives, and not the other way around.

Among the diverse topics, "**Digital Timberland**" discussions were popular, highlighting the potential of cutting-edge remote sensing techniques such as photogrammetry and LiDAR to revolutionize forestry practices. The event also delved into groundbreaking areas, such as the optimization of bucking techniques in cut-to-length operations, where technology can streamline processes and boost efficiency. Additionally, it shed light on the digitalization of trees for precision forestry using **LiDAR**, encompassing both mobile and UAV-based applications.

The power of Artificial Intelligence (AI) took the stage, with **CERFO's presentation** on AI-driven species recognition using Sentinel-2 and Planetscope satellite imagery. Discussions also revolved around leveraging digital transformation for reactive operational planning, showcased by **Remsoft** and Groupe Savoie.

A stimulating field day took participants into the heart of the AV Group NB Ltd. forests, where participants had the opportunity to brainstorm about the complexity of hardwood forest management and gain insights into cutting-edge technologies that have the potential to support the sector. As such, UAV capabilities were showcased by **SDF Solutions** in large surface area surveys, while A.L.P.A. Equipment's sophisticated track harvester impressed the attendees. The event also introduced a harvester simulator designed for the training of field staff.

In essence, the Fredericton conference strongly emphasized that technology is a key factor that will reshape the future of forestry. One notable challenge the forestry sector is facing is the declining number of field staff interested in forest inventory careers. Here, technology may step in as a solution. By shifting data collection from purely field-based to a combination of field and office-based approaches, the sector aims to attract a new generation of tech-savvy forest technologists. Through the integration of digital tools, training, and innovative approaches, the sector can overcome challenges, optimize practices, and pave the way for a sustainable future.

TECHNOLOGY

EMERGING TRENDS

Managing variable data quality	Optimizing bucking
Slow progress on system/data integration	Value chain digitization
Finding the right ICT partners	AI

RESEARCH GAPS

Adding value via digitization of the value chain	AI and technology training
Analytical tools for regeneration forecasting	Standardizing data capture for business
Standardizing forestry specific software/hardware	

RELATED PRESENTATIONS

Hugues Power, Ph.D.

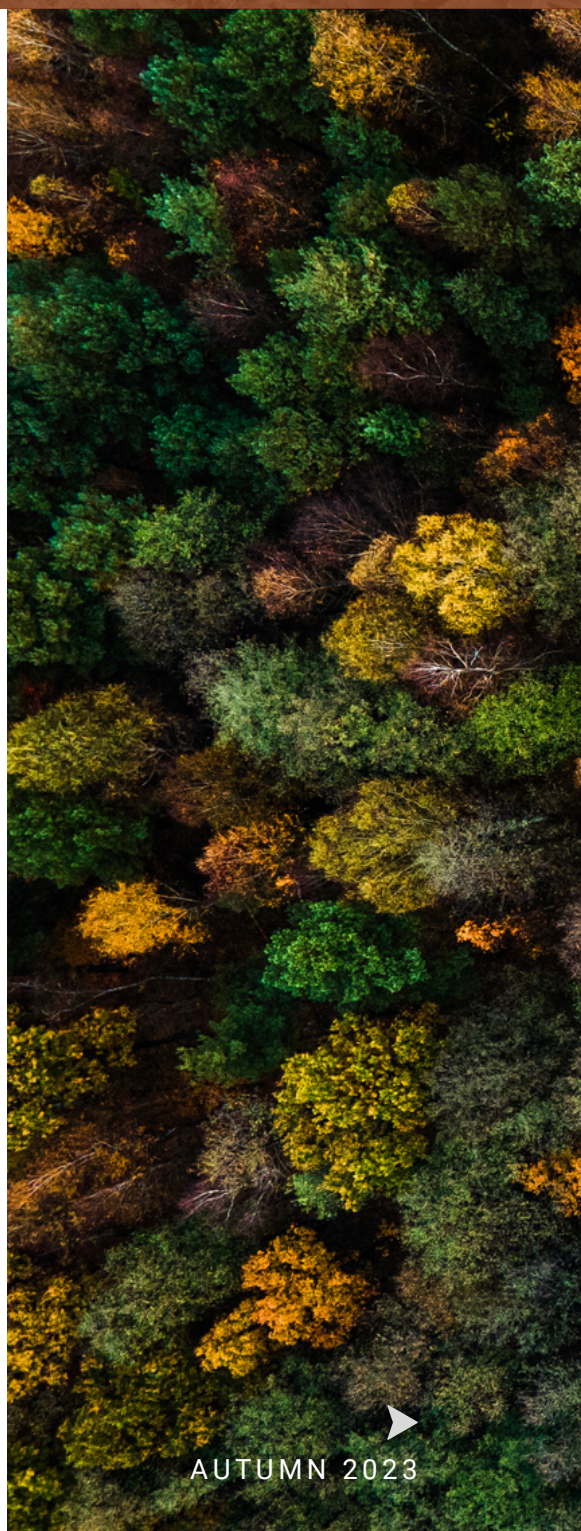
Fabian Ewald Fassnacht, Joanne C.White, Michael A.Wulder and Erik Næsset

