NORTHERN HARDWOODS RESEARCH INSTITUTE'S QUARTERLY NEWSLETTER

ALL 202



HARVEST KNOWLEDGE, PROMOTE GROWT

THE CHALLENGES OF GROWING MORE HARDWOOD

VOLUME AND BETTER QUALITY

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

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HARVEST KNOWLEDGE | PROMOTE GROWTH

FOREWORD Pamela Hurley Poitras, Silviculture Specialist/Drone Pilot

Welcome to the Fall edition of the Leaflet.

ALL 2021

I bet if you ask any foresters what's the best season to be in the woods, they will probably say fall is the best time of the year with no flies, beautiful temperatures, breath taking colours and let's not forget hunting season for many. Speaking of hunting hope all moose hunters had a safe and successful hunt!

Going back to the summer which treated us with nice warm weather, NHRI foresters were very occupied with Precision Block Planning and working on establishing Digital Timberland 20/20 Frames and trying new Drones with LiDAR. Stay tuned for updates on this exciting technology in the winter edition!

As field work advanced, it was noticed that the regeneration of commercial species was a bit scattered, which brings me to our main topic; "Can intermediate treatments in mixed and hard-wood stands fix the anticipated shortfalls in volume, piece-size, species composition and quality for New Brunswick? "



It's a very important question to ask ourselves to ensure the future of our forest can be fruitful for many generations to come.

New to our Newsletter will be a literature monitoring from M. Michel Huot, a retired researcher from Ministère des Forêts, de la Faune et des Parcs du Québec with a keen interest in what is going on and what is being done in the research world.

Enjoy your read and feel free to let us know what you think. NHRI is always opened to suggestions, ideas or just good critical feedback.

Pamela Hurley Poitras Silviculture Specialist/Drone Pilot

VOLUME 3, ISSUE 4





Above: A yellow birch stand that received PCT 25 years ago and on track to receive a commercial thinning soon

INTRODUCTION

For the forest sector of New Brunswick that is dependent on the hardwood resource, the situation is alarming, and the un-mitigated future looks bleak. Like a perfect storm of sorts, the growing stock is diminishing while the proportion of desired species is dropping at the detriment of interfering and less financially attractive species such as American beech, balsam fir, red maple and shade-intolerant hardwoods. To add insult to injury, the proportion of large trees and overall quality will continue to decrease which is a terrible constatation for our facilities that depend on high-grade material.



The actual magnitude of these shortfalls is yet to be figured out and the staff of the New Brunswick department of Natural Resources and Energy Development along with all members of the forest sector in our Province are working hard on understanding the issue as they prepare the next strategic management plan. One potential solution that is currently being considered is to increase intermediate treatments (i.e. thinning) in young mixed and hardwood stands.

We are all familiar with thinning of softwoods, where the goal is to focus the site's growth potential on the crop trees by removing individuals of less desirable species, inferior quality, and poor growth potential. Thinning is a family of intermediate treatments implemented in young, even-aged stands – to optimize site productivity, control species composition, and improve overall stand quality (Figures 1 and 2). The most common treatments are pre-commercial thinning, commercial thinning, and the crop tree release variant. Will this work? Do we have enough experience in and out of our Province to determine the effectiveness of those treatments as partial or complete reversal of the situation to come?

Intermediate treatments become more important if the landowner's goal is to produce high quality sawlogs. High quality sawlogs are produced only from high quality trees of desired species. At the young stage, it is important to increase the proportion of high-quality trees of desired species and make them to grow faster. This

can be done through stand density management (pre-commercial or commercial thinning) at different stages of stand development. Undesirable species and poor-quality trees of desirable species are generally removed to provide better growth condition for high quality trees of desirable species. Density regulation treatments in young, evenage stands can be part of the answer, but only if we pay attention to some key concepts.



This young yellow birch stand is an ideal candidate for a crop-tree release variant PCT with an average height of more than 6m, good crown differentiation, natural pruning and more than 5000 stems per hectare.

