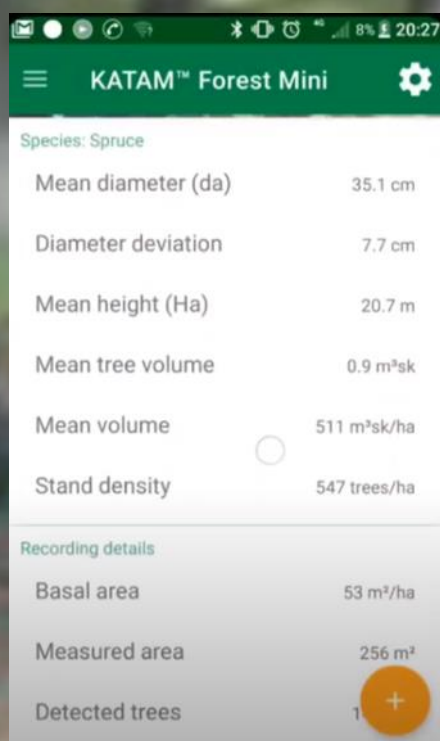


NORTHERN HARDWOODS RESEARCH INSTITUTE'S QUARTERLY NEWSLETTER

THE LEAFLET

HARVEST KNOWLEDGE, PROMOTE GROWTH



The screenshot shows the KATAM Forest Mini app interface. At the top, it says 'KATAM™ Forest Mini' with a settings gear icon. Below this, it lists 'Species: Spruce'. The main data section includes:

Mean diameter (da)	35.1 cm
Diameter deviation	7.7 cm
Mean height (Ha)	20.7 m
Mean tree volume	0.9 m³sk
Mean volume	511 m³sk/ha
Stand density	547 trees/ha

Below this is a 'Recording details' section:

Basal area	53 m²/ha
Measured area	256 m²
Detected trees	1

At the bottom right of the detected trees section is an orange circular button with a white plus sign.

THE LEAFLET
Past Issues



PRECISION FORESTRY FOR BETTER FOREST MANAGEMENT

Leverage technology to better characterize trees and stands, assign treatments, optimize bucking, increase value and reduce cost !



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Cover page: showing Katam Technologies' digital forest measurement using a smartphone
(<https://www.katam.se/products/forest/>)



**FEATURE ARTICLE*****Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box***

Early into its beginnings, the NHRI realized that efficient ways to translate knowledge into solutions needed to be developed and our journey into precision forestry was born. Precision Forestry is the use of measurement and monitoring tools such as LiDAR, UAVs, Satellite imagery, etc. and decision-making tools including spatial optimization and multi-criteria decision analysis with highly repeatable measurements, actions and processes to support decision-making for the forestry sector to maximize economic return in a sustainable way. It is also about leveraging modern techniques such as artificial intelligence, machine and deep learning, leveraging big data and modern analytics to solve problems in the supply and value chains.

The Northern Hardwoods Research Institute (NHRI) has launched a multi-year and multi-phase initiative to develop a suite of tools to improve and render more sustainable and feasible the management of mixed and hardwood forests in the region. The concepts also apply to pure softwood forests.

We will be creating a suite of technology solutions (modules within a tool box) that is to be made available to forestry professionals for the planning and silviculture of mixed and hardwood stands and forests. The NHRI will lead the development of the tool box and leverage its already existing body of knowledge. The Hardwood and Mixed-wood Silviculture Toolbox will consist of 13 separate modules that, while interconnected, can be used independently (see figure 1).

By promoting the sustainable development of hardwood-dominated forests, the Institute is a key player for a stronger and more resilient forest sector in eastern Canada and North America but also, supports other sectors such as ITC, aerospace, machine manufacturing, etc.

Value Proposition or Cost of Poor Quality (COPQ)

Improvements in forest management planning can materialize in the following tangible and other enabling benefits:

1. **Increase (maintain) growing stock, annual allowable cut and annual harvest levels.** The NHRI has determined that any increase in harvest levels on Crown Lands offsets expensive replacement wood coming from out of the Province. The benefits include cost savings, increased production, start-up of closed facilities, etc. Depending on the calculation method and the consideration of economic activity multipliers, the benefits can be in the range of tens of millions of dollars for the whole sector in New Brunswick. In New Brunswick, depending on the approach to calculate, one cubic meter of fibre contributes between \$100 and \$200 to the economy (GDP & taxes).



FEATURE ARTICLE

Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box

2. **Increase in High Value Products.** Better planning will lead to better utilization and a higher proportion of high-grade material such as prime sawlogs and veneer logs. Our NHRI rule of thumb is that any increase of one percentage point in high-grade material is worth \$ 1 000 000 to the forest sector.
3. **Reduced risk and adaptation to cumulative negative effects.** Some future benefits that are more difficult to forecast and to determine economic impacts include adaptation to climate change (increase in drought and frequency of severe weather events such as ice and windstorms) and reducing threats of forest health decline. Specifically, the status quo approach is likely to reduce the growing stock of sugar maple at the benefit of species of commercial value (intolerant hardwoods, red maple and American beech).
4. **Improve commercialization of Intellectual Property generated in our Province.** Because of the implication of several private sector partners in addition to those of the forest products industry (IT, aerospace, analytics), there are great opportunities to increase commercialization of products and services from IP associated with the initiative. This could also lead to the start-up of new firms and enterprises in the province.
5. **Sustain economic growth of our firms in the sector by:**
 - Increasing harvesting productivity and reducing cost
 - Provide better utilization of products and increase the proportion of high-grade products
 - Reduce waste
 - Reduce the reliance on raw materials from outside the region
 - Improve sustainability of the resource

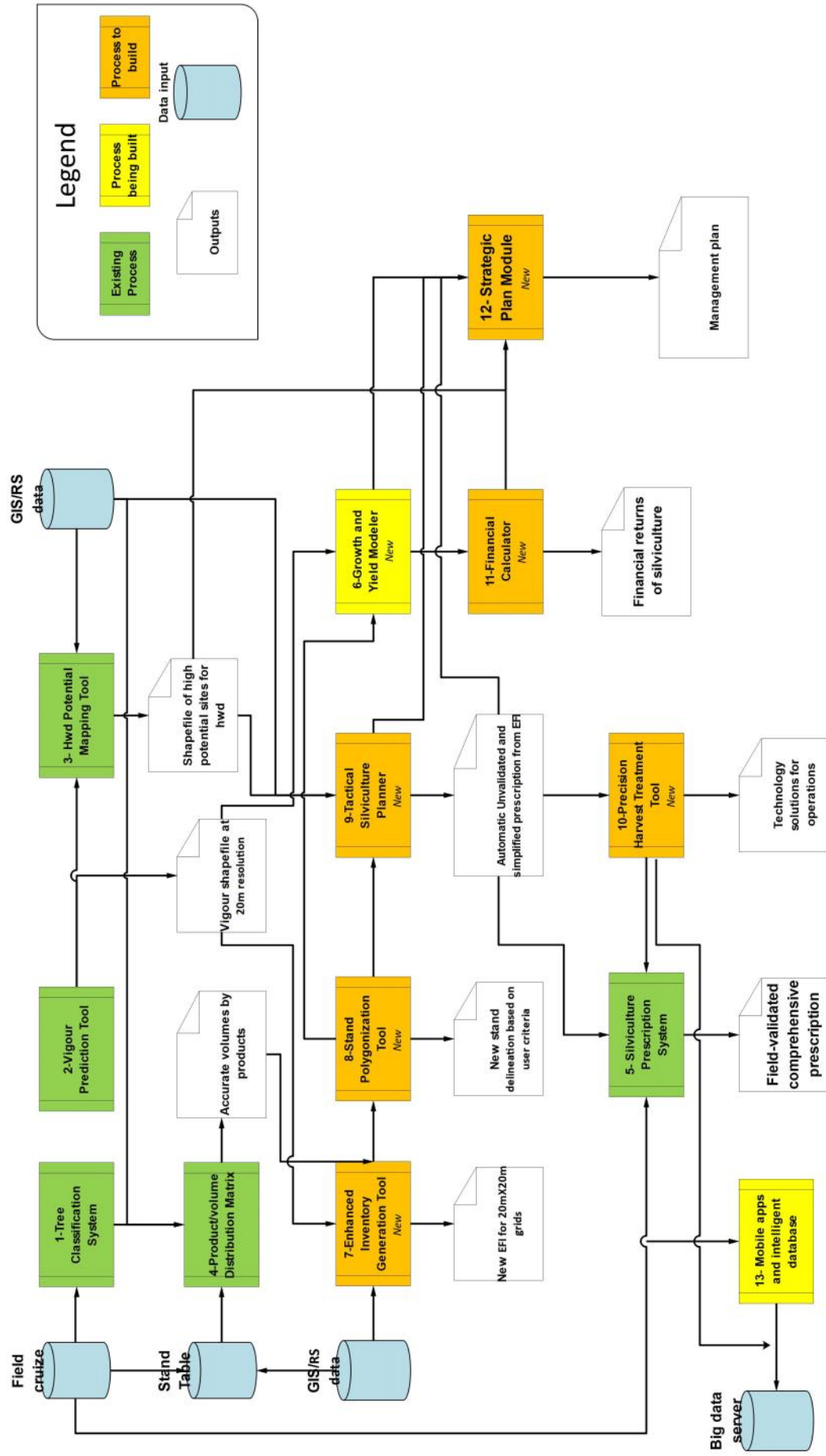
What are the tools (modules) in this box? (see diagram page 5)

Module 01- Tree Classification System (status: ready)

The NHRI has developed a [Tree Classification System](#) (page 6) for New Brunswick. It is a simple tool to classify trees their form and risk of losing vigour. It provides the knowledge of single-tree stem attributes that are critical in the decision-making process. As an example, it is important to consider tree vigour and health when choosing a silvicultural system and prescriptions. Tree form are in turn useful in determining product potential as well as predicting harvesting and processing costs.

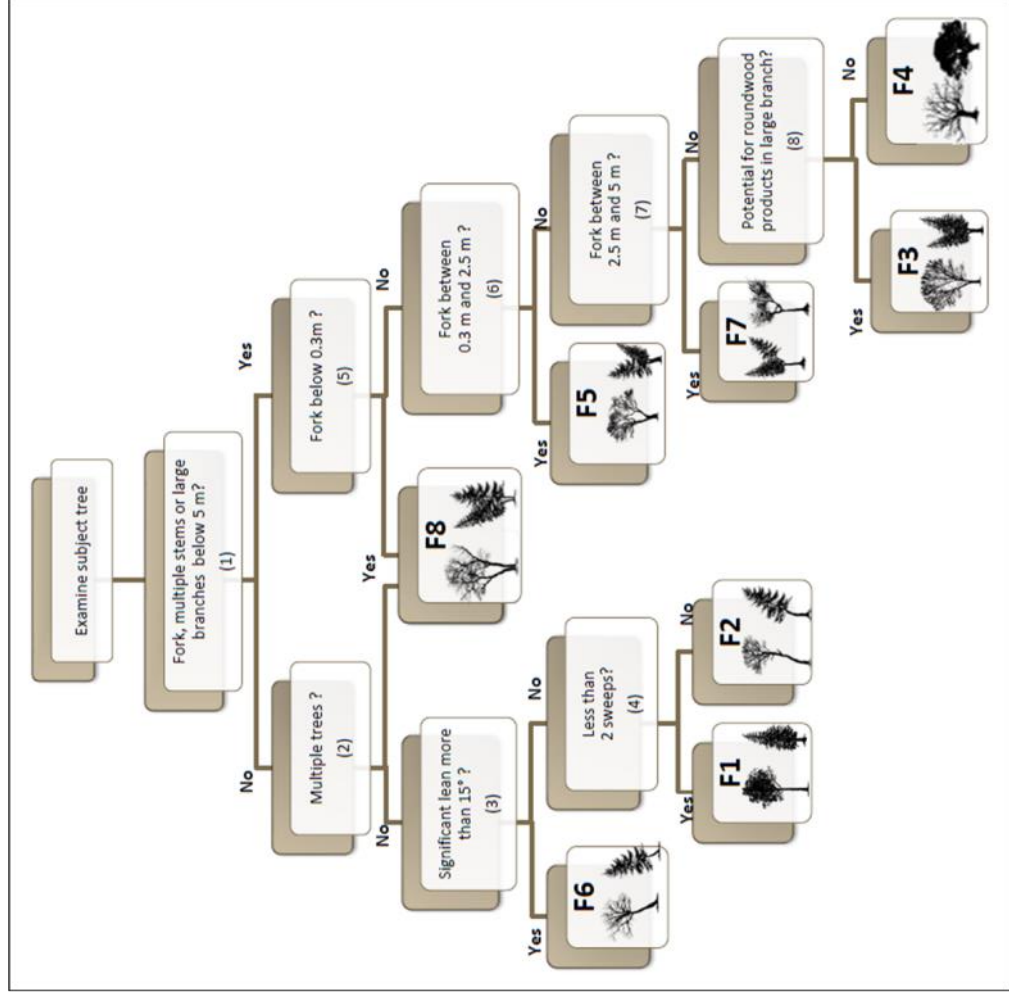
To use the Tree Classification System, one needs to evaluate trees in stand plots while doing the forest inventory and assign a form class and a risk class to each tree. Alternatively, data from remote sensing can be used to assign proportions of form class and risk class for forest areas or pixels. That tool is ready and mature.