SILVICULTURE RESEARCH IN NORTHERN HARDWOODS

by Regina Smith, Program Manager, Cooperative Forestry Research Unit

Laura Kenefic, Ph.D., is a Research Forester and Team Leader for the U.S. Forest Service based out of the Northern Research Station in Bradley, Maine. She has decades of experience with the CFRU as a research scientist and is a valued member of our advisory committee. The CFRU is currently supporting her work to create a new silvicultural mixedwood management guide for Maine and beyond.

Kenefic's decades of silvicultural expertise have garnered attention and collaboration from researchers and practitioners in the Northeast and beyond. Her recent work has been in collaboration with a group of researchers from across the eastern United States and Canada who call themselves the Mixedwooders, specializing in mixedwood management and ecology. **Kenefic** presented some of her team's most recent work and findings related to managing mixedwood forests at the NHC. Mixedwood is a forest condition of hardwood and softwood where neither component is greater than 75-80% of the basal area and are often a result of site disturbances (harvesting, windthrow, insect outbreaks). Mixedwood forests have a plethora of benefits including market flexibility for product demands, reduced susceptibility to insects and diseases, potential for carbon sequestration, and wildlife habitat diversity. Kenefic's current work seeks to address how to keep different types of mixedwood forests, mixed through management.



Composition can vary over time and mixedwood forest types tend to move to a hardwood-dominated composition following repeated or heavy harvesting. During her NHC presentation, Strategies for Managing Compositionally Degraded Mixedwood Stands, Kenefic pointed to "limiting species" as a common issue in mixedwood management. These are often species that can be difficult to regenerate and recruit in the understory due to depleted seed sources from logging history, competition, and narrow regeneration requirements. These include softwoods like red spruce and hardwoods like yellow birch. Silvicultural solutions for maintaining the balance of hardwoods and softwoods in mixedwood stands depend on managing stand structure and composition at each entry. For limiting species solutions may include maintaining seed source trees, creating suitable conditions for seedling establishment where absent, enrichment planting, and releasing desired species during the recruitment phase.

Fig. 2.

