Eastern CANUSA Forest Science Conference

October 17-18, 2008
University of Maine
Orono, Maine

Conference Proceedings

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Editor

Spencer R. Meyer

Host

University of Maine

Introduction

Welcome to Orono, Maine for the 2008 Eastern Canada - United States (ECANUSA) Forest Science Conference!

The northeastern United States and eastern Canada share a vital and common link to the northern forest. In addition to strong economic dependence, people of the region derive considerable recreational, aesthetic, and ecological values from this forest. The future of the region clearly relies upon the sustainable management of this highly valued forest resource.

Because of the northern forest's importance to the region, forest managers and researchers from the northeastern states and eastern Canadian provinces are working continuously to find solutions to a wide variety of natural resource problems. The already great work occurring on both sides of the US/Canadian border is further enhanced by regular information exchanges about issues affecting the northern forest. The Eastern CANUSA Forest Science Conference was developed to provide a regular venue for this exchange among forest managers, scientists, policy makers, students, natural resource professionals, and others interested in forest resource issues on both sides of the Canadian/US border.

The ECANUSA conference has the following 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

Previous ECANUSA conferences include:

Year	Host	Location
2002	University of Maine	Orono, ME
2004	University of New Brunswick	Fredericton, NB
2006	Natural Resources Canada, Ministère des Ressources naturelles et de la Faune du Québec, and Université Laval	Québec City, QC

These conferences each built upon the previous events and now we have a tremendous group of organizers, speakers and participants that look forward to the conference every two years. Laval University set the bar high in 2006 with the first ECANUSA that included a field tour. This year we hope to continue to improve upon our experiences and will again include a field tour. This year's tour will showcase more than 60 years of forest research at the Penobscot Experimetnal Forest (PEF), which is jointly managed by the U.S. Forest Service and the University of Maine. During the concurrent sessions we will hear many talks that highlight graduate student and faculty research on the PEF.

The 2008 conference brings together some 120 participants, giving 56 oral 36 poster presentations. Research topics include everything from soil disturbance impacts on herbaceous vegetations, to landscape-scale ecosystem management models, to the interface between wildlife management and forest harvesting, to the influence of energy prices on the Acadian Forest.

Despite the policitcal boundary, we all share the Acadian Forest. Over the course of ECANUSA, we hope you will learn about many new aspects of our shared resource and take home new ideas for research. We have a lot to grow on!

...and when ECANUSA 2008 is all wrapped up, start looking forward to the next conference in 2010, hosted by our friends in New Brunswick.

2008 Organizing Committee

Robert Wagner (General Chair), School of Forest Resources, University of Maine

Spencer Meyer (Arrangements Chair), Cooperative Forestry Research Unit, University of Maine

Plenary Session

Guy Larocque, Natural Resources Canada, Canadian Forest Service

David MacLean, University of New Brunswick

Stephen Wyatt, University of Moncton

Technical Sessions

Jeffrey Benjamin, University of Maine

John Hagan, Manomet Center for Conservation Sciences

Jessica Leahy, University of Maine

Andrew Whitman, Manomet Center for Conservation Sciences

Jeremy Wilson, University of Maine

Graduate Student Program and Field Tour

Andrew Nelson, University of Maine

Matthew Olson, University of Maine

Acknowledgements

We thank the graduate students at the University of Maine for their volunteer efforts, the University of Maine Conference Services Division, especially Bruce Stinson and Debra Wright for logistical arrangements, and all the other UMaine people who helped make ECANUSA 2008 a success. Matthew Russell assisted with editing these Proceedings.

Generous funding for ECANUSA 2008 was provided by the School of Forest Resources, the Cooperative Forestry Research Unit, and the Center for Research on Sustainble Forests at the University of Maine.

www.crsf.umaine.edu/ecanusa

Thursday, October 16

Wells Conference Center

7:00-9:00 PM	**Ice-Breaker Social (with cash bar)** **Conference registration**

Friday, October 17

Wells Conference Center

7:00-8:00 AM	**Registration and continental breakfast**

GENERAL SESSION

Wells Conference Center (**Meeting Room 1**)

Introduction

8:00-8:15 **Dr. Bob Wagner**, *University of Maine* (Moderator)

Keynote presentations

8:15-8:55
8:55-9:05 Q&A
Climate Change and the Potential Impact on Northeastern Forest Ecosystems

George L. Jacobson, *University of Maine, Climate Change Institute, Orono, ME*

9:05-9:45
9:45-9:55 Q&A
Modeling Forest Productivity in a Changing Climate: Uncertainties and Challenges

Guy R. LaRocque, *Canadian Forest Service, Sainte-Foy, Quebec*

9:55-10:20 **BREAK**

10:20-11:00
11:00-11:10 Q&A
Carbon Markets and Opportunities for the Acadian Forest

Matt Smith, *FORECON, Falconer, NY*

11:10-11:50
11:50-12:00 Q&A
Bioenergy Futures and the Role of the Acadian Forest

Eric W. Kingsley, *Innovative Natural Resource Solutions, Portland, ME*

12:00-1:30

LUNCH & POSTER SESSION

Wells Conference Center (**Atrium**)

Participants will join poster authors in a "walk-around" lunch to view and discuss a wide array of poster presentations.