NHRI Hardwood & Mixed Wood Silviculture Tool Box



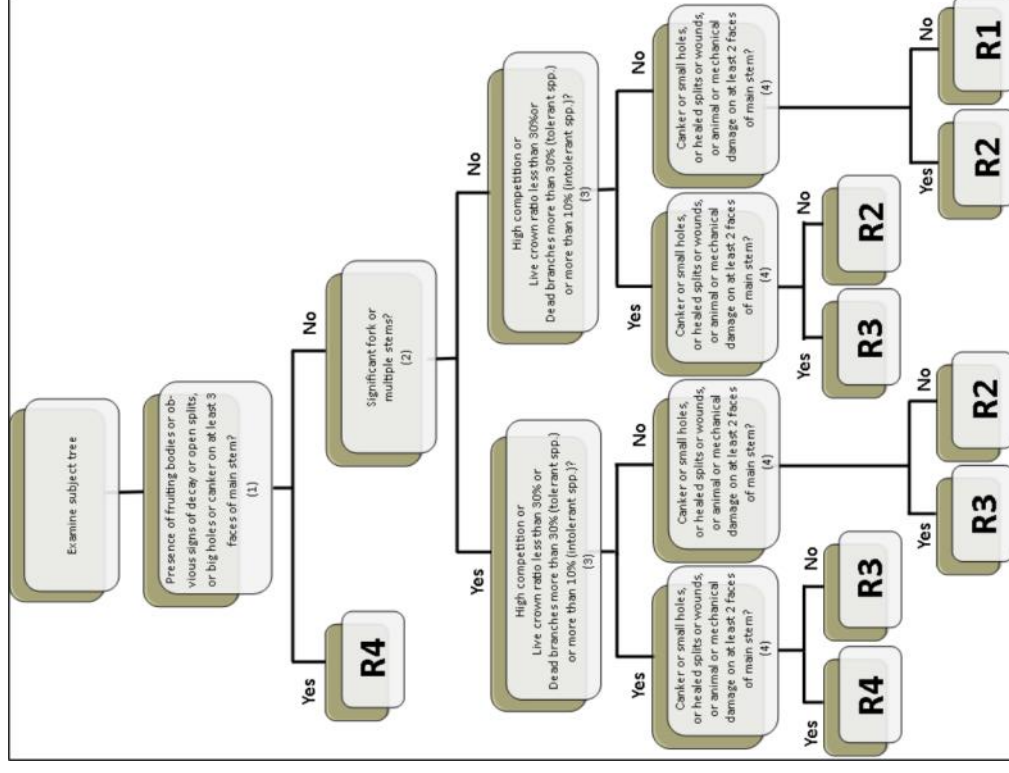
NHRI Tree Classification System

Tree Form—Determination Key



NHRI Tree Classification System

Risk—Summary and Determination Key

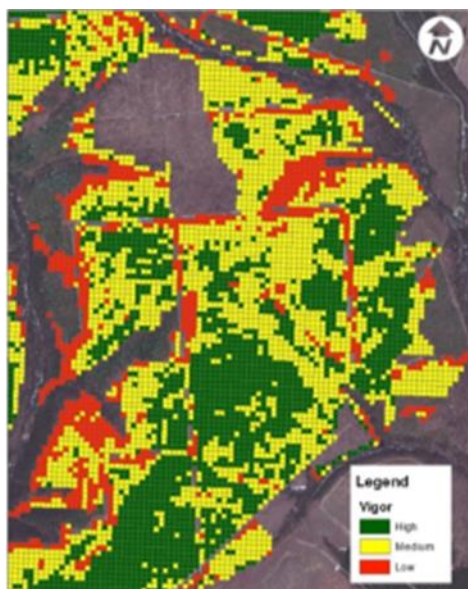
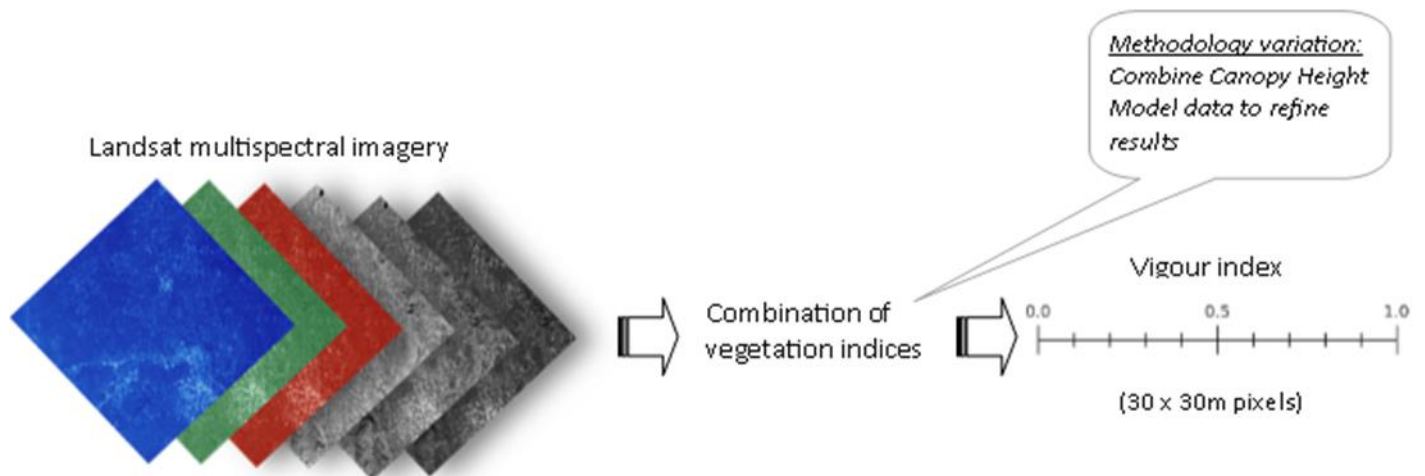




FEATURE ARTICLE

*Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box***Module 02- Vigour Prediction Tool** (Status: in improvement mode)

In 2016 the NHRI developed a tool that uses remote sensing to predict vigour in hardwood dominated forest stands. This valuable product enables forest managers and planners to make better silviculture recommendations and identify priority areas for harvest. According to our own definition, vigour is represented as the proportion of commercial trees likely to survive in the next 15 years and/or their value expected to remain stable or improve over time (R1&R2 from the NHRI Tree Classification system for New Brunswick).



The NHRI has forged a strong partnership with [Scene Sharp Technologies](#) from Fredericton and together, they are improving the tool built in 2016 to include better logic, leverage AI and higher resolution satellite imagery such as that of Sentinel II.

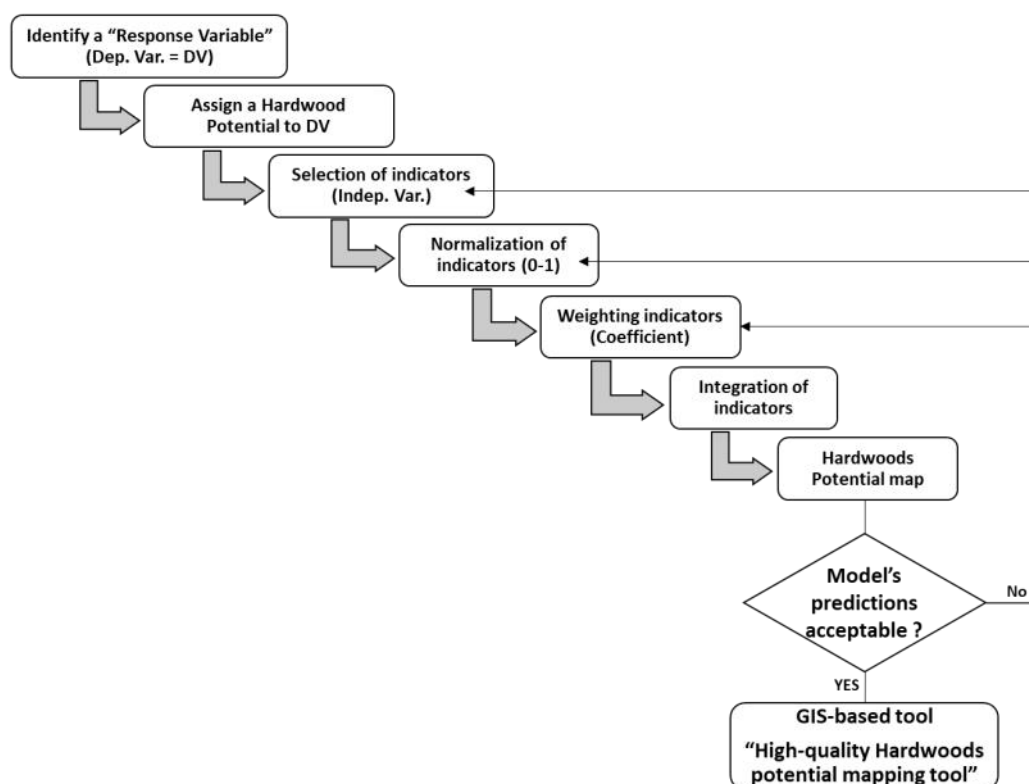


FEATURE ARTICLE

*Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box***Module 03- High Quality Hardwood Potential Mapping Tool** (status: in development)

The NHRI Quality Hardwood Potential mapping tool is designed to identify, and rank sites based on their potential to produce high quality hardwoods. The specific objectives of this tool are to estimate the potential of forest sites to produce high quality hardwoods by allowing users to adjust input variables and modify weights to adapt the model to different contexts and locations across eastern Canada.

The GIS-based product leverages New Brunswick's unique abundance of high resolution site information such as Biomass Growth Index (Hennigar), new soil layers (UNB, Shane Furze), Depth to Water Table (UNB, Paul Arp), Species Affinity Indices (Hennigar), the suite of NB ecological land classification system layers produced since the 1980's and a few new variables tested at the NHRI. It will also use the vigour predictions derived from Module 02. To complete the module, we need to produce an improved model, validate with an independent dataset, produce the final tool and conduct a pilot on one land base in N.B.

High Quality Hardwoods Potential mapping tool methodology

We are revamping this tool in 2020 so that it is more accurate, customizable and takes into account new information.

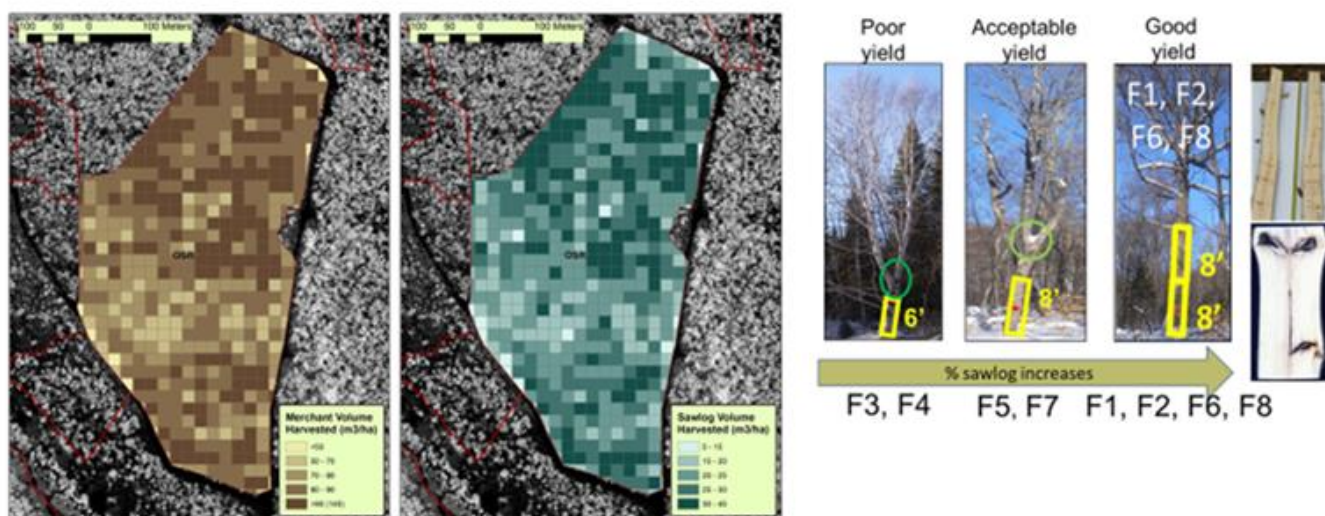


FEATURE ARTICLE

*Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box***Module 04- Product/volume distribution matrix** (status: ready and improving)

Early on, we developed a tool that allows practitioners to predict product recovery using data from four tree characteristics: species, DBH, form class and risk class.