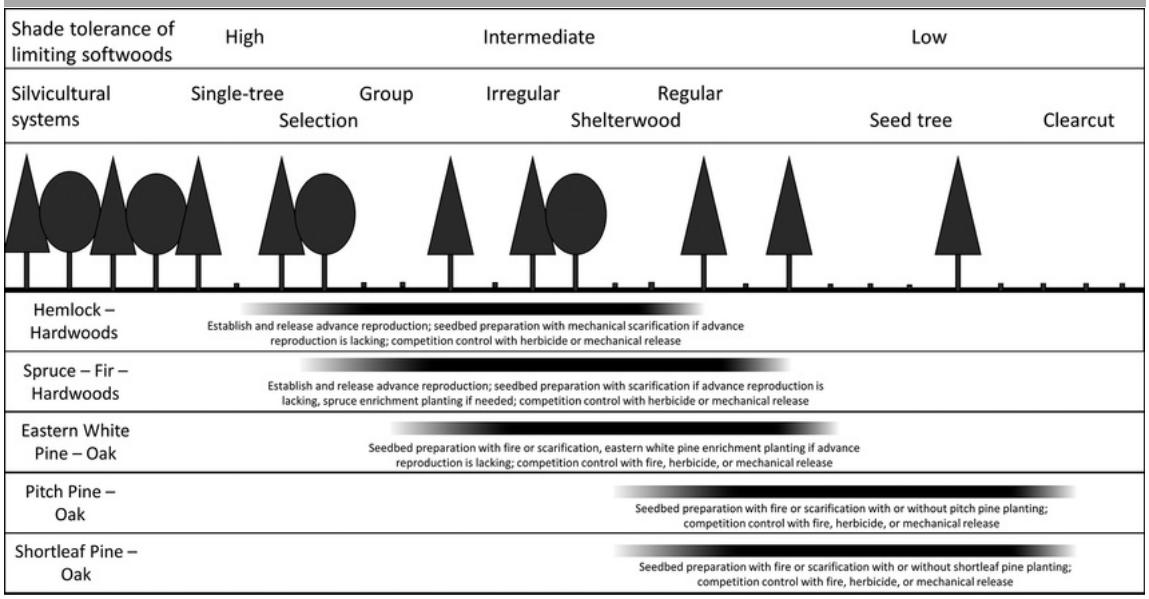


Fig. 2. Conceptualization of silvicultural systems for maintaining limiting species in five mixedwood compositions, with additional treatment considerations for regeneration and recruitment.

Kenefic and her team are currently developing a Temperate Mixedwood Management Guide. The Guide will be submitted to the U.S. Forest Service for publication and to the Quebec Ministry of Forests, Wildlife, and Parks for translation and publication and is anticipated to be completed in June of 2026. You can read more about her work in the **Canadian Journal of Forest Research**.

SILVICULTURE RESEARCH IN NORTHERN HARDWOODS

EMERGING TRENDS

- Limiting species
- Stand degradation
- Regeneration limitations
- Management practices changing away from STS/USS
- Causes behind poor regeneration (herbivores, climate change, disease/pests, past management)

RESEARCH GAPS

Limiting species identification	Finding complicating factors
Maintaining seed sources	Controlling (sub)merchantable competition
Manipulating regeneration substrate/microclimate	

RELATED PRESENTATIONS

Simon Bilodeau-Gauthier, Ph.D.
Mike Walters, Ph.D.
Steve Bédard, M. Sc.
Nicole Rogers, Ph.D. (c)

Sweet Nectar of the Forest

David Briggs of Briggs Maples was on hand to share some of New Brunswick's finest maple products including maple cotton candy! Thank you to the Maple Syrup Association of Canada for supporting NHC 2023.

EMERGING TRENDS
Five Themes of the Northern Hardwood Conference

CLIMATE CHANGE

by Storm Robinson, Manager of Knowledge Mobilization, NHRI

The NHC highlighted many new ideas and projects that hope to address climate change issues. Silviculture practices have been changing slowly since the beginning of management, but with a rapidly changing climate comes a rapidly changing set of tools, regimes, and research avenues for silviculture.

The main tool discussed at the conference is the movement of warm-adapted species or genotypes further north in the hopes the warmer species will be more adapted to the future climate. This climate change adaptation strategy, known as assisted migration, is becoming more and more popular among researchers.

Two of our presenters showcased new assisted migration projects; Christel C. Kern of the US Forest Service presented the **DREAM project**, short for Desired REgeneration through Assisted Migration, and Loic D'Orangeville of the University of New Brunswick presented the **TransX project** ; a new network of provenance trials (planting seeds from multiple seed sources in the same experiment to see how they handle changes in climate).

Through collaboration with the DREAM team (a group of ~10 researchers in Wisconsin and 20 in Quebec), Dr. Kern hopes to build models, experiments, and produce research to assess the potential for assisted migration. Dr. Kern discussed the cost-benefit analysis of assisted migration, highlighting many barriers including site suitability and seed sourcing.

Dr. Loic D'Orangeville's TransX project involves planting red maple, yellow birch, white birch, red oak, and sugar maple along with some conifers to test their adaptation potential in the northern climate. To address the issue of deer and moose posing a threat to hardwood plantations during their experiments, they had the foresight to plan and implement enclosures. They hope to learn the role of canopy and terminal growth phenology through cameras, and they hope for major collaboration in seed sourcing. Many of the questions from the audience were considering the on-the-ground feasibility of assisted migration such as where the seeds are going to come from, how to source genetically improved hardwood species, and how to ensure survivability in the field when enclosures are not an option. The answers are always the same, that these trials are brand new, and the researchers are seeking collaboration to help put this research into practice.