A RECAP ON DENSITY REGULATION TREATMENTS IN YOUNG EVEN-AGED STANDS

Pre-commercial thinning (PCT), carried out in well-stocked stands with an adequate number of well-distributed crop trees, is intended to reduce stand density to a certain target (i.e., 2,500 stems/ha) at the sapling stage. The treatment is generally conducted when the trees have a DBH of less than 10 centimeters, and it is usually carried out using brush saws. Commercial thinning is conducted in older stands once the trees have reached pole size (10-20 cm) and can generate some products such as pulpwood. The treatment is well suited for small, wheeled harvesters. The crop tree release variant can be used in either case. Rather than space trees uniformly. the focus is solely on releasing the crowns of selected crop trees (200-400/ha), leaving



Figure 1: The key features of even-aged forest management

NHRI Silviculture Prescription System LEARN ABOUT OUR



CLIENT DRIVEN.

We take great pains to ensure that our cli-ents' needs are understood and elevated to priority number one. All activities within our walls start and end with fulfilling the needs of our clients. Our research is client centric and aims to find solutions for various forest management stakeholders.









Figure 2: A stand development pathway following a major disturbance and timing by thinning types (Adapted from Kerr and Haufe 2011)

2- GUIDELINES FOR CONDUCTING THINNING IN MIXED AND HARDWOOD STANDS

One thing we know for certain is that conducting thinning operations in the same manner as in softwood stands does not work. Studies of pre-commercial thinning operations from more than 20 years ago reveal that the systematic spacing of crop trees, without attention to species and quality, can have negative consequences. Such an approach is not likely to improve species composition and quality, which are the main objectives in applying the treatment. Silviculturists need to adjust their thinning prescriptions in mixed and hardwood stands.



MAINE'S FORESTS ARE GETTING DENSER, AND THAT'S NOT NECESSARILY A GOOD THING



"There is a need for more active forest management to prevent trees from dying off or succumbing to climate change-related stressors"

Aaron Weiskittel,

LEARN MORE

Director of the Center for Research on Sustainable Forests at the University of Maine

What happens when a forest gets too dense? Trees get too crowded and begin to die off. They become stressed for resources (water, nutrients and sunlight). Crowded and stressed forest are more vulnerable to climate change-related stressors, wildfire, insects and diseases.



 Table 1: Intermediate treatment description

	DESCRIPTION
PRE-COMMERCIAL THINNING	STAND: Well stocked stand with adequate number of well distributed crop trees* Crop trees are at the intense competition (not in the dominant crown position) TREATMENT: Reduce stand density at the young stage (2500 stems/ha) OBJECTIVE: Change/control species composition Promote growth of desired species Improve stand quality
MMERCIAL THINNING (CT)	STAND: Adequate number of well distributed crop trees Fully or overstocked stand TREATMENT: Reduce stand density at the pole stage (Thin to Q-line or B-line) OBJECTIVE: Change/control species composition Promote growth of desired species Improve stand quality Obtain intermediate products
CROP-TREE RELEASE VARIENT (CTR)	STAND:Limited number of crop trees are availableCrop trees are intermixed with non-desirable/ or low-quality speciesTREATMENT:Only 300-400 best quality trees are released either at young or at the pole stageOBJECTIVE:Promote growth and quality of selected crop trees





Source: http://www.extension.umn.edu/distribution/naturalresources/images/3473-12.jpg

Crown position	Description
Dominant	The crown extends above the general layer of the stand and intercepts direct sunlight across the top and upper branches
Co-dominant	The crown is within and helping to form the main canopy for the stand and intercepts direct sunlight mainly across the top and upper side branches
Intermediate	The crown extends into the lower part if the main canopy and only intercepts direct sunlight on a limited area at the top.
Suppressed	The crown is entirely below the main canopy and covered by branches of taller trees with little, if any, direct sunlight reaching it.