We currently have **over 35 posters** registered!

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Friday, October 17, continued

Concurrent Sessions

	SESSION 1 Location: Meeting Room 1	SESSION 2 Location: Meeting Room 2	SESSION 3 Location: Meeting Room 3
1:30-3:10 pm	**Wood Products & Forest Operations / Engineering** *Moderator: Jeff Benjamin*	**Silviculture & Forest Production** *Moderator: Bob Seymour*	**Forest Ecology** *Moderator: Andy Whitman*
1:30 - 1:50	Back to the future: the new wooden urban village *James S. Peters*	New findings from an 80-year-old northern hardwood silviculture study *Laura S. Kenefic and Christel C. Kern*	Responses of herbaceous layer over nine years following different harvesting disturbance *Takamitsu Mamashita and Mark R. Roberts*
1:50 - 2:10	Inventory patterns and critical factors affecting pulpwood inventory levels in the northeastern United States *Bob Rice and Kevin M. Todd*	Value of hardwood stands after selection cutting using positive and negative tree marking *Papa Déthié Ndione, Martin Béland and Edwin Swift*	Relationships between non-native invasive plant distribution, silvicultural treatment, and soil drainage in the northern conifer forest *Elizabeth Bryce, Laura Kenefic, John Brissette, Alison Dibble and William Livingston*
2:10 - 2:30	Finding and removing barriers to sustainable harvest and primary processing of Massachusetts native woods *David T Damery, Lava Yadav and Yuxi Zhao*	Natural regeneration 15 years after various partial cuts in tolerant hardwoods in northern New Brunswick *Bruno Chicoine, Martin Béland and Marilou Beaudet*	Late-successional attributes of stands of differing silvilcultural treatments in northern hardwoods and upland spruce-fir forest *Andrew Whitman*
2:30 - 2:50	Assessing disturbed soils through relative bulk density *Eric R. Labelle and Dr. Dirk Jaeger*	Improving species compositions in beech-dominated northern hardwood stands in Maine *Andrew S. Nelson and Robert G. Wagner*	Evaluation of the conservation value of post-harvest residual forest stands in the eastern balsam fir-white birch eco-region of Québec: a multi taxa approach *Marie-Michelle Vézina, Luc Sirois and Mathieu Côté*
2:50 - 3:10	Modelling the decomposition rate of surface- versus buried wood blocks and dowels, across a wide range of climate conditions in North America *Amanda C. Smith and Paul A. Arp*	Neighborhood-scale structure and growth in oak-pine species mixtures in Maine *Justin Waskiewicz, Laura Kenefic and Robert Seymour*	Spatial associations among living and standing-dead balsam fir in two central Maine mixedwood stands *Matthew G. Olson and Robert G. Wagner*
3:10-3:30	**Break *(refreshments in atrium by posters)***		

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Friday, October 17, continued

Concurrent Sessions

	SESSION 1 Location: Meeting Room 1	SESSION 2 Location: Meeting Room 2	SESSION 3 Location: Meeting Room 3
3:30-5:10 pm	**Forest Landscape Management & Policy** *Moderator: Jeremy Wilson*	**Silviculture & Forest Production *(Continued)*** *Moderator: Bob Seymour*	**Forest Ecology *(Continued)*** *Moderator: Andy Whitman*
3:30 - 3:50	Variation in snowshoe hare densities as related to Canada lynx and forest management in eastern North America *William B. Krohn, Daniel J. Harrison, Shonene A. Scott, Laura L. Robinson, Christopher L. Hoving, Angela K. Fuller, and Erin M. Simons*	Reconstruction of the competitive dynamics of mixed-oak forests *Daniel Heggenstaller, Patrick Brose, Eric Zenner and Kim Steiner*	Tree motion and bending stresses in response to wind *Vincent A. Webb and Mark Rudnicki*
3:50 - 4:10	Biodiversity issues of ecosystem-based management in the Laurentian Highlands of eastern Québec *Nelson Thiffault, Yan Boucher and Marc Leblanc*	Sustainable biomass production and nutrition in spruce-fir forests – knowns and uncertainties *H. Lee Allen*	Effects of ageing and maturation on the reproductive development and vegetative growth of conifers *Michael E. Day and Michael S. Greenwood*
4:10 - 4:30	Re-mapping forest soils with improved precision and resolution *Mina Nasr and Paul A. Arp*	Improving natural regeneration of white spruce by coupling silvicultural techniques with a masting episode *Alix C. Rive, David F. Greene, and Brian D. Harvey*	The response of bryophytes to precommercial thinning in the Acadian forest *A.D. Witkowski and K.A. Frego*
4:30 - 4:50		Commercial thinning in pole-sized spruce-fir stands: 6-year results from the CFRU thinning study *Robert S. Seymour, Robert G. Wagner and Spencer Meyer*	Bryophyte-substrate associations and relationships to forest management responses in the Acadian forest of southern New Brunswick *Krystal A. Mathieson and Katherine A. Frego*
4:50 - 5:10		Long-term results from partially cut stands highlight concerns about northern white-cedar sustainability *Catherine Larouche, Laura S. Kenefic, Jean-Claude Ruel, Jean-Martin Lussier*	Calicioid lichens and fungi of the Acadian forest region of eastern North America *Steven Selva*

