ECANUSA
Congrès sur les sciences forestières / Forest Science Conference

14 au 16 octobre 2010 / October 14 - 16, 2010

UNIVERSITÉ DE MONCTON
CAMPUS D'EDMUNDSTON

Faculté de foresterie

Edmundston, Nouveau-Brunswick

Actes du congrès / Conference Proceedings

ECANUSA Forest Science Conference

Congrès sur les sciences forestières ECANUSA

Octobre 2010
Université de Moncton
Campusd'Edmundston
Edmundston, N.-B.

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Université de Moncton, campus d'Edmundston
Edmundston, Nouveau-Brunswick

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Hôte / Host

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CAMPUS D'EDMUNDSTON

Faculté de foresterie

Welcome to ECANUSA 2010

Eastern Canada and the northeastern USA share a forest heritage that goes well beyond the Acadian Forest. The forests were, and remain, the traditional lands of First Nations. The waterways provided access to Europeans seeking out fur and timber resources and land to settle. The forests provided resources for economic growth for our communities as well as a wide variety of ecological, recreational, aesthetic and cultural values. Forests remain dominant in the landscapes of the region, and sustainable management of these is essential for our future.

And yet, management of the northern forest is increasingly under threat. The crisis in the forest industry has reduced income for forest owners, producers, workers, governments and communities. Climate change, invasive species, regional extinctions and complex ecosystems all present new challenges for ensuring sustainable management. Knowledge about the northern forest and its place in our lives is more important now than ever. This context provides the theme for our conference: **in search of new solutions for forestry**

Responding to this challenge is the heart of ECANUSA - a forum where managers, scientists, policy-makers, students, professionals and others can share experiences and find solutions to common problems. ECANUSA has three main objectives:

1. Promote cross-border communications about current and emerging issues affecting the northern forest.
2. Provide a forum for communication among US and Canadian forest researchers.
3. Provide a forum for graduate and undergraduate students working on forest-related problems to present their research findings, meet other forest scientists and students working on similar problems, and become educated about northern forest issues.

As host, the Faculté de foresterie of the Université de Moncton, campus d'Edmundston reflects the nature of ECANUSA - situated on the border between the USA and Canada and in a region where Acadian, Boreal and Great Lakes forests meet. This is also a region of shared cultures and so, for the first time, ECANUSA is bilingual, welcoming presentations in both English and French. The Faculté de foresterie is a young school, but we are proud to welcome you as we celebrate our 25th anniversary.

This year, ECANUSA brings together more than 120 participants. Our keynote speakers come from both the USA and Canada and will provide different views of where forestry is and where it needs to go. A total of 70 oral presentations are being made and you will have to choose between four parallel sessions. 24 posters presentations are on display, and the Saturday afternoon field trip provides a unique opportunity to visit the Black Brook forest of JD Irving Ltd, guided by researchers from a number of different institutions.

We hope that these presentations will help you to rise to the challenges facing forests and forest managers. We also hope you will learn more, not just about our shared forests but also our shared cultures. And finally we look forward to seeing you again for ECANUSA 2012.

Stephen Wyatt, President, ECANUSA 2010

Bienvenue à ECANUSA 2010

La région de l'Est du Canada et le Nord-est des États-Unis partagent un héritage qui se définit bien au delà de la forêt Acadienne. Les forêts étaient et demeurent les terres traditionnelles des Premières Nations. Les cours d'eau ont rendu possible l'accès pour les européens qui étaient à la recherche de fourrures et de bois, ainsi que de terres dans le but de s'établir. Les forêts ont fourni des ressources à nos communautés pour notre développement économique, aussi bien que pour une variété de valeurs écologiques, récréationnelles, esthétiques et culturelles. Les forêts dominent dans les paysages de nos régions, et l'aménagement durable de celles-ci est essentiel pour notre futur.

Malgré toutes ces idéologies, l'aménagement des forêts nordiques est en péril. La crise que vit présentement l'industrie forestière réduit les revenus des propriétaires forestiers, des producteurs, des travailleurs, des gouvernements et des communautés. Les changements climatiques, les espèces envahissantes et en voie d'extinction et les écosystèmes complexes, tous présentent de nouveaux défis afin d'assurer l'aménagement durable. Les connaissances de la forêt nordique et la place qu'elle occupe dans nos vies est plus qu'importante. C'est dans ce contexte que nous retrouvons le thème de notre congrès **« En quête de nouvelles solutions pour la foresterie ».**

Trouver une réponse à ce défi est au cœur d'ECANUSA - un forum où les gestionnaires, les chercheurs, les décideurs, les étudiants et étudiantes, les professionnels et d'autres parties intéressées peuvent partager leurs expériences et trouver des solutions aux problèmes communs. ECANUSA a trois principaux objectifs :

1. Promouvoir les communications à travers les frontières sur les enjeux contemporains et émergeants en ce qui concerne les forêts nordiques.
2. Faciliter la collaboration entre les chercheurs « états-unisiens » et canadiens.
3. Encourager les étudiants travaillant sur les problématiques reliées aux forêts à présenter leurs résultats, à rencontrer d'autres chercheurs et étudiants intéressés aux questions semblables et à apprendre davantage sur les forêts nordiques.

À titre d'hôte, la Faculté de foresterie de l'Université de Moncton campus d'Edmundston reflète la philosophie d'ECANUSA. Nous sommes situés à la frontière des États-Unis et du Canada, dans une région où les forêts acadiennes, boréales et celles des Grands Lacs se rencontrent. C'est une région qui témoigne d'un patrimoine partagé et, pour la première fois, ECANUSA est bilingue avec des communications tant en français qu'en anglais. La Faculté de foresterie est une jeune institution, mais nous sommes fiers de vous accueillir pendant notre 25e anniversaire.

Cette année, ECANUSA réunit plus de 120 participants. Nos conférenciers invités viennent des deux côtés de la frontière et vous présentent différentes opinions de l'état de la foresterie et où nous devrons nous diriger. Il y a un total de 70 communications orales et vous devrez choisir entre quatre sessions concurrentes. 24 affiches seront présentées et la sortie terrain du samedi après-midi fournira une occasion unique pour visiter la forêt de J.D.Irving Ltd. à Black Brook. Cette visite sera guidée par des chercheurs de diverses institutions.

Nous espérons que ces communications vous aideront à faire face aux défis de la foresterie. De plus, nous espérons que vous apprendrez davantage sur nos forêts communes, ainsi que sur nos cultures. Et finalement, nous avons hâte de vous revoir pour ECANUSA 2012!

Stephen Wyatt, Président, ECANUSA 2010

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  - **Dave Maclean**

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  - **Luc Sirois**

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  - **Actes du congrès préparé par / Conference Proceedings prepared by Héloïse Raisin**

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Congrès ECANUSA sur les sciences forestières

ECANUSA Forest Science Conference

Octobre 2010 / October 2010
Université de Moncton
Campus d'Edmundston
Edmundston, N.-B.

jeudi 14 octobre / Thursday, October 14

Faculté de Foresterie

7:00 - 9:00 PM	**Accueil des participants - Inscription / Registration**

vendredi 15 octobre / Friday, October 15

Musée historique du Madawaska

7:30 - 8:30 AM	**Accueil des participants - Inscription - Déjeuner / Registration and breakfast**

SESSION GÉNÉRALE / GENERAL SESSION

Musée historique du Madawaska

8:30 - 9:00 AM — **Mot de bienvenue / Welcome**

- **Paul Albert,** *vice-Recteur, Université de Moncton, campus d'Edmundston*
- **Jean-Marie Binot,** *doyen, Faculté de foreserie, UMCE*
- **Stephen Wyatt,** *president, ECANUSA 2010*

Conférenciers invités / Keynote presentations

9:00 - 9:40 AM — **Science, values and forest management**

***Tom Beckley**, University of New Brunswick*

PAUSE / BREAK

Commandité par / Sponsored by Twin Rivers Inc.

10:10 - 10:50 AM — **Towards a unified theory of forest carbon management: exploring tradeoffs within an ecosystem management framework**

***William Keeton**, University of Vermont*

10:50 - 11:30 AM — **Optimizing the modern forest bioeconomy networks**

Optimisation des réseaux modernes de la bioéconomie forestière

***Sophie D'Amours,** Université Laval*

vendredi 15 octobre, suite / Friday, October 15, follow up

11:30 - 13:30 AM - PM — **REPAS & PRÉSENTATION DES AFFICHES**
LUNCH & POSTER SESSION

Commandité par / Sponsored by Groupe Savoie Inc.

5è étage / 5th floor: Pavillon Simon Larouche, Salle / Room : PSL 507, 511

1:30 - 5:20 PM — **Sessions simultanées / Concurrent sessions**
Présentation des affiches, pause / poster session, break: 2:50 - 3:20 PM

BANQUET
Hôtel Clarion, Salle / Room : Assomption

6:00 - 6:30 PM — **Cocktail**

6:30 PM — **- Sénateur Percy Mockler,** *président, Comité sénatorial permanent de l'agriculture et forêts / Chair, Standing Senate Committee on Agriculture and Forestry.*

Souper / Dinner

- ***Yves Gagnon***, *Université de Moncton*
Sustainable development, energy and the forest sector
Développement durable, énergie et le secteur forestier

9:00 PM — **Soirée sociale / Social gathering,** *La Cheminée: pub étudiant / Student pub*

samedi 16 octobre / Saturday, October 16

7:30 - 8:40 AM — **Déjeuner / Breakfast**

8:40 - 11:40 AM — **Sessions simultanées / Concurrent sessions**
Pause / Break: 10:00 - 10:20 AM

11:40 - 12:00 AM — **Mot de la fin / Wrap-up**
Salle - Room: PSL 536

VISITE TERRAIN / FIELD TRIP

Optionnel, préinscription requise / optional, pre-registration required

12:00 - 12:15 PM **Départ / Departure**

Entrée principale / Main entrance: Pavillon Simon Larouche

Distribution des boîtes à lunch dans le bus / distribution of lunch boxes in the bus

12:15 - 5:00 PM **J.D.Irving's private forestlands at Black Brook**

Forêt privée de J.D. Irving à Black Brook

Chercheurs / Scientists:

- **Jean-Marie Binot,** *Faculté de foresterie, Université de Moncton, campus d'Edmundston*
  - Effects of different commercial thinning intensities in a 21-year-old white spruce (*Picea glauca* Moench) plantation in northwestern New Brunswick
- **Claude Samson,** *Parks Canada and Faculté de Foresterie, Université de Moncton, Campus d'Edmundston*
  - Ecology of the American Marten (Martes americana) in intensively managed spruce plantations
- **Allison MacKay,** *Chaire de recherche du Canada en conservation des paysages, Université de Moncton*
  - Can we alter thinning treatments applied to spruce plantations to conserve dead wood dependent birds?
- **Luke A. Binks,** *University of New Brunswick*
  - Dynamics of Mixedwood Stands in Northwest New Brunswick
- **Chris Henningar,** *J.D. Irving, Limited Post-doctoral Fellow and University of New Brunswick*
  - Carbon Projects Conducted Between UNB & JDI
- **Martin Béland,** *Faculté de foresterie, Université de Moncton, campus d'Edmundston*
  - Tolerant hardwood natural regeneration 15 years after silvicultural treatments on an industrial freehold in northwestern New Brunswick
- **Marc-André Villard,** *Canada Research Chair in Landscape Conservation, Université de Moncton*
  - Effects of selection harvesting on biodiversity in tolerant hardwoods of the black brook district, new brunswick: forest songbirds as a model system

Commandité par / Sponsored by : IRVING J.D. IRVING, LIMITED

vendredi 15 octobre / Friday, October 15 : Sessions simultanées / Concurrent sessions

Heure Time: pm	Session 1 - Salle/Room : PSL 536	Session 2 - Salle/Room : PSL 532	Session 3 - Salle/Room : PSL 528	Session 4 - Salle/Room : PSL 515
	Wood value Le bois et ses produits ***Modératrice : Sophie d'Amours***	**Intensive management** Aménagement intensif ***Modérateur : Martin Béland***	**Stand dynamics and silviculture** Sylviculture et dynamique des peuplements ***Modérateur : Derek MacFarlane***	**Economics, Policy, Social & Indigenous** Politique, économie, société et autochtones ***Modérateur : Ted Howard***
1:30 - 1:50	Profit-size relationships : a wood value expression to facilitate stand management decision making ***Michel Soucy***	Mesure des écarts de composition forestière entre la forêt préindustrielle (de 1836 à 1940) et la forêt aménagée (de 1995 et 2003) en Gaspésie ***Hirondelle Varady-Szabo***	Within-stand site variability in northern conifers: influence on silvicultural outcomes in managed Acadian conifer forests ***Collin A. Calhoun***	Harvesting and Silvicultural Practices in Maine, 1982-2008, Trends, Multiresource impacts, and Some Implications ***Lloyd C. Irland***
1:50 - 2:10	Properties evaluation on salicornia stalk and stalk-based composites ***Yi Shao***	Identification des sites à fort potentiel pour l'intensification de la production ligneuse : 1.Mise en contexte et productivité potentielle ***Vincent Laflèche***	Green River Precommercial Thinning Trial: A fity-year legacy of forest research continues ***Michael Hoepting***	Developing geospatial tools to forecast management outcomes across a diverse landscape of ownership types and stakeholder interests ***Jeremy Wilson***
2:10 - 2:30	Influence of tree spacing on spatial distribution of shrinkage properties in white spruce tree stem ***Mingkai Peng***	Identification des sites à fort potentiel pour l'intensification de la production ligneuse : 2. Contraintes à l'aménagement et produit final ***Guillaume Cyr***	Green River Precommercial Thinning Trial: roundwood production and the effects on stumpage, harvesting and extraction costs, and recovery and value of lumber and pulp and paper ***Michael Hoepting***	First Nations involvement in forestry in eastern Canada: practices and policies in five provinces ***Stephen Wyatt***
2:30 - 2:50	Influence of wood value on profitability of thinning regimes ***Michel Soucy***	Comparaison des modes de tenure privés et publics de la forêt du Bas-Saint-Laurent en fonction d'indicateurs environnementaux et socio-économiques ***Patrick Morin***	Influence of Silvicultural Intensity and Compositional Objectives on the Productivity of Regenerating Acadian Forest Stands ***Andrew Nelson***	Forestry and road development : an Aboriginal interpretation ***Marie-Christine Adam***
2:50 - 3:20	**PRÉSENTATION DES AFFICHES, PAUSE / POSTER SESSION, BREAK Salle / Room :PSL 507, 511** **Commandité par / Sponsored by Twin Rivers**			

vendredi 15 octobre / Friday, October 15: Sessions simultanées(suite) / Concurrent sessions (follow up)				
Heure **Time: pm**	**Session 1 - Salle/Room : PSL 536**	**Session 2 - Salle/Room : PSL 532**	**Session 3 - Salle/Room : PSL 528**	**Session 4 - Salle/Room : PSL 515**
	Wood value **Le bois et ses produits** ***Modérateur : Michel Soucy***	**Modeling and GIS** **Modélisation et Télédétection** ***Modérateur : Dave Hobbins***	**Stand dynamics and silviculture** **Sylviculture et dynamique des peuplements** ***Modérateur : Bob Wagner***	**Soils** **Pédologie** ***Modérateur : Hector Adegbidi***
3:20 - 3:40	Analysis of dimensional stability of a novel two-layer laminated wood product using finite element method ***Ling Li***	Assessing model prediction uncertainty in forecasting long-term tree basal area and diameter increment for the primary Acadian tree species ***Mathew B. Russel***	The use of historic land surveys to reconstruct the presettlement forest in Quebec (Canada) ***André de Römer***	Using Artificial Neural Network model to produce high resolution forest soil property maps ***Fan-Rui Meng***
3:40 - 4:00	Effect of finger geometry on ultimate tensile strength of single-joined boards ***Shuzhan Rao***	Predicting Probability of Species Persistence as a Function of Modelled Response to Landscape Biophysical Conditions and Biotic Interaction ***Mark Baah-Acheamfour***	Development and growth-limits in temperate conifers : An evolutionarily stable perspective ***Michael Day***	A Proposed Forest Land Classification System for Maine ***H. Lee Allen***
4:00 - 4:20	Propriétés de panneaux sandwichs composites bois-plastique à haute teneur en fibres d'épinette ***Brian Vezeau***	Developing and evaluation algorithms for the ZELIG-CFS gap model to predict individual-tree growth and mortality in north American mixed forest types ***Guy Larocque***	Spatial patterns of coexisting shade-tolerant northern hardwood regeneration in understories dominated by Fagus grandifolia in Maine ***Andrew Nelson***	Base caption distribution, uptake and cycling in three common forest ecosystems in Eastern Canada ***Sylvie Tremblay***
4:20 - 4:40	Modélisation des caractéristiques de branches et de nœuds de l'épinette noire (Picea mariana) et du pin gris (Pinus banksiana) ***Emmanuel Duchateau***	Forest stands structure classification using LiDAR and photography: human and computer comparison ***Etienne Bellemare Racine***	D Effects of neighborhood-scale competition and composition on individual tree growth in oak-pine mixed stands in Maine ***Justin Waskiewicz***	Nutrient co-limitation in aggrading northern hardwood forests ***Ruth D. Yanai***
4:40 - 5:00		Extraction de mesures forestières de façon rétrospective à partir des données Lidar aéroporté ***Lacina Coulibaly***	Evaluating stem taper and bark thickness equations for the major conifer species in the Acadian Region of North America ***Rongxia Li***	Soil Carbon Monitoring Plots in Vermont's Managed Forests ***Donald S. Ross***
5:00 - 5:20				Poultry manure and liming to improve yield of New Brunswick sugarbushes ***Richard Barry***