Source: Kerr and Haufe 2011

avoid treating stands that have high proportions of intolerant hardwoods and Balsam fir. Focus attention on co-dominant trees with symmetrical and oval crowns (avoid vase shape), and a crown ratio of greater than 50 percent. Boles should be straight, and free of defects and large branches or forks. Trees that are already in a position of dominance respond poorly to any type of thinning, as they are already free to grow (see Figure 3 and Figure 4), in addition to the fact that they are usually of poorer quality, with large limbs and crowns. Whenever possible, avoid leaving trees that regenerated from stump sprouts and if the proportion of these are too high, stratify your stand to take those areas out of your thinning plan. Finally, pay attention to small trees that are not necessarily young. Old but small trees have usually witnessed a long period of suppression and will not develop into quality material as described in Figure 5.

The first consideration is the quality of crop

trees. Give priority to desired species, such as yellow birch, Sugar maple, and oaks and





Figure 4: Diameter growth comparison between yellow birch trees in an undisturbed stand (grey circles) and a stand subject to PCT (red and blue solid lines). DBH= over bark diameter in cm. Stand age=breast height age + years to reach breast height





Figure 5: Effects of suppression history on growth and wood quality. Photos shown in the upper column are the crosssection at the breast height of the same diameter trees but different age. When the stand was harvested, the one in the left was 52 years old and the one in the right was just the 4. After harvesting, both grew well but the one on the left developed significantly larger discoloured wood column compared to the one in right. When all the samples were analyzed together, similar result was observed (see lower graph "B": old=advanced regeneration, and young=regenerated after harvesting). In the case of yellow birch, no yellow birch sample associated to suppression history at the sapling stage was available. However, the new grown yellow birch in intermediate crown position developed relatively larger discoloured wood column than dominant and co-dominant yellow birch trees (Figure A). CP=crown position, C=codominant, D=dominant and I=intermediate. Error bars indicate 95% confidence interval.



Table 2 Intermediate treatments eligibility for a fully stocked stand. YB=yellow birch, SM=sugar maple, RM=red maple, TA=trembling aspen, WB=white birch. PCT=pre-commercial thinning, CT=commercial thinning and CTR=crop tree release.

	STAND AGE		STAND AGE	
SPECIES COMPOSITION	<20 Years (QMD<10 cm)	20-40 Years (20 cm>QMD>10 cm)		
YB (>60%) dominated stand	Wait, PCT	СТ		
SM (>60%) dominated stand	Wait, PCT	ст		
YB in dominant crown class and SM as co-dominant	Wait, PCT	ст		
RM in dominant crown class, SM and YB as co-dominants	PCT, CTR	CT, CTR		
TA and WB in dominant crown class, RM, YB, SM as co- dominants	PCT, CTR	CT, CTR		
Other but adequate number of YB and SM crop trees	CTR	CTR		
Other but inadequate number of YB and SM crop trees	Out of scope	Out of scope		

When considering pre-commercial thinning, the height of the saplings is of particular importance. For hardwoods, we recommend treating a stand only when it has reached a height of six meters. This will ensure that some self-pruning has occurred, minimizing the potential for large branches to develop. It also allows for natural differentiation among potential crop trees, making selection easier.

More importantly, we recommend looking at density regulation holistically, not just in terms of identifying stands to justify a specific operation. In other words, when stand parameters are marginal, it is perfectly acceptable to skip PCT and wait for the stand to become eligible for commercial thinning with small harvesters. Again, the goal is to focus growth on a few crop trees. That will happen on its own if the treatment is properly conducted. Similarly, in a stand with high potential to grow quality, tolerant hardwoods might receive both a pre-commercial and a commercial thinning treatment.

3.1- THE CROP-TREE VARIANT

The crop tree release (CTR) variant applies to both types of thinning. It offers the advantages of reducing costs, focus on future crop trees by performing positive selection and adjusting the composition in stands with some variability. We recommend choosing between 200 and 400 crop trees per hectare; releasing



their crowns on at least three sides; and leaving the rest of the stand largely untouched. Silviculturists can communicate to silviculture workers what the outcome might look like by referring to spacing (Table 3-pg. 16) but the concept may lead to systematic spacing if not explained properly. It is desirable to leave small companion trees that do not interfere with the crop tree, to provide shade along their stems and reduce the likelihood that it will grow large limbs on the bole (Figure 6).