The format is an interactive matrix where one can input inventory data to get product volume as output for a cutting bloc or a stand. Alternatively, remote sensing data (LiDAR) can also be used to predict volumes for larger areas. This product is already mature, but we are constantly improving when new data becomes available. Ultimately, the New Brunswick Slasher program will be modified with this information.

The NHRI product prediction tool**Module 05- Silviculture Prescription System** (status: ready and being implemented)

Managing hardwood and mixed-wood stands requires well-planned treatments that not only improve existing trees but also regenerate desirable species. The successful recruitment of new cohorts of key tree species is vital to sustaining our resource. Better silviculture will lead to better productivity and a higher ratio of more valuable trees. We think that it is also directly compatible with other values and objectives such as habitat and ecosystem services. A thorough understanding of the relationships among species, site, environment, and climate – informing a sound silviculture framework – allows forest managers and landowners to balance timber production objectives with habitat and biodiversity values.



FEATURE ARTICLE

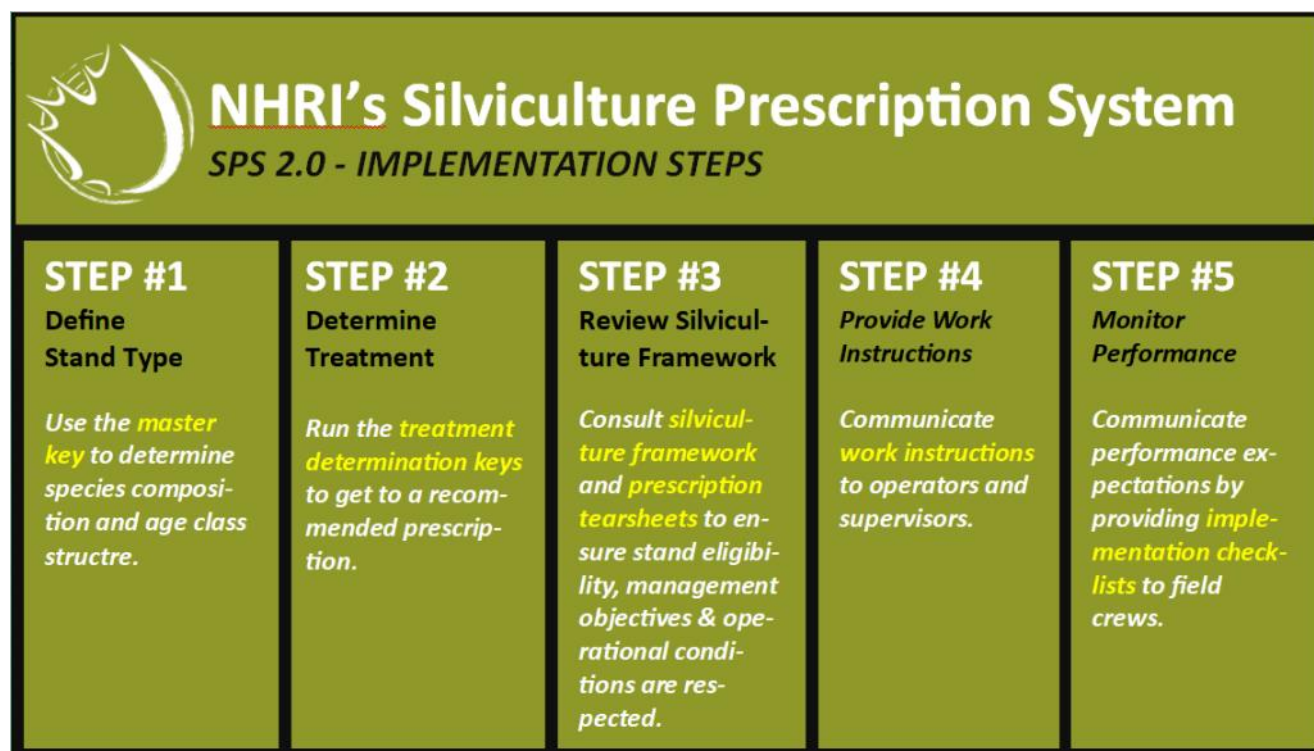
Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box

In short, better silviculture based on the best available science leads to healthier, more productive, and more valuable forests. That is why our team has devoted so much energy, resources, and brainpower to developing and mobilizing the Northern Hardwoods Research Institute's [Silviculture Prescription System](#) (NHRI – SPS 2.0).

The NHRI's Silviculture Prescription System is a 5-step process that starts with the description of a stand and ultimately recommends very specific treatments in forests that are dominated by hardwoods.

The NHRI Silviculture Prescription System was introduced in 2015 and its implementation was gradually undertaken in various stands of all tenure types in New Brunswick. From these trials, several improvements were recommended and led to the re-design of the SPS. Version 2.0 of the SPS was completed in January 2020. Improvements brought to our original SPS include:

- Simplified framework;
- New nomenclature of silviculture systems to minimize confusion on two-aged/extensive systems (formerly called “Irregular Shelterwoods”);
- More robust logic for treatment determination;
- Better instructions for implementation.

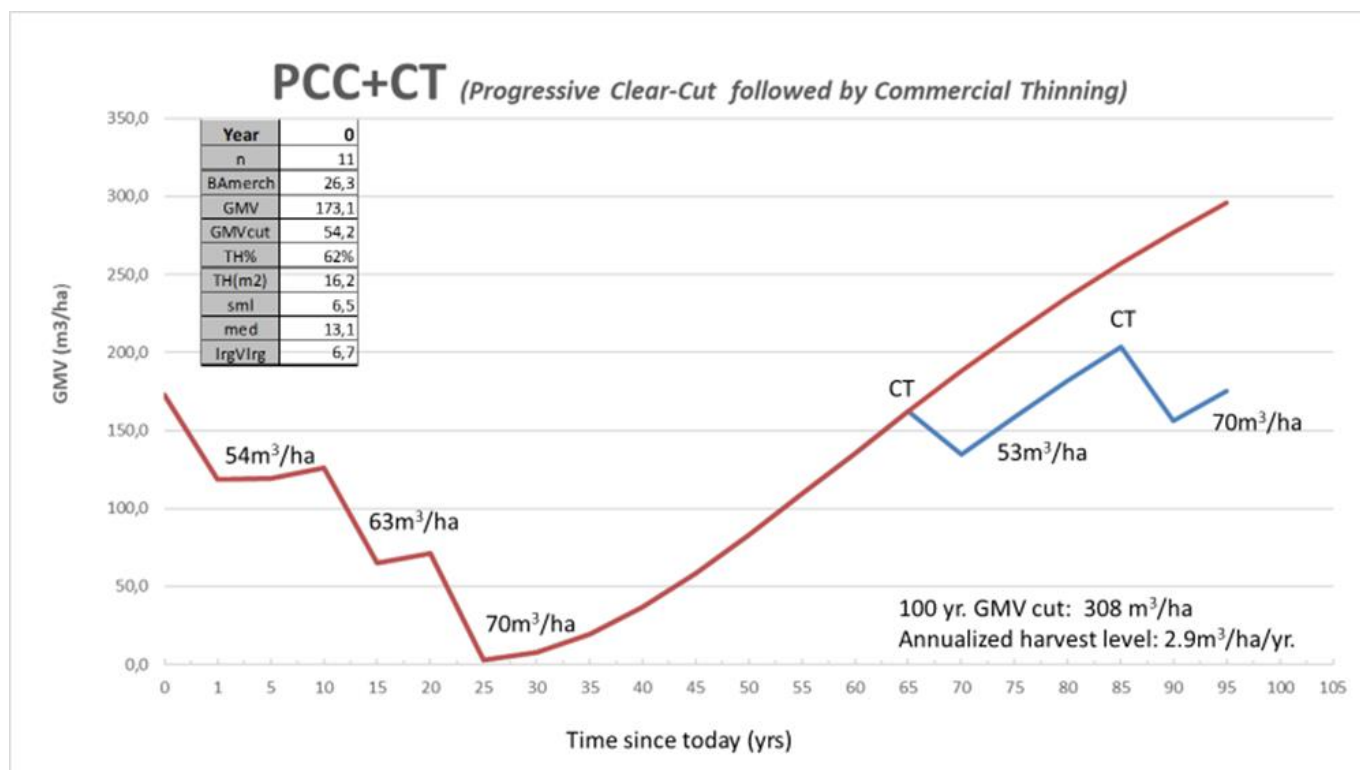




FEATURE ARTICLE

*Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box***Module 06- Stand Growth and Yield Modeller** (status: ready and improving)

NHRI has been working with [FORUS Research](#) since 2013 to improve the quality of hardwood growth and yield predictions in the FORUS (OSM) software platform. Hardwood management enhancements include: 1– added Tree Risk and Form tracking in tree list (cannot predict Risk or Form yet, but if known from cruising, this information can be used to prioritize trees for harvest in the model); 2– new 'J' command for retaining trees across a range of DBH classes to emulate single tree selection method given: Q factor (diameter distribution shape), trails, target residual basal area; 3– spatial constraints for partial harvests (command for simulating pseudo-spatial operational constraints on crop-tree selection and, command for simulating random crop tree selection issues or operational errors); 4– auto DBH and height growth increment calibration routines that can automatically modify underlying growth predictions in the model to better match local growth rates observed in the field— tested with retrospective survey 20 years after partial harvest in tolerant hardwoods. These OSM local calibration files are made available by FORUS Research for alternate forest types and treatments and are updated as new versions are released.





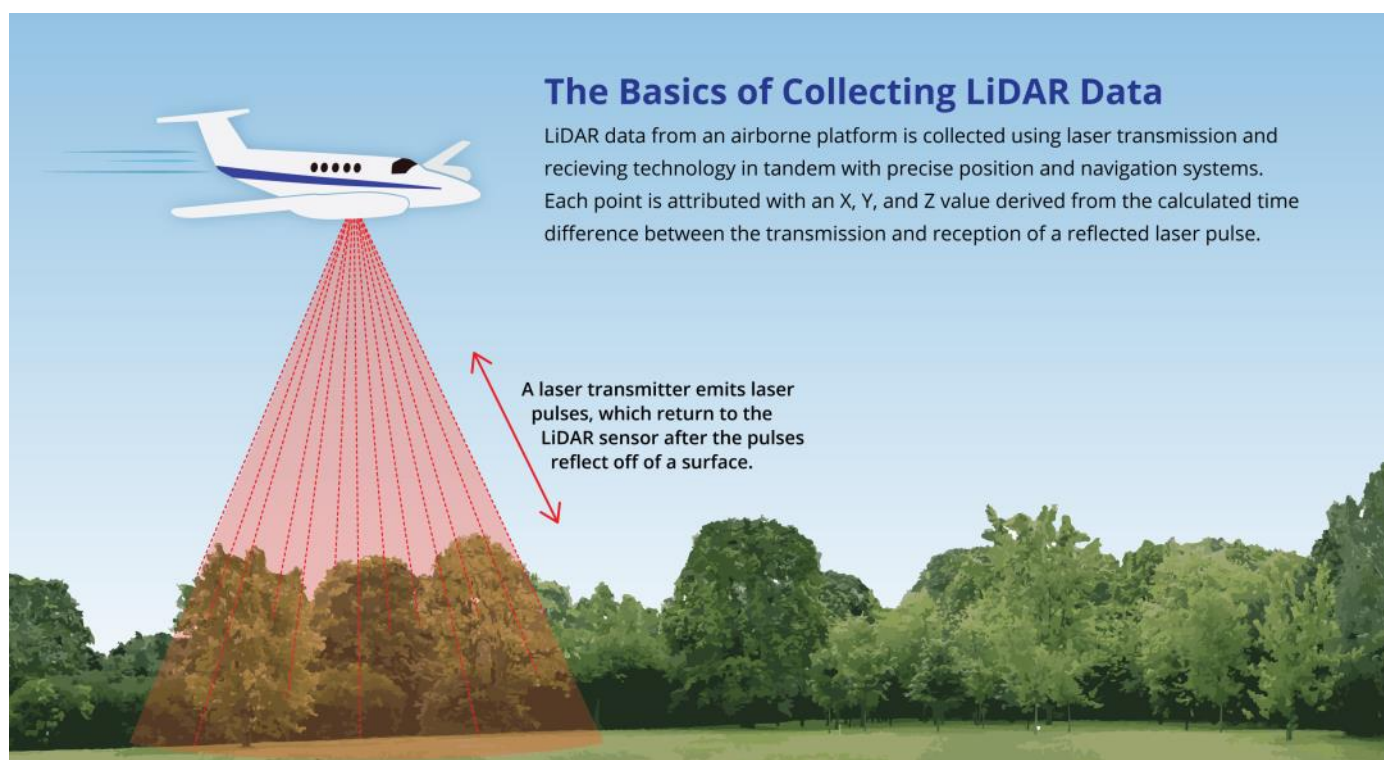
FEATURE ARTICLE

Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box

Module 07- Enhanced Forest Inventory Simulator (status: not started)

The purpose of this component is to develop a process to generate new and improved inventory variables using remote sensing technologies to automate silvicultural diagnostics in complex hardwood and mixed wood stands and in tactical planning (5-10 years).