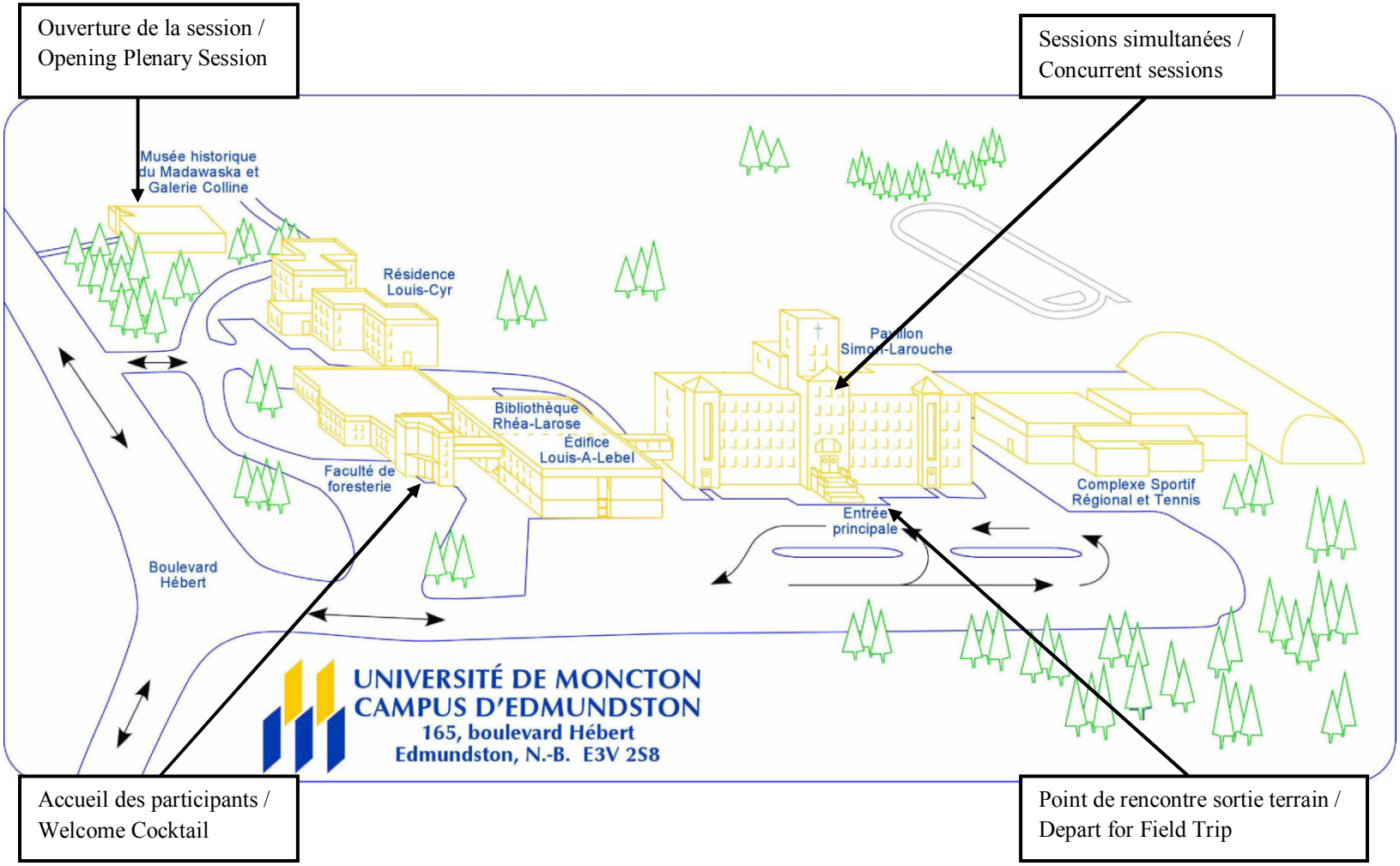
Congrès ECANUSA sur les sciences forestières		ECANUSA Forest Science Conference	Octobre 2010 / October 2010 Université de Moncton Campus d'Edmundston Edmundston, N.-B.

samedi 16 octobre / Saturday, October 16: Sessions simultanées / Concurrent sessions				
Heure Time: AM	**Session 1 - Salle/Room : PSL 536**	**Session 2 - Salle/Room : PSL 532**	**Session 3 - Salle/Room : PSL 528**	**Session 4 - Salle/Room : PSL 515**
	Young forests **Jeunes peuplements** ***Modérateur : Andrée Morneault***	**Ecophysiology** **Écophysiologie** ***Modérateur : Luc Sirois***	**Stand dynamics and silviculture** **Sylviculture et dynamique des peuplements** ***Modérateur : Guy Laroque***	**Perturbations** ***Modérateur : Roger Roy***
8:40 - 9:00	Optimizing the competing uses of brush for bioenergy and soil protection ***Eric R. Labelle***	Bryophyte - coarse woody debris (CWD) associations in softwood-dominant forest stands in north-western New Brunswick ***Leah Dalrymphe***	Stem Quality Assessment from a Long-term Study of Early Precommercial Thinning in Northern Hardwoods of the Acadia Forest Region ***Ed Swift***	The early colonization of burned stands by saproxylic beetles in the northern boreal forest ***Yan Boulanger***
9:00 - 9:20	Jeunes plantations d'érable à sucre et de bouleau jaune dans les forêts tempérées froides de l'Est du Québec : utilisation d'un protecteur en tissus et gestion de la végétation compétitive ***Samuel Pinna***	"Xylogenesis in black spruce: the role of growing season length, soil temperature and nitrogen availability" ***Carlo Lupi***	40-Year Compositional Dynamics of a Long-Term Silviculture Experiment in Northern Maine: The Austin Pond Study ***Matthew G. Olson***	Effets des caractéristiques de station et de peuplement sur le régime de perturbation par chablis de la Côte-Nord ***Kaysandra Waldron***
9:20 - 9:40	Réponses morphologiques et nutritionnelles de plantations juvéniles de conifères fertilisés en tourbières résiduelles ***Jean-Pierre Jean-François***	Mineral weathering rates in podzol of southern Quebec ***Fougère Augustin***	Past and upcoming dynamics of red oak at its northern range limit, in eastern Quebec, Canada ***Ariane Tremblay-Daoust***	Using mechanistic models to manage windthrow risk in large tracts of natural forests: potential and challenges ***Jean-Claude Ruel***
9:40 - 10:00	Managing understory vegetation for sustaining productivity in black spruce forests : A synthesis and future developments ***Nelson Thiffault***	Influence de l'augmentation des dépôts azotés en milieu naturel sur les communautés ectomycorhiziennes de l'épinette noire. ***Adam Bordeleau***	Habitat characteristics in tolerant hardwood stands after selection harvest performed with crop tree release ***Martin Béland***	
10:00 - 10:20	**PAUSE / BREAK**			

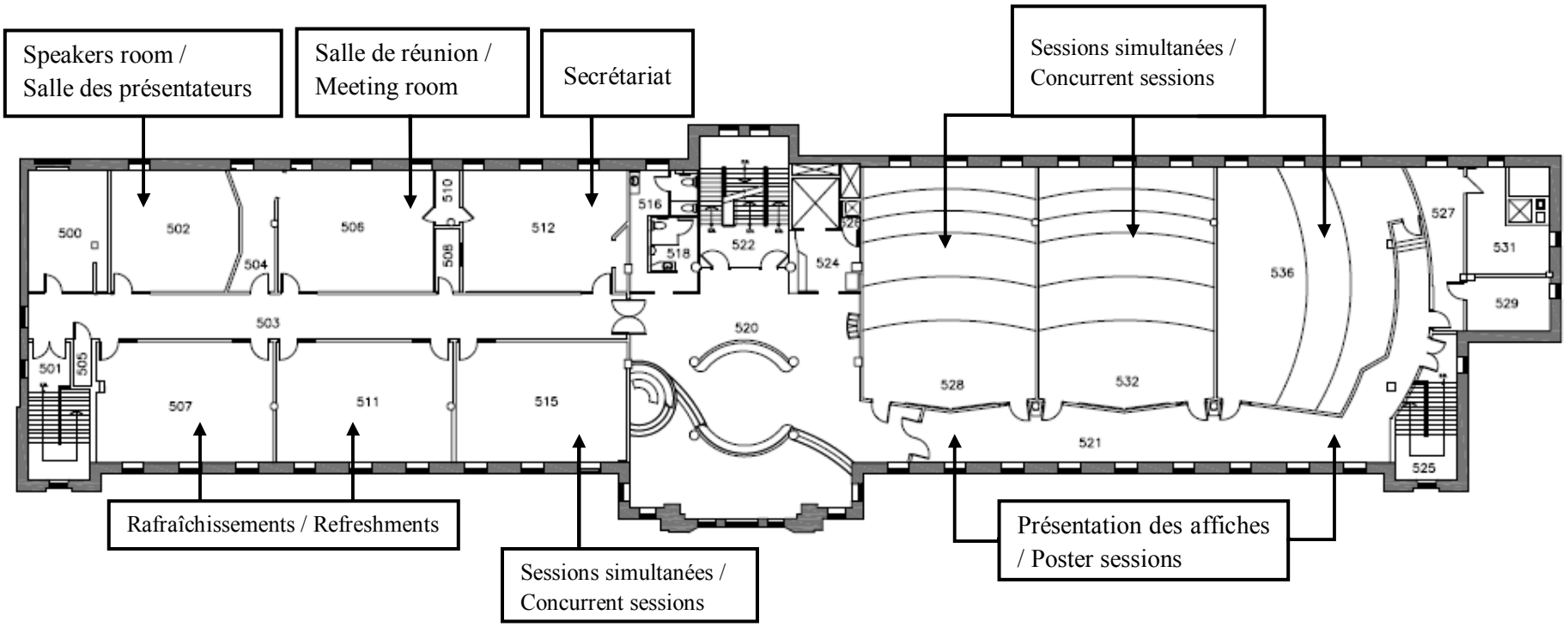
samedi 16 octobre / Saturday, October 16 : Sessions simultanées(suite) / Concurrent sessions (follow up)				
Heure **Time: AM**	**Session 1 - Salle/Room : PSL 536**	**Session 2 - Salle/Room : PSL 532**	**Session 3 - Salle/Room: PSL 528**	**Session 4 - Salle/Room : PSL 515**
	Forest ecology **Ecologie forestière** ***Modérateur : Dave Maclean***	**Forest entomology** **Entomologie forestière** ***Modérateur : Richard Barry***	**Stand dynamics and silviculture** **Sylviculture et dynamique des peuplements** ***Modérateur :Nelson Thiffault***	**Wildlife and NTFPs** **Faune et PFNLs** ***Modérateur : Claude Samson***
10:20 - 10:40	Assessing the Ecological Continuity of *Thuja occidentalis*-dominated Forests in New Brunswick using Calicioid Lichens and Fungi ***Steven B. Selva***	Essais en laboratoire de lutte biologique contre la cochenille impliquée dans la Maladie Corticale du Hêtre ***Jean-Yves Blanchette***	La coupe progressive irrégulière pour le maintien des attributs des peuplements à structure complexe ***Patricia Raymond***	Of Deers and Fir: Disentangling initial seedling size, scarification, and deer browsing effects on plantation success on Anticosti ***Julie Faure-Lacroix***
10:40 - 11:00	Silvicultural Rehabilitation of Cutover Mixedwood Stands ***Laura S. Kenefic***	Quantifying effects of balsam fir sawfly defoliation on growth and survival using permanent sample plots, dendrochoronology, and Bayesian statistics ***Javed Iqbal***	Development of regional height to diameter allometric equations for naturally-regenerated, mixed species, and multi-cohort forests of the Acadian Region ***Baburam Rijal***	Effects of selection harvesting on biodiversity in tolerant hardwoods of the Black Brook district, New Brunswick: forest songbirds as a model system ***Marc-André Villard***
11:00 - 11:20	Some Ecological Effects of Harvesting and Site Preparation in White Pine Stands Managed Under the Shelterwood System ***Andrée Morneault***	Landscape-scale spatial dynamics of balsam fir sawfly populations and of its baculovirus during an outbreak ***Gaétan Moreau***	First decadal response to treatment and insights into long-term productivity and viability of an expanding gap, disturbance-based silviculture experiment in Maine ***Justin E. Arseneault***	La récolte de "pointes" de sapin baumier pour la fabrication de produits ornementaux est-elle compatible avec l'objectif de production ligneuse ? ***Dodick Gasser***
11:20 - 11:40	Simulated Carbon Projections for Uneven-aged Northern Hardwood Stands ***Diane Kiernan***	Benefit-cost analysis of spruce budworm (Choristoneura fumiferana Clem.) control: incorporating market and non-market values ***Wei-Yew Chang***	Potential Productivity for Spruce Forests of Maine and Eastern Canada ***H. Lee Allen***	Integrating Fungi harvest in forest management plan : an opportunity for the diversification of forest resources ***Marie-France Gévry***

PRÉSENTATION DES AFFICHES / POSTER SESSION 5è étage / 5th floor: Pavillon Simon Larouche		
Wood products and forest operations/ Engineering		
N° 1	**Nguyen Quy Nam**	Preliminary results on the properties of wood pellets made from wood and bark of sugar maple and yellow birch low quality trees
N° 2	**Stephen Shaler**	The effect of waxes and adhesives on the static coefficient friction of wood strands
Silviculture and forest production		
N° 3	**John Brissette**	Penobscot Experimental Forest in Maine: 60 Years of Research and Collaboration
N° 4	**Daniel Chalifour**	Préparation de terrain et croissance des plants dans un contexte de regarni de la régénération naturelle en forêt boréale mixte
N° 5	**Patrick Clune**	Commercial Thinning Research Network:New site additions and plans for future analysis of commercial thinning responses in Maine spruce-fir stands
N° 6	**Louis-Vincent Gagné**	Modélisation du développement de la qualité du bouleau jaune (betula alleghaniensis britton) en forêt mixte
N° 7	**Sébastien Lavoie**	Windthrow after variable retention in the boreal forest
N° 8	**Joseph Pekol**	The effects of precommerical and commercial thinning on individual-tree mortality in red spruce – balsam fir stands across Maine
N° 9	**Ben Rice**	Effects of nonselective partial harvesting in Maine's working forests
Forest ecology, physiology, soils and carbon, genetics		
N° 10	**Sylvie Carles**	Genetic variation in budbreak and height growth of (2+0) white spruce half-sib families in response to interactions of elevated CO2 and temperature
N° 11	**Carlo Lupi**	Xylogenesis in black spruce on two sites in the boreal forest of Quebec: the importance of temperature for the onset and duration of cell differentiation

Plan du campus / Map of campus



5è étage - Pavillon Simon Larouche / 5th floor - Pavillon Simon Larouche



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Wood products and forest operations/ Engineering

Silviculture and forest production

Forest ecology, physiology, soils and carbon, genetics

Forest policy, socio-economic concerns

Forest planning, modeling and information systems

Wildlife, insects, NTFPS

Conférenciers invités

Keynote Presentations

Optimizing the modern forest bioeconomy networks
Optimisation des réseaux modernes de la bioéconomie forestière

Sophie D'Amours

Université Laval, Email: FOR@C

The Canadian forest industry has relied on its massive fibre supply, capturing economies of scales through a "push to market" business model. However, it is becoming clear that this low-cost business model will not be sustainable, either economically, environmentally or socially. To support the transformation needed, we propose a value chain approach in order to synchronize and optimize forest decisions with business ones so that market opportunities are optimally exploited while sustaining and improving Canada's forest assets.

"Value" as often used in management, finance and social science is a measure of the utility function used in making a decision. Optimizing the combinatorial set of forest-industry values is a complex task in the bioeconomy. The second central concept is that of "chain"—a series of links that go together to make an entire entity. It implies a network of forest decision-making and harvest flows over a variety of time and spatial scales.

Dr Sophie D'Amours holds a mechanical engineering bachelor degree, a MBA and a Ph.D. in Mathematics for engineers. She joined University Laval in 1995 and currently leads the FORAC Research Consortium. Dr D'Amours holds a Canada Research Chair Tier 1 in Planning Forest Sustainable Networks as well as an NSERC Industrial Chair on Collaborative Integration and Synchronization of the Forest Products Supply Chains. Her research activities include advanced planning systems, integrated simulation and operation research and the impacts of new information technologies on business models. Finally, Professor D'Amours was awarded the YWCA Women Award in Technology (2003), the Practice Award from the Canadian Society of Operational Research (2007) as well as the "Distinction Henri-Gustave-Joly-de-Lotbinière" for an exceptional contribution to the forest sector in Québec.

Sophie D'Amours possède un baccalauréat en génie mécanique et un M.B.A. (option opérations et systèmes de décision) de l'Université Laval, ainsi qu'un doctorat en mathématiques appliquées et génie industriel de l'École polytechnique de Montréal. Aujourd'hui, madame D'Amours est professeure à l'Université Laval et directrice du Consortium de recherche FORAC. Elle est également titulaire de la chaire de recherche du Canada intitulée Planification de réseau de création de valeur durable dans l'industrie forestière et de la chaire de recherche industrielle Collaborative Integration and synchronization of the forest products supply chains. Elle s'implique dans plusieurs demandes de recherche portant sur les systèmes de planification avancée, la simulation intégrée avec recherche opérationnelle ainsi que l'étude des technologies émergentes de l'information et des modèles d'affaires.

Science, values and forest management

Tom Beckley

University of New Brunswick

Forestry is sometimes described as the art and science of managing forests, tree plantations and related natural resources. As with many applied disciplines, the science component emphasized in school. It is largely assumed that forestry practitioners will develop the "art" later, in the field. There is a dynamic tension between values and ethical components of forestry and input from science. As well, there is a dynamic tension between the role of professional foresters, key vested interests, stakeholders, scientists, institutional players and the general public. This presentation identifies some myths and realities about the interplay between science and values-based input into forest management and policy decisions. It also provides commentary on how, as a society, we have a difficult time combining the values-based input and scientific input in productive ways to meet the objectives of society.

Dr. Tom Beckley has been working in the field of forest sociology in Canada for over 17 years. He teaches in the Faculty of Forestry at UNB, though his Ph.D. is in Sociology and his Masters degree is in Rural Sociology (both from the University of Wisconsin-Madison (USA). Prior to joining UNB in 2000, he worked for the Canadian Forest Service in Alberta and New Brunswick. His research topics include; forest dependent communities, public participation in resource management and policy, criteria and indicators of sustainable development and community forestry. Tom is also a woodlot owner.

Dr. Tom Beckley travaillait dans le domaine de la sociologie forestière depuis 17 ans. Il enseigne à la Faculté de foresterie de l'University of New Brunswick, même si ses études de doctorat et de maîtrise étaient en sociologie et sociologie rurale à l'University of Wisconsin-Madison (USA). Avant de se joindre à l'UNB en 2000 il travaillait au Service canadien des forêts en Alberta et au Nouveau-Brunswick. Ses intérêts de recherche incluent les communautés dépendantes de la forêt, la participation du public dans l'aménagement des ressources et la politique, les critères et indicateurs du développement durable et la foresterie communautaire. Tom est également propriétaire d'un boisé privé.