Box 1: Criteria for selecting a crop tree

Criteria	Description	
Species	Give priority to desired species (Yellow birch, sugar maple)	
Crown class	Dominant and co-dominant	
Crown form	Symmetrical crown, CR>50 %, oval shaped crown (avoid vase shaped)	
Bole	Straight, absence of any disease or defects	
AGS	R ₁ , F ₁ : good health, no low forks	
Origin	Avoid stump sprouts as possible	



Figure 6 –left, A graphic representation of crop tree release for any development stage (source: Miller et al 2007)

Right- A young hardwood stand that received PCT 20 years ago. The treatment removed too many stems and large branches developed.



3.2 - SAPLING-STAGE STANDS

Sapling stage stands are the young stands (age <20 years) with mean stand diameter less than 10 cm. Thinning a stand at this developmental stage is known as pre-commercial thinning because cut trees have not reached to the merchantable size. Three different regime pathways are represented in Figure 7.



Figure 7: Schematic representation of the intermediate treatments applied in sapling stage stands. Upper row=stand condition before treatment, Lower row= stand condition before treatment. Trees within red circles=crop trees released after the operation. SM=sugar maple, YB=yellow birch, RM=red maple, OTH=Other hardwoods.

Studies at the Northern Hardwoods Research Institute have clearly demonstrated that the cost of implementing this variant is half of a traditional thinning operation, and the productivity of PCT workers is largely unaffected by the number of crop trees left (Figure 8). Seasoned thinners have relatively few problems adjusting to this method, but managers and landowners must revise their quality-control protocols.



SUSTAINING OUR HARDWOODS

a video documentary produced by NHRI



Figure 8. Impacts of treatment type and stem density on (A) Time to thin a hectare of forest and (B) thinner's productivity (ha per productive man hour). SPH=stems per ha. PCTR-250: 250 Pre-commercial crop tree release, PCTR-500: 500 Pre-commercial crop tree release, PCTR-750: 750 Pre-commercial crop tree release, TPCT-2500: traditional pre-commercial thinning with 2500 crop trees. Error bars indicate 95% confidence interval.

3.3 POLE-STAGE STANDS

In commercial thinning, trees that have reached the merchantable size (dbh≥10 cm) can be cut and merchandized. This brings immediate revenue while improving the stand condition for the future. This treatment is recommended for fully or over stocked pole-stage stands where adequate numbers of crop trees are available to occupy the growing space.

Between two variants of commercial thinning, **low thinning** is recommended for a high-quality pole stand whereas **free thinning** is recommended in the case of a poor-quality stand. In this case, quality sugar map-



ple trees in intermediate crown position can be released as free thinning as it allows us to release crop trees without regard for their crown position. Residual crop tree density must be determined based on the need of promoting natural pruning of lower branches. Average height to the base of live crown (BLC) of the crop trees is used to assess this requirement. The suggestion for the stand is to thin to B-line (low residual density) if average BLC>4 m otherwise it is suggested to thin to Q-line (higher residual density). Use of a stocking guide is recommended to determine residual density related to B-line and Q-line (Figure 9). In the case of the first condition, management focus is to increase the diameter growth rate of the crop trees. But, in the case of second condition, management focus is to promote natural pruning of lower branches without compromising the crop trees for full utilization of growing space. In the future, these stands can be partially harvested to reduce stem density as trees grow bigger. *Figure 9: Thinning requirement using stocking guide parameterized for New Brunswick. Assessment: Point*



A=initial stand condition that can be thinned to point B. With time, the stand will develop towards point C. When the stand reaches to Point C, then the stand can be thinned to point D. Once the stand is thinned to point D, it will develop towards point E. Stand values at different points are provided in the table. Note: 'A', 'B' and 'C lines are the stocking levels. The 'A' line represents the normal condition of maximum stocking for undisturbed stands of average structure. The 'B' line is the

lower limit of stocking needed for full occupancy of the site. Stands at 'C'-level stocking are expected to reach the 'B' level within 10 years (Gingrich 1967). Q-line is the stocking level suggested to ensure natural shedding of live branches at the lower section of the crown.