Friday, October 17, continued	
5:30-6:00	**Cash bar and informal poster session** *(Atrium)*
6:00-7:00	**Dinner Banquet** Wells Conference Center *(Optional – Tickets Required, cash bar)*
7:00-8:00	**After Dinner Presentation:** ***"The Myth of Renewable Energy"*** **Professor Dick Hill** *Retired Engineering Professor and radio personality*
Saturday, October 18	
7:00-8:00 AM	**Continental breakfast** (Wells Conference Center)

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Saturday, October 18, continued

Concurrent Sessions

	SESSION 1 Location: Meeting Room 1	SESSION 2 Location: Meeting Room 2	SESSION 3 Location: Meeting Room 3
8:00-9:20 am	**Forest Landscape Management & Policy *(Continued)*** *Moderator: Jeremy Wilson*	**Silviculture & Forest Production *(Continued)*** *Moderator: Guy LaRocque*	**Forest Social Science** *Moderator: Jessica Leahy*
8:00 - 8:20	Integration of remote sensing and land cover data to evaluate forest landscape change *Kasey R. Legaard, Erin M. Simons,and Steven A. Sader*	The Acadian Forest Ecosystem Research Program (AFERP): 10-year results from the expanding-gap experiment *Matthew G. Olson, Robert G. Wagner, Robert S. Seymour and Michael R. Saunders*	The evolution of public discourse on forest management in forest management in New Brunswick *Tom Beckley and Solange Nadeau*
8:20 - 8:40	Automated high-resolution mapping in the northeast United States: capabilities, limitations, and possibilities *Wilfred J. Mercier and Steven A. Sader*	Crop-tree silviculture of eastern white pine *Robert S. Seymour, Chris Guiterman and Nicole Mercier*	Moving beyond stakeholders approaches: citizens views of forest policy and management in New Brunswick *Solange Nadeau, Tom Beckley, Emily H. Kennedy, Bonita McFarlane and Stephen Wyatt*
8:40 - 9:00	Crossing boundaries: building a forest model for 14 contiguous townships in northern Maine *Jeremy S. Wilson and Erin M. Simons*	Can we manage ericaceous shrub invasion in the eastern Québec's black spruce stands by selection cutting? An ecophysiological perspective. *François Hébert, Alison D. Munson, Nelson Thiffault, Jean-Claude Ruel*	First nations in New Brunswick's forest industry: what do harvesting agreements deliver ? *Stephen Wyatt and Genevieve Bernier*
9:00 - 9:20	How will expensive oil affect Maine timberland: a preliminary sketch? *Lloyc C. Irland and Jack Lutz*	Development of an Acadian variant of the FVS individual tree growth model *A. Weiskittel, J.A. Kershaw, Jr. and J. Brissette*	Social acceptability of forest management on Anticosti Island: a wildlife reserve *Marie-Hélène Rousseau, Louis Bélanger and Louis Guay*
9:20-9:40 am	**Break *(refreshments in atrium by posters)***		