Forestry, Renewable Energy and Sustainable Development
La foresterie, les énergies renouvelables et le développement durable

Yves Gagnon

Université de Moncton

The forestry industry in North America is currently in a period of profound transformation where the sectors of wood products and pulp and paper, notably, have been in decline for many years. On the other hand, the energy sector is also in profound transformation, where renewable energy sources are gaining a growing importance in energy portfolios. The presentation will look at forestry and renewable energy in a perspective of sustainable development.

L'industrie de la forêt en Amérique du nord vit actuellement une période de grande transformation où les secteurs du bois d'œuvre et des pâtes et papiers, notamment, sont en déclin depuis plusieurs années. D'autre part, le secteur de l'énergie est en grande transformation, où les énergies renouvelables occupent une place de plus en plus importante dans les portefeuilles énergétiques. La présentation portera un regard sur la foresterie et les énergies renouvelables dans une perspective de développement durable.

Dr. Yves Gagnon is professor and holds the K.C. Irving Chair in Sustainable Development at the Université de Moncton, along with being Adjunct Professor of Mechanical Engineering at UNB, UNBSJ and the École de technologie supérieure (Montréal). He is regularly solicited as an expert on alternative energy sources, on economic and community development and on public policy. Prior to joining the Université de Moncton, Dr. Gagnon held the position of Visiting Executive at the Natural Sciences and Engineering Research Council (NSERC) of Canada, he was founding President and CEO of the New Brunswick Innovation Foundation and he was Associate Vice-President of Research and Dean of the Faculty of Graduate Studies and Research at the Université de Moncton.

Yves Gagnon est professeur et titulaire de la Chaire K.-C.-Irving en développement durable à l'Université de Moncton, tout en étant professeur associé de génie mécanique à UNB, UNBSJ et à l'École de technologie supérieure. Il est régulièrement sollicité à titre de spécialiste externe concernant les sources alternatives d'énergie, le développement économique et communautaire et la politique publique. Auparavant, Yves Gagnon a occupé les fonctions de cadre supérieur invité au Conseil de recherches en sciences naturelles et en génie (CRSNG) du Canada, il a été président fondateur et directeur général de la Fondation de l'innovation du Nouveau-Brunswick, et il a été vice-recteur adjoint à la recherche et doyen de la Faculté des études supérieures et de la recherche à l'Université de Moncton.

Towards a unified theory of forest carbon management: exploring tradeoffs within an ecosystem management framework.

William S. Keeton

University of Vermont

Emerging science is exploring strategies for enhancing and maintaining forest carbon sinks as part of climate change mitigation efforts. Developing carbon markets are increasingly looking to both actively and passively managed forestlands, and forest managers will need to consider whether carbon management is desirable within the broader mix of objectives. Yet the scientific community is divided when it comes to the question of which forest management strategies are most effective at increasing carbon sequestration and storage over baseline levels. There is an extensive literature showing that, despite increased rates of carbon uptake and flux to wood products, intensified forest management results in a net increase in carbon emissions. It follows that extended rotations and increased post-harvest structural retention would offer the greatest net carbon benefits (termed "additionality"). I will present a simulation study supporting this conclusion and exploring co-varying ecosystem functions, such as stand structural complexity. However, others have argued the opposite in several recent papers. They maintain that intensified forest management actually maximizes additionality. This conclusion is reached mainly when "substitution effects," or the emissions offsets achieved by replacing fossil fuels or energy intensive building materials with wood energy or wood products, are included in the carbon accounting. These findings are equally valid though limited by uncertainties and assumptions about substitution effects. Are carbon management strategies mutually exclusive? I will argue they are not. In fact, they are potentially complimentary if employed within a broader framework of ecosystem management, so long as net carbon storage increases and net emissions decrease. Within the near term scientific research may converge on a unified set of recommendations through improved carbon accounting and modeling.

William Keeton is an Associate Professor of Forest Ecology and Forestry at the University of Vermont's Rubenstein School of Environment and Natural Resources. His current research focuses on forest carbon management including modeling, climate change impacts on forest ecosystems, natural disturbance-based silvicultural systems, natural disturbance ecology, the structure and function of late-successional forest systems, forest-stream interactions, and forest biodiversity. Dr Keeton directs UVM's Carbon Dynamics Laboratory, has been a Fulbright Scholar in Ukraine (2008) and continues to work actively on sustainable forest management in Eastern Europe

William Keeton est professeur agrégé d'écologie forestière et de foresterie à l'École Rubenstein de l'environnement et des ressources naturelles de l'Université du Vermont. Ses recherches actuelles se concentrent sur la gestion du carbone forestier incluant : la modélisation, les impacts des changements climatiques sur les écosystèmes forestiers, les systèmes sylvicoles basés sur les perturbations naturelles, l'écologie des perturbations naturelles, la structure et les fonctions des forêts de fin de succession, les interactions entre forêts et cours d'eau et la biodiversité forestière. Le Dr Keeton dirige le laboratoire UVM sur la dynamique du carbone, a été un boursier Fulbright en Ukraine (2008) et continue à travailler activement sur l'aménagement forestier durable en Europe de l'est

Présentations orales
Oral Presentations

Forestry and road development: an Aboriginal interpretation

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The forestry industry is a significant contributor to the development and maintenance of roads. However, roads pose a particularly challenging forest management problem due to the trade -offs in benefits and costs at social, environmental and economic scales. Through interviews, this article offers a case study approach to explore how an Aboriginal community interprets and responds to the increasing development of road networks in their territory. The results are interpreted in accordance to the theory of access which disaggregates access to include more than ownership and control issues. The results showed a negative overtone of Aboriginal perception of road development suggesting that the initial benefits of access have been replaced. The respondents showed that there are many levels to the impacts of road development in Aboriginal communities involving many actors and affecting access mechanisms such as: social relations (Aboriginal and non-Aboriginal), environment, knowledge, technology and identity. In this study, respondents believed roads to disturb relationships and communication between actors rather than promote them. Intra-, inter- Aboriginal relations and socio-environmental relations were most discussed as being affected by road development. More specifically, although road increase the ability to benefit from resources the norms dictating the rightful use have been eroded. Respect and permission to use were the key issues which consistently emerged as a result of the increased ease, speed and availability of the territory by roads. In effect, roads have increased individualistic behaviors and changed Aboriginal occupational patterns which consequently: 1) led to significant departures from characteristic Aboriginal ways, 2) affected community ties, and 3) changed Aboriginal relationships with the land. Using Aboriginal preoccupations over roads and access could help further define Aboriginal preferences for forestry strategies or re-think management such that forestry can better weigh the benefits versus losses incurred from road development on Aboriginal values.

A Proposed Forest Land Classification System for Maine

H. Lee Allen

C.A. Schenck Distinguished Professor Emeritus, Department of Forestry & Environmental Resources, North Carolina State University, Email: hlallen@bellsouth.net

A good land classification scheme is essential for making cost-effective and sustainable forest management decisions. Land classification information can be used to improve growth and yield estimates, suggest appropriate species composition, plan roads, identify road building material, guide the timing and type of harvesting operations, determine the need for tillage based on soil physical limitations, indicate nutrient deficiencies, guide herbicide prescriptions based on soil and landform differences in vegetation composition, and identify areas with high windthrow hazard or frost risk.

A soil grouping scheme was developed based on knowledge that parent material (till vs outwash), soil drainage class or depth to water table, and depth to a restrictive layers are important determinants of species distribution, productivity, and the need for various silvicultural treatments in Maine and eastern Canada. In addition, these attributes were selected because they can be derived from existing NRCS soils information, easily identified in the field, or assessed by GIS/remote sensing techniques. Examples are given to use this scheme as the foundation for preparing recommendation charts concerning suitability for intensive management, species selection, and potential productivity.

Potential Productivity for Spruce Forests of Maine and Eastern Canada

H. Lee Allen

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Production rates in spruce stands in Maine and eastern Canada are typically low averaging less than 3 m^3/ha/yr; however, CAI rates in fully stocked spruce plantations in Scandinavia often exceed 20 m^3/ha/yr. Low rates of productivity result from slow seedling establishment, slow individual tree growth resulting in a prolonged period preceding crown closure and full site occupancy, and poor stand growth once full stocking is achieved.

Fortunately, during the last two decades our understanding of the ecophysiology bases for forest production and the genetic, climatic, and soil factors that affect production has greatly increased. It is now known that much of the variation in stand production can be accounted for by differences in light interception and light use efficiency. At any given site, light interception is principally related to the amount of leaf area and low levels of available soil resources (nutrients and water) can result in low leaf production and/or poor leaf retention and consequently low leaf area display. Limitations in these same soil factors can also reduce light use efficiency. Unfortunately many questions remain concerning the magnitude and extent of soil resource limitations and how these limitations can best be ameliorated to optimize production in spruce forests.

First decadal response to treatment and insights into long-term productivity and viability of an expanding gap, disturbance-based silviculture experiment in Maine

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Maintenance of late-successional structures to enhance biodiversity and sequester carbon has been a major focus of forest research over the past two decades. Several long-term, disturbance-based silvicultural trials have been installed to try to balance the maintenance of complex forest conditions yet allow for economical extraction of timber.

The Acadian Forest Ecosystem Research Program (AFERP) was established in 1995 in the Penobscot Experimental Forest in Bradley, Maine. One of AFERP's goals was to develop alternative silvicultural techniques and systems based on regional disturbance ecology which would maintain the economic advantages of even-aged methods while providing many of the structural features found in uneven-aged stands (Saunders et al. 2005).

The presentation will provide a summary of the observed changes in forest structure and composition in the first decade following treatment. The presentation will also review our efforts to incorporate differential growth and regeneration responses, due to varying degrees of canopy release and proximity to canopy openings, when modeling these systems in the northeast variant of the Forest Vegetation Simulator. Insights regarding the potential long-term productivity and viability of these "disturbance-based" systems in relation to other traditional silvicultural systems will also be discussed.

Reference

Saunders, M.R., Wagner, R.G., 2005. Ten-year results of the Forest Ecosystem Research Program – successes and challenges. In: Peterson, C.E., and Maguire, D.A., (Eds.) Balancing ecosystem values: innovative experiments for sustainable forestry. USDA Forest Service Gen. Tech. Rep. PNW-GTR-635, pp. 147-152.

Mineral weathering rates in podzol of southern Quebec

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Soil mineral weathering is an important component of nutrient cycling in terrestrial ecosystems. Although various methods exist for estimating this crucial biogeochemical reaction, quantifying weathering rates has always been a challenge in part because of the lack of long-term soil or watershed studies. The objective of this field study is to quantitatively estimate mineral weathering rates for a series of 16 catchments of the Québec lakes network, located on the Canadian Shield. The sites vary with respect to hydro-climatic conditions, soil properties (pH, texture, mineralogy) and forest cover. We used three methods to estimate base cations (Ca, Mg, K, Na) weathering rates: 1) the profile mass balance method of Brimhall *et al*. (1991), 2) the watershed input-output budget method and 3) the biogeochemical model PROFILE. Base cations weathering rates (Keq ha^{-1} yr^{-1}) varied from 0.03 to 0.70, from 0 to 2.22 and from 0.05 to 2.54 for the three methods respectively. Correlation analysis, Passing-Bablok and Bland-Altman methods show that pairs of the three methods of estimation agree depending on the nature of the base cation, suggesting that these methods are not always interchangeable.

Predicting Probability of Species Persistence as a Function of Modelled Response to Landscape Biophysical Conditions and Biotic Interaction

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Predicting and monitoring changes in the distribution of plant species are part of the international criteria for evaluating sustainability of forestry practices. In this paper we present a framework of enhancing current potential species distribution (PSD) modelling capabilities based in part on the work of Bourque et al. (2000) and Hassan et al. (2007). PSDs of eighteen tree species across Nova Scotia were modelled as a function of landscape-level description of: (i) growing degree days (GDD: a temperature accumulation index), (ii) incident photosynthetically active radiation (PAR), (iii) soil water content (SWC), and (iv) biotic interaction among competing species (i.e., inter-specific competition). PAR and SWC were generated with an existing process-based model, namely the Landscape Distribution of Soil moisture Energy and Temperature (LanDSET) model and GDD, from remote-sensing thermal data. Species interaction and species persistence probabilities over the long term (ψ) were simulated with an ecological forest succession model, JABOWA™. Species persistence was then used to modify PSD by multiplying ψ-values with the normalised values of species simulation of environmental-response to GDD, PAR, and SWC. The approach provides a new and quantitatively efficient method of introducing competition into current PSD-modelling techniques to account for an improved predictive performance of species distribution.

Fumier de volaille et chaulage pour améliorer le rendement des érablières du Nouveau-Brunswick.

Poultry manure and liming to improve yield of New Brunswick sugarbushes

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Le déséquilibre nutritionnel résultant de l'acidification des érablières entraînant une réduction de vigueur et de croissance des peuplements réduit leur productivité et les rendent plus vulnérables aux perturbations. Le rétablissement de l'équilibre nutritionnel et de la vigueur des arbres constitue l'objectif des essais de fertilisation entrepris dans une érablière du Nord-Ouest du Nouveau-Brunswick. Les effets des fertilisants testés (fumier de volaille - *NutriWave 4-1-2*, chaux dolomitique), admissibles par les organismes de certification biologique (OCB), sur la vigueur et le rendement en sucre ont été évalués sur 102 arbres. Au printemps 2006, quatre traitements (a: équivalent à 125 kg N/ha; b: équivalent à 250 kg N/ha; c: b + 2 T/ha chaux dolomitique; d: témoin) ont été appliqués aux arbres-échantillons. Les paramètres de santé (nutriments foliaires et vigueur) et de production de sucre (volume de coulée, teneur en sucre et production de sucre journaliers, collectés sous vide et sous gravité) ont été suivis durant trois années. Les traitements ont occasionné des modifications de l'équilibre nutritionnel des arbres, notamment des augmentations de concentration de macronutriments foliaires (N, P, Ca, Mg), ainsi que l'amélioration de la vigueur. Les arbres traités dont la sève était collectée sous vide produisaient jusqu'à 29,9% plus de sucre que les témoins. On peut donc favorablement modifier l'équilibre nutritionnel des érables par des traitements acceptés par les OCB, et améliorer la vigueur et la productivité des érablières à court terme.

Caractéristiques de l'habitat en peuplements de feuillus tolérants après coupe de jardinage réalisée avec dégagement des arbres d'avenir

Habitat characteristics in tolerant hardwood stands after selection harvest performed with crop tree release

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Les coupes par dégagement d'arbres d'avenir permettent de concentrer l'effort sylvicole, de protéger et de stimuler la croissance des arbres d'avenir de grande qualité et valeur. On suppose que la concentration de la récolte engendre une distribution spatiale plus hétérogène qui devrait avoir des répercussions sur l'atteinte d'objectifs de gestion écosystémique. Nous avons mesuré en 2009 divers paramètres de l'habitat dans un dispositif expérimental installé en 2008 en peuplements de feuillus tolérants au Nouveau-Brunswick qui visait à comparer une coupe de jardinage par marquage négatif des arbres à couper à une autre par marquage positif des arbres d'avenir selon deux intensités de récolte, soit 35 et 50%.

La quantité de chicots (≅ 14/ha) est semblable entre tous les traitements incluant le témoin. Les coupes engendrent plus de débris ligneux que les peuplements témoins, et une plus grande proportion de débris récents. Le type de marquage ne semble pas influencer ce paramètre. Contrairement à nos attentes, la coupe après marquage négatif a produit plus de grandes trouées qu'après marquage positif. Ces résultats suggèrent que l'impact du type de coupe de jardinage sur la structure de l'habitat pourrait varier selon l'abondance et la distribution spatiale des arbres d'avenir dans le peuplement avant la coupe et selon l'intensité de coupe.

Forest stands structure classification using LiDAR and photography: human and computer comparison

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Forest map is at the roots of Quebec's (Canada) forest management. This mapping is performed entirely by photo-interpreters, scanning the territory every ten year to describe our forest's attributes. Recently, the use of stereo digital plotting has improved the accuracy of mapping and allowed envision complementarity with automatic processes.

In our study, we evaluated the ability of lidar to detect structural information of the forest stand at a landscape scale. We acquired 355 km² of airborne photography and LiDAR in Gaspésie (Québec), from which was extracted a digital terrain model, a canopy height model and treetops. These derived data were then used in an interpretation algorithm to assess the structure of forest polygons (dominant height, layering, density, gaps, etc). These polygons were then photo-interpreted following the same definitions. We then compared the human photo-interpretation to automatic interpretation. It appears that certain structure elements identified using the lidar with results similar to the photo-interpretation could be used to assist the photo-interpreter. The integration of automatic interpretation to the mapping process could not only improve management and sylvicultural practices, but allow a productivity gain from photo-interpreters.

Essais en laboratoire de lutte biologique contre la cochenille impliquée dans la Maladie Corticale du Hêtre

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La Maladie Corticale du Hêtre cause la mortalité des hêtres à grandes feuilles (*Fagus grandifolia* Ehrh.) dans l'Est de l'Amérique du Nord. Le champignon pathogène (*Neonectria faginata* (Lohman *et al.*) Cast. & Rossman), responsable de la maladie, utilise comme portes d'entrée les micro-blessures préalablement occasionnées sur l'écorce par la cochenille du hêtre (*Cryptococcus fagisuga* Lind.).

L'objectif principal de cette recherche était de tester en laboratoire l'effet létal potentiel de deux champignons entomopathogènes, Mycotal® (*Lecanicillium lecanii muscarium*) et Vertalec® (*Lecanicillium lecanii longisporum*), comme agents de contrôle biologique contre la cochenille.

Les objectifs secondaires étaient de tester comparativement les effets de trois différents dosages (10^6, 10^7 et 10^8 spores/ml).

Les champignons entomopathogènes Mycotal® et Vertalec® ont démontré un effet létal significativement différent sur les cochenilles. Une rapide progression dans la mortalité des cochenilles a été observée dans les deux premières semaines suivant leur application. Trente jours après l'inoculation, la proportion de cochenilles mortes avait atteint 100% pour Mycotal® et 90% pour Vertalec® (tous les dosages). Si la lutte biologique à l'aide d'entomopathogènes semble prometteuse, d'autres études seront nécessaires afin d'appliquer les champignons en milieu naturel.