Spacing	Trees per hectare		
(m)	Square	Equilateral	
2	2500	2887	
2,5	1600	1848	
3	1111	1283	
4	625	722	
5	400	461	
6	278	321	
7	204	236	
8	156	180	



Table 3 Spacing require-
ment to maintain given
amount of residual stand
density according to tree
arrangement Note: use
only as a guide to com-
municate how to visual-
ize crop trees but not as
a measure to avoid the
pitfall of implementing
systematic spacings

CONCLUSION

Density management can be a powerful strategy for mitigating reduced future growing stock of quality tolerant hardwood trees, if the practice is tailored for hardwood stands. Intermediate treatments in young mixed and hardwood stands will contribute to better species composition and better growth on crop trees but not necessarily on overall volume as density regulation does not usually increase site productivity. The silviculturist, forest manager, and landowner must also adopt the objective of improving the quality of stands and trees. Density management must be conducted with much latitude, with due consideration for the timing and the combination of treatments. Waiting until the stand reaches operability targets, such as minimum stand height, is perfectly acceptable. Whenever possible, adopt the crop tree release variant. And most importantly, spend enough time to properly stratify your stand; it will be beneficial in the long run, reducing cost and focusing resources where they are needed.

This article is inspired by the work of current and former employees of the NHRI notably; Sharad Baral, Pascal Soucy, Gabriel Danyagri and Pamela Hurley-Poitras. It is a modified version of the article published in the July edition of the <u>Atlantic Forestry Review</u> as part of our ongoing partnership with the magazine showcased in the winter edition of our <u>Leaflet</u>.

IN THE SPOTLIGHT:

JEFF SMITH NHRI's new team member with a problem-solving attitude

Jeff Smith is our new Geomatics Specialist on the team. He has joined us from Nova Scotia after completing the Geographic Sciences program at the NSCC Centre of Geographic Sciences. For this edition of *In The Spotlight*, we interviewed him to learn more about how he got his start in the geomatics field and the work he has been doing at the Institute. He brings a problem-solving attitude that fits well into the dynamic at the NHRI.

Tell us about what job you were doing before and what inspired you to change career path?

Before attending NSCC COGS and taking my current position at NHRI, I was working at a collision centre in Quispamsis, New Brunswick, as an autobody repair technician, painter, and a few other titles. Basically, if there was something that needed to be fixed on a car, I could do it.

During my time in collision repair, one of my favorite things was solving problems. The need to always be learning and paying attention kept the trade interesting until I discovered the world of geomatics and data presentation. The everexpanding use and application of data was a world I hadn't been exposed too much, until during a mountain bike ride, I was introduced to a phone-app centered around outdoor sports focused on trails, such as biking or hiking.

The app compiled many different datasets, such as elevation levels, trails that were collected and added by users, along with weather data and trail popularity. Until using the app, I didn't realize how useful so many pieces of information could be, or how they could be put together so well. The ease of use within the app caught my interest but thinking about all the challenges to get a smooth interface is what made me want to learn more. With a fire to learn more about geomatics (a term I didn't even know existed until applying for college) freshly lit in me, I applied to the Geographic Sciences program.

cont'd pg. 18



"With a fire to learn more about geomatics freshly lit in me, I applied to the Geographic Sciences program."



IN THE SPOTLIGHT:

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What was your specialization during your academic program?

The Geographic Sciences program I took had a two-year structure, with the first year focusing on four different areas in geomatics and the second year focused on a specialization that students chose. I chose to specialize in Remote Sensing since it was the most interesting and challenging to me. That means working with images or data captured by satellites, planes, or drones.