Initially, four new inventory variables for micro-stands (20m X 20m) will be produced; the species composition, vigour, quality/grade of trees (AGS / UGS ratio) and the presence of pre-established quality regeneration and the distribution of trees within the 20m cell. We will eventually apply the methodologies being developed (AI) to improve the suite of the nearly 50 existing EFI variables that were derived mostly from LiDAR data.



<https://blog.bluemarblegeo.com/2017/04/27/got-lidar-now-what/>

A lidar instrument principally consists of a laser, a scanner, and a specialized GPS receiver. Airplanes and helicopters are the most commonly used platforms for acquiring lidar data over broad areas.

Lidar systems allow scientists and mapping professionals to examine both natural and manmade environments with accuracy, precision, and flexibility.

Source: National Oceanic and Atmospheric Administration, U.S. Department of Commerce

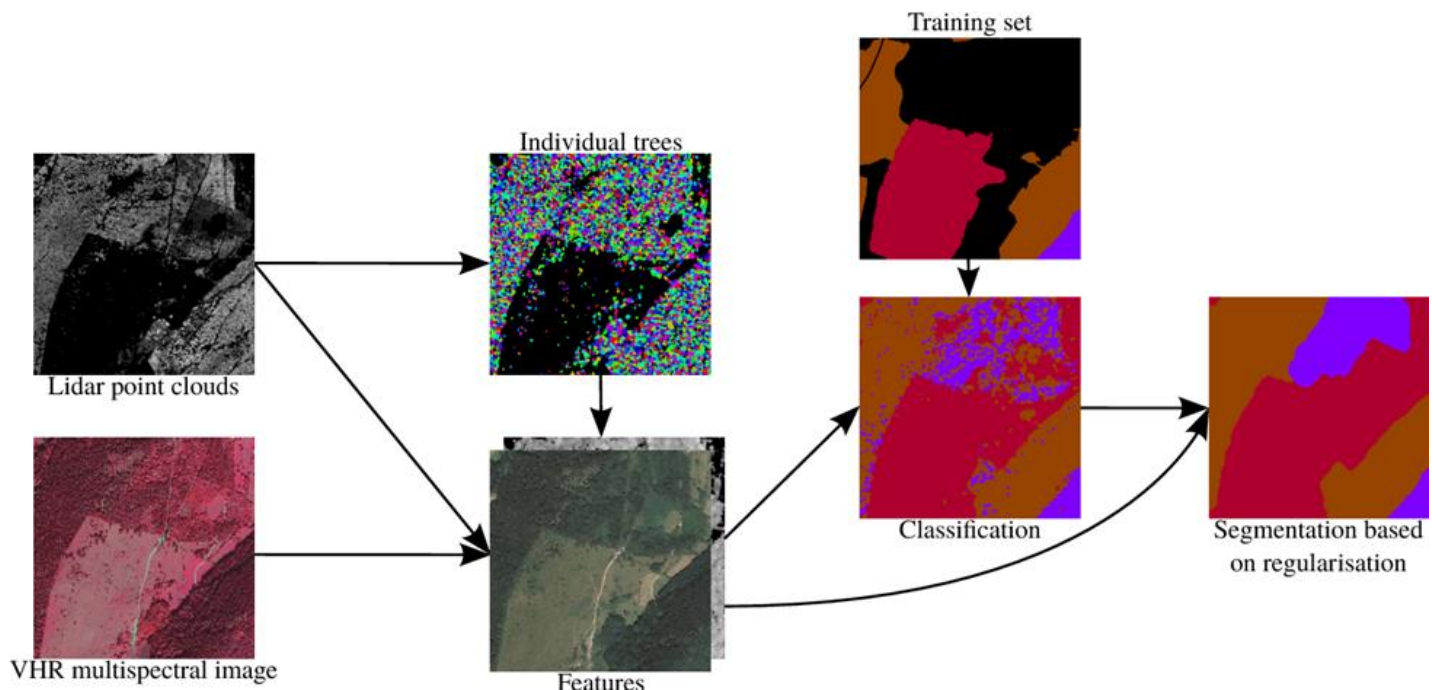


FEATURE ARTICLE

*Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box***Module 08: Stand Polygonization Tool** (status: not started)

Because of the recent change in the paradigm with regards to the resolution at which are becoming available through remote sensing, we must revisit the process by which stand boundaries are being defined. In New Brunswick, forest inventory variables are created for micro-stands (20mX20m). While the resolution is required for some applications, it is overwhelming for others and a process to amalgamate cells into larger units is needed.

This completely new tool will function in two separate ways. First, a relatively simple GIS process will be created where from user inputs and criteria, cells will be amalgamated into larger units and form stands as defined by the user. Secondly, a heuristic optimization algorithm will be created (using the same inputs as in the previous approach) so that the new stand configuration is based on optimal solutions.

Example of a stand polygonization tool initiative

Source: Dechesne, C. et al., 2016. Forest stand segmentation using airborne LiDAR data and very high resolution multispectral imagery. *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLI-B3, 207–214.



FEATURE ARTICLE

Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box

Module 09: Tactical Silviculture Planner (status: in development)

This brand-new module consists of a tool that will automatically assign a high-level silvicultural regime (treatment) to a stand or micro-stand using enhanced forest inventory (EFI) and site variables in one phase and prepare an optimized tactical or operations plan based on the silvicultural requirements for harvest season and system. It will function in the following way:

- Create a simplified NHRI SPS logic for management planning;
- Design an algorithm to assign NHRI treatment to micro-stands using existing information;
- Interface with the stand polygonization module to create larger stands;
- Assign an optimal silviculture regime to the larger stand.

The user will be able to select a number of candidate stands and prepare an optimal tactical (multi-year) or operating plan with an objective function and constraints that consider the mandatory harvest season and system and requirements to successfully establish new cohorts of future trees.

Module 10: [Harvest Treatment Planning Tool](#) (status: not started)

Variations in species composition, diameter and height distributions, and quality make the management of hardwood-dominated stands difficult, particularly when considering mechanized forest operations. This tool will be designed to improve the feasibility of forest operations in heterogeneous forest stands.

Taking advantage of harvester's on-board-computer (OBC) technology and data, It will build operational maps identifying the type and spatial extent of silvicultural treatments to be performed. Once uploaded to positioning systems in harvesting machines, the operators will be provided guidance on the silvicultural treatment to be performed and the location of the suggested machine trails.



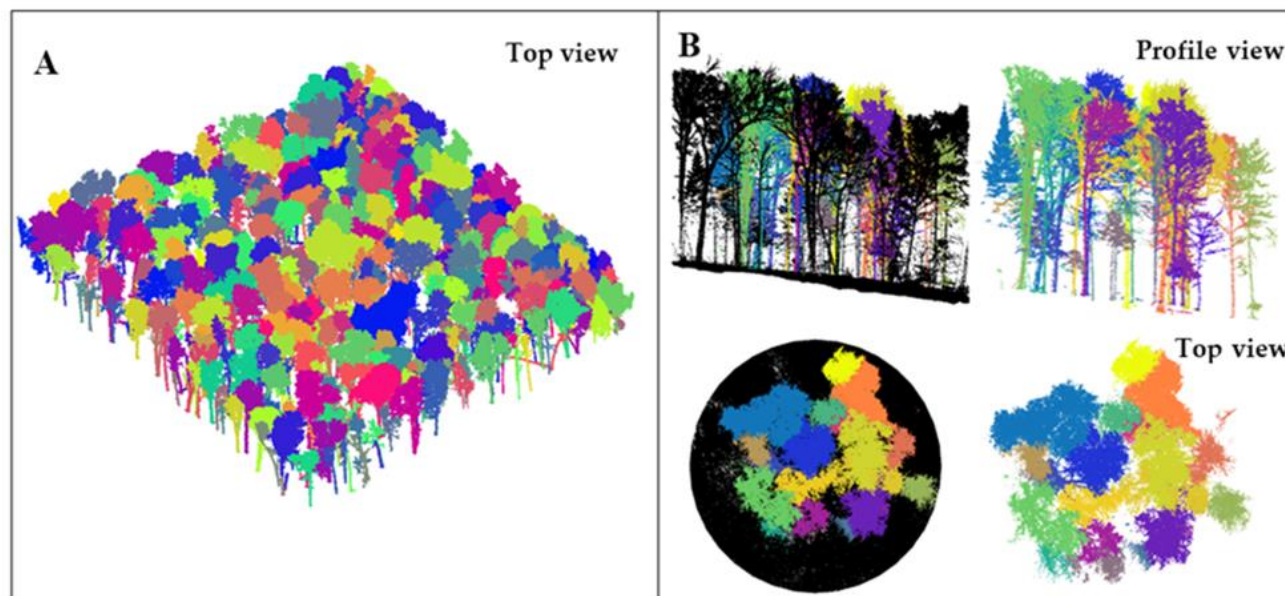
Much energy will be focused on the refinement of silviculture treatment determination logic, keys, and algorithms. We envision that a change of paradigm is needed so that we cease to deal with silviculture planning separate from operations planning as well as producing forest and stand inventory.



FEATURE ARTICLE

Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box

This tool will connect with modules #7, #8 and #9 and require the development of interfaces with harvesting equipment that leverage augmented reality technologies. We will also explore the use of super-high (>2000 points per m²) point cloud technology to enable better decisions by operators.



Segmentation of trees from super-high-density LiDAR data (Vandendaele, 2020)

Module 11: Financial calculator (status: Beta version ready and improving)

We have built a beta model of a financial tool to evaluate different silvicultural options at the stand, woodlot, second-order watershed, or assemblage of stands within a tactical unit/plan scale in NB. The tool is designed in consultation with potential users and will be sensitive to recruitment of new cohorts, growth rates, species composition and evolution of tree quality under the conditions identified under objective 1.

The tool will allow for a direct comparison of adaptation options based on several biological indicators and financial criteria such as the rate of return (IRR and ROI), net present value (NPV), and annual equivalent value. An interface with current mainstream operational applications (GIS-optimization) will be developed. Initially the tool will operate as a non-spatial unit. Later, a spatially explicit model will be built using common GIS platforms.

Module 12: Strategic planning tool (status: not started)

There is a strong need to explore strategic planning alternatives for mixed and hardwood stands that are fundamentally different than those inherent to the much simpler softwood forests. In addition, a new process must be developed to encourage this change.

**FEATURE ARTICLE*****Precision Forestry and the NHRI's Mixed-wood and Hardwood Silviculture Tool Box***

Our tool will be built upon the NHRI hardwood potential mapping tool to “zone” quality hardwoods. It will also enable to explore new ways to optimize hardwoods for products and volume that include:

- Creation of a High Quality Hardwood Potential Tool from Module #03;
- Easing-off “sustainable, non-declining” flows to allow the immediate improvement of quality hardwood forests;
- Leverage vigour mapping to queue blocks and stands;
- Create a process to generate new stand polygons;
- Build new yield scenarios based on the novel silviculture of the NHRI.

The novel approach will be demonstrated on an actual industrial land base in New Brunswick.

Module 13: Mobile applications and intelligent database

The NHRI has developed a few tools that can be used by forest practitioners to better manage their forests and operations, but these tools are not available on a common platform in which users could enter, collect and retrieve their data. The current application's architecture, which does not allow to fully integrate other tools or manage users' data without having to rewrite the complete application is a stand-alone software not integrated with larger framework.

To provide better service and value to its customers and partners, and to promote the use of their developed tools, the NHRI is seeking software engineering and development companies to build a web/cloud-based server and a suite of web and mobile applications. Recommendations for implementations, such as using APIs, MySQL and Amazon Web Services (AWS), have already been proposed from a software engineering firm.

The practising forestry professionals who use our tools and solutions will benefit from a suite of apps all integrated within an agile web server and a framework that allows for growth in the future. A concept validation project has already been conducted with one.

For this specific module, the project consists of:

- Constructing mobile app (iOS, Android) and a web-based application to run the NHRI Silviculture Prescription System (SPS) in its second version that will collect and store (on a server) field data when within cell phone coverage;
- Initiating the web-server platform to accommodate the SPS application and subsequent ones;
- Setting the stage for the development of future applications.