Influence de l'augmentation des dépôts azotés en milieu naturel sur les communautés ectomycorhiziennes de l'épinette noire.
Inorganic nitrogen depositions impact on black spruce ectomycorrhizal communities in a field experiment

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Dans la forêt boréale, les dépositions d'azote, un des principaux facteurs limitant la croissance des arbres, ont augmenté durant les dernières décennies. En Amérique du Nord, bien que certaines forêts de l'ouest montrent des signes de saturation, les forêts de l'est retiennent encore les dépositions azotées. Le temps de séjour dans le sol est inférieur à une journée pour l'ammonium et les nitrates parce que ces substances sont immédiatement absorbées par la microflore. Ainsi, l'augmentation de la disponibilité en azote pourrait avoir des effets sur la flore microbienne et fongique, et particulièrement sur les mycorhizes, qui sont la principale voie d'absorption de l'azote pour l'arbre. Pour analyser les effets des dépôts azotés sur la vitalité des racines et sur les ectomycorhizes, un projet a été mis en place dans la réserve faunique Ashuapmushuan. Deux concentrations de nitrate d'ammonium (NH_4NO_3) ont été appliquées pendant 8 ans sur des quadrats de 100 m^2 représentant 3 et 10 fois les dépositions d'azote normales. Le site est un peuplement mature d'épinette noire [*Picea mariana* (Mill.) BSP]. Des analyses au microscope sont effectuées pour déterminer la vitalité et la mycorhization des racines fines et pour classifier les mycorhizes à l'aide d'anatomo-morphotypes. Notre hypothèse est que l'augmentation de la disponibilité en azote réduira la diversité des espèces ectomycorhiziennes et des apex colonisés. Les résultats préliminaires montrent une augmentation de la vitalité des apex des racines en fonction de l'augmentation de l'azote ainsi qu'une hausse de la proportion d'apex mycorhizés.

The early colonization of burned stands by saproxylic beetles in the northern boreal forest

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In this study, we investigated the colonization pattern of saproxylic beetles the same year of the fire in the James Bay area, Québec. Beetles were collected by means of trunk-window traps in 66 plots located in a 2005 burn. A total of 139 potentially saproxylic species were collected including 55 predaceous, 41 xylophagous and 30 mycophagous taxa. Colonization was mostly influenced by local burned habitat attributes, mostly fire severity. Several predaceous and xylophagous species were attracted to severely burned stands at very large scales (~10 km, 2650 m). Distance to source habitats had almost no negative impact on the ability of species to reach the suitable habitat considering the great dispersal capabilities of most early colonizers. This also suggested that the early colonization pattern is a multistep process involving the selection of environmental attributes at several spatial scales. Surprising differences were noticed between environmental attributes selected by xylophagous adults the same year as the fire and attributes that led to higher larvae abundance the year after. Even though adults were most abundant in the severely burned stands, larvae were most common in lightly burned trees. This counterintuitive result and apparent non-optimal behavior might be related to an evolutionary pressure that mostly pushed species to detect rare substrate in a green matrix rather than specific burned attributes.

Within-stand site variability in northern conifers: influence on silvicultural outcomes in managed acadian conifer forests

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Site characteristics strongly influence the development of forest stands and their responses to management. The effects of fine-scale within-stand variation in site quality have not been investigated for mixed conifer stands in northern New England. We are assessing the effects of within-stand variation in soil drainage class on silvicultural outcomes in the long-term U.S. Forest Service Study on the Penobscot Experimental Forest in Maine. We have established sampling grids within selected compartments of this study to develop a fine-scale map of soil drainage classes in research compartments managed under five silvicultural systems. We are assigning each grid cell to a soil drainage class based on the measured depth to redoximorphic soil features. Additional data collection will identify tree-level growth and yield characteristics of selected trees in the grid cells. Data on the composition and structure of the overstory will be gathered along transects within the sampling grids. Analysis of these data should allow us to quantify the impact of fine-scale variation in soil drainage class on tree- and stand-level metrics of growth and yield. Soil drainage data will be used to evaluate the utility of predictive tools that could facilitate the efficient application of site-stand relationships identified by the study.

Benefit-cost analysis of spruce budworm (*Choristoneura fumiferana* Clem.) control: incorporating market and non-market values

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This study employs a benefit-cost analysis (BCA) framework to estimate market and non-market benefits and costs of controlling future spruce budworm (SBW; *Choristoneura fumiferana*) outbreaks on Crown forest lands in New Brunswick, Canada. We used: (i) an advanced timber supply model to project potential timber volume saved, timber value benefits and costs of pest control efforts; and (ii) a recently conducted contingent valuation method (CVM) analysis that evaluated non-market benefits (i.e. changes in recreation opportunities and existence values) of controlling future SBW outbreaks in the Province. A total of six alternative scenarios were evaluated, including two uncontrolled future SBW outbreak severities (moderate vs. severe) and, for each severity, three control program levels (protecting 10%, 20%, and 40% of the susceptible Crown land forest area). The economic criteria used to evaluate each SBW control program scenario included benefit-cost ratios (BCR) and net present values (NPV). Results indicated that the highest BCR and NPV occurred when protecting 10-20% (284,000-568,000 ha) of the susceptible area. The inclusion of non-market values generally increased the BCRs and NPVs of the control programs, and in some cases, led to higher levels of control being supported. Results of this study highlight the importance of including non-market values into the decision making process of forest pest management.

Identification of sites with a high potential for intensification of wood production: Management constraints and final product

Identification des sites à fort potentiel pour l'intensification de la production ligneuse: 2. Contraintes à l'aménagement forestier et produit final

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Les superficies retenues pour l'intensification de la production de matière ligneuse doivent également être libres de toutes contraintes importantes à l'aménagement forestier liées par exemple à un accès ou un déplacement difficile de la machinerie ou à la fragilité du milieu. Toute cette question a été prise en compte dans un vaste travail qui a consisté à documenter une quinzaine de contraintes pour lesquelles un indice a été développé en se basant sur des caractéristiques stationnelles cartographiées.

Les résultats de la productivité potentielle et des contraintes sont disponibles pour chacun des polygones de la carte écoforestière du MRNF. Pour chaque unité d'aménagement forestier (UAF), lesquelles constituent le territoire public, une analyse de voisinage a permis d'identifier des concentrations de polygones à fort potentiel de croissance et de faibles contraintes formant ainsi des aires potentielles d'intensification de la production de matière ligneuse. Le choix final des aires et leur localisation doit se faire en collaboration avec les communautés autochtones, les CRÉ (conseil régional des élus), la table locale de GIRT (gestion intégrée des ressources et du territoire) ainsi que les ministères et les organismes concernés. Cet exercice doit passer par la prise en compte de toutes autres considérations notamment d'ordre social, économique, faunique, environnemental ou liées à des usages actuels du territoire.

Bryophyte - coarse woody debris (CWD) associations in softwood-dominant forest stands in north-western New Brunswick.

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Reduced bryophyte diversity in intensively managed mixed and boreal forests has been attributed to reduced abundance of coarse woody debris (CWD), which is thought to be an optimal or even required substrate for some species. In order to better understand the role of decaying wood in forest bryophyte diversity, we require basic data on log characteristics that may influence bryophyte establishment and growth (e.g. their shape, size, wood chemistry and stage of decay), and the bryophytes that are associated with these characteristics. We sampled bryophytes within 200 cm² units on the top surface of 158 logs in unmanaged softwood-dominant forest stands, located within a matrix of softwood plantations, in north-western New Brunswick. Associations between the characteristics of CWD (wood type, shape, measures of decay) and the bryophyte assemblage (abundance, richness, composition) will be evaluated using descriptive and multivariate statistics. Preliminary recommendations will be made for the refinement of current guidelines on coarse woody debris retention for biodiversity conservation.

Development and growth-limits in temperate conifers: An evolutionarily stable perspective

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Forest trees undergo immense changes in growth habit over their life spans. Of particular interest to foresters, forest managers and others is the time course of productivity, a principal factor in determining optimum age for harvest as well as estimating rates of carbon sequestration. Foresters have long observed that stemwood productivity peaks somewhat before the midpoint of the average lifespan of a tree species, followed by an 'age-related decline'. The basis for this phenomenon has interested tree physiologists for decades, with numerous 'universal' hypotheses proposed, then subsequently contested for ambiguous experimental verification or real-world observations. Common to these hypotheses has been the focus on a specific physiological mechanism interacting with a physiochemical restriction.

The intricate relationships between size, age and ontogenetic (whole-tree developmental) life-stage results in significant challenges to understanding the trajectories of morphological and physiological changes over a lifetime, controlled by both internal genetic aging programs and the external environment. From over two decades of studying this phenomenon at our lab, including the longest running age-class reciprocal grafting experiments, we are presenting a new approach to this issue centered on a whole-tree, whole-lifespan evolutionarily stable perspective. This is defined as the evolution of a tree species ontogeny both under pressures from biotic competitors and restrictions from the abiotic environment to the point that the species maintains an established niche within a forest ecosystem. Collaterally to this hypothesis is the evidence by our lab and others that age-related declines in productivity may be non-existent or, at least, greatly overstated, and may instead represent evolutionarily stable strategies in shifting resource allocations.

Modélisation des caractéristiques de branches et de nœuds de l'épinette noire (Picea mariana) et du pin gris (Pinus banksiana)

Modeling the branch and knot characteristics of black spruce and jack pine

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Face aux problèmes actuels de l'industrie forestière, il est nécessaire d'obtenir une meilleure compréhension de l'impact de nos choix sylvicoles. Cela passe notamment par des modèles de croissance couplés à des modèles de qualité du bois.

La présence de nœuds à l'intérieur de la tige est l'une des caractéristiques internes qui a le plus d'impact sur les propriétés mécaniques du bois et sur le classement visuel de sa qualité.

L'utilisation d'images issues d'un tomographe à rayons X nous permet de visualiser l'ensemble des défauts à l'intérieur de la bille et d'obtenir la position exacte des nœuds.

À l'aide d'un modèle mixte, on observe que le statut de l'arbre et la structure du peuplement dans lequel il croît ont un impact direct sur la durée de vie des branches. On constate ainsi que la probabilité qu'une branche âgée de 30 ans soit vivante avoisine 10% dans un arbre dominé alors qu'elle est de 45% pour un arbre dominant ou co-dominant. Dans le cas des arbres ayant poussé dans des peuplements de structure irrégulière, cette probabilité peut atteindre 75%. Ces différences ont un impact direct sur le diamètre des branches et sur la morphologie des nœuds.

La récolte de « pointes » de sapin baumier pour la fabrication de produits ornementaux est-elle compatible avec l'objectif de production ligneuse ?

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La récolte, l'achat et la transformation de « pointes » de sapin baumier en produits ornementaux donne lieu à une activité saisonnière ayant des retombées socio-économiques importantes dans plusieurs régions. Pourtant, très peu d'études ont examiné la compatibilité de cette récolte avec la production ligneuse.

Nous avons dressé un portrait régional de cette récolte en Gaspésie et testé quatre modalités de récolte définies selon leur intensité et leur sévérité.

Les sites les plus propices à la récolte sont les éclaircies pré-commerciales et les bordures de chemins forestiers. Environ 7,0 millions de livres de « pointes » de sapin sont récoltés annuellement en Gaspésie sur environ 3,3 millions de sapins. Selon la modalité de la récolte, le degré de prélèvement varie de faible et négligeable (< 6 %) à modéré mais significatif (≈ 20 %).

En se basant sur la réponse du sapin baumier à l'élagage et à l'herbivorie, il semble peu probable que la récolte de « pointes » de sapin ait un impact négatif significatif sur la mortalité et la croissance des sapins récoltés. Le suivi de l'étude expérimentale permettra de mesurer les effets réels de la réponse du sapin baumier à la récolte de « pointes » de sapin.

Integrating Fungi harvest in forest management plan : an opportunity for the diversification of forest resources

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Lack of knowledge about the ecology of edible ectomycorrhizal mushroom (ECM) currently hinders the development of this ressource in Eastern Canada. Our study aims to (i) determine the influence of environmental factors on the distribution of ECM species in the boreal forest of eastern Quebec, and (ii) identify preferred habitats for each species.

The sporocaps of ECM species were sampled weekly for two seasons in 15 forest habitats representative of the study area. The environmental data measured explained 32% of the variance with a canonical redundancy analysis (RDA). The floristic data matrix was the one who explain the majority, followed by the stand structure, edaphic and topography matrix. Among the floristic variables, the percentage held by the main tree species were the most decisive in explaining the distribution of ECM species, together with richness of ericaceous and shrubs, and moss and lichen cover. Habitat preferences were also determined for 5 of 12 species. Our results suggest the main variables to advocate for the identification of areas with high yield potential across the landscape, from available data on forest maps. Our study opens the way for future research to promote conservation and enhancement of edible fungi in sustainable forest management plans.

Quantifying effects of balsam fir sawfly defoliation on growth and survival using permanent sample plots, dendrochronology, and Bayesian statistics

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Balsam fir sawfly (*Neodiprion abietis* (Harris)) is a wasteful defoliator of softwoods especially balsam fir with periodic outbreaks in eastern Canada. Our objective was to quantify impacts (growth and survival) using information from Permanent Sample Plots (PSPs) and dendrochronology. Bayesian statistics were used in order to combine results from different source of data, each having its own limitations and associated uncertainty. 67 Newfoundland Forest Service PSPs segregated on severity of defoliation (class 1 – 6), age and management interventions (precommercially thinned vs. natural) measured before and after defoliation (1996 – 2008) were analyzed. No mortality was observed in immature plots 12 years after defoliation while survival reduced to 30 % in mature plots. Severity class 1 with one year of moderate defoliation (30 – 70%) showed 22% cumulative growth loss and complete recovery to pre defoliation growth increment 5 years after defoliation. Growth increments in severity classes 2 – 6 did not recover to pre-defoliation levels even 10 years after defoliation with mean cumulative growth loss ranging between 26 – 40 %. Natural and thinned plots appeared to have responded similarly to all defoliation severity classes. These results suggest that proactive control measures need to be implemented as the impacts are severe even with one year of severe (71 – 100%) defoliation.

Harvesting and Silvicultural Practices in Maine, 1982-2008, Trends, Multiresource impacts, and Some Implications

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Forest practices in the northern Maine woods have had a complex and contentious history. The contention reached a peak in the 1990's as two major statewide referendum campaigns aimed to severely restrict clearcutting. While both failed, they reflected strong conflict over management practices. Successive legislative actions attempted to address these issues but did not fully resolve any of them. Public concerns shifted over the period, ranging from worry that vast areas would be clearcut, to concerns about widespread chemical uses, to effects on deer herds, to concerns about trout habitat and other more subtle aspects of habitat and ecosystem function. Others wondered how changing ownership would affect management. They wondered whether current harvests were sustainable, and how rising biomass markets would affect the forest. This paper assembles some of the data bearing on these topics and attempts an initial rough assessment of selected issues. It will speak generally to several questions: what happened? What were the cumulative effects on the forest? What would be possible future effects, if recent management trends continue? And, what are the implications?

Réponses morphologiques et nutritionnelles de plantations juvéniles de conifères fertilisés en tourbières résiduelles

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L'extraction industrielle de la tourbe transforme les tourbières en un milieu généralement dépourvu de végétation et de faune. Le réaménagement de tourbières résiduelles par l'afforestation est l'une des options de réhabilitation d'un tel écosystème. L'objectif de cette étude était de comparer les effets de deux modes de fertilisation sur la croissance juvénile et l'état nutritionnel de conifères (mélèzes laricin et hybride, et épinette noire) plantés sur des tourbières résiduelles dans la Péninsule Acadienne du Nouveau-Brunswick en 2005 et 2006. Les traitements à la plantation étaient de l'engrais sous formes de pastilles (10g/plant, 20-10-5) ou poche de thé (10g/plant, 20-11-9). La survie, la biomasse sèche racinaire, la densité racinaire dans le substrat, la croissance de la pousse terminale et les concentrations en éléments nutritifs des aiguilles ont été mesurées en 2008. En général, il n'y a pas de différence significative entre les 2 types de fertilisant. Des déficiences en P et K ont été observées chez toutes les espèces. Le mélèze hybride a montré une sensibilité aux conditions ambiantes alors que le mélèze laricin et l'épinette noire semblent bien adaptés pour l'afforestation des tourbières résiduelles étudiées. Une augmentation des taux de potassium et de phosphore dans les formules des fertilisants et un choix judicieux des espèces à planter lors du réaménagement des tourbières résiduelles sont suggérés.

Silvicultural Rehabilitation of Cutover Mixedwood Stands

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We are studying precommercial rehabilitation of mixedwood stands degraded by repeated commercial clearcutting (removal of all merchantable trees) in the long-term U.S. Forest Service silvicultural experiment on the Penobscot Experimental Forest in Maine, USA. Three rehabilitation options were applied in 2008-2009 (20 years after the last harvest entry): (1) control (no rehabilitation); (2) moderate rehabilitation (crop tree release); and (3) intensive rehabilitation (crop tree release, removal of unacceptable growing stock and non-commercial species (timber stand improvement, TSI) and fill- and under-planting of red spruce [Picea rubens Sarg.]). Crop trees > 1.3 m in height were selected and released based on potential for improved growth and value, desirable spacing and species. Release was accomplished with a combination of mechanical (brushsaw and chainsaw) and chemical (basal spray of Garlon 4 ® and oil) treatments. Our presentation will include time and energy used in treatment application; pre- and post-treatment stand structure, composition and quality; crop tree density, species and size distribution; first-year survival and herbivory of planted seedlings; projected future conditions and financial analysis. We anticipate that our findings will both serve as a cautionary tale for those considering commercial clearcutting, and inform the rehabilitation and management of cutover mixedwoods in the Acadian Region.

Simulated Carbon Projections for Uneven-aged Northern Hardwood Stands

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We developed an individual tree growth and yield simulator to predict changes on both the production and recoverable yields of both wood and carbon. The goal of this project was to provide forest managers with information to facilitate decisions about silvicultural alternatives for managing uneven-aged northern hardwood stands dominated by sugar maple. Long-term remeasurement data came from managed stands with an emphasis on responses to partial cuttings of various kinds. Using a series of different modeling techniques, we created diameter growth, mortality and ingrowth functions. The simulator will be used to identify similarities and differences between alternative management strategies in terms of timber and carbon.