Saturday, October 18, continued

Concurrent Sessions

	SESSION 1 Location: Meeting Room 1	SESSION 2 Location: Meeting Room 2	SESSION 3 Location: Meeting Room 3
9:40-11:20 am	**Forest Landscape Management & Policy *(Continued)*** *Moderator: Jeremy Wilson*	**Silviculture & Forest Production *(Continued)*** *Moderator: Guy LaRocque*	**Wood Products** *Moderator: Jeff Benjamin*
9:40 - 10:00	Mapping ecosystem and ecological resources of East Rock Park *Moe Myint, Jorge Figueroa, Julie Witherspoon and William R. Burch*	Comparing stochastic and deterministic models: beyond random numbers, is there any difference in model predictions? *Mathieu Fortin and Luc Langevin*	A spatial analysis of sawmill wood procurement in the Northern Forest *Nate Anderson, René Germain and Eddie Bevilacqua*
10:00 - 10:20	Land conservation in Maine: a retrospective assessment and analysis of alternative land use futures *Robert J. Lilieholm, Christopher S. Cronan, Jill Trembley and Charles Ravis*	Analysis of volume prediction error in black spruce (Picea mariana) dominated forests in north-western Québec, Canada *Narayan Dhital and Frederic Raulier*	Development of sawing patterns and lumber recovery estimates using spreadsheets *J. Benjamin and Y.H. Chui*
10:20 - 10:40	The snowball sampling technique targets information rich sources to discover how forest policy is developed *Wm. Ashton and T. Needham*	Spatial tree mapping and angle count sampling (ACS) using photography *Adam R. Dick, John A. Kershaw, Jr. and David A. MacLean*	Formation quality evaluation of oriented strand composites *Victor Gaete-Martinez, Stephen M. Shaler, Russell Edgar and Jon Hill*
10:40 - 11:00	Public participation in forest management: experiences, perceptions and expectations of social economy organizations in New *Diane Landry, Stephen Wyatt and Solange Nadeau*	Explaining pipe model variations with sapwood taper *Robert Schneider*	Oriented strand board (OSB) from hot water extracted wood *Juan Jacobo Paredes Heller and Stephen M. Shaler*
11:00 - 11:20	Stakeholder perceptions of uncertainty: a driver of New Brunswick forest policy *William F.A. Anderson*	Regional variation in dominant height growth for balsam fir and red spruce in Maine *Rongxia Li and Aaron Weiskittel*	Adhesion issues of wood plastic composites surfaces (WPC) *Gloria S. Oporto, Douglas J. Gardner and David J. Neivandt*

Saturday, October 18, continued

11:20-12:00

CONFERENCE WRAP-UP SESSION

Meeting Room 1

Speakers

Several prominent speakers in the fields of Silviculture & Production, Ecology & Wildlife, and Forest Management & Operations will provide an overview of the state of research presented at the conference.

12:00 pm

BOX LUNCH

(Pick up a lunch and take it with you,
whether you are attending the field tour or headed home)

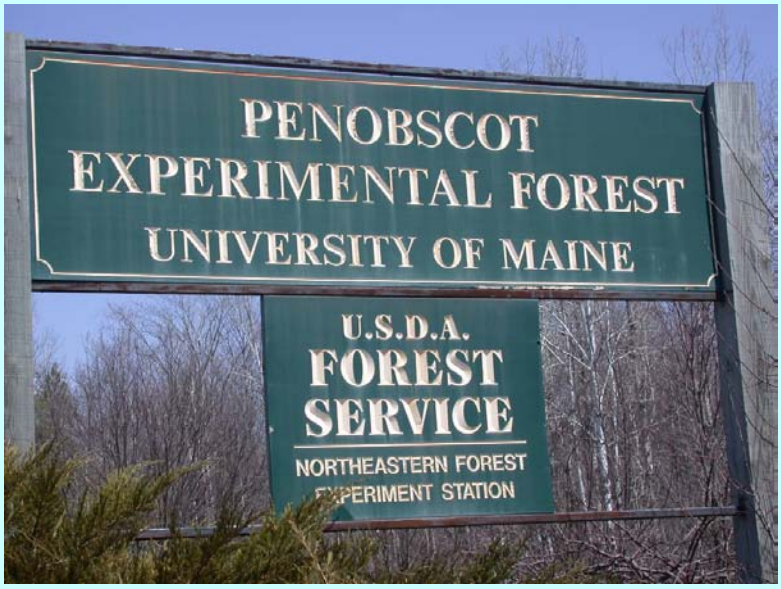
12:00-4:00

Field Tour of Long-term Silviculture and Ecological Research on Penobscot Experimental Forest

(Optional, **pre-registration required**)

Tour Organizers: Olson & Nelson

USFS Silvicultural Systems Experiment –Brissette & Kenefic
CFRU Commercial Thinning Study –Seymour, Wagner & Meyer
Acadian Forest Ecosystem Research Program (AFERP) –Wagner, Seymour, & Olson
LEAP Amphibian Ecology Study –Hunter & Popescu



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Background

Keynote Presentations

Oral Presentations

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Keynote Presentations

Climate change and the potential impact on northeastern forest ecosystems

George L. Jacobson

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Research in paleoecology and paleoclimatolgy has produced strong independent evidence about the post-glacial vegetation and climate of northern New England and adjacent Canada. From the end of the most recent ice age (ca.14,000 years ago) to present, changing climate has produced shifts in distribution and abundance of forest species.