What is your role now at the NHRI:

My main role at the NHRI is to find solutions to the forest sector's problems through application of remote sensing, GIS, and other geospatial skills. What typically happens is that a question or problem is proposed, and I break it down into sections and pieces. Using a combination of research, existing knowledge, feedback from coworkers, and usually some inventing, solutions are constructed and tested. Often, these solutions go through several iterations as research is performed, or as the final user requirements change and adapt. I find this part to be very rewarding, since a lot of the time there are complex problems requiring complex solutions, but it all turns into a puzzle. As one piece of the solution puzzle is found, it adds to the next. The tools developed could be anything from complex processes that are used once a year to more simple tools that automate common processing steps to make it easier on the enduser.

Can you give us a few examples of projects/tools you are working on?

A couple tools I've been working on have focused on making it easier to process satellite imagery for different projects. Often, I work with Sentinel-2 imagery, and as expected working with images captured from space, shadows can be an issue. I've built a tool to use in our GIS software to automatically derive a shadow filter based on an image, giving the user a file that can be used to "mask" the shadowed areas, essentially telling the software not to process those areas. By building this into a tool, not only does it save time, but it also means that if someone else needs to perform the same task, I can share the tool with them as well.



Red Edge Chlorophyll Image



IN THE SPOTLIGHT

JEFF SMITH

NHRI's new team member with a problem solving attitude



Another example is the tool/system to predict basal area based on imagery and other variables. This has been one of those projects where a complex task has been broken down into several sub-tasks or projects and the solution is built from the many pieces. The project is still on-going, but it has involved researching potential solutions, testing theories and methods, refinement based on the testing and working collaboratively with one of the NHRI's partners to construct a final product. Being able to troubleshoot and problem-solve with people both inside and outside of the NHRI has been a big help in the project and has been a great learning opportunity for me.

What do you find the most rewarding in your job?

Being able to use previously completed tools on incoming or new ones is a rewarding part of the process in my role, since it proves the usability of the products in more ways than simply the task they were created for. And being able to combine research with inventive solutions and usable products is a very enjoyable part of my job!





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A NEW WINDOW ON CURRENT PUBLICATIONS





SCIENTIFIC PUBLICATIONS NOW AVAILABLE!

Are you interested in the silviculture management of deciduous and mixed forests but you are running out of time to follow the literature of interest? Here is your opportunity to keep yourself well informed.

It often happens that practitioners and planners prioritize activities other than literature monitoring, a role they gladly leave to researchers.

Our watch will endeavor to bring you to the full text of the publications. This is not always possible and in this case you will at least have the summary. Fortunately, more and more journals are becoming open access.

My name is Michel Huot and I left the Ministère des Forêts, de la Faune et des Parcs du Québec in June 2015. I worked there as a forest engineer and touched on various fields including forestry research. I followed up on certain studies undertaken either by Lise Robitaille in Duchesnay, or Jean-Louis Boivin in the Outaouais. During my stay at the Direction de la recherche forestière, I was able to plan missions outside Quebec and meet researchers from Ontario, the United States and even the Maritime provinces. This openness to neighboring experimental forests has been beneficial and has enabled networking with experts. Just before retiring, I worked on producing volume 1 of the Guide sylvicole du Québec with Bruno Boulet. I then continued to monitor the literature on various topics including forestry, and provided information to around 90 people including researchers. The feedback received has always been positive.

I can entrust you with a personal interest in long-term follow-ups although they are often restricted to areas of recognized experimental forests. It must be admitted that in forestry, monitoring and experiments carried out in the context of operations will also contain very useful information that can complement the continuous flow of literature; a real wheel that turns and never stops. New fields of research are developing rapidly (carbon, silviculture adapting to climate change, ecosystem management, invasive species, new health problems, etc.).

I wish you happy reading with this new section. Thank you to NHRI for its initiative to create this column.

A NEW WINDOW ON CURRENT EVENTS





Hamann, J. 2021. Le hêtre en voie de supplanter l'érable à sucre dans nos forêts. La prolifération du hêtre pourrait changer le visage des érablières à moyen terme. Université Laval Nouvelles. Université Laval, Québec, QC.