Optimizing the competing uses of brush for bioenergy and soil protection

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Efforts to mitigate climate change combined with attempts to generate new income or utilize alternative energy sources have prompted forest and wood processing industry to consider forest biomass as a source of renewable energy. Signs of this paradigm have been apparent in the uprising trend to build co-generated power plants. The amount of available forest biomass to be used as bio fuel depends on stand and site characteristics. To maintain its full calorific value, brush (i.e. tree limbs and tops) needs to be free of contaminants such as mineral soil. In cut-to-length operations, this eliminates any use of brush as bio fuel since it is placed on machine operating trails, thus prolonging trafficability and avoiding rutting along the trails. Using brush exclusively for bio fuel will leave operating trails uncovered of brush and result in severe damage since a machine's ground pressure is directly and fully exerted to the ground, leading to potential increases in soil density and other disturbances. In order to manage the two competing uses of brush, this study determines minimum brush amounts needed for efficient soil protection. More specifically, brush mattresses of differing quantity and quality are tested for their ability to divert the loading exerted by machinery driving on top of the mattresses. A total of 20 test scenarios were performed with an 8-wheel forwarder to analyze differences in peak loadings recorded underneath brush mats of 5, 10, 15, 20, 25, and 30 kg m-2 each subjected to 2, 6, and 12 forwarding cycles. Preliminary results indicate the highest peak loads were recorded within the first few forwarding cycles located on the thinner 5 kg m^{-2} brush mat.

Of Deer and Fir: Disentangling initial seedling size, scarification, and deer browsing effects on plantation success on Anticosti

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Anticosti Island is known for its high white-tailed deer density. Plantation is used to restore the original vegetation that was affected by intensive browsing. However, ideal conditions to ensure seedling establishment remain unknown. Our objective is to identify silvicultural options to successfully establish balsam fir plantations in this context. We verify that 1) early seedling survival and growth is proportional to their relative height to vegetation and logging debris; 2) a one year delay between scarification and planting limits browsing due to trench invasion by vegetation; and 3) high level of attractiveness to deer increases seedling browsing risk. We established two experimental plantations according to complete split-plot designs with 6 replicates. First, we controlled seedling size (small, medium and large) and browsing pressure (using exclosures). Preliminary results suggest that small seedlings had a higher height/diameter ratio compared to larger ones after two growing seasons, an indicator of light competition. Medium seedlings seemed to encounter more lateral browsing and less apical browsing, and to have lower mortality than other seedling sizes. In a second experiment, we also controlled the delay between scarification and plantation. After one season, planting delay did not seem to significantly affect survival, but browsing risk was increased in scarified plots compared to controls.

Identification des sites à fort potentiel pour l'intensification de la production ligneuse:
1. Mise en contexte et productivité potentielle

Identification of sites with a high (fertility) potential for intensification of wood production: Introduction and potential productivity

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La Direction des inventaires forestiers (DIF) du Ministère des Ressources naturelles et de la Faune (MRNF) a été mandatée pour identifier les superficies les plus propices à être affectées aux aires d'intensification de la production de matière ligneuse (AIPL). Ces superficies sont caractérisées par un potentiel élevé de production de matière ligneuse et de faibles contraintes à l'aménagement. C'est parmi ces superficies que devraient être investis les principaux efforts d'intensification de la sylviculture en vue d'une plus grande production de matière ligneuse en quantité et en qualité.

Pour mener à bien ses objectifs, la DIF s'est associée avec l'équipe de dendrométrie et de productivité forestière de l'Université Laval afin de développer des modèles d'indices de qualité de station potentiels (IQS) pour les principales essences résineuses et feuillues intolérantes. Pour quantifier la productivité potentielle des essences feuillues tolérantes et de quelques essences résineuses plus marginales, des modèles d'accroissements potentiels en surface terrière ont été développés à la Direction de la recherche forestière du MRNF. Les résultats combinés de ces deux types de modèles ont permis d'obtenir des indices de productivité potentielle pour chacun des polygones écoforestiers productifs ce qui a permis d'identifier les AIPL pour tout le Québec méridional.

Developing and evaluating algorithms for the ZELIG-CFS gap model to predict individual-tree growth and mortality in north American mixed forest types

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Gap models are used to predict the natural course of forest succession. They have contributed to better understanding the long-term natural course of species replacement for several forest types. Despite the great achievements, there is a need to continue the development and evaluation of their basic algorithms to improve their predictive capacity. The ZELIG-CFS model, an updated version of the ZELIG model, was modified to integrate new components on crown interaction effects and survival rate. Seven algorithms representing crown interactive effects between different species within a stand were developed and evaluated. Historical data from three north American mixed forest types in southeastern Canada were used to evaluate the new algorithms. Two of these algorithms predicted the changes in basal area and individual-tree-growth with greater accuracy than the other algorithms: (1) the mean available light growing factor (ALGF), which is the proportion of light intercepted at different levels of individual crowns adjusted by the species-specific shade tolerance index, and (2) the ratio of mean ALGF to crown width. Survival rate was modelled by deriving species-specific survival probability equations as a function of dbh and dbh growth rate. The predicted patterns of change in basal area and stand density were consistent with the life history of the different species.

Analysis of dimensional stability of a novel two-layer laminated wood product using finite element method

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A novel two-layer laminated wood product consists of densified wood as surface layer and virgin wood as substrate, which inherits the superior mechanical properties of densified wood and costs less in manufacture in comparison to the fully densified wood. However, the change in dimensions and shape of this laminated wood product could occur due to the change of relative humidity (RH) and temperature. The reason is due to the different mechanical and physical properties (e.g. modulus of elasticity and hygroscopic expansion coefficient) between two layers. This study was aimed at examining the influence of thickness ratio (R_T) of densified and virgin wood on the deformation of a two-layer laminated densified wood product. The finite element method (FEM) was used to model the deflection of this laminated wood product. The FEM model was verified using experimental data. Both densified and virgin wood were made of balsam fir (*Abies balsamea (L.) Mill.*). Two types of specimens of R_Ts (0.18 and 0.58) were conditioned at 85%RH and 20°C for one week, followed by 10%RH and 60°C for another week. The images of each specimen were captured by a Canon digital camera, and the deflection was extracted by Image J software. The rest FEM analysis on the deformation is ongoing and will be finished by the end of July.

Evaluating stem taper and bark thickness equations for the major conifer species in the Acadian Region of North America

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Numerous stem taper equations and bark thickness equations exist in the forestry literature, but relatively few are specific to the Acadian Region. Ten commonly used taper equations were investigated for their predictive ability for balsam fir [*Abies balsamea* (L.) Mill], red spruce [*Picea rubens* (Sarg.)], and white pine [*Pinus strobus* (L.)]. The Kozak (2004; For. Chron 80: 507-515) taper equation was identified as the most reliable and easy-to-fit equation. We then applied the Kozak (2004) equation to 11 conifer species for stem form and volume predictions. We found the taper equation greatly improved the volume prediction accuracy by reducing the bias up to 39% compared to results using the Honer (1967) volume equations.

We also evaluated 10 bark thickness equations and found the equation proposed by Cao & Pepper (1986, equation 5; Southern Journal of Applied Forestry 10: 220-224) performed significantly better than other equations for most of our study species. The mean absolute bias was found to be reduced up to 74% compared with using a fixed ratio approach employed in the widely used Northeastern variant of the Forest Vegetation Simulator (FVS-NE) growth and yield model. Mixed-effects modeling techniques were employed to fit both stem taper and bark thickness equations.

Xylogenesis in black spruce: the role of growing season length, soil temperature and nitrogen availability

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In the boreal forest, nitrogen availability and low temperatures are considered the limiting factors for tree growth. Recent studies hypothesize that the recent increased growth of boreal forest in the northern hemisphere may be due in part to climate warming and nitrogen depositions. The aim of this study is to quantify the effect of an increase in soil temperature and nitrogen availability on cambial activity and wood formation in the stem and roots of black spruce (Picea mariana (Mill.) BSP). The study started in 2008 and was carried out in 2 mature black spruce stands. In each site a heating treatment was combined with N fertilization according to a split-plot design. In the warmer site, the onset of wood formation started earlier (10 days), while the ending took place later (10 days). Both treatments led to later lignification of xylem cells. Starting from the 2nd year of treatment, treated trees produced more cells. In conclusion, these preliminary results support the hypothesis that climate warming and N depositions are responsible for increased growth of the boreal forest.

Extraction de mesures forestières de façon rétrospective à partir des données Lidar aéroporté

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Cette étude vise l'extraction de mesures forestières (hauteurs d'arbres, diamètres de couronne, DHP) à partir de données Lidar aéroporté. Des données Lidar d'archive sont utilisées afin de prédire de façon rétrospective les mesures forestières dans des zones qui n'ont jamais été inventoriées par le passé, mais dont on dispose de données d'inventaires plus récentes. Un modèle numérique de hauteur (MNH) a été créé en soustrayant le modèle numérique de terrain (MNT) de celui de la surface (MNS) de la canopée en utilisant la méthode d'interpolation TIN. À partir de ce MNH dérivé du Lidar, les hauteurs et les diamètres de couronne des arbres individuels ont été extraits à l'aide d'algorithmes de détection des maxima locaux et de segmentation. Le DHP a été estimé à partir des hauteurs Lidar par régression en utilisant des équations de régression préalablement établies avec les données de terrain récentes. Pour valider les résultats obtenus, une estimation rétrospective du paramètre hauteur par la méthode de « courbes de l'indice de station » a été faite par espèce au niveau de la placette. Les paramètres DHP et diamètres de couronne ont été déduits par la suite par régression à partir de ces mesures rétrospectives de la hauteur. Les résultats obtenus donnent des R^2 de l'ordre de 0,91 pour la hauteur; 0,51 pour le diamètre de couronne et 0,88 pour le DHP. Ces résultats montrent que les paramètres dendrométriques peuvent être estimés de façon rétrospective à partir de données Lidar d'archive avec un bon niveau d'exactitude.

Using Artificial Neural Network model to produce high resolution forest soil property maps

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Soil property maps are considered as the most important input information for decision support and policy making in agriculture, forestry, flood control as well as environmental protection. Traditionally, soil property maps are mainly obtained from field surveys. Field soil survey is generally time consuming and expensive, which limited it application over a large area. As such, high resolution soil property maps are only available for small areas, very often, being obtained for research purposes. In this research, artificial neural network technology was used to generate high resolutions soil property maps. Hydrological parameters derived from digital elevation maps combined with information extracted from existing coarse resolution soil maps were used as input for the proposed model. Detailed soil survey information from Black Brook Watershed in Northern New Brunswick was used to test the model performance. We found that ANN models base model can be used to predict soil texture, soil drainage classes and soil organic matter content across landscape with reasonable accuracy. The high resolution soil maps derived with this method could be used for growth and yield assessment, silviculture design and making forest management plans .

Landscape-scale spatial dynamics of balsam fir sawfly populations and of its baculovirus during an outbreak

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It has been shown that forest management in the form of thinning treatments alters the oscillations in density of the balsam fir sawfly (Neodiprion abietis Harris), with population fluctuations having higher amplitude in managed stands than in natural stands, but a similar duration in both types of stand. This change was associated with an increase in balsam fir defoliation due to this insect in managed stands, as well as an expansion of the range usually subjected to severe defoliation by this insect. Because the natural collapse of balsam fir sawfly outbreaks is initiated by the baculovirus NeabNPV (Neodiprion abietis nucleopolyhedrovirus; Baculoviridae), NeabNPV applications have been examined as a tactic to suppress epidemic populations of balsam fir sawfly. These applications indicated that the sole introduction of NeabNPV in field populations of this insect can induce a premature collapse of increasing or peaking populations. In addition, landscape-scale spatial dynamics of balsam fir sawfly populations and NeabNPV infection revealed an intricate relationship between the baculovirus and its host.

Comparaison des modes de tenure privés et publics de la forêt du Bas-Saint-Laurent en fonction d'indicateurs environnementaux et socio-économiques

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Les forêts sont de plus en plus perturbées par les activités de récolte de bois, alors que la population demande une gestion des ressources forestières mieux équilibrée entre les valeurs environnementales, sociales et économiques. Les modes de tenure peuvent être divisées en deux grands types, soit privée et publique. Historiquement, les forêts du globe étaient presque exclusivement sous tenure publique. Aujourd'hui, 81% des forêts de la planète sont publiques, mais une part grandissante (19%) sont sous tenure privée. Cette tendance, dans un contexte où les exemples de surexploitation des ressources se multiplient, commande une réflexion sur les effets potentiels de ces changements dans les types de gestion.

Cette étude compare et met en contraste les forêts publiques (sous CAAF) et privées (petits lots boisés) de la région du Bas-Saint-Laurent, qui se partagent à parts égales une même région écologique. Vingt-deux bassins hydrographiques, d'une superficie moyenne de 50 km^2 et qui sont en partie sous tenure privée et publique, ont servi d'échantillon pour vérifier comment la structure des écosystèmes forestiers est affectée par la tenure. Nous avons notamment constaté des différences au niveau d'attributs tels la fragmentation et l'âge des peuplements ainsi que le type de couvert forestier. Afin de comprendre l'origine de ces différences structurales, nous avons examiné les données d'opérations forestières des années 1990 à 1999. Nous y avons découvert des « recettes » d'aménagement forestier contrastées qui expliquent les différences dans la structure, en plus d'une création d'emploi considérablement réduite par la mécanisation sous tenure publique. La simulation des conséquences à plus long terme de ces types d'aménagement suggèrent que ces deux modes de gestion peuvent être complémentaires pour en arriver à une gouvernance bien intégrée des ressources naturelles et du territoire forestier.

Some Ecological Effects of Harvesting and Site Preparation in White Pine Stands Managed Under the Shelterwood System

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Silvicultural practices used on Ontario's public lands are required by the province's *Crown Forest Sustainability Act* to be ecologically sustainable: they must regenerate desirable tree species while maintaining site quality and ecological function. White pine forests in central Ontario are managed using the uniform shelterwood silvicultural system in which the overstory is removed in a series of partial harvests. This study was established to evaluate the effects of the uniform shelterwood system and current site preparation techniques on several ecosystem components: white pine regeneration; seed production; competitive vegetation; health and growth of overstory trees; genetic diversity of overstory trees; eastern red-backed salamander populations; dead woody material; and vegetation diversity and succession. The study was established in 1994 using a randomized complete block design with 3 replicates and 5 treatments. The treatments include (1) no harvest, no site preparation; (2) regeneration cut, no site preparation; (3) regeneration cut, mechanical site preparation; (4) regeneration cut, chemical site preparation; and (5) regeneration cut, mechanical and chemical cite preparation. Baseline data were collected in 1995, harvest and site preparation treatments were applied from fall 1995 to fall 1997, and white pine seedlings were planted in spring of 1998. We will discuss results obtained in the first 5 years after site preparation.

Spatial patterns of coexisting shade-tolerant northern hardwood regeneration in understories dominated by *Fagus grandifolia* in Maine

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American beech (Fagus grandifolia Ehrh.) commonly dominates and may interfere with the regeneration of sugar maple (Acer saccharum Marsh.) in naturally regenerated northern hardwood stands in Maine. To enhance the understanding of the coexistence of the two species in post-harvest stands, spatial patterns were quantified. Regeneration densities were sampled at three sites using 24 x 24 m grids with 1 m2 quadrats. Densities were separated into three height classes (≤ 30 cm tall, 30 – 90 cm, and > 90 cm, ≤ 4 cm dbh) to test two hypotheses: 1) beech regeneration spatial patterns are random among height classes; 2) small sugar maple patterns (≤ 30 cm tall) are contagious. All beech height classes and the smallest sugar maple height class were found to be contagious, so the first hypothesis was rejected and the second hypothesis was not rejected. Spatial patterns of the two species in post-harvest stands suggest that beech will continue to dominate in the long-run. However, the relatively even-distribution of sugar maple indicated that the composition of the stands could be shifted toward sugar maple dominance with an appropriate selective technique to reduce beech and preserve sugar maple.

Influence of Silvicultural Intensity and Compositional Objectives on the Productivity of Regenerating Acadian Forest Stands

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Nearly 690,000 hectares of forestland in Maine is dominated by early-successional species and structures, but their response to various intensities of silvicultural practices are often poorly understood. During 2003 & 2004, a long-term experiment was installed on the Penobscot Experimental Forest (PEF) in central Maine, with early-successional stand conditions. A 3 x 3 +1 factorial of species composition and silvicultural intensity were applied ranging from untreated controls to high intensity white spruce and hybrid poplar artificial regeneration to better understand how various management intensities affect growth and survival. Four clones of hybrid poplar have been planted to test the performance and survival of individuals in the Acadian region for short-rotation biomass production. Growth and yield data have been collected since the start of the experiment and early results indicate that early stand thinning benefits both conifer advance regeneration and fast-growing hardwood species. Future research will focus on investigating how management intensity affects ecophysiology of different species and related growing conditions.

40-Year Compositional Dynamics of a Long-Term Silviculture Experiment in Northern Maine: The Austin Pond Study

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Located in Bald Mountain Township, Maine, the Austin Pond Study (APS) was one of the first experiments established by the University of Maine's Cooperative Forestry Research Unit (CFRU) over 30-years ago. The APS began as a trial testing the efficacy of herbicide treatments in controlling broadleaf species to favor softwood regeneration on a shrub-dominated mixedwood site initiated by commercial clearcutting in 1970. Prior to clearcutting, the site was dominated by mature, softwood stands. In August 1977, two replicates of fourteen herbicide treatments were applied: twelve herbicides and a water-only treatment applied aerially with a helicopter and a no-spray control. In 1986, the APS was treated with pre-commercial thinning applied to half of all the original treatment units, which spaced residual stands and favored softwoods. This sequence of treatments created a range of hardwood, softwood, and mixedwood stand types. Presently, the structure and composition of these stands represent nearly 7-million acres of mid-rotation forestland across northern Maine. We used multivariate analysis in conjunction with descriptive statistics on stand attributes to retrace the compositional dynamics of these 40-yr old stands. Results of this investigation will be discussed as well as future research opportunities for this long-term silviculture experiment.

Influence of tree spacing on spatial distribution of shrinkage properties in white spruce tree stem

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Distortion in lumber, such as twist, cup, spring and bow, can cause serious problems for its use in service. Lumber distortion is largely caused by differential shrinkage in wood in different directions and the presence of different types of wood (i.e. juvenile and mature wood) in a single piece. Silvicultural practices, such as initial tree spacing and thinning, have a great influence on tree growth and wood properties. In this study, white spruce (Picea glauca) trees from three different stand densities were sampled. Longitudinal, radial and tangential shrinkage values are measured using digital image correlation (DIC) technique. The work described in the paper is part of a larger study to develop a modelling technique to predict distortion of lumber based on its position in a tree stem. This paper describes the sampling of test material, shrinkage data in longitudinal, radial and tangential directions. The influence of initial tree spacing and the formation of juvenile wood over time on the spatial distribution of shrinkage values will be discussed.