Stratigraphic changes in physical and biological characteristics of lake sediments indicate that between 9000 and 5000 years ago, temperatures were as much as 2°C warmer and that the moisture balance (precipitation minus evaporation) was considerably lower (drier) than today. White pine (*Pinus strobus*) was widespread and abundant in the early to middle Holocene, probably because frequent fires created conditions favorable for seedling establishment. During that same time, both white pine and hemlock (Tsuga canadensis) were present at elevations as much as 300 to 400 m higher than their present upper limit in the White Mountains of New Hampshire and the Adirondack Mountains of New York.

Conditions changed considerably during the past few thousand years, however, as the climate became cooler and moister. Fossil-pollen evidence shows that the distribution of white pine, which had been so extensive during the drier early and middle Holocene, has diminished consistently during the past 4000 years. This decline appears to have resulted from a reduction in frequency of forest fires during the late-Holocene shift toward a cooler, moister climate.

As white pine (and oak) became less abundant in the recent past, other tree species have assumed much more prominent roles in the region's forests. Good examples include some of the most prominent components of our modern Adadian forests. Within the past 1000 years, populations of several boreal forest taxa, including spruces (*Picea* spp.) and balsam fir (*Abies balsamea*) expanded along the southern margins of their distribution in Canada and along the northern tier of the United States from Minnesota to Maine. The strong expansion of spruce in the Great Lakes-New England region, especially the past 500 years, appears to have been associated with summer cooling of about 1°C during the Little Ice Age.

What does this tell us about forests of the future? General Circulation Model (e.g. NCAR CCM3) projections for a future with increasing concentrations of atmospheric CO_2 suggest that both summer and winter conditions in northern New England may be as much as 3°C warmer than at present, and that precipitation may also be greater. If the models are correct, the summer conditions may be as warm as or warmer than those 6000 to 8000 years ago. For forests, the clear implications are that the distribution and abundance of tree species in this region will undergo changes as dramatic as some of those that have taken place in response to changing climate in the past.

These projections have several important implications for natural biodiversity and for economic uses of the region's natural resources. Long-term changes in the distribution and abundance of forest species will be influenced by the matrix of forest cover and by whatever land-management practices have been in effect. The changing mix of species in the forests will also likely require the forest-products industry to adapt its research goals, its silvicultural practices, and its production technologies. While it is quite possible that these forests will be able to produce more biomass per unit area than is currently the case, composition of the forests will certainly be different. Therefore, adaptations within the forest-products industry should logically begin soon.

Modelling forest productivity in a changing climate: uncertainties and challenges

Guy R. Larocque[1], Louis Archambault[1], Claude Delisle[1], Nancy Luckai[2] and Shailendra Adhikary[2]

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Forest productivity models are the focus of active research in many jurisdictions. The three main model categories, empirical growth and yield, gap and process-based, were designed and are being further developed to meet specific needs. Growth and yield models, based on the empirical use of stand inventory data, focus on the prediction of annual allowable cut and the effects of silvicultural treatments. Gap models, characterized by representations of intermediate complexity of stand dynamics processes, can be used to evaluate the potential long-term effects of small- scale disturbances on forest succession. Process-based models contain relatively detailed descriptions of the ecophysiological processes that govern tree and stand growth. They are the most effective to evaluate the impacts of major disturbances, such as climate change. Despite the fact that major accomplishments have been achieved in the last few decades, uncertainties in the predictions of forest productivity models still remain important. Several difficulties are specifically associated with their development. These include dealing with natural variability, representing the complex interactions inherent to forest ecosystems, and integrating the longevity factor. Also, in order to make sound decisions about natural resource management, users expect a high degree of accuracy in the predictions. These issues are particularly important more than ever before as there is an urgent need to improve the capacity of different model types to predict the effects of climate change on forest productivity. Although the natural inclination might be to add more code or increase the complexity of statistical methods, these are not necessarily the answer. The fact is that the changing climate poses new challenges that can best be met by returning to significant and relevant basic research questions related to the mechanisms affected by climate change, including ecophysiological processes, carbon allocation, disturbance rate and/or forest succession. But this time, the lack of understanding identified by existing models can contribute to improving the design of research protocols and field and laboratory experiments can be intimately linked to garner significant and relevant information. Specifically, there is a need to improve the biological consistency of the mathematical representations of the complex nonlinear interactions within forest ecosystems and to address in more depth different time and spatial scale issues. As a consequence, it is likely that the complexity of the next generation of forest productivity models will increase appreciably. Modellers will have to rely more on specific methods to deal with complexity, such as hierarchy theory or systems analysis, to avoid developing models that require too much data to calibrate them, a common complaint of model users. Also, more importance should be put on the computation of uncertainty estimates. These will allow the users to (1) evaluate the errors in the predictions and (2) compare the predictions of different model types. Even though process-based models have the most potential to predict the effects of climate change, they are not necessarily suitable for predicting short-term and small-scale management interventions or simulating forest succession. However, their output can be used to adjust growth and yield or gap models to account for the effects of climate change. The cycle of modelling can then be extended and the information used in the most efficient way.