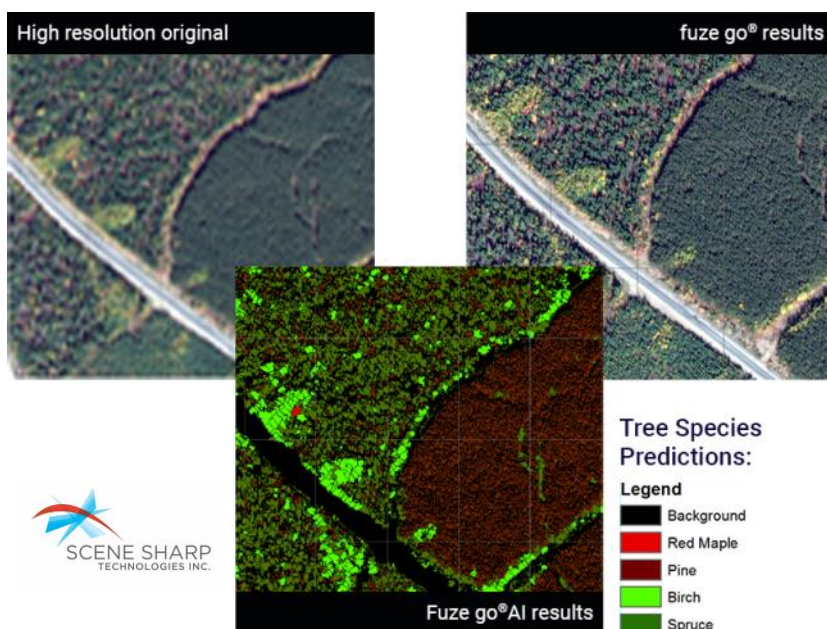
PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

Showcase of project with SceneSharp Technologies

NRHI has entered into a partnership with New Brunswick-based [SceneSharp Technologies](#) to enhance their species determination capabilities, build a forest stand vigour assessment tool and explore other technology solutions for here at home and around the world. Leveraging remote sensing and machine learning, the research collaborative will make predictions at the 10-metre resolution level.

“Our institute was created to partner with innovative companies like SceneSharp,” says Gaetan Pelletier, Executive Director. “This collaboration will pair their high-quality visual data collection capabilities and artificial intelligence technology with our expertise in forest management and knowledge transfer. This will lead to deeper learning and greater digitalization of the industry, especially regarding the upstream portion of the forest products value chain. We have worked with many organizations in the past few years but SceneSharp’s cutting edge technology and agile approach separates them from the pack.”

SceneSharp’s flagship technology, fuse go AI, improves the quality of any image from any source whether it be from satellite, drone, or security camera by revealing the data behind the picture. The AI model is applied to the image, enhancing the data, and bringing it to life. This means better data is available through machine learning to support effective planning, management and decision making.



“NRHI is helping us to get to a higher level of accuracy of species determination by providing us with their training data and industry knowledge,” says Rick MacPhee, SceneSharp CEO. “The training data is teaching our AI to more effectively map tree species and monitor any changes in forest health such as pest infestations. We are building a smarter way for forest companies, woodlot owners and managers to protect and improve their investment.”

Accurate mapping of species is critical to managing forest inventory, making biomass and stand volume estimation but more importantly, make better silviculture decisions. In large forests and woodland areas, it is difficult to get current and precise information on the spatial distribution of species, abundance and density, especially if the species composition is as complex as seen in eastern North



PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

Showcase of project with SceneSharp Technologies

America. Relying on ground-based or aerial survey data, which could be up to 10 years out of date, makes it very challenging to conduct sustainable forest management practices and resource evaluation.

Together, NHRI and SceneSharp will advance its fuze go technology to deliver four to six times improved quality across all spectral bands from any satellite or aerial sensor and increase the usefulness from a wide range of data sources. It will allow for specific species predictions at the micro strand level. This will be achieved through the capture of unique spectral signatures (fingerprints) for forests and crops as well as for other natural and man-made features.

["SceneSharp's fuze go AI 2.0"](#) will track trees over their entire lifecycle if needed, enabling forest managers to grow a better product, faster and more cost-effectively," continues MacPhee. "Woodlot owners can also transition to a proactive management strategy, dealing with complex conditions as they arise."

Assessing forest health and complexity is key to assessing its value. Having up-to-date information about the quality, types and number of trees will enable forestry companies and landowners to determine what is required to harness the potential. The analytics can also be used to track changes in conditions and provide the necessary information for calculating accurate forest inventories that include carbon.

"Our role is to bring relevance to research and represent the voice of the customer," says Pelletier. "They are looking for AI-based solutions that support decision-making, monitors risk and increases sustainability and profitability. This initiative aligns well with the needs of industry, woodlot owners and our institute's partners. What's even more exciting is this world-class technology will be developed here in New Brunswick."

The goal is to increase SceneSharp's ability to accurately predict species with 80 to 90 percent accuracy. It currently predicts eight species, seven times out of 10. That information, coupled with vigour, will allow for better predictions of growth rates.

"The strengthening of our accuracy and analytics will enable us to provide an even better solution," said MacPhee. "This learning from this partnership will allow our customers to grow higher quality trees, faster. They will be more agile and better positioned to make solid business decisions, while capitalizing on the advantages automation presents to the industry."

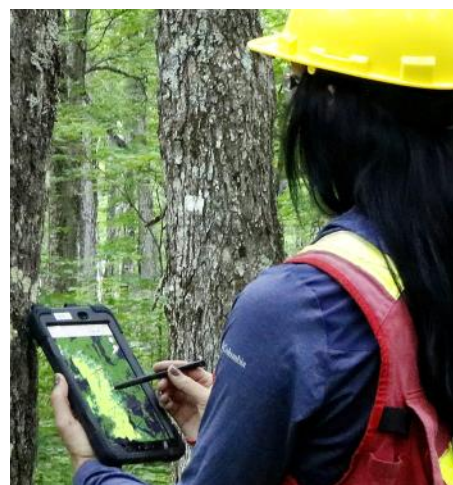


Photo: Myriam Cyr Photography



PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

Showcase of projects with Lim Geomatics and Groupe Système Forêt – Forest inventory for decision making

There is no doubt that at some point into the near future, the need to go to the forest and physically measure some trees to understand tree and stand attributes will be greatly diminished. But today the production of precise information from remote sensing is still emerging and requires substantial R&D. A partner of our institute often says, 'Remote sensing has for the past decades consistently over promised and under delivered...'. There is certainly some truth to that statement.

While we are learning the merits and usefulness of technology such as LiDAR, machine and deep learning, artificial intelligence, modern high-resolution imagery and unmanned aerial systems carrying state-of-the art sensors, the NHRI is convinced we need solid processes to adequately acquire cruise data in the most efficient way. The following article describes the partnership the NHRI has established with two leading solution firms to improve their applications and adapt them to its needs.

« Remote sensing has for the past decades consistently over promised and under delivered ... »



Photo: Myriam Cyr Photography



PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

Showcase of projects with Lim Geomatics and Groupe Système Forêt – Forest inventory for decision making



Groupe Système Forêt (GSF) is a team of multi-disciplinary professionals working mainly in the development of geomatic solutions for the forest industry.

GSF provides tools to efficiently plan, monitor and exploit the forest with top of the line products like GSFNav Windows for forestry machinery and GSFNav Android for field surveys, and ArcMap extensions like GSFOutil, GSFondage and GSFDebit for forestry planning and monitoring in the office. GSF is also involved in training, custom software development, satellite imagery and GPS sales and consulting.



Our mission is to simplify geomatic and surveying for forestry people, and to promote customer knowledge and development through training and ongoing support. Forestry solutions are developed on the Windows platforms using ESRI products (ArcGIS Desktop, ArcGIS Pro, etc.). Business partner of ESRI Canada Limited since 1995, GSF remains to this day a strong retailer in Canada of ESRI Canada Desktop solutions and its extensions such as Spatial Analyst and 3D Analyst. Well established in the eastern North America (Quebec, Ontario and the Maritimes), GSF works in several sectors such as forestry, mining, environmental and municipal.

NHRI's experience shows that traditional field inventory is still the most reliable source of information necessary to assign harvest-based silviculture activities for a particular location in mixed and hardwood stands.

Predictions of tree and stand attributes derived by remote sensing applications such as LiDAR and multispectral imagery, while the way of the future, have not reached the level of maturity that is required at this point. Their current use today remains that of planning at the tactical scale and certainly augment knowledge that is out there.



It is certainly undeniable that the spatial resolution obtained by remote sensing-derived products is phenomenal and cannot be achieved solely by increasing sample size in traditional inventories.

Until recently, no efficient software solution permitted data gathering and compilation in the field to assign a prescription from the NHRI Silviculture Prescription System (SPS 2.0).



PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

Showcase of projects with Lim Geomatics and Groupe Système Forêt – Forest inventory for decision making

For this reason, NHRI contacted GSF, a well-known subject matter expert, to adapt their existing software, GSF-Sondage, to the particularities of the New Brunswick forest sector. Because GSF-Sondage was developed for the Quebec forestry environment, modifications needed to be made mostly in the vocabulary, terminology, types of data collected, and generated outputs. Therefore, GSF and NHRI collaborated on the development of GSF-Sondage «NB version» over the winter and spring of 2020.

NHRI first transmitted the obvious elements that should be created or modified, then the GSF team realized those modifications. Afterwards, the «beta» version was tested and only a few minor adjustments were necessary to produce the final version of the application. This version allows capture, transfer, and compilation of all inventory data as well as the production of a report used in granting an SPS 2.0 prescription.

In parallel, NHRI also worked with Lim Geomatics to use their new cruising platform for its silviculture prescription work.



[Lim Geomatics](#) and the NHRI are kindred spirits on the quest to digitally transform the forest industry. In 2006, Dr. Kevin Lim, President and Chief Executive Officer of Lim Geomatics, founded the company to operationalize his doctoral research on estimating the biophysical properties of forests using lidar data. Today, the firm has a team of developers, designers, and data scientists working from locations across Canada and from two main offices in Ottawa and Calgary. That original ethos of innovation has inspired a range of precision forestry technologies.

"We really understand how far you can push these tools and where they're going to have the biggest impact," says Candice Fulgencio, Director of Marketing and Communications. Lim Geomatics has specialized in creating precision forestry tools that go the extra step and allow foresters to address business problems, like how to reduce costs or increase merchantable volume, instead of just technical problems. "That's when we know we've hit that innovation sweet spot, when clients can ask the system a question and get an answer that drives efficiency or profitability," says Fulgencio.

Developing ways for clients to maximize the value of their investments in geospatial data is also what led Lim Geomatics to put such a high premium on design. "We have user-experience designers on staff because we've learned that the more accessible the tool, the more valuable it becomes."



PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

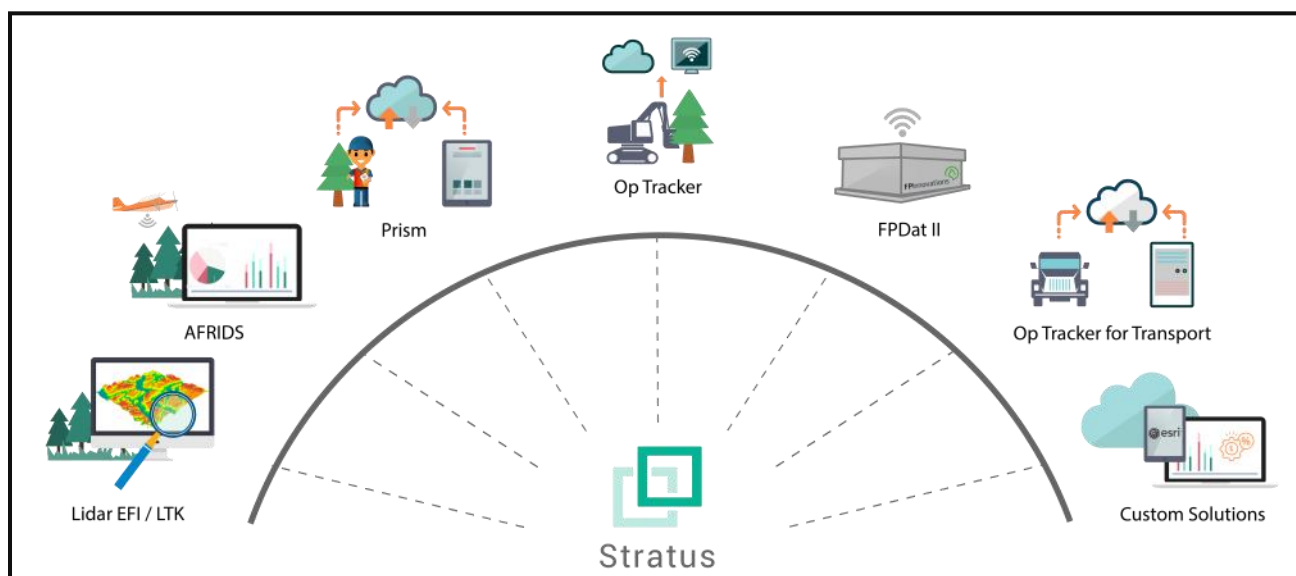
Showcase of projects with Lim Geomatics and Groupe Système Forêt – Forest inventory for decision making

Here are three examples of precision forestry tools created by your friendly neighbourhood innovation team at Lim Geomatics:

Stratus: They leveraged decades of forestry and geospatial domain expertise to develop this next generation asset and inventory management system. Clients can manage every step of the value chain—lidar-based inventory, cruising, road construction, wood flow logistics, short and long-term strategic plans—from one modern and intuitive interface. Stratus forms the hub of an integrated digital approach to forestry.