Jeunes plantations d'érable à sucre et de bouleau jaune dans les forêts tempérées froides de l'Est du Québec : utilisation d'un protecteur en tissus et gestion de la végétation compétitive

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Afin d'augmenter les chances de succès des plantations, il faut développer les techniques appropriées et connaître les facteurs écologiques limitant qui varient en fonction des essences utilisées et des conditions régionales. Des essais de plantations d'érable à sucre (*Acer saccharum* Marsh) et de bouleau jaune (*Betula alleghaniensis* Britton) ont été menés dans un contexte de climat tempéré nordique (essences à leur limite de distribution septentrionale). Dans neuf plantations de deux à trois ans, nous avons évalué d'une part, l'utilisation d'un protecteur à maille fine et d'autre part, les effets du type de végétation compétitive (herbacée ou ligneuse) sur le broutage, la vigueur et le développement de 353 semis.

Malgré une certaine perte de robustesse de la tige et une possible malformation de la couronne, l'utilisation des protecteurs est très bénéfique pour stimuler la vigueur et la croissance des semis. Les dommages occasionnés par les herbivores ont été limités grâce au protecteur mais spécifiquement, le broutage par les ongulés (chevreuil et/ou orignal) est resté invariable. Le contrôle de la végétation herbacée est essentiel pour optimiser le succès des plantations tandis que la gestion optimale de la végétation ligneuse mérite d'être investigué plus en profondeur.

Green River Precommercial Thinning Trial: A fifty-year legacy of forest research continues.

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The Green River watershed, located north of Edmundston, New Brunswick, has served as the backdrop for forest research in balsam fir dominated forests since 1939. The Green River precommercial thinning (PCT) trials were established by Dr. Gordon Baskerville between 1959 and 1961 in naturally regenerating balsam fir (Abies balasamea (L.) Mill.) dominated stands to address concerns over imminent age-class gaps that threatened future wood supply in the region. Three nominal spacings of 4' (1.2 m), 6' (1.8 m), and 8' (2.4 m) were compared to an unthinned control in 6 replicate blocks. In fall of 2008, following completion of the ninth sequential evaluation of the study's 48 permanent sample plots, three of the six replicates were clearcut harvested, with data being collected to quantify the effects of precommercial thinning on the forest value chain. This large collaborative undertaking, involving all divisions of FPInnovations, is serving to quantify the impact of PCT on growth and yield, stumpage value of roundwood products, operational harvesting and wood extraction costs, root and butt rot incidence and severity, lumber recovery and value, pulp and paper recovery and value, and the overall balance between costs and benefits.

Green River Precommercial Thinning Trial: roundwood production and the effects on stumpage, harvesting and extraction costs, and recovery and value of lumber and pulp and paper.

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Maturity of the balsam fir dominated stands of the Green River precommercial thinning (PCT) trial (47-49 years post-treatment) presented a unique opportunity to study the effects of PCT on the entire forest value chain. Three of the study's six replicate blocks were harvested in fall 2008. Staff from all four divisions of FPInnovations collected data to quantify roundwood product recovery and value, harvesting and wood handling efficiency, lumber recovery and value, incidence and severity of root and butt rot, and pulp and paper recovery and value. Stands thinned to 6' spacing provided gains of 20% for gross merchantable volume, 28% for sawlog volume, and a potential increase in stumpage revenues of 28%. Thinning supported positive net present values for stumpage through discount rates up to 8%. PCT positively impacted harvesting operations by reducing harvesting and wood handling costs between $700 and $1500 per hectare. Peak lumber production in the 6' and 8' thinned stands was 23% greater than unthinned stands, creating a benefit of nearly $6000 per hectare without appreciably sacrificing lumber quality. PCT had minimal effect on pulping and pulp quality; differences between the sites harvested were greater than observed between the PCT treatments.

Effect of finger geometry on ultimate tensile strength of single finger-joined boards

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Finger-joining is an economic method to transform low-grade short pieces of wood to produce high-quality lumber of any length. The typical finger length of structural finger-joints in North America is longer than that in New Zealand, Australia and Europe. A longer finger length would result in more waste of wood, thereby increasing the production cost. The overall objective of this research was to develop a short finger profile for structural finger-joined lumber with the minimal influence on joint strength. The specific goal of this study was to evaluate the effect of geometric parameters on the ultimate tensile strength of single finger-joined boards.

Seven finger profiles with three finger lengths were designed. Single finger-joined boards of eastern white-pine (*Pinus strobus*) were prepared using computer numerical controlled (CNC) machine, and a polyurethane adhesive. Tension tests were conducted to determine ultimate tensile strength (UTS). It was found that UTS increased with decreasing finger slopes. Finger profile F2 of the shortest finger length exhibited the highest UTS among the seven groups. It was promising to adopt a short finger-joint in manufacturing of finger-joined lumber for structural uses.

The irregular shelterwood system for the maintenance of structurally complex stands attributes

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With the adoption of a new law on the sustainable management of forested land, Québec is undertaking a turn towards ecosystem-based management of its forests. This implies that silvicultural practices must emulate ecological processes and interactions if composition, structure, and ecosystem functions are to be maintained within theirs limits of natural variability. At the stand scale, this management context brings into question current practices and how they can contribute to sustain ecological values. Among classical regeneration methods, the irregular shelterwood system may be compatible with ecosystem-based management in stands driven by partial stand mortality and gap dynamics and provides opportunities for maintaining old-growth forest structural attributes. Since this system is poorly known in Québec, a research program was implemented to assess its effects in different stand types. This presentation will compare the initial effects of irregular shelterwood systems and current practices on stand structure, snags, and coarse woody debris in two experimental designs, one being set in the balsam fir-spruces stands in Gaspésie and the other in balsam fir-yellow birch stands in the wider Quebec City region.

Development of regional height to diameter allometric equations for naturally-regenerated, mixed species, and multi-cohort forests of the Acadian Region

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Allometric equations that relate individual tree diameter at breast height and total height (H-D) are important as total height is rarely measured and need to estimate volume or predict height. Regional allometric equations for H-D were developed for selected fifteen tree species of Acadian Forest. The species consists of eight hard woods (*Acer rubrum, A.saccharum, Betula populifolia, B. papyrifera, B. alleghaniensis, Fagus grandifolia, Populus tremuloides and Quercus rubra,)* and seven confer (*Abies balsamea, Picea glauca, P. mariana, P.rubens, Pinus strobes Thuja occidentalis and Tsuga canadensis).*

Data were available from School of Forest Resource, University of Maine that has organized an extensive databank of repeatedly measured forestry data of Acadian Region including Maine, three provinces of Canadian Maritimes and Quebec. Various models forms were evaluated and included: (1) Chapman-Richards (1959) (CR); (2) Wykoff (1982); and (3) Curtis-Arney (1967). The Forest Vegetation Simulator (FVS) Northeast variant uses the latter two model forms. FVS and CR models were compared in this study. Regional model were fitted by adding tree and stand level covariates to capture regional variation. Based on model selection criteria (MSC), the best model was the CR constructed by non linear mixed effect technique (NLME) and two covariates added, which were crown competition factor and basal area larger than subject tree. Compared with FVS, the best CR model was superior in all of the MSC and species examined. For example, the root mean square error and bias reduced by 67% and 99% respectively.

The study concludes that the CR H-D model is a better model to predict total height and minimizes the bias across the region. This study has important implications for developing an effective growth and yield modeling system for the Acadian Region.

The use of historic land surveys to reconstruct the presettlement forest in Quebec (Canada)

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Early land survey records are useful for reconstructing presettlement forest conditions. Most reconstructions in North America using this approach are based on witness tree data from General Land Office (GLO) records of the east coast of USA. In the province of Quebec (eastern Canada) a different system of land survey was used in the 19th century: line descriptions along range lines. Although the period of earliest survey varied considerably throughout Quebec (1790-1810s in the west and the south, 1850-70s in the central area and the east, early 20th century in the north) the survey system was broadly consistent. These line descriptions are characterized by a high density of observations (average of 2.9 per kilometer), permitting a good approximation of vegetation trends and occurrence of disturbances across the landscape and along environmental gradients. Our analysis of survey records in an area of 10 000 square kilometers in eastern Quebec indicates that the presettlement forest was composed mainly of spruce (Picea spp), balsam fir (Abies balsamea), and eastern white cedar (Thuya occidentalis), along with yellow birch (Betula alleghaniensis), white birch (B. papyrifera) and sugar maple (Acer saccharum). At present there are more aspen (Populus tremuloides) and maple and less cedar and spruce.

Soil Carbon Monitoring Plots in Vermont's Managed Forests

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Sustainable forest management relies on understanding and maintaining site quality. Increased demands for biomass heat, energy and local wood products will increase harvesting and site disturbance, potentially reducing long-term storage of carbon. Information is limited on current forest soil stores of carbon and forest management effects on these stores. Our project goal was to establish reference plots in Vermont on actively managed forested lands. We selected 18 locations representing the major forest soil types and forest communities (northern hardwood, rich northern hardwood and lowland red spruce-balsam fir). Plots were intensively sampled by soil horizon and depth increment to bedrock or dense till. Total soil carbon, including the forest floor, ranged from 43 to 193 Mg ha-1. Above-ground carbon stores had a similar range of 62 to 180 Mg ha-1. The distribution of carbon in the soil profile was affected by past land-use and an Ap (plow layer) horizon was often present. Near-surface carbon is more susceptible to management impacts. Extensive measurements showed that the forest floor thickness varied widely, between 1 and 11 cm. Results (www.uvm.edu/~soilcrbn) will inform land managers and the public, and be used as a baseline for additional sampling to investigate changes, if any, after harvest activity.

Using mechanistic models to manage windthrow risk in large tracts of natural forests: potential and challenges.

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In recent years, a trend of reducing clearcut size and using more partial cutting in Eastern Canadian boreal forests has raised concerns regarding a possible increase in windthrow risk. Mechanistic models are a potential tool to incorporate windthrow risk into management strategies but existing models require adaptation for the conditions typical of natural boreal forests and currently only operate at the stand level. This presentation will focus on progress in modifying wind risk models for use in the boreal forest and the challenges that still remain to be addressed.

The first step in model adaptation was to develop empirical overturning resistance equations through tree pulling studies. This was done for the major species of the Eastern boreal forest of Canada, growing in regular stands. Some work has been carried out in irregular stands but an additional effort is required to properly model such stands because the risk has to be modelled at an individual tree level.

Management of the Eastern Canadian boreal forest currently remains extensive. To try to provide forest managers with a practical risk management tool, a version of ForestGALES was linked with the GIS database currently used in Quebec. Even though critical wind speeds can then be estimated for each stand, their reliability will be strongly limited by the precision of the input data. However, this integrated tool could prove useful for developing management strategies at the management unit scale.

Assessing model prediction uncertainty in forecasting long-term tree basal area and diameter increment for the primary Acadian tree species

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Tree basal area or diameter is universally used to represent tree secondary growth in individual tree growth models. Often, justification is not provided for the preference of using either tree basal area or diameter increment for predicting growth. Early work has shown no difference in model precision when either is used, however this has not been tested using data gathered from long-term silvicultural experiments that use contemporary modeling techniques common to today's growth and yield simulators. The objectives of this analysis are to 1) fit localized basal area and diameter increment equations for six conifer and four hardwood species, 2) evaluate the performance of each, and 3) test model uncertainty by comparing predictions with observed growth via Monte Carlo simulation. Using over thirty years of data gathered from the silvicultural experiment conducted at the Penobscot Experimental Forest (Bradley, ME), annualized nonlinear mixed-effects models were constructed for each species. Results indicated a higher proportion of explained variability for all species when basal area was used over diameter increment. The Monte Carlo simulations compared expected and observed coverages of confidence intervals for plot-level attributes such as basal area, basal area growth, and volume. Results illustrate the importance of long-term data and the need to better incorporate model uncertainty in growth projections.

Assessing the Ecological Continuity of *Thuja occidentalis*-dominated Forests in New Brunswick using Calicioid Lichens and Fungi

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The intimate physiological relationship between lichen thalli and the environment, the perennial nature of lichens and their sensitivity to disturbance, dependence on nutrients and chemicals not derived from their substratum, an ability to concentrate compounds from weak solutions, and also the range of species with different requirements and sensitivities, means that lichens act as continuous monitors of the environment. An appreciation of their qualities as biological monitors, and the study of the parameters limiting the occurrence of particular species, has led to their use as indicators of a variety of environmental factors.

--Hawksworth and Hill (1984)

As part of an ongoing effort to assess the ecological continuity of forests in the Acadian Ecoregion using calicioid lichens and fungi, eleven *Thuja occidentalis*-dominated cedar stands in New Brunswick have been investigated. Using a Restricted Taxa Approach based on the number of calicioid species found at each site, these stands are ranked and compared with other forests that have been similarly assessed in eastern Canada.

Given the fact that the diversity of microhabitats can be expected to increase over time in an aging forest and that the calicioid lichens and fungi can be found growing in more of these microhabitats than any other group of organisms, it is argued that an index based on the total number of calicioid species collected at a site provides a more accurate assessment of continuity than any other methods currently being used. The higher the number of calicioid species collected at a site, the more ancient the site, and vice versa:

Successional Stage	**Total Number of Calicioid Species Collected**
Pioneer Forest	0-2
Seral Forest	3-10
Young Old-Growth Forest	11-15
Ancient Forest	16 or more

Prior to the current investigation, the most ancient of the forests in the Acadian Ecoregion have been the coniferous stands at French River (21)) and Panuke Lake (18) in Nova Scotia, and the northern hardwood stands at Margaree River (21), North River (20), and Sugarloaf Mountain (20) in Nova Scotia and the Townshend Woodlot (16) on Prince Edward Island. All eleven of the *Thuja*-dominated stands in New Brunswick have attained ancient status, with calicioid species numbers ranging from 16 to 38. The cedar stand at Berry Brook, which harbors 38 calicioid species, is quite an impressive forest!

Properties evaluation on salicornia stalk and stalk-based composites

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Salicornia (*Salicornia bigelovii* Torr.) is an oilseed halophyte for seawater irrigation, which grows in North America and was introduced to China in 2000. Basically, salicornia is used for improving alkaline land. This study was aimed at examining the feasibility of manufacturing salicornia stalk-based composites boards as a replacement of wood-based composites panels. To reach this, the properties of salicornia and stalk-based composites boards were investigated.

The pH value, ash content and chemical components of salicornia stalk were measured according to the Chinese National Standards, GB/T6043 "Method for determination of pH value of wood", GB2677.3 "Fibrous raw material- Determination of ash" and GB 2677.4 "Fibrous raw material- Determination of water extraction". It was discovered that salicornia stalk had a pH value of about 7, an ash content of 13.01% and a hot-water extractive amount of 15.96%. The X-ray photoelectron spectroscopic analysis showed the existence of some wax in the cortex. The FT-IR Spectrometric analysis discovered that smashed salicornia stalks had a higher percentage of hydroxyl than the virgin ones.

Stalk-based composites boards of 300x300 mm^2 were made at a pressure of 3.5 MPa, temperature of 160^oC and pressing time of 6.5 minutes. A combination of 20% poplar particles and 80% salicornia particles could produce good quality boards by adding 1% wax, 2% curing content (NH_4Cl) and 12% urea-formaldehyde resin. The internal bonding (IB), Modulus of rupture (MOR), modulus of elasticity (MOE), and 2-hour thickness swelling (TS) of the stalk-based boards were 0.51MPa, 2045.46MPa, 12.55MPa and 17.80%, respectively, which met the requirements of the Chinese National Standard GB/T4897.2 "Particleboard-Part1:Requirements for general purpose boards for use in dry conditions".

Influence of wood value on profitability of thinning regimes

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Wood value ($/m3) is known to be highly variable. Nonetheless, it is generally accepted that wood from larger stems is more valuable than from smaller ones. For that reason, thinning is often considered as a means to increase a stand's overall value. Unfortunately thinning also shows to be an unprofitable venture in many situations. The influence of wood value on thinning profitability is not well understood. This presentation summarizes an investigation of the influence of wood value, as expressed in the form of profit-size relationships, on thinning profitability. Specifically, this study analytically examined the sensitivity of thinning profitability to wood value and identified its determinants. Results indicate that thinning profitability is mainly dependent on two variables that combine wood value with stand volume characteristics: wood value harvested in thinning, and stem size opportunity. Stem size opportunity is the additional value of growing trees to size classes beyond those obtained at rotation when the stand is left unthinned. We can safely conclude that thinning profitability depends on specific wood value characteristics. Considering those wood value characteristics can help managers understand why thinning is profitable or not.

Profit-size relationships: a wood value expression to facilitate stand management decision making

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We present an alternative approach to expressing net value of wood in standing trees in relation to important tree characteristics. The approach aims to increase managers' understanding of stand profit production and lead to consideration of stand interventions with higher profitability than those suggested by commonly used guidelines designed for maintaining biologically desirable stock levels. For demonstration purpose, the approach is applied to an example white spruce (Picea glauca (Moench) Voss) stand in eastern Canada. Two scenarios of net value of wood in relation to stem size are presented with their implications on profitability of thinning. The information provided by this simple approach cannot be found in either the biologically-based guidelines nor in the stand's cash flow analysis as commonly performed. The results indicate that considering value of wood in relation to tree characteristics influenced by stand interventions can increase one's ability to design profitable interventions.

Stem Quality Assessment from a Long-term Study of Early Precommercial Thinning in Northern Hardwoods of the Acadia Forest Region

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Northern hardwood stands are a major natural resource for the forests of eastern North America in ecological and economical values. The economic value of hardwood species for sawlogs and higher quality projects is determined by a number of factors that are initially assessed visually on the exterior of the tree stem. The potential quality of a tree can be assessed at fixed internals or "floating" variable internals along the stem. This presentation provides stem quality assessment and comparisons between various methods 22 years after early precommercial thinning interventions from a long-term study in the northern hardwoods of the Acadia Forest. Stem quality assessment was conducted when the stand of this experiment is entering the "window of opportunity" for commercial thinning prescriptions. The objective of this portion of the study is to determine and illustrate whether the value of the stand can be increased using a floating variable internal assessment for potential quality of sawlogs. The study is part of a current eastern hardwood research initiative being conducted by the Canadian Wood Fibre Centre and FPInnovations.