Donnie McPhee of the National Tree Seed Centre also highlighted the national seed shortage and large demand for seed for assisted migration research in his Indigenous seed collection presentation. He also discussed the success of collaboration with Indigenous communities to help answer many of these questions. The importance of collaboration and knowledge mobilization cannot be understated in this conference theme.

CLIMATE CHANGE

EMERGING TRENDS

Adaptive silviculture	Reducing competition
Assisted migration potential CAN – USA collaboration	Seed shortages

RESEARCH GAPS

Commercial hardwood artificial regeneration	Seed sourcing
Predicting future adapted forest conditions	Mitigating climate change via new practices and products

RELATED PRESENTATIONS

Storm Robinson, MScF.

WILDLIFE AND ECOLOGY

by Sophie Cation, Research Forester at NHRI

Researchers presented ecological dynamics that shape forest ecosystems to inform the development of successful adaptive forest management strategies. The ecological patterns and relationships that form northern hardwood and mixed wood forests are understood through spatial and temporal limits, that determine the scope and direction of research.

Neil Pederson from the Harvard Forest blended themes of archeology, climatology, and ecology to describe long-term development of northern hardwood and mixedwood forests. Pederson and his research team sought to study northern hardwood dynamics from a larger spatial-temporal scale, region and century-wide, rather than the typical understanding from a stand and decade level. Using available data from the international tree ring database and onsite tree coring in old growth stands, large scale disturbance patterns across large swaths of the northern hardwood range were uncovered. Pederson suggests that mesic temperate forests experience large scale synchronous disturbance regimes that must be considered when managing hardwood forests under climate change.

Under the lens of wildlife research, Stephanie Landry from the Université du Québec à Rimouski and **Amanda McGraw** from the Wisconsin Department of Natural Resources presented their research on ungulate browsing pressure in northern hardwood and mixedwood forests.

In her preliminary research, Landry found that the spatial relationship of North American moose browsing pressure and stand composition in hardwood dominated forests was not well explored. Her results showed that winter browsing pressure increased with snow precipitation and proportion of coniferous trees in the canopy and decreased with sapling density. Her study also presented the attraction of moose to recent cut blocks and advised managers against aggregating cut blocks to promote seedling viability.

Similarly, increases in deer populations across the northern hardwood range has resulted in decreased regeneration of hardwood species and to the dominance of understory ferns. McGraw and her team sought to better understand deer browse preference throughout Wisconsin by creating a spatial understory tool. They were then able to create an estimate of total biomass across all of Wisconsin of red oak and sugar maple sapling and seedlings to ultimately produce a forage quality map. This kind of work lends to active monitoring of hardwood regeneration to promote successful, long-lasting stands under climate change.

WILDLIFE AND ECOLOGY

EMERGING TRENDS

- Objective trade-offs
- Managing browsing
- Browsing impacts on regeneration

RESEARCH GAPS

- Managing browsing commercially
- Multi-value incorporation
- Management and monitoring wildlife occurrence

RELATED PRESENTATIONS

Darren Sleep, PhD, Sustainable Forestry Initiative

EMERGING TRENDS
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HARDWOOD MANAGEMENT

by Emily Nicholson, Research Forester at NHRI

The management of hardwood species was one of the central themes of the conference. Opening remarks from NHRI Executive Director Gaetan Pelletier and Assistant Deputy Minister Chris Ward of the NBDNRED discussed the absolute importance of continued hardwood management for the provincial economy, wood supply and future of the species. **Impressive statistics** show that hardwood cover accounts for 49% of the forest ranging from complete hardwood stands to mixedwood groups. NHRI is taking their role in continued hardwood management seriously with the continuous development of silviculture prescription systems to better maximize stand productivity and tree utilization.