<u>Read more</u>



Moore, J.-D., M.-E. Roy et R. Ouimet. 2021. Le chaulage des érablières: est-ce que les effets bénéfiques d'une application unique de chaux se maintiennent à long terme? Avis technique no. 167. Ministère des Forêts, de la Faune et des Parcs. Direction de la recherche forestière. Gouvernement du Québec. <u>Read more</u>



Bilodeau Gauthier, S., H. Power, F. Guillemette et S. Bédard. 2021. Solutions pour mieux simuler l'évolution des peuplements situés sur les végétations potentielles de l'érablière dans un contexte d'envahissement par le hêtre. Avis technique no. SSRF-24. Ministère des Forêts, de la Faune et des Parcs. Direction de la recherche forestière. Gouvernement du Québec. Read more



Jain, P., S. Khare, J.-D. Sylvain, P. Raymond et S. Rossi, 2021. Predicting the location of maple habitat under warming scenarios in two regions at the northern range in Canada. For. Sci. Read more

Spruce-Fir-Ha



Kenefic, L.S., J.M. Kabrick, B.O. Knapp, P. Raymond, K.L. Clark, A.W. D'Amato, C.C. Kern, L.A. Vickers, D.C. Dey et N.S. Rogers, 2021. Mixed wood silviculture in North America: the science and art of managing for complex, multi-species temperate forests. Can. J. For. Res. 51: 921-934 <u>Read more</u>



Vickers, L.A., B.O. Knapp, J.M. Kabrick, L.S. Kenefic, A.W. D'Amato, C.C. Kern, D.A. MacLean, P. Raymond, K.L. Clark, D.C. Dey et N.S. Rogers, 2021. Contemporary status, distribution, and trends of mixed woods in the northern United States. Can. J. For. Res. 51(7): 881 -896. <u>Read more</u>

A NEW WINDOW ON CURRENT EVENTS





Bilodeau-Gauthier, S., G. Palma Ponce, J.-C. Georges, A. Miquel, S. Brais, B. Lafleur et N. Bélanger, 2021. Growth and foliar nutrition of a hybrid poplar clone following the application of a mixture of papermill biosolids and lime mud. Can. J. For. Res.

Read more



Bédard, S., F. Guillemette et **M.-E. Roy**, 2021. Production de bois de qualité et maintien d'attributs structuraux. Comment conjuguer les deux objectifs dans nos érablières jardinées ? Progrès forestier 238 (Été): 18-21.

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VanderMolen, M.S. and C. R. Webbster. 2021. Influence of deer herbivory on regeneration dynamics and gap capture in experimental gaps, 18 years post-harvest. College of Forest Resources and Environmental Science, Michigan Technological University, 1400 Townsend Dr, Houghton, MI 49931, USA. <u>Read more</u>



Brullhardt, M., P. Rotach, D. I. Forrester and H. Bugmann. 2021. Sustainable regeneration in uneven-aged mixed deciduous forests managed by selection silviculture: the role of demographic structure. Forestry: An International Journal of Forest Research, cpab041. <u>Read more</u>



Premer, M. and R. E. Froese. 2021. The recurring role of site challenges assumptions about regeneration under selection systems in northern hardwoods. Canadian Journal of Forest Research. <u>Read more</u>





Check out this interactive tool for a virtual visit of the

Gounamitz 3 marteloscope

to test the effect of your tree selection to simulate a silvicultural prescription

WHAT IS A MARTELOSCOPE?

The marteloscope is a forestry training tool. All trees have been measured, classified, and mapped. Combined with different computer models, it allows us to understand the immediate and longer-term consequences of our choices of stems to be cut. It therefore makes it possible to test different management strategies.

See the results in terms of density, basal area, volume, species ratio and quality. We have completed phase one of the project. The "Gounamitz 3" marteloscope is in a tolerant hardwood maple grove located in northwestern New Brunswick.



See the reference article:

Increasing the effectiveness of knowledge transfer acitvities and training of the forestry workforce with

marteloscopes

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