Prism: They developed this data collection and reporting application to meet the needs of every field-data entry aspect of the forest operations cycle. Prism was built tough and designed so it's easy to use under the canopy. It has a mobile and web component that work together to improve the quality and efficiency of data collection, from undertaking timber cruises before a harvest right through to site prep for the next fresh crop of seedlings.

Op Tracker: First released in early 2014, Op Tracker has become an indispensable tool for foresters and logging contractors across Canada and the United States. The digital solution consists of a web and a mobile application that work in tandem to provide operators and managers with the latest information from the field. The end result is more informed decision-making at every level of a harvest. We're talking right from the initial boundary marking of a block to machine operators cutting wood to frontline supervisors monitoring the harvest and all the way up to superintendents making long-term strategic plans.



Lim Geomatics: Forestry Geospatial Platform



PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

Showcase of project with Groupe Savoie inc. – Precision Operations planning

Since 2019, NHRI collaborates actively with Groupe Savoie's forestry department in the implementation of Precision Block Planning. Precision inventories that combine field timber cruises with remote sensing are conducted to assign silviculture prescriptions, set harvest productivity, and volume and sawlog recovery targets. Operational results are then compared to inventory-based forecasts to ensure follow-up and continuous improvement. This initiative is where we put the beta versions of our tools to the test and get feedback from end users.

More importantly the initiative establishes concrete targets that aim to improve the productivity of participating companies on several fronts. These targets are incentives and key process indicators for the teams involved (NHRI and Company) to think outside the box and strive to use the best available knowledge and cutting-edge tools. When those are not available, or not yet efficient enough from an operational perspective, our team finds the right partners to develop them and then work towards implementation as fast as possible - and the cycle continues.

« Hardwood operations vary a lot more than in softwood, which can impact greatly our contractor's productivity and our wood costs. »

Yves O'Brien

At NHRI we always strive to advance knowledge and tools by following the principles of Agile design and development. The precision block planning initiative is a perfect project for such an approach. It allows us to work with a multitude of partners (mainly IT and geomatics companies) to test out new technologies and processes to improve productivity. By setting out ambitious objectives, we force ourselves and our partners to focus on solutions and always think in terms of continuous improvement. Like Yves O'Brien* said: "With the help of the Institute, Groupe Savoie is working on the improvement of forest operations planning and execution using a management system and Precision Block Planning."

For the 2020 season, NHRI will assist Groupe Savoie inc. in the implementation of Precision Harvest Planning (page 25) by testing the most recent technologies available today. The coveted solutions



PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

Showcase of project with Groupe Savoie inc. – Precision Operations planning

should ideally allow coordination and data challenges across forest operations planning and scheduling. It should also centralize and make all the harvest, delivery, and destination information instantly accessible via an intuitive web interface and, finally, create a unified view of the supply chain to support collaborative, real-time planning and scheduling.

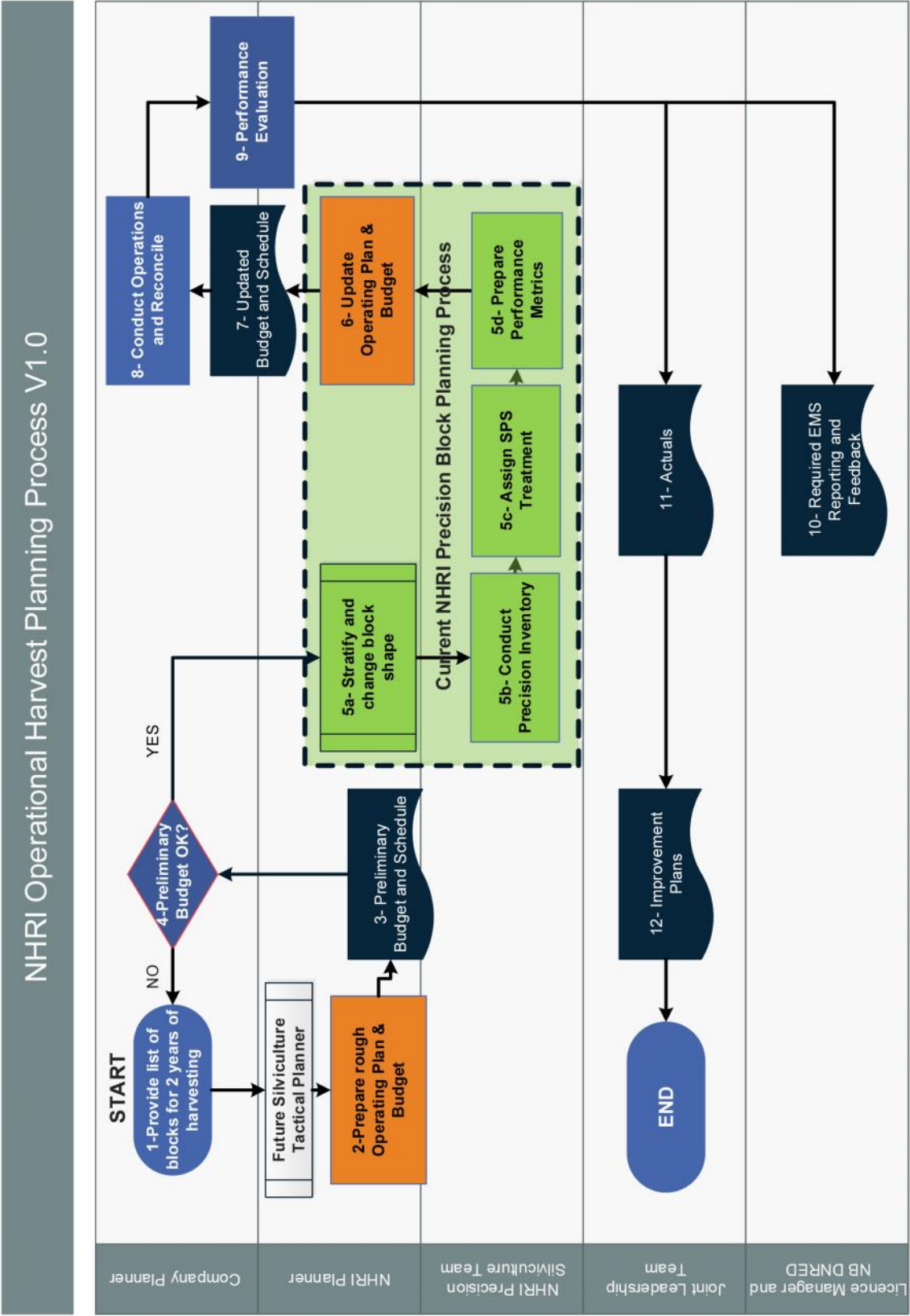
“The partnership with NHRI is a key element of this initiative. Their technical support, expertise and experience in forest inventory and precision tools are an important advantage for us. We have a lot of responsibilities in our day-to-day work and we just do not have at this time the resources Precision forestry requires. Beyond the obvious sustainable forestry objectives, we seek the same goals, control wood supply costs, stop contractor turnovers, make better decisions, and ease the whole wood supply process.”



Native from Saint-Quentin, Yves O'Brien is Procurement Vice President at Groupe Savoie inc. He has a forestry degree from la Faculté de foresterie of Université de Moncton, and he is responsible of all wood fiber procurement, from round wood to biomass either from Crown lands or private woodlots.



PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY





PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

Showcase of project with Remsoft – Tailoring digital supply chain optimization to small to medium-sized enterprises in forestry

Forestry supply chains are composed of businesses of all sizes: a complex network of companies that range from large, multi-national organizations, to middle-sized businesses with 100-500 employees, and small businesses with 10 or more employees. Each business fills a niche and plays a key role in growing, harvesting, processing, and delivering wood products to market.

The large companies manage greater volumes of product, have bigger budgets, and more staff with a wider range of skills. Small to medium-sized enterprises (SMEs) are leaner and nimbler. Regardless of size, however, they all face the same challenge of managing a complex forestry supply chain.

Options for managing your operation within a complex supply chain sometimes favor the larger companies. Large companies can afford specialized software solutions that help to optimize their planning, tracking and efficiency and allow them to engage more effectively with other stakeholders in the supply chain. In many cases, these software solutions are designed for larger, multi-site operations, and they are beyond the reach of the SMEs who equally need management and optimization tools for their business.

Digital Forestry Solutions for SMEs

Recognizing an opportunity to improve operations and lower costs for SMEs through digital supply chain management, Remsoft and NHRI have partnered to support best practice implementation of the [Remsoft Operations Cloud](#) within small and medium-sized enterprises in the forestry sector. The first SME pilot implementation is underway this month with a leading producer of hardwood products in Canada. Research for the project is supported through the New Brunswick Innovation Foundation's (NBIF), [Innovation Voucher Fund](#).

[Remsoft](#) is a leading provider of forestry software solutions for planning, scheduling, and operational management. For more than 25 years, Remsoft solutions have helped global forest companies and government to develop and manage sustainable, repeatable solutions. These solutions focus on increasing efficiencies, managing risks, and reducing cost: outcomes businesses of all sizes strive for.

[NHRI](#) brings their unique expertise in data and research related to the management of hardwoods and mixed forests to the partnership; and their experience in developing solutions to forestry management challenges including resource growth, silviculture prescriptions, timber value and long-term sustainability.



PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

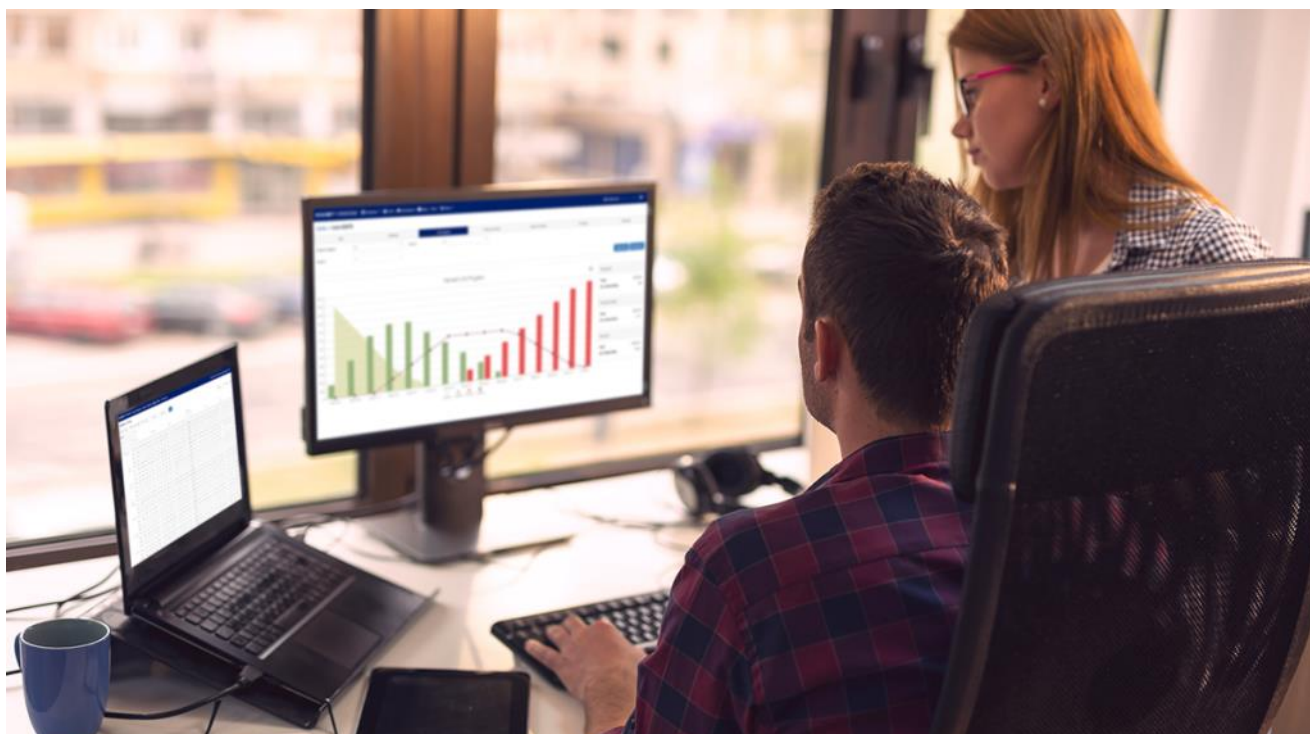
Showcase of project with Remsoft – Tailoring digital supply chain optimization to small to medium-sized enterprises in forestry

The Remsoft Operations Cloud

Remsoft Operations is a cloud, SaaS solution for managing the forest supply chain. Within the Remsoft Operations Cloud, forest product companies can consolidate and connect all the people, processes and data sources needed to manage the entire supply chain from the forest to the mill. It provides real-time supply chain visibility to support better operational management, improve costs and margins.

The ability to see everything in one, real-time view is key to unlocking cost savings, revenue, and performance opportunities across the forest value chain. And, with its cloud architecture and modular design, Remsoft Operations can scale to any company's needs.