The growing demand for hardwood products means more strain on the wood supply and given the incoming decrease in the annual allowable cut, more long-term management strategies are required. These might look like the TRIAD system being deployed in Nova Scotia, where defined percentages of the land base are designated for high intensity operations and management. This type of approach requires frequent plot remeasurements to establish stand health and productivity as well as measuring for regeneration and tending to crop trees. The results of these experimental harvests displayed successful sugar maple and yellow birch regeneration in the stands that were successful post treatment.

Thomas McCay presented the concept of irregular shelterwood treatments as a mechanic for hardwood management. Previous Ontario management strategies for single tree selection (STS) harvest have now resulted in stands that are ineligible for STS – the original mindset being that they would always be eligible and ready for STS harvest.

This revelation prompted the use of shelterwood when STS was not an option. Over time a push to shift the practice to irregular shelterwood has been met with some uncertainty and on large swaths of land there are valid concerns from road planning to wood supply. For small woodlot owners this is a very appealing strategy.

New innovation on management strategies and combining approaches from diverse forests and forest goals resulted in fresh ideas and new understanding of emerging issues and solutions in hardwood management.

HARDWOOD MANAGEMENT

EMERGING TRENDS

- Balancing mixed stakeholder values
- Degradation of forest stands, changing management/harvest practices
- Applying operator training or tree marking
- Limitations and regeneration impacts of cut to length systems for wood supply

RESEARCH GAPS

- ISS variants
- Increased precision forestry
- Forecasting model accuracy with new practices

RELATED PRESENTATIONS

Greg Edge, MS.
Gaetan Pelletier, NHRI

Emerging priorities, research gaps, and further challenges facing northern hardwoods management

The Northern Hardwood Conference 2023 was an opportunity for the NHRI team to confirm the usefulness of our current work, and more importantly, to adjust our knowledge production and mobilization activities going forward. The information presented during the conference allowed us to identify research gaps applicable to northern hardwood forests. Our interactions with industry during the event gave us the opportunity to further understand their most pressing needs. From those experiences we are now in the process of adapting our strategic objectives, operational goals and workplans.

Whether it is the effects of climate change, forest degradation, regeneration and vigour issues, or the challenges of matching forest operations to market demand, it was clear during NHC 2023 that the northern hardwood forest is changing, and forestry practices must urgently find ways to adapt to this new reality. Time tested forestry systems must be adapted and the required tools to implement those changes, and measure the results, must be improved, or developed.

EMERGING TRENDS
Conclusion

In a nutshell, the need for applied research that aims to equip foresters facing those challenges has never been greater.

For over 10 years now NHRI's mandate has been to develop, field test, and help implement tools for foresters with boots on the ground and eyes on the canopy. Many issues that emerged during NHC 2023 have been part of our knowledge production and mobilization efforts since our inception.

Our team has been dedicated to enhancing forestry systems through a variety of initiatives, including:

- Adapting forestry systems to meet the demands of a changing forest
- Addressing the impact of beech on sugar maple regeneration
- Integrating multispectral analysis into precision forest inventory workflows
- Collaborating with managers, technicians, and harvester operators to make knowledge more accessible
- Bridging the gap between ICT service providers and forestry departments

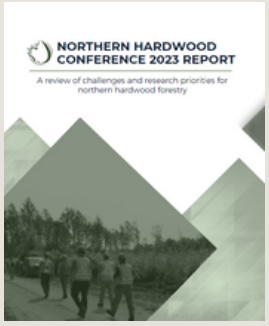
Most of these challenges have now moved from the fringe to the mainstream, making it easier to convince partners to invest time and resources into dealing with them on an operational level. During NHC 2023 it was heartening to observe that we may not always do things perfectly right, but we are convinced, more than ever, that we are doing the right things. Our efforts seem to be aligned with the needs of industry, and thus, heading in the right direction.

Based on our experience and our observations of emerging issues, we believe that our contribution going forward can be grouped into three closely interrelated themes:

- Implementation of adaptive silviculture
- Digitalization of the forest value chain
- Northern hardwood silviculture training

by Storm Robinson and Joey Volpé, Mobilization Management at NHRI

CONTACT US TO LEARN MORE



Northern Hardwood Conference 2023 Report

Click here for a full review of conference presentations and how NHRI's work plan going forward helps to address these emerging issues. Also available in the first article in the **2023 NHC Proceedings**.