Carbon market opportunities for the Acadian Forest

Matthew S. Smith, CF, ACF, EMS-A

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As markets for ecosystem services develop globally, forests are playing an increasingly important role for addressing climate change through the sequestration of atmospheric carbon dioxide. With the increasing awareness of the value of forests and the potential for realizing new revenue streams through the sale of carbon credits, many forest owners are exploring opportunities that may exist for their forest resource.

In the US and Canada, voluntary and mandatory climate change programs have evolved into a complex and diverse set of rules, policies, processes, and objectives. These programs have recognized and embraced the role of managed forests to varying degrees. Some programs are only now considering recognition of carbon sequestered in managed forests. Other programs have embraced the role of managed forests and have developed policies that favor managed forest enrollment as offsets. Others still allow for managed forests, yet impose strict policy and economic barriers to their participation.

The presentation will provide an overview of the current state of the mandatory and voluntary carbon markets with an emphasis on the opportunities these new markets present and the forest carbon offset policy implications for each. The presentation will also identify policy challenges for forest inclusion in current and proposed programs, and will explore potential solutions to these challenges.

Bioenergy futures and the role of the Acadian Forest

Eric W. Kingsley

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The Acadian Forest, one of the great forests of the world, holds enormous promise as a source of clean, renewable energy. For centuries wood has heated our homes, providing an efficient and local source of thermal energy. More recently, forest industries have used wood energy for thermal and process application, and stand-alone electricity facilities have been built to help provide renewable, locally derived electricity to regional consumers.

As fossil fuel prices rise, and concerns mount over carbon emissions and energy security increases, opportunities for a new generation of wood-based energy present themselves. Wood pellet manufacturing is growing, and policy makers in the US and Canada are providing significant funds to move wood-based liquid fuel production from the laboratory to the mill. These opportunities represent the tip of the iceberg, and wood can meet an incredibly broad range of our needs (i.e. thermal, electric, transportation and bio-product) as we move forward.

This opportunity carries with it an enormous set of challenges, and not only at the technical level. In some areas of the Acadian Forest, new markets for energy products will be welcomed as an opportunity. In other areas, competition from these new markets may threaten existing, long-incumbent industries – and the hundreds or thousands of well-paying union jobs they represent. Concerns about the sustainability of the forest, and the sustainability of the forest ownership and harvesting infrastructure, will need to be faced directly. The mechanisms to capture value from the "renewable", "carbon neutral" and other environmental attributes are just developing and need careful attention. Transitioning will not be nearly as easy white papers can make it seem, and the technical and market challenges will need equal effort if we are to achieve long-term success.

Oral Presentations

Sustainable biomass production and nutrition in spruce-fir forests: knowns and uncertainties

H. Lee Allen

Professor Emeritus and Director, Emeritus Forest Nutrition Cooperative
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With rising energy costs, interest is again focused on more aggressively utilizing forest biomass directly as a fuel or as a feed stock for biofuel production. A major concern associated with increasing biomass removals is whether production is sustainable, especially if these removals result in more intensive and/or more frequent harvests. Research has clearly shown that greater utilization of nutrient rich crown materials (branches and foliage) can result in 100% or greater increases in nutrient removals with only modest increases in biomass yields. Frequently it is assumed that sustainable production will only be possible if all nutrients removed during harvest are replaced; however, this is only a hypothesis and it has been rarely tested.

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. For many forest systems, we now know that chronic and widespread nutrient (especially nitrogen and phosphorus) limitations already limit productivity. Fortunately by coupling our conceptual understanding of forest production with empirical results from field trials where resource availability has been experimentally manipulated, we have been able to devise cost-effective and environmentally sound silvicultural regimes that ameliorate nutrient limitations and enhance, not just maintain current levels of forest production. It is now recognized that nutrient additions are required to achieve optimum production levels in most managed forest systems. Clearly inputs are required when optimum outputs are desired!

Applying these same concepts to existing data from the spruce-fir forest in northeastern United States and eastern Canada suggests that biomass production in many areas is already limited by nitrogen and possibly other nutrients. Substantial gains in annual biomass production and ultimately yield should be realized with silvicultural regimes that include treatments that add needed nutrients and/or enhance the availability of existing nutrient pools. Many questions remain concerning the magnitude and extent of nutrient limitations and how these limitations can best be ameliorated to optimize biomass production in spruce-fir forest. I will wrap-up by proposing a series of research projects to address these needs.