Large, global operators with hundreds of users, across different teams are actively planning and scheduling in the Remsoft Operations Cloud, and the system is being used to manage thousands of harvest units and several millions of tons of fibre. The project with NHRI is focused on streamlining the implementation process, data preparation, and data integration templates and procedures to drive down implementation and ongoing costs such that SMEs can adopt the Remsoft Operations Cloud for improved supply chain management and control.



View harvest progress, from standing volume to roadside, in the Remsoft Operations Cloud.



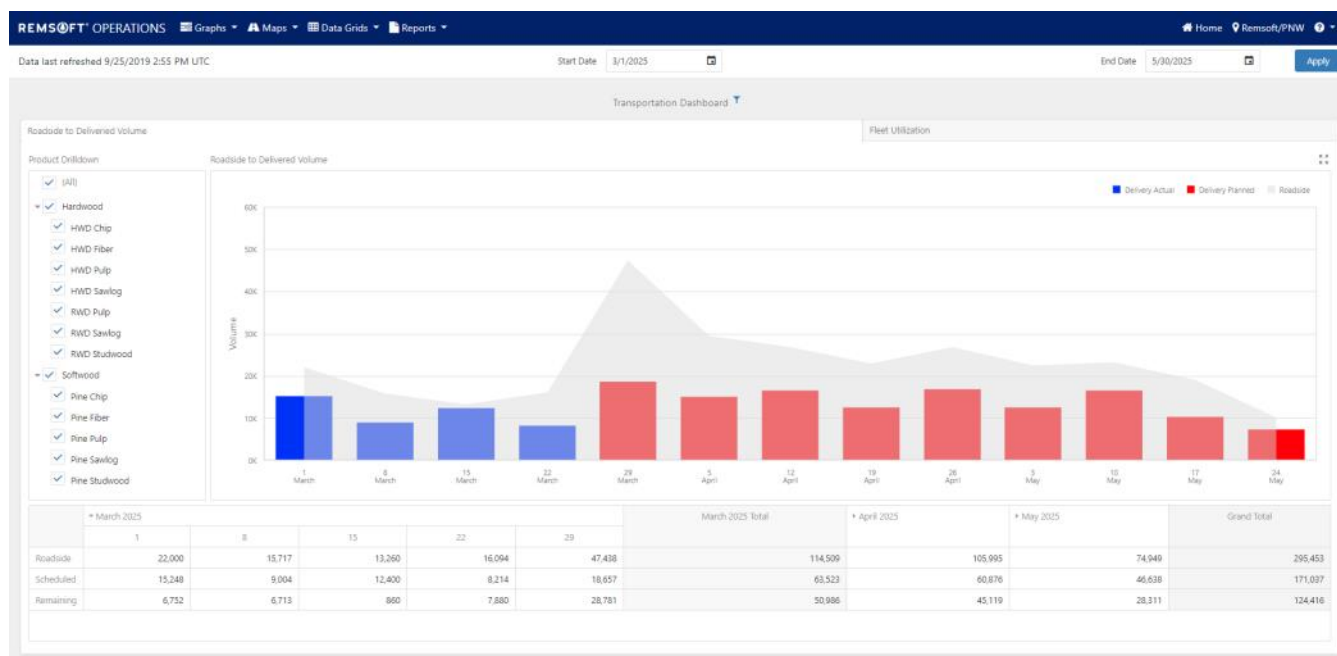
PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

Showcase of project with Remsoft – Tailoring digital supply chain optimization to small to medium-sized enterprises in forestry

Steps to Success

A key challenge for small to mid-sized businesses adopting digital forest supply chain solutions such as Remsoft Operations is preparing the necessary data. The NHRI-Remsoft partnership will leverage NHRI's expertise to overcome this challenge by streamlining the implementation process, including data preparation and integration.

As a first step, Remsoft, NHRI and the SME end users will work together to prepare, review, and validate the SME's existing operational data. Remsoft experts will then determine the data load requirements and confirm the data transfer schedule/frequency. Next, Remsoft will provide a streamlined version of Remsoft Operations and work closely with the SME to load data, tailor the software to their needs, and configure it to align with complimentary software, such as Esri ArcGIS.



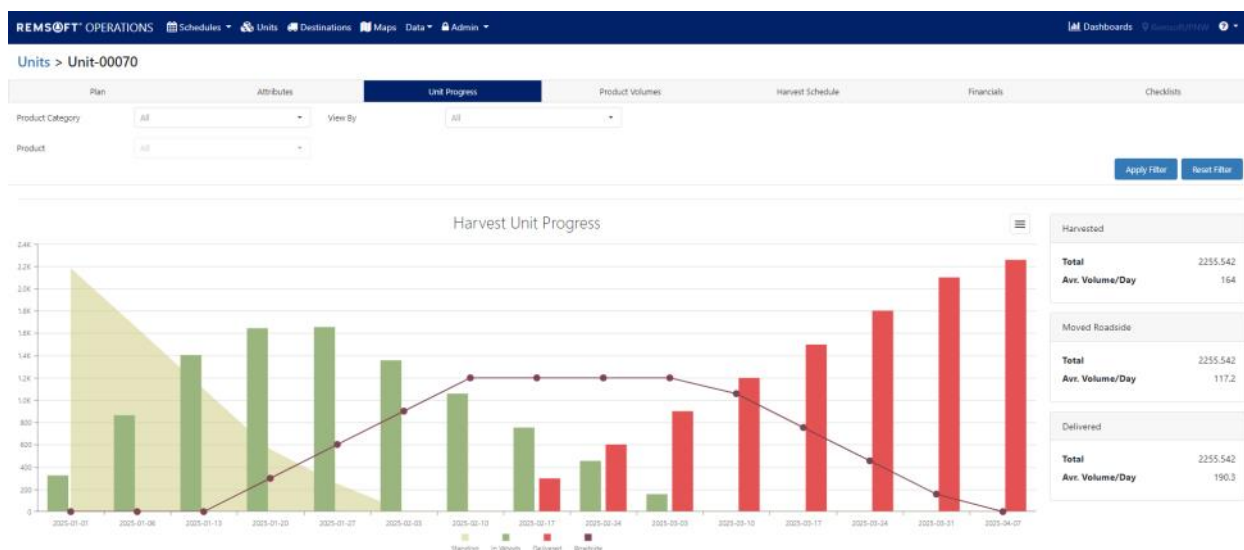
View planned and actual delivered volumes, against roadside volume, in the Remsoft Operations Cloud.

The overall goal of this project is to streamline the Remsoft Operations implementation process for SMEs with a scope and budget that is within reach of the SME market. During the project, Remsoft will work in tandem with clients to identify areas for improvement to the product and implementation process to support the SME market.



PROMISING PARTNERSHIPS TO MAKE DIGITALIZATION OF THE FOREST PRODUCTS VALUE CHAIN A REALITY

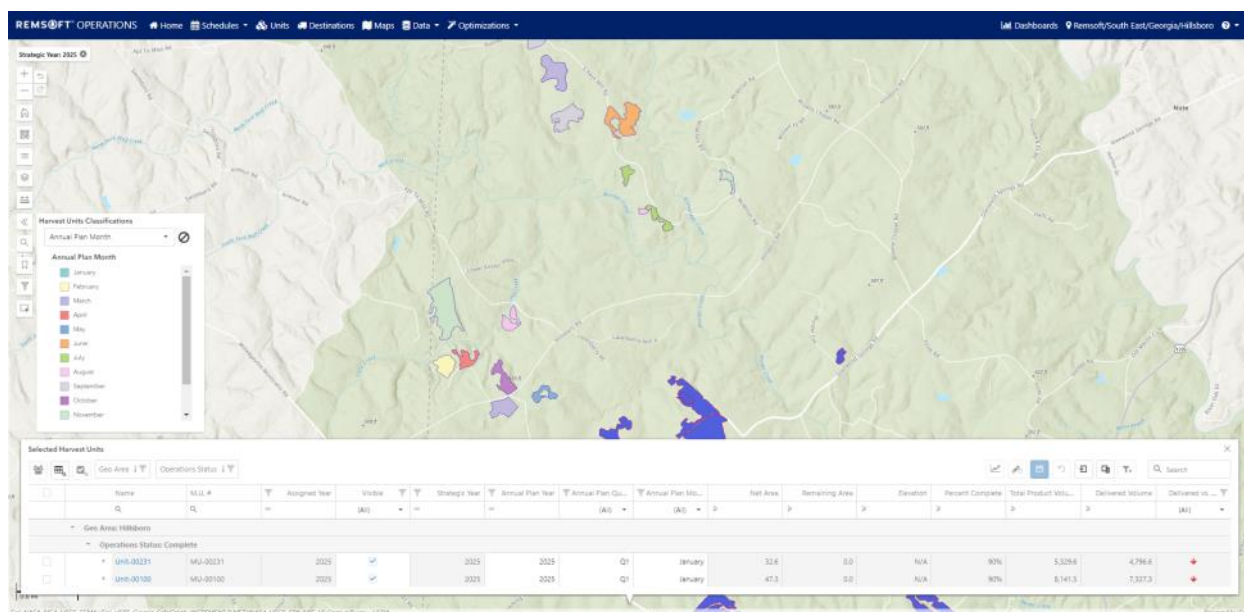
Showcase of project with Remsoft – Tailoring digital supply chain optimization to small to medium-sized enterprises in forestry



View of Harvest Progress in Remsoft Operations.

Stronger Together

Beyond the pilot project, Remsoft and NHRI hope that by tailoring digital supply chain solutions to SMEs, this will contribute to improved operations, better delivered wood costs for the forest sector and a sustainable and globally competitive SME forestry sector in the province of New Brunswick and beyond.



Map View of Annual Plan in Remsoft Operations.



FACES OF NHRI

The people behind NHRI's precision forestry initiatives



Gaetan Pelletier - Executive Director

As the executive director, Gaetan is accountable for everything that goes on at NHRI. He manages the team and all the ins and outs associated with running an applied research center. On top of reporting to the board, constantly identifying new funding opportunities and developing promising partnerships; Gaetan is also a hands-on director who likes to get involved with partners, clients and supporting the team in delivering projects and products.

Expertise: * Applied research operations and management

- * Forest management strategies
- * Forest operations and management
- * Silviculture and ecology
- * Large-scale practices for planted stands, natural mixes woods and hardwoods
- * Leading edge precision forestry trends and available tools

Joey Volpe - Knowledge Mobilization Manager

Joey's diversified background and versatile skill set are an asset for our team and more importantly for our clients trying to navigate the innovation ecosystem. His role within our team is to manage knowledge mobilization. Joey is the person responsible for making sure the knowledge we develop at NHRI is useful and accessible to our partners and clients. Whether it's for launching a new training, promoting a new product or making sure we share the results of a study with the world; Joey is responsible for leading our knowledge transfer activities. Part of his time is also spent recruiting and managing clients and identifying and pursuing new projects and business opportunities.

Expertise: * Applied research operations and project management

- * Business development and client management
- * Innovation funding opportunities and financial leveraging
- * Marketing and knowledge mobilization



**FACES OF NHRI***The people behind NHRI's precision forestry initiatives***Pamela Hurley Poitras - Silviculture Specialist and Drone Pilot**

Pam joined the NHRI team in 2013 and she has played a pivotal role in our organization ever since. She is often relied upon as the link between applied field knowledge, industry partners, cutting edge technology and our research team, a forest management Rosetta Stone of sorts. Since joining our team, Pam has worked on a wide variety of projects from detecting change in canopy structure using 3D modeling, to creating HD inventory in the McCoy Brook area and investigating the use of remote sensing for regeneration characterization. To say that she has kept herself at the cutting edge of technology when it comes to forest management would be an understatement.

Expertise:

- * Silviculture operation's management
- * Drone piloting
- * GIS field application and data analysis
- * Precision Forestry equipment and field application

Monique Girouard - Project Coordinator

Monique Girouard has been part of our team at NHRI since 2013. Since then, she has occupied various roles and managed several key projects for our partners and clients. Her official title is Project Coordinator, but contrary to most who have a similar title she is responsible for providing support to many projects at the NHRI as well as creating training packages.

Expertise:

- * Applied research project management
- * Continuous improvement processes
- * Growth and yield modeling
- * Various in-analyses and models developed by NHRI





FACES OF NHRI

The people behind NHRI's precision forestry initiatives



Jeannot Lebel - Forester

Jeannot's role at NHRI is to bring support to our field operations in terms of planning and the development of new forest management tools. Over the next year, Jeannot will be working on developing the NHRI Tactical Silviculture Planner (TSP). His mandate will be to put together a variety of tools developed by NHRI and our partners into an easy to use and accessible forest management toolkit. Jeannot will also work closely with our Precision Forestry Team in order to validate and field-test these new technologies and bring them support in terms of planning the NHRI's field operations.