Managing understory vegetation for sustaining productivity in black spruce forests: A synthesis and future developments

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The sustainable management of the boreal ecosystem requires the establishment of a vigorous forest regeneration following harvesting activities. Ericaceous shrubs such as Kalmia angustifolia are recognized to rapidly invade boreal sites following major disturbances. On some sites, such invasion induces a "growth check" of established conifers through a combination of direct and indirect competition mechanisms, resulting in a stagnant growth that can last several decades. On other sites, peat accumulation and water table rise following harvesting activities force the roots of regenerating conifers out of the relatively nutrient rich and warm mineral soil into the relatively nutrient poor and cool organic layer, with drastic effects on aerial growth. Such shifts from once productive forests to ericaceous heaths or paludified sites have significant effects on forest productivity and biodiversity. We review how understory vegetation influences ecosystem dynamics in boreal Québec, and present a multi-scale research model elaborated to limit the loss of productive and diverse boreal ecosystems. Our research model, which integrates the understanding of plant-level mechanisms to the development of silvicultural tools and to a better understanding of the loss of productive boreal sites at the provincial scale, can be exported to other forestry contexts.

Base cation distribution, uptake and cycling in three common forest ecosystems in Eastern Canada.

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The pool of base cations (BC: Ca, Mg and K) in forest soils has been depleted in the recent decades, in part because of acidic precipitation. In order to better understand of BC cycling in forests, we estimated organic matter (OM) and BC distribution, uptake and cycling in three mature forest stands in Eastern Canada.

Ecosystem OM levels were respectively 692, 732 and 266 Mg ha^{-1} in a stand of 85-130 year-old hardwoods (HW), 48 year-old balsam firs (BF) and 60 year-old black spruces (BS). Ecosystem BC and OM pools were strongly correlated. Whole-tree harvesting would export 29-55% of ecosystem BC, while stem-only harvesting would reduce BC exportation by 35-60%. Stand increment was equivalent to litterfall in BF and BS, but was negative in HW, due to higher mortality. Net primary production (NPP) of 1 Mg OM ha^{-1} required twice the K uptake in HW than in BF or BS. In HW, 120% of BC uptake was recycled by detritus production, mainly by dying trees and litterfall. In BF and BS, 62-71% of BC uptake was recycled, mainly by litterfall. The biogeochemical cycle represents thus an important source of BC for the three stands, depending on the decomposition rate of detritus.

Past and upcoming dynamics of red oak at its northern range limit, in eastern Quebec, Canada

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Red oak (*Quercus rub*ra) is a tree species of intermediate shade-tolerance, whose distribution is patchy at its northern range limit, which in Eastern North America occurs in the Gaspé Peninsula in Eastern Quebec. An aerial survey in 2004 over the gaspesian Forillon National Park (FNP) identified 47 sites having red oaks. We evaluated the demographics of red oaks in 19 of these sites to understand how these populations change through time, and used cartographic documents to explain their spatial location. Specifically, we have aimed to 1) establish the structure and origin of current populations, 2) characterize the recent past dynamics, and 3) foresee upcoming demographic trends. Our preliminary results suggest that oak abundance in the FNP peaked in the beginning of the 19th century and diminished afterwards, probably in response to human activity in the preceding century. Such anthropogenic interference seems to have favoured the presence of this thermophilic tree species at the expense of species better adapted to the relatively harsh climate of the peninsula, and thereby facilitating the FNP forest's adaptability to the current trend of climate warming. This is a case where the presence of humans appears to have benefited a forest's adaptability to its environment.

Mesure des écarts de composition forestière entre la forêt préindustrielle (de 1836 à 1940) et la forêt aménagée (de 1995 et 2003) en Gaspésie

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L'aménagement écosystémique s'inspire des perturbations naturelles pour reproduire, dans les forêts aménagées, les attributs et caractéristiques propres aux forêts naturelles. La détermination des écarts entre la forêt naturelle (souvent représentée par la forêt préindustrielle) et la forêt aménagée (forêt actuelle) permet de définir les caractéristiques forestières qui ont été changées par les interventions humaines. En but de mettre en place l'aménagement écosystémique sur le territoire gaspésien, la composition végétale du Portrait forestier historique de 1836 à 1940, des quatre régions écologiques présentent en Gaspésie a été comparé avec celle du Portrait forestier actuel de 1995 à 2003. La comparaison des deux portraits suggère des changements notables en termes de composition forestière dans les quatre régions écologiques du territoire. Tout d'abord, il existe une augmentation généralisée de l'abondance/fréquence du peuplier faux-tremble et du taxon érable sp. Ensuite, il existe une diminution importante des essences de choix pour l'exploitation forestière au XIXe et XXe siècles (épinette sp., pin blanc, thuya occidental, et bouleau jaune). Pour tendre vers un paysage plus proche du paysage naturel, il sera préférable de favoriser les espèces en régression sur le territoire et d'assurer un contrôle des espèces potentiellement envahissantes (particulièrement le peuplier faux-tremble) et des espèces exotiques.

Properties of wood-plastic composite sandwich structures with high fibre content

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In this project, wood chips from white spruce (*Picea glauca*) or black spruce (*Picea mariana*) are valorized in a composite sandwich panel, i.e. an advanced engineering material. More precisely, the panel skins are made of wood/plastic composite (high wood content) and a foamed polyethylene core links them together. A chemical blowing agent (azodicarbonamide: $C_2H_4O_2N_4$) was used as the foaming agent. Good bending properties combined with lightness, high impact strength and good insulation properties are attributes expected from a sandwich panel. These attributes can be potentially beneficial for many structural or appearance products (furniture, building insulation, transportation, sporting goods, etc). The objective of the project is to evaluate the potential of two spruce species in wood-plastic composite sandwich panels for appearance products. Three principal equipments are used: a ring refiner, a twin screw extruder and a semi-automatic laboratory press. Results show an improvement in bending properties and foam quality when higher particle content was introduced in the skin. Adhesion between the skins and the core is good. We must focus on pressing parameters and layer thickness to avoid buckling of the skins. Finally, it was reasonable to introduce wood particles into the foamed core layer, but it changes the cellular structure.

Effects of selection harvesting on biodiversity in tolerant hardwoods of the Black Brook district, New Brunswick: forest songbirds as a model system

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Partial harvesting offers the possibility of meeting both commercial and biodiversity conservation objectives. Previous work has shown that forest songbirds can sustain a moderate harvesting intensity, beyond which their probability of presence or reproduction drops significantly. In this study, we investigated the processes underlying the response of two focal species to first-entry single tree selection (30-40% removal) in shade-tolerant hardwoods. These species, the Ovenbird and the Brown Creeper, are strongly associated with closed-canopy and old tolerant hardwood stands, respectively. We addressed the following questions: does the treatment influence the return rate of marked individuals and the recruitment of unmarked ones? Do nest predators (e.g. red squirrel, chipmunk) show a numerical response to the treatment? As expected, both bird species had lower densities and productivity per unit area in treated plots than in controls. Ovenbird return rates were lower in treated plots in the 2nd and 3rd year post-harvest. The abundance of nest predators varied strongly between years but not as a function of the treatment. Feeding rate at Brown Creeper nests was lower in treated plots than in controls. In summary, short-term treatment effects appeared moderate but their cumulative impact at the regional scale call for a landscape-level conservation strategy for these and other sensitive species.

Effets des caractéristiques de station et de peuplement sur le régime de chablis de la Côte-Nord, Québec.

Effects of stand and site characteristics on windthrow in the Quebec North Shore region.

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Le chablis est une perturbation qui demeure à ce jour encore peu documentée au Québec. Mon projet vise à comprendre la dynamique de cette perturbation naturelle pour pouvoir appliquer ces nouvelles connaissances en aménagement forestier écosystémique. La base de données SIFORT (Système d'Information FORestière par Tesselle) mise sur pied par le Ministère des Ressources naturelles et de la Faune du Québec a été utilisée pour effectuer une analyse spatiotemporelle du chablis sur la Côte-Nord, à l'est du Québec, en fonction des caractéristiques de station et de peuplement. Le chablis a été analysé sur trois périodes temporelles et séparé en deux niveaux de sévérité. Différents sites ont été caractérisés en termes de topographie, de drainage, de dépôt et de type de peuplement. Les données régionales de vent prises à 10 m du sol ont aussi été considérées dans l'analyse du chablis afin de relier le patron de perturbation aux variations régionales de la vitesse de vent. Ainsi, les liens existant entre les caractéristiques de station et de peuplement et le patron de perturbation par chablis ont pu être vérifiés. Il en ressort que la topographie et la composition du peuplement forestier sont des facteurs influençant le taux de chablis.

Effects of neighborhood-scale competition and composition on individual tree growth in oak-pine mixed stands in Maine

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Red oak – white pine dominated mixtures are a common forest type on non-industrial private lands in New England. In a set of stands of this type in southern Maine, we examined differences in species' responses to local neighborhood competition and composition. Such differences have implications for the development of growth and yield models, as well as for the desirability of certain species juxtapositions. We built species-specific linear models of volume growth rate as a function of initial tree volume, indices of neighborhood competition, and measures of neighborhood composition. We evaluated the sensitivity of each species to competition and composition on the basis of fit statistics (AIC, R2) for models with contrasting levels of neighborhood information. White pine responded more strongly than other species to indices of competition, especially those quantifying light exposure, whereas hemlock responded weakly to most competition indices, but best to those quantifying general crowding. We found evidence that red oak subject trees are sensitive to the composition of their neighbors, responding negatively to increased local abundance of hemlocks and fellow oaks. Neighbor species sensitivity was found to be much lower among other species.

Developing geospatial tools to forecast management outcomes across a diverse landscape of ownership types and stakeholder interests

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To adequately address Maine's forest sustainability challenges in the future, we must better understand the coupled dynamics of budworm outbreaks and forest management practices. Specifically, data and analysis tools are needed to evaluate how the ecological and policy environment of today will shape management options and outcomes in the future. By integrating very large-scale geospatial data with spatial forest planning software and advanced DSS tools, we are developing a process to evaluate current forest conditions and potential outcomes of future resource management strategies, including effects on harvest volumes and wood supply, wildlife habitat, and budworm vulnerability. Our research team is analyzing the tradeoffs involved when managing forestland to meet multiple natural resource goals across a diverse landscape of ownership types and stakeholder interests. Moreover, because Maine's citizens hold the "social contract" on forest management practices, and because the outcomes of past budworm outbreaks have strongly influenced social attitudes and forest policy, we are empirically evaluating the relationship between environmental values and reactions to communications about forest planning and the potential outcomes of alternative management strategies and budworm mitigation efforts. Analytical approaches, unforeseen difficulties, and current successes in this ongoing project will be discussed.

First Nations involvement in forestry in eastern Canada: practices and policies in five provinces

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Indigenous engagement in the management and exploitation of forestlands across Canada has become increasingly common over recent decades, occurring in a wide variety of forms and being promoted by governments, forest industries and Aboriginal people themselves. Based on a review of more than 200 published studies of industry/aboriginal collaboration in Canada and an inventory of cases from 485 Aboriginal communities we identified five different approaches to collaboration.

In this presentation we describe the extent of collaborative arrangements in the five eastern-most provinces. We relate the frequency of different approaches among communities to policies in each province, and comparing these to the national situation. Perhaps unsurprisingly, Quebec presents the greatest variety in both practices and policies. Although Nova Scotia and New Brunswick have a similar number of First Nations communities, the types of collaboration in which these communities are involved are very different. In Newfoundland and Labrador the experience of Aboriginal people is very different depending upon where they reside. Prince Edward Island is not ignored, but presents the fewest forestry options for First Nations. This analysis demonstrates the importance of developing and implementing a diversity of policy mechanisms if governments wish to encourage Aboriginal involvement in forestry.

Nutrient co-limitation in aggrading northern hardwood forests

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Although temperate forests have long been thought to be primarily nitrogen limited, resource optimization theory suggests that ecosystem productivity should be co-limited by multiple nutrients. In northeastern North America, air pollution and forest harvesting disturbance elevate N availability and contribute to the likelihood of P limitation. The Multi-Element Limitation (MEL), which now includes P, light, and water as well as N and carbon, predicted a greater response of aboveground productivity to N+P than N or P alone. In older stands, MEL predicted a greater response to N than to P addition, but in younger stands, the supply of N from detritus was predicted to be sufficient to create P limitation. Field observations in replicate young (26-30 years) and mature (>100 years) stands in the Bartlett Experimental Forest, New Hampshire, support these predictions. Fine roots foraged preferentially for P in young stands and for N in mature stands, according to ingrowth into nutrient-amended cores. Foliar retranslocation of P exceeded that of N in yellow birch and sugar maple, especially in young stands. Experimental nutrient manipulations are planned to test the prédiction that young stands are commonly more P limited and mature stands are more N limited in this widespread forest type.

Présentation des affiches

Poster Presentation

Que faut-il pour bien gérer les boisés privés? Une enquête sur les besoins, en terme de soutien à l'aménagement, auprès des propriétaires forestiers au nord-ouest du Nouveau-Brunswick

What does it take to manage a woodlot? Identifying the management support needs of woodlot owners in northwestern New Brunswick

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Au Nouveau-Brunswick, 30 % du territoire forestier est composé de boisés privés non industriels qui fournissent une proportion équivalente des besoins en fibres à l'industrie forestière, ainsi qu'une diversité d'autres biens et services. Malgré l'importance de l'aménagement durable de ces forêts pour la province, les services de soutien aux propriétaires sont relativement limités et les niveaux de financement sont dépendants des instances gouvernementales et de l'état de l'industrie forestière.

Dans le cadre d'un projet de recherche de premier cycle en foresterie, nous avons tenté de déterminer quels services de soutien les propriétaires de la région désireraient obtenir. Pour ce faire, une enquête a été réalisée auprès des propriétaires de boisés privés dans le Nord-Ouest du Nouveau-Brunswick. Au total, 1969 propriétaires ont été répertoriés dans la zone d'étude. Des questionnaires ont été postés à un échantillon aléatoire de 700 personnes. Des questions ont notamment été posées sur les raisons d'être propriétaire, les diverses activités d'aménagement et de récolte réalisées et futures, les sources d'information utilisées et souhaitées de même que les besoins des propriétaires en terme d'aide et de service. L'analyse des données est actuellement en voie de réalisation et nous permettra de mieux comprendre les objectifs des propriétaires de boisés privés, ainsi que leurs besoins en soutien, si la société souhaite favoriser l'aménagement durable des forêts. Ainsi, ces informations serviront aux organismes impliqués dans la gestion des boisés privés afin de réorienter leurs services.

500 years of past spruce budworm (*Choristoneura fumiferana* [Clem.]) outbreaks in southern Québec

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Several authors stated that spruce budworm (SBW) outbreak dynamic has drastically changed in the last century, mostly as a result of anthropogenic disturbances. However, very few reconstructions are available for the XVIIIth century and before. Moreover, SBW history was, obviously, mostly studied for spruce- and balsam fir-dominated forests where its impact is thought to be the most severe whereas very few have investigated the SBW history in a more meridional context. In this study, we used dendrochronological material from patrimonial buildings and old-growth forests to reconstruct SBW outbreaks in southern Québec. Furthermore, we used early land survey records to reconstruct the

presettlement forests in order to consider changes in forest budworm susceptibility. Eight, possibly eleven, distinct outbreaks were recorded during the 1595-1996 time period. At the regional level, most outbreaks were classified as moderate. As oppose to most studies, three of the four most severe outbreaks were recorded before 1820. According to wavelet analysis, the outbreak recurrence cycle was stable around 40 years over the last 400 years. Early surveys revealed that abundance of balsam fir lightly increased in the last century whereas there was a strong decline of spruces. We discussed about potential hypotheses to explain this shift in outbreak severity.

Penobscot Experimental Forest in Maine: 60 Years of Research and Collaboration

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The 1,500-ha Penobscot Experimental Forest (PEF) was established in 1950. The land was purchased by nine industrial and land-holding companies and leased to the U.S. Forest Service for an experimental forest in the spruce-fir, or northern conifer, type. Research includes a large-scale, replicated silvicultural experiment that has been ongoing for over 50 years. Initially it focused on stand-level mensuration and composition but over time expanded to include regeneration; ingrowth, growth, and mortality of individual trees; tree heights, crown sizes and spatial location of individual stems. Numerous short-term studies have been overlaid on the long-term study, including research on wildlife and wildlife habitat, spruce budworm, seed and seedling predation, understory vegetation, soils, root development, regeneration substrates, and leaf area. In 1994, the PEF was donated to the University of Maine Foundation; research and management today are overseen by a joint Forest Service – University "Research Operations Team." The University initiated a large-scale, long-term experiment called the Acadian Forest Ecosystem Research Program. Portions of the PEF not in research are managed for education, demonstration, and income generation. The PEF is one of 81 Forest Service experimental forests and ranges in the U.S., and is an outstanding example of successful, long-term research collaboration.

Landscape occupancy by American marten and Fisher in Forillon National Park: a possible road barrier effect?

I*nfluence négative de la route 197 sur l'occurrence de la martre d'Amérique et du pékan dans le Parc national du Canada Forillon*

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Le Parc national du Canada Forillon (PNF), situé à l'extrémité de la péninsule de Gaspé, fait face à un enjeu d'isolement accentuée par la présence de la route 197. Nous avons comparé le taux d'occupation de la martre d'Amérique (Martes americana) et du pékan (M. pennanti) dans le PNF et dans le territoire adjacent au parc, à l'ouest de la route 197, afin d'évaluer l'effet de la route sur la conservation de populations fauniques dans le parc. L'occupation a été déterminée par des méthodes d'échantillonnage non-invasives : pistes dans la neige, capture de poils, fèces, et caméra de surveillance. L'échantillonnage s'est déroulé entre novembre et février en 2008-09 et en 2009-10. Cinquante-sept sites ont été échantillonnés en 2008-09 (28 dans le PNF et 29 à l'extérieur) ainsi que 97 en 2009-10 (42 dans le PNF et 55 à l'extérieur). Les taux d'occupation de la martre et du pékan dans le PNF étaient inférieurs à ceux mesurés à l'extérieur. La composition du paysage environnant les sites occupés à l'extérieur du parc tant par la martre que par le pékan était différente de celles des sites inoccupés. Le taux d'occupation de la martre et du pékan observée dans le PNF était plus faible que le taux attendu en se basant sur l'habitat disponible dans le parc. Les résultats de cette étude suggèrent que la route 197 a un effet de barrière sur ces deux mustélidés, pouvant limiter l'immigration, et par conséquent empêcher le maintien de ces espèces à des densités représentatives de l'écosystème du parc.