A spatial analysis of sawmill wood procurement in the Northern Forest

Nate Anderson, René Germain and Eddie Bevilacqua

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Sawmills in the northeast United States and eastern Canada depend on local roundwood to meet production requirements. On average, American mills in this region procure 90% of their wood supply from within 30 to 70 miles of the mill, but procurement operations can range 200 miles or more, depending on a mill's products and production output. This study uses spatial analysis in GIS to map competition for sawlogs and procurement pressure across the Northern Forest based on the overlapping wood procurement regions of individual mills, also known as "woodsheds." Woodshed maps provided by 273 sawmills in the northeast United States and eastern Canada are the foundation of the analysis. Individual paper woodshed maps were digitized and linked to procurement and production data that were collected in the same mail survey. The analysis also includes the woodsheds of 280 non-respondent mills, which were predicted based on regression models and production data published in state, provincial and industry directories. Hotspots of competition and procurement pressure are discussed in light of industry agglomeration, transportation networks, log exports to Canada, and trends in land use and urbanization. In addition, a simulation of the effects of woodshed contraction due to high fuel prices is presented. This simulation supports the hypothesis that concentration in procurement pressure occurs in areas of industry agglomeration, and highlights the need for using spatial models when examining questions related to future wood supply and demand.

Stakeholder perceptions of uncertainty: a driver of New Brunswick forest policy

William F.A. Anderson

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Since 2001, there has been a protracted debate concerning the sustainable management of New Brunswick's Crown forests, with industrial fibre supply being of significant public concern. In 2004, in response to growing public pressure over this question, the New Brunswick government creating an all-party Legislative Assembly Select Committee on Wood Supply. As part of its public hearing process, the Committee received written briefs and comments from scientists, environmental organizations, forest industry representatives as well as non-governmental organizations covering a wide array of forestry topics. This paper will present early results of a case study investigating the science/policy interface. Thematic analysis of a sub-set of Select Committee documents showed that while uncertainty represented an important factor in public policy for the various stakeholder groups, its characterization varied greatly among them. For example, the forest industry perceived uncertainty as declining harvest levels, a varying regulatory framework and the possibility of uncompetitive forest sector. Environmental groups and scientists expressed concerns over the unknown impacts of intensive forest manage on wildlife, habitat and biodiversity, the lack of progressive management of many forest values, and offered adaptive management as a possible strategy for learning under uncertainty. Others highlighted the uncertain future as the result of a changing climate, the possible shifting of forest product markets, and Aboriginal land claims. These results point to the need for better understanding and communication of the multi-dimensional aspects of uncertainty. With better understanding of varied perceptions of uncertainty, policy makers may be able to develop more comprehensive and inclusive policy options or initiatives.

The snowball sampling technique targets information rich sources to discover how forest policy is developed

Wm. (Bill) Ashton[1] and Ted Needham[2]

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More people and groups are participating in developing forest policy in North America than ever before. To examine how forest policy is developed, identifying a sample population was an initial challenge. The snowball sampling technique was used. In the first steps, informants identified from related background reports were contacted and asked to provide names of other informants. Second, all informants helped distinguish the most influential groups and individual policy makers. In this way, the snowball sampling technique allowed for a comprehensive search plus narrowed it to only the most influential policy makers who could then be interviewed. The technique was applied to four recent but different forest policy initiatives: two from New Brunswick, one from Ontario, and one from British Columbia. The technique effectively and efficiently identified influential groups and influential policy makers who could reveal how forest policy is developed in Canada.

The evolution of public discourse on forest management in New Brunswick, Canada

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Since the inception of the Crown Lands and Forests Act in 1982, there has been a discussion regarding the amount and manner of public engagement that is appropriate and necessary in the management of Crown land. In the last decade, there has also been an active and vocal debate amongst a variety of stakeholders regarding the forest values for which Crown land is managed. Throughout this debate over protected areas and fiber supply, the NB government has struggled with how and how much to involve the public. Recently, the NB government has engaged a team of external social scientists to advise and implement some new public involvement strategies, including a public opinion survey. This paper describes the evolution of public involvement over the last few decades, including recent experiments with province-wide, random-sample survey research. The paper also discusses the "growing pains" in this evolution, as government attempts to respond to increasing demand for opportunity for public involvement while still being somewhat skeptical of the public's ability to contribute meaningfully to forest policy debates. We conclude with some lessons and observations about doing sociology in the public sphere.

Development of sawing patterns and lumber recovery estimates using spreadsheets

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In its simplest form, sawing lumber and boards from logs is the same as cutting squares from circles. When a variety of standard product dimensions (width and thickness) and desired lengths are combined with the seemingly infinite combinations of log size and shape, it is obvious that the sawmilling process is by no means simple. Many sawmills use sophisticated scanning equipment combined with complex simulation software to increase overall product recovery by considering detailed log parameters such as sweep, crook, eccentricity, and knots.

Foresters typically assess wood products at the log level. In many cases, especially at the operational planning level, the only information available for log sizes is top and bottom diameter and log length. Total lumber volume is estimated using standard log rules based on limited log data (i.e., top and bottom diameter, and length), but log rules provide no information on specific lumber products or sawing patterns, both of which can be important to aspects of forest management planning. It can be more effort than it is worth to use complex sawing simulation packages with such limited log data and, at the most basic level, sawing patterns can be developed with simple geometric relationships between product sizes and log dimensions.