- Expertise:
- * Forest management planning
 - * Forest operations and management
 - * Silviculture and field operations
 - * Application and interpretation of forest management tools – GIS, LIDAR, Remote sensing technologies, etc.
 - * Forestry regimes and requirements in both New Brunswick and Québec

Dr Ines Khedhri - Scientific Researcher

Her work at NHRI revolves around researching modelling approaches applicable to the prediction of regeneration, quality and growth of northern hardwoods. She is currently building a statistical model that will help better predict the growth and quality of hardwoods in a given stand. The models constructed by Ines will serve to develop various field tools to help foresters better predict these variables based on field data. Doctor Khedhri brings a wealth of knowledge to our team, especially when it comes to her experience in managing large databases and developing statistical models.

- Expertise:
- * Modeling and statistical analysis of remote sensing forest data
 - * Development of modelling and statistical analysis approaches applicable to the prediction of regeneration, quality and growth of northern hardwoods



**FACES OF NHRI***The people behind NHRI's precision forestry initiatives***Jennifer Amanda Cyr - Forester**

Jennifer is comfortable working in both forest operations and knowledge mobilization. Her main duties revolve around working within the Precision Silviculture Team where she is responsible for completing and coordinating field work related to service contracts and research and development projects. She also works on certain aspects of GIS data analysis. Jennifer is sometimes called upon to bring a helping hand when it comes to mobilizing the knowledge developed in the field.

Expertise:

- * Forest data collection and analysis
- * Forest inventory using cutting edge technology
- * GIS applications to field work and planning
- * Knowledge mobilization

Angela Oliveira - Graduate Student

Angela's work is focused on investigating the benefits of commercial thinning in hardwood forests. Under the guidance of Tom Erdle she is working on modeling the impacts of commercial thinning treatments at both the stand and forest level.

Expertise:

- * Extensive experience in forest production planning (strategic, tactical, and operational levels – harvesting and transportation)
- * Optimization modelling
- * Economics and feasibility studies
- * Database management and data analysis



**FACES OF NHRI***The people behind NHRI's precision forestry initiatives***Anis Zouagui - Graduate Student**

Anis' work is focused on developing a model for predicting the production potential of tolerant hardwoods. This tool will identify and classify sites based on their potential to produce high quality tolerant hardwoods. And thereafter, to support silvicultural methods that encourage the sustainable yield of the desired species and products.

- Expertise:**
- * Research in remote sensing and geomatics applied to forestry
 - * Spatial and statistical analysis of spatial reference data
 - * Production of detailed information on the forest by remote sensing, GIS, LiDAR
 - * Integration of multi-source information in decision support systems

Stéphanie Landry - Graduate Student

Stéphanie's research centers around the use of remote sensing tools, such as satellite and LiDAR, to determine characteristics of regeneration. Stéphanie's main research project is attempting to fill that void by estimating regeneration occupancy in the Acadian forest of New Brunswick using a combination of satellite images and LiDAR. This project will also help better understand the limits of remote sensing in terms of its ability to penetrate through the forest canopy and thus be a useful tool to estimate regeneration characteristics. She is also investigating herbivory pressure (browsing) on regeneration.



- Expertise:**
- * GIS and remote sensing (satellite images and LiDAR)
 - * Wildlife ecology and management
 - * Statistical modeling
 - * Scientific vulgarization
 - * LASTools
 - * Forest Regeneration



FACES OF NHRI

The people behind NHRI's precision forestry initiatives



Mohammed Henneb - Post-doctoral fellow

Mohammed's postdoctoral project is a partnership between the K.-C.-Irving Research Chair at the Université de Moncton and the NHRI. It aims on the modelization of commercial hardwoods sapling density in the Acadian forest. The main goals of this project are to : 1) assess the effects of the silvicultural, environmental, and, ecological variables on the sapling density of those species; 2) generate statistical probabilities of the species-specific sapling density. The results of this study will contribute to improve our knowledge on the hardwoods regeneration in the Acadian forest. Finally, these results will give operational answers (silviculture guidelines) to our industrial partners.

Expertise:

- * Forest ecology
- * Forest regeneration and forest management
- * Forest soils
- * Cartography (GIS)
- * Statistical analysis of ecology data

Marie-Andrée Giroux - Collaborator

Marie-Andrée is an assistant professor at Université de Moncton and holds the K.-C.-Irving Research Chair in Environmental Sciences and Sustainable Development since 2016. Her research program aims at understanding how human activities affect connections between ecosystems that are established, for instance, through migration and movement of wildlife across ecosystem boundaries. She works on a range of biological models, including mammals and birds inhabiting temperate and arctic environments. In parallel of her graduate and postdoctoral experience in Université du Québec à Rimouski, Université Laval and University of the Arctic (Norway), Marie-Andrée acquired professional experience with the Government of Nunavut and the Centre de la science de la biodiversité du Québec. This led her to develop a collaborative and interdisciplinary approach that aims to feed policy makers with the knowledge required to implement evidence-based policies in a world under global pressures.



**FACES OF NHRI***The people behind NHRI's precision forestry initiatives***Yves Claveau - Collaborator**

Yves is a forester and possesses a master in dendrometry and silviculture. He also did doctoral and postdoctoral studies to improve his comprehension of trees and forest ecosystems. This specialization gave him the opportunity to carry out terms as auditor and chief auditor according to forest management norms of Forest Stewardship Council. Lately, Yves teaches natural resources management, vegetal ecology, and statistics in different universities.

Yves's work at NHRI focuses on assessing the vulnerability of New-Brunswick forests to climate change. He also wishes to identify new approaches that will improve the adaptation of silviculture or hardwoods and mixed forests to those changes. Yves will also have the occasion to comment training videos and courses produced by NHRI.

**Learn More
On Our Team**





SPOTLIGHT ON OUR PARTNERS

Congratulations to Nicholas Coops for receiving the world's most prestigious forestry honour, the Marcus Wallenberg Prize.

What is the Marcus Wallenberg Prize?

- The Marcus Wallenberg Prize is **ranked as the world's highest recognition for excellence** within the field of forest industry research.
- Considered to be the Nobel Prize of forestry, the Marcus Wallenberg prize is presented to the winners by **King Carl Gustaf XVI of Sweden**.
- The Prize recognizes groundbreaking scientific achievements that significantly contribute to technical development and broadening knowledge in fields important to forestry and forest industry.

Who is [Nicholas Coops](#)?

- Professor at University of British Columbia (UBC) in the Faculty of Forestry
- Canada Research Chair (Tier 1) in remote sensing
- Head of the Integrated Remote Sensing Studio (IRSS) within the Faculty of Forestry at UBC
- Has published over 460 peer-reviewed journal papers
- Was the editor in chief of the Canadian Journal of Remote Sensing for 10 years
- In 2018-2019, he collaborated (through the AWARD project) with NHRI ([see video here](#)) on the use of repeated super-high-resolution UAV multispectral imagery to understand how tree phenology can be leveraged to increase accuracies of spectral and point cloud products. Two scientific papers were produced by his graduate students in record time:
 - **Examining the Multi-Seasonal Consistency of Individual Tree Segmentation on Deciduous Stands Using Digital Aerial Photogrammetry (DAP) and Unmanned Aerial Systems (UAS)**
 - **Vegetation Phenology Driving Error Variation in Digital Aerial Photogrammetrically Derived Terrain Models**



[Presentation of the prize by Mikael Hannus](#), executive secretary of the Marcus Wallenberg Foundation.

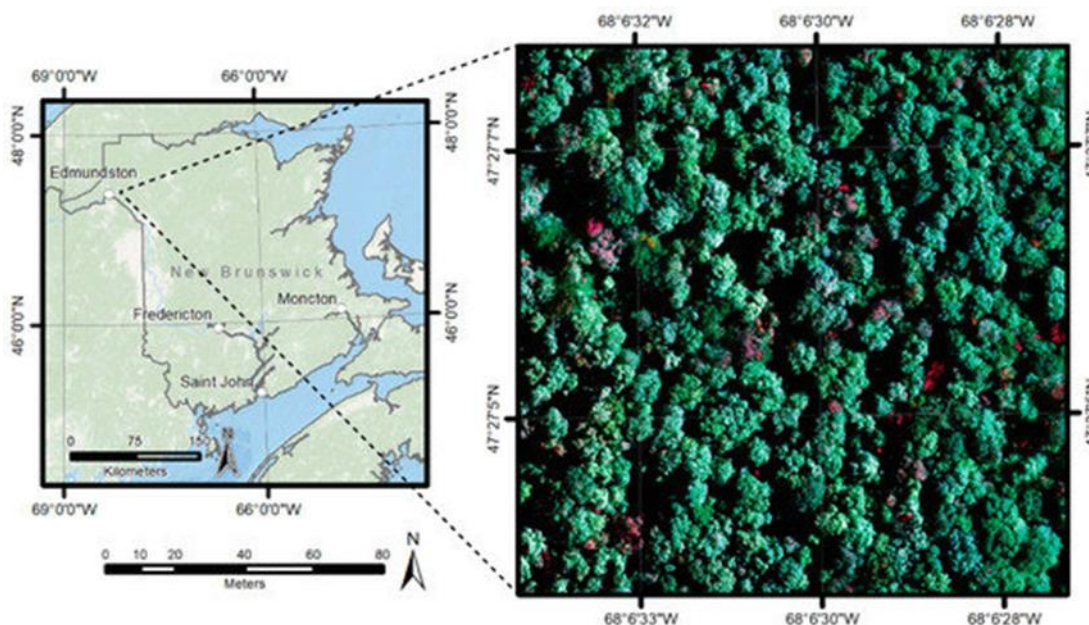


SPOTLIGHT ON OUR PARTNERS

Congratulations to Nicholas Coops for receiving the world's most prestigious forestry honour, the Marcus Wallenberg Prize.

From 2015 to 2017 multiple imagery acquisition using drones were undertaken by the NHRI's Precision Forestry Unit in the McCoy brook research and training forest area of New Brunswick. Based on those images, and by using a promotion algorithm, Dr. Coops researchers at the Integrated Remote Sensing Studio of the University of British Columbia (IRSS-UBC) were able to generate three-dimensional recreations of these forests. This line of research can help us better understand how forests are structured and create useful geospatial data, like digital terrain models.

The NHRI Team wish to congratulate Dr. Nicholas Coops for receiving the world's most prestigious forestry honour, the Marcus Wallenberg Prize.



McCoy Brook study area near Edmundston; an orthophoto of 25 July 2017 is displayed in a false color composite of red, green, and near-infrared. Both maps are projected in WGS 84/UTM zone 19N.

- The more we know about our forests, the better we can manage them !
- Imagery acquisition timing influences tree height measurement and tree detection accuracy !
- Drones are key tools to helping us be more sustainable & responsible !
- Timing of DAP acquisitions can influence the accuracy and coverage of DTMs in low cover vegetation areas !



UPCOMING EVENTS

Due to the restrictions in place because of the pandemic, there are no trainings, or in-person workshops planned for the moment. However, we are very busy making content available electronically for our followers. The NHRI currently has many videos available and easy to access through our YouTube Channel on the following subjects:

- **NHRI:**

- ⇒ Business Model

- **TOOLS:**

- ⇒ Precision harvest treatment tool
 - ⇒ New Brunswick tree classification system
 - ⇒ Stand density management diagram

- **WORKSHOPS:**

- ⇒ Tree bucking
 - ⇒ Towards hardwood sawlog yield increase

- **CONFERENCE:**

- ⇒ 2019 CWF Fall meeting presentations

- **SPS:**

- ⇒ Silviculture Prescription System (SPS)
 - ⇒ Trees from the same disturbance
 - ⇒ Over mature strata and patches of intolerant hardwoods and fir
 - ⇒ Shade tolerance
 - ⇒ Horizontal structure
 - ⇒ Base live crown
 - ⇒ Basal area
 - ⇒ AGS and UGS
 - ⇒ Acceptable regeneration

- **MISCELLANEOUS:**

- ⇒ « Our forest at risk » (climate change)
 - ⇒ Collaboration — NHRI & IRSS (UBC)
 - ⇒ Operational trial of UAV-Based LIDAR scanning
 - ⇒ Optimizing the Hardwood Value Chain





UPCOMING EVENTS

The NHRI also has online courses available via the [UdeMy](#) platform, for which you can register free of charge. The « Introduction to Hardwood Tree Bucking for Value » course is ready to go and we will post new ones as they become available.

⇒ **UdeMy (French Version)**



⇒ **UdeMy (English Version)**



THE LEAFLET

**NHRI'S QUARTELY
NEWSLETTER**



"SMART ADAPTIVE SILVICULTURE
IN CHALLENGING MIXED AND HARDWOOD STANDS "

2022 NORTHERN HARDWOODS CONFERENCE
UNB-AFRC/NHRI

NORTHERN HARDWOODS CONFERENCE 2022

"SMART ADAPTIVE SILVICULTURE IN CHALLENGING MIXED AND HARDWOOD STANDS "

Conference organized by:

**UNB's Atlantic Forest Research Collaborative
Northern Hardwoods Research Institute**

Fredericton, NB
2022



Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.





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