Genetic variation in budbreak and height growth of (2+0) white spruce half-sib families in response to interactions of elevated CO2 and temperature

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Tree improvement programs aim to develop families or multi-varieties that are adapted to future growing conditions. According to the A1 scenario of the Intergovernmental Panel on Climate Change's 2007 report, atmospheric CO2 concentration could double before 2100 and, in Canada, average temperature could increase by 4.3°C. In a growth chamber experiment, we therefore subjected white spruce seedlings from 61 of the best performing full-sib families in Québec's current breeding program to a combination of two temperature regimes (present day and anticipated future temperatures) and two levels of CO2 (380 vs 760 ppm) for the duration of their second growing season and evaluated the family level responses of budbreak and height growth to elevated CO2 and temperature. Budbreak occurred earlier under the higher temperature regime, indicating a possible susceptibility to early spring frosts in a warmer climate. Height growth was positively affected by both elevated CO2 and temperature. However, there were significant family x treatment interactions and the behaviour of a limited number of families explained about 50% of the variance associated with the interactions. The relative performance of the majority of the families remained stable under elevated CO2 and temperature, which is good news for tree breeders who are producing trees for a future that will likely include a changing climate.

Préparation de terrain et croissance des plants dans un contexte de regarni de la régénération naturelle en forêt boréale mixte

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Le scarifiage est requis pour assurer le succès des reboisements sur les stations forestières de la pessière caractérisées par des humus épais (25-30 cm). Son efficacité demeure toutefois incertaine pour les stations à humus d'une épaisseur intermédiaire, telles celles rencontrées dans la sapinière boréale. Nous avons entrepris une étude afin de vérifier les effets de trois modalités de mise en terre sur la croissance des plants de Picea mariana et de Picea glauca dans un contexte de regarni dans la sapinière boréale. Des plants ont été mis en terre dans un dispositif en blocs aléatoires complets et parcelles divisées, selon l'une des trois méthodes suivantes : i) collet à la limite supérieure de l'humus; ii) collet à l'interface des horizons organique et minéral; et 3) collet à la limite supérieure d'un mélange organique-minéral issu d'un scarifiage à la taupe forestière. Au terme de deux saisons de croissance, l'épinette noire présente des accroissements en hauteur et en diamètre supérieurs à ceux de l'épinette blanche ($p<0,001$). Par ailleurs, l'enfouissement complet de la carotte dans le sol minéral stimule la croissance en hauteur des plants lorsque comparé aux autres traitements ($p<0,001$), mais aucun des traitements n'a d'effet sur la croissance en diamètre ($p=0,117$).

Commercial Thinning Research Network: New site additions and plans for future analysis of commercial thinning responses in Maine spruce-fir stands

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The Commercial Thinning Research Network (CTRN) was established in 2000 by the University of Maine's CFRU to study tree and stand responses to commercial thinning (CT) in even-aged spruce-fir stands. Six sites have a history of precommercial thinning (PCT); six others have no history of early silvicultural treatment (NoPCT). The PCT sites were young (ages 25-40 yrs), have high site quality (60-80), and are dominated by balsam fir; CT treatments in this study are 33% and 50% removal (based on relative density) at three different timings or entry five years apart. The NoPCT sites were middle-aged (55-70 yrs), low to average site quality (all but one is within the range 45-55 yrs), and most are dominated by red spruce; CT treatments in this study are 33% and 50% relative density reductions using low, crown and dominant thinnings. To expand the range of sites within the CTRN, three new PCT sites were added to the network in 2009-10 to represent stands of lower site quality than the original six PCT sites. A thorough analysis of the decade-long growth response data is beginning this year as part of a new graduate student research project and will include: 1) stand-level growth & yield comparisons among treatments in both NoPCT and PCT studies, 2) an analysis of individual-tree growth responses to thinning to better understand how tree attributes at the time of thinning are related to post-thinning growth responses, 3) a financial analysis of commercial thinning treatments based on stand growth responses and projected responses, and 4) refined growth equations for predicting the response of spruce-fir stands to CT to improve regional growth & yield models.

Commercial thinning and canopy gaps influence nitrogen cycling in a young forest soil

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Uneven-aged and irregular forest restoration is an explicit goal of ecosystem base management in the mixedwood boreal forest in eastern Quebec and commercial thinning is the first step toward this conversion. The goal of this study was to investigate soil nutritional conditions after this first step of structure restoration. We used replicated 0.75 ha plots (n=4) within uncut forest and within commercially thinned forest, both combined with openings of 0.05 ha or no openings. An incubation experiment was set out in May 2009, following the commercial thinning that took place in November 2008. In each treatments, we measured concentrations of dissolved organic nitrogen (DON), ammonium (NH_4^+) and nitrate (NO_3^-) before and after 8-week *in situ* buried bag incubations of forest floor and mineral soil samples. Preliminary results showed that net mineralization and net nitrification rates were higher in canopy gaps than in thinned and uncut plots and that variance in those rates was higher in thinned plots than in uncut plots. Because of the key role that nitrogen availability play in seedling establishment, the measured changes could be take into account for the optimization of the operations that aim to restore an uneven-irregular forest structure from even-aged young stands.

Non-Industrial Private Landowner's Knowledge and Awareness of Sustained Yield Management in the Northern Forest

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The majority of the forestland in the Northeast is owned by non-industrial private forest owners (NIPF). Timber harvesting on these lands has seen a significant increase in recent decades. This makes the sustainable management of these forests increasingly important if they are to continue to supply high quality timber. Understanding a landowner's knowledge, awareness, and decision to use sustained yield forestry can be an important factor in determining the sustainability of forest practices on their forestland. In this study we interviewed landowners and conducted forest stocking field surveys on 60 NIPF properties of at least 25 acres, in a four-county region of Vermont, where harvesting had occurred in the last 5 years. Using Rogers' Diffusion of Innovation theory we will determine a landowner's knowledge and decision to use sustained yield forestry during a harvest. Our two-pronged methodology will be able to determine how much of an impact a landowner's knowledge and awareness of sustained yield forestry has on forest management. This information will help policy makers and natural resource managers to better understand and facilitate sustainable practices on NIPF lands.

Settling the Bill: Building Trust and Cooperation between Consulting Foresters and Family Forest Owners.

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There is concern about how few family forest landowners use consulting foresters to actively manage their private woodlots. Past studies have shown that consulting foresters are the predominant source of technical assistance to family forest owners. Furthermore, referrals lead to 83% of a consultant or firm's business with family forest owners. These consultants use diverse billing methods in order to charge family forest owners for forest management services. Conflicts of interest as a result of billing method and the misalignment of objectives between these two groups may be an obstacle to effective forest management. This poster will present a Master of Forestry student's study design for investigating what billing method is most cost effective for different management activities, as well as how family forest owners evaluate the performance of consultants. This study will provide consulting foresters with valuable information regarding how they can improve their representation of the needs and priorities of family forest owners as well as promote better overall forest management of private forestland. The study will compare landowners who have and have not used professional advice. It will make preliminary recommendations for increasing the rate at which consulting foresters are sought for services by family forest landowners.

Modélisation du développement de la qualité du bouleau jaune (*betula alleghaniensis britton*) en forêt mixte

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Certaines pratiques sylvicoles autrefois appliquées à la forêt mixte et feuillue ont entraîné la diminution du volume sur pied et de la qualité d'essences nobles telles que le bouleau jaune. Devant ce constat, des efforts de restauration sont envisagés, mais la faible présence de cette espèce dans le couvert forestier soulève des questions quant à sa capacité réelle de croître et de constituer une ressource de qualité.

Une analyse préliminaire des placettes échantillons temporaires du Ministère des Ressources naturelles et de la faune du Québec nous a permis de cibler certains facteurs affectant la présence et la qualité du bouleau jaune. Nous avons constaté que le bouleau jaune tend à présenter une meilleure qualité lorsque l'altitude est comprise entre 200 et 500 mètres et que les peuplements sont âgés et de structure inéquienne. Aussi, les arbres situés dans la région de Portneuf sont généralement de meilleure qualité que ceux situés plus au nord et à l'est. Un échantillonnage sur le terrain nous permettra d'analyser le développement de la qualité à l'échelle de l'arbre, de manière à déterminer si les différences régionales observées sont surtout attribuables aux conditions de compétition dans le couvert ou plutôt aux caractéristiques de la station.

Integration of Silviculture Prescriptions in the Decision Model of the Forest Products Industry: A Proposal

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The current crisis facing the forest industry necessitates the management to incorporate stand level and tree level information in the planning process to direct raw material to manufacture highest value product and maximize profitability. Silviculture treatment can be used to alter natural stand dynamics, the wood qualities are altered simultaneously. Knowledge on interrelationship between silviculture, forest growth and transformation technology can provide the industry the agility required to compete in the global market. Building such an integrated model remains a challenge. We propose to do research to 1) Gain an understanding on the interrelationship between silviculture, forest growth and end-product. 2) Build an integrated holistic model of the forest industry based on the relationships. 3) Determine when and how the forest should be harvested to attain a product mix that maximizes revenue. 4) Determine what investments should be made to ensure prosperity of the forest sector. The challenge will be to evaluate the feasibility of such plan on the long term strategic plan. The outcomes of the research will become a basis for cooperation between companies. It can help companies identify investments that should be made and also stimulate the growth of secondary manufacturing industry

Fifty Years of Maine Stumpage Prices: Analysis of Trends

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The Maine Forest Service has compiled stumpage prices in Maine for fifty years. This is one of the longest stumpage price series available in the East that is consistently collected. Over that time, markets, utilization, wood measurement, and landownerships have changed greatly. We analyze the longrun changes in the time series of a number of key forest products, and comment on issues of data coverage and precision. In addition, we compare the trend in stumpage price levels to overall inflation, to price levels of lumber and paper, and to benchmark stumpage items from other regions. Analyzing this stumpage dataset leads to several useful general conclusions about analyzing longterm stumpage trends, as well as to specific results for Maine.

Windthrow after variable retention in the boreal forest

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In a context of sustainable forest management, new silvicultural approaches have been proposed. Among these, variable retention has been designed to maintain structural legacies in the regenerating forest. However, variable retention can cause an increase in windthrow of leave trees. This increased mortality would mean that merchantable wood would have been left with little gain on structural attributes.

The aim of this study is to determine the impact of variable retention on windthrow of leave trees in the boreal forest. Two patterns of retention are studied: grouped and dispersed. In both cases of retention, the level of windfall losses was sampled after 2-5 years. Moreover, some factors that could significantly influence windfalls were measured, including characteristics of stands, soil conditions, exposure to wind and topography. Preliminary results show that the best predictive models include tree (dbh and species) and soil characteristics. At the end of the study, some recommendations will be made to improve silvicultural approaches on variable retention harvesting.

“Xylogenesis in black spruce on two sites in the boreal forest of Quebec: the importance of temperature for the onset and duration of cell differentiation »

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Durant les dernières années, la réactivation du cambium au printemps et le début de l’élargissement des trachéides formant le cerne de croissance a été largement associé à la température. Cependant, il y a peu d’informations sur les facteurs déterminants la fin de la formation des trachéides, caractérisé par les processus de formation des parois secondaire et de lignification. Comprendre la fin de la formation du cerne de croissance est fondamentale pour mieux modéliser l’effet d’un changement de ces facteurs sur la xylogenèse. À l’aide de l’étude de la xylogenèse chez l’épinette noire situé dans deux sites de conditions de température et d’enneigement différentes, un modèle est proposé afin d’expliquer les liens de cause à effet entre les phenophases (début-fin) et le nombre des trachéides constituant le cerne de croissance. Les résultats ont démontré que la xylogenèse est active lorsqu’une valeur seuil de la température de l’air est atteinte (10°C). Le début de l’élargissement cellulaire est significativement plus hâtif dans le site plus chaud (7 jours). En général un début plus hâtif de l’élargissement est associé à la production d’un nombre plus élevé des trachéides. Par contre, la fin de la lignification des trachéides est généralement plus tardive quand le nombre de cellules produites est plus élevé. En conclusion, la durée de la formation du cerne de croissance est beaucoup influencée par le nombre de cellules produites.

Sawtimber Procurement Pressure and Sustained Yield Management on Non-industrial Private Forestlands of the Northern Forest

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Non-industrial private forestlands (NIPF) make up the majority of forestlands in the Northern Forest. Management trends on NIPF therefore have broad implications for the whole of the region. To promote sustainable forest management in the Northern Forest we must better understand those factors that influence forest management on NIPF. Harvesting decisions are closely tied to regional sawtimber markets. There is no empirical evidence, however, to show the effects of sawtimber demand on the sustainability of forest management in the region. This study builds on recently published geospatial data of saw log procurement pressure across the Northern Forest to explore the relationship between procurement pressure and sustained yield management on NIPF. Field measurements were completed on approximately 60 recently harvested NIPF properties with 25 acres or more of forestland across a four-county area of Vermont representing a broad continuum of sawmill procurement pressure. Forest stocking and Acceptable Management Practices were evaluated to determine the extent of sustained yield management used on each property and the potential relationship with procurement pressure. The results will help forest managers, outreach personnel, and policy makers to promote and facilitate sustainable use of the Northern Forest.

Preliminary results on the properties of wood pellets made from wood and bark of sugar maple and yellow birch low quality trees

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The use of wood pellets as a solid bio-fuel is increasing as the cost of fossil fuels is rising and as environmental concerns regarding greenhouse effect and climate change are growing. In 2008, Canada produced over 1.3 million tons of wood pellets. Canada continues to be the world's largest wood pellets exporter due to a relatively abundant supply of sawmill residues. However, wood pellets producers are facing shortage of the traditional raw material supplies due to recent downturn in lumber production. In the province of Québec, hardwood forests have been subjected to selective harvesting called "diameter-limit cutting method" where the most valuable high quality trees were removed, leaving sugar maple and yellow birch low quality trees with lower commercial value. To our knowledge, there is no published report on the utilization of this material for wood pellet production. Moreover, the pelletization of hardwoods is difficult. The objective of this project is to determine the effect of raw material moisture content, composition and particle size on some of the physical and chemical properties of pellets made from wood and bark of sugar maple and yellow birch low quality trees. In the longer term, the effect of hot water extraction on the properties of wood pellets will be tested.

The effects of precommerical and commercial thinning on individual-tree mortality in red spruce – balsam fir stands across Maine

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A Commercial Thinning Research Network (CTRN) was established throughout Maine in 2001 to measure the effects of precommercial (PCT) and commercial thinning (CT) on red spruce (Picea rubens) and balsam fir (Abies balsamea L.) stands. Repeated observations over the last 9 years have created an extensive database that allows for assessment of individual tree growth and yield across a range of thinning types (dominant, low), thinning intensities, and stand characteristics. In this study, patterns of mortality will be assessed at both the individual tree and stand- level using multiple variable generalized linear mixed logistic regression models. The effectiveness of different site (soil depth, drainage, etc.), stand (thinning intensity and type), and tree (size and social position) variables for estimating the probability of mortality will be assessed. It is hypothesized that: (1) higher intensity thinning on sites with higher water tables and a lower drainage class will see increased mortality; (2) stands treated with dominant thinning will see increased individual tree mortality; and (3) low thinning will result in the least amount of mortality. Preliminary results suggest that thinning density, application of PCT and years six – nine after treatments are highly significant at the 5% level. The results of this analysis will be important for correctly predicting and managing the large amount of spruce-fir forests quickly maturing into merchantable volume in Maine.

The effect of waxes and adhesives on the static coefficient friction of wood strands

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While the macrosurface characteristics of the wood strands may have the greatest effect on frictional forces, visual evidence of an effect of wax on strand movement through the manufacturing process has been seen while conducting experiments on the AEWC OSB/OSL pilot forming line. It was noted during an experiment that strand flow increased when wax was added to strands, which may be attributed to a reduction in friction, but it has never been quantified. The broad hypothesis is that strand additives, such as adhesives and waxes may have an effect on strand movement because of changes in the frictional forces between strands themselves and between the strands and equipment. These changes could be due to changes in surface tack or surface energies, which would theoretically make the strands adhere more or less to each other, thus, affecting the frictional forces. In addition, mechanical interlocking may have an effect on frictional forces between the strands.

Interacting effects of defoliation and soil chemistry on sugar maple health following a forest tent caterpillar outbreak in the northeastern USA

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Defoliation is a significant stressor of forest stands that may incite decline disease of sugar maple (Acer saccharum: Marsh). The recent outbreak (2002–2007) of forest tent caterpillar (Malacosoma disstria: Hübner) in the northeastern United States offered the opportunity to assess the interacting effects of defoliation and site conditions on sugar maple health. We measured 51 stands in New York and Vermont in the summer of 2007. Dieback ($P = 0.07$) and mortality ($P = 0.04$) were both worse in stands defoliated by forest tent caterpillar. Low growing–season soil moisture during the outbreak, indicated by Palmer's Z-index; cool mean temperature during the outbreak; and concave microrelief were also important predictors of forest damage. In 2008, we found the highest mortality in sites with the greatest crown dieback in 2007. In 2009, soil samples were collected from 34 of the previously studied sites. Mortality was highest on sites with low soil calcium, consistent with previous research on sugar maple decline in the Allegheny Plateau. We present the results of our multiple regression equations for stand dieback and mortality in tables that can be used by forest managers to evaluate the vulnerability of their sugar maple stands to decline after defoliation.

Effects of nonselective partial harvesting in Maine's working forests

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Maine's long history of forest management has progressed through centuries of changes in equipment technology, market conditions, forest health and silvicultural knowledge. Over the past 20 years another dramatic shift from a heavy reliance on clearcut harvesting to nonselective partial harvesting has occurred. This approach removes timber from trails but leaves a matrix of unharvested areas. This transition in harvesting practices is occurring within the context of continuing timberland ownership pattern changes and concerns over long-term forest management in the region. Given widespread use of nonselective partial harvesting, the relative recent advent of this practice and gaps in our knowledge concerning the short and long term effects of nonselective partial harvesting, we lack the ability to adequately describe the current state of Maine's forest or provide the information necessary to make meaningful projections of future forest conditions. Therefore, assessments of Maine's wood supply, long-term wildlife habitat viability and economic forecasts are severely constrained. In order to begin developing an understanding of nonselective partial harvesting, three general questions need to be addressed:

1) Given the strong spatial patterns resulting from nonselective partial harvesting, are current sampling schemes adequate?

2) How have patterns of nonselective partial harvesting affected structure and composition of residual stands?

3) How will resulting structures and composition influence future stand development?

We present the design of a research project to address these three questions.

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