A product recovery spreadsheet simulator (PRSS) was developed using Microsoft Excel and Visual Basic applications to estimate product distribution and sawing patterns based on limited log geometry provided by stand level models. Using trigonometric equations and geometric relationships, PRSS provides estimates of lumber product recovery using standard sawing patterns (e.g., live sawing or cant sawing). Options exist to maximize lumber value recovery based on a user-defined prices and estimated knotty core size or to manually orient sawing patterns around known knot locations.

Relationships between non-native invasive plant distribution, silvicultural treatment, and soil drainage in the northern conifer forest

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Anthropogenic disturbances may promote the encroachment of nonnative invasive plants. Forest managers are concerned about protecting the integrity of forest ecosystems against this threat. To address this concern, we investigated the relationships among nonnative invasive plants, soil drainage, canopy openness, and harvest type and intensity in a mixed conifer forest in northern New England. Our study area is the U.S. Forest Service, Northern Research Station's long-term silvicultural experiment on the Penobscot Experimental Forest (PEF) in Maine.

We sampled 22 stands representing 10 twice-replicated silvicultural treatments (including no harvest) as well as 2 unmanaged stands on former agricultural sites. We recorded the percent cover of woody and herbaceous plants to species, and bryophytes to genus or group. Percent canopy openness was determined from hemispherical photographs, and drainage class was determined from soil pits.

Analysis of variance revealed differences in plant richness and diversity among the treatments. The former agricultural area and the unregulated harvest treatment were the richest and most diverse, while the shelterwood and no-harvest treatments were the least rich and diverse. The former agricultural area averaged 3 times as many species as the no-harvest treatment. Non-metric multidimensional scaling showed substantial differences in community composition between the former agricultural and forest management areas.

These results suggest a strong relationship between land use history and the presence and abundance of nonnative invasive plants. Nonnative invasive plants were abundant in stands on former agricultural sites; they included glossy and European buckthorns, shrub honeysuckles, Oriental bittersweet, Japanese barberry, multiflora rose, and purple loosestrife. These invasive plants were rare within forest management areas; a few small seedlings of glossy buckthorn and shrub honeysuckle were found on plots in the unregulated harvest treatment.

Our findings provide a detailed view of the composition of the understory plant community and associated environmental conditions on the long-term plots of the PEF, as well as important baseline data for future monitoring of and research on nonnative invasive plants.

Natural regeneration 15 years after various partial cuts in tolerant hardwoods in northern New Brunswick

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Selection, shelterwood, patch and strip cuts have been common practices for J.D. Irving Ltd. in hardwood stands of New Brunswick for over 15 years in order to stimulate natural regeneration of shade-tolerant species, and to preserve or enhance high quality growing stocks. But the true effects of those operations on the regeneration and stand evolution are uncertain, as no study has taken place to confirm of infirm desired effects. The way to perform partial cuttings could be modified to better meet management objectives.

The objective of the present study is to compare density and composition of natural regeneration after different treatments. Sampled stands (n=37) were hardwood dominated or mixed, and have been treated by one of the four partial cuts: Selection (n=14), shelterwood (n=9), patch cut (n=6), strip cut (n=5) or none (n=5). The time since treatment allows grouping stands into four categories: 1 to 5 years (n=5), 6 to 10 years (n=14), 11 to 15 years (n=8) or none (n=5).

Data has been collected in the field to quantify seedlings, competitors (herbs and shrubs), organic matter depth, residual composition, soil moisture, substrate types and transmitted light. Data analyses have shown no significant difference in yellow birch or sugar maple seedlings densities amongst neither partial cut nor time since treatment. Small beech seedlings (<1m) were more numerous in patch cuts than in selection and this difference is probably related to initial composition. Plot scale regressions showed that regeneration is negatively affected by competition from shrubs and herbs and organic matter depth. Sugar maple regeneration is positively linked with its proportion in residual canopy and distance from the edge. Residual composition is different amongst treatments, with a significantly higher proportion of beech in old strips, and shelterwood cuts of 6 to 10 years old. Results suggest little effect of treatment due to little control over substrates and competition. Moreover, the lack of difference between selection and shelterwood, patch or strips may be due to the low residual basal area left after the selection cuts that opened up the stand enough to promote the less shade tolerant species like yellow birch.

Effects of ageing and maturation on the reproductive development and vegetative growth of conifers

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The regulation of age- and size-related changes in vegetative growth rates, reproductive development and foliar morphology of forest tree species is poorly understood. For example there is controversy as to the cause of a developmental decline in height growth that occurs relatively early in the life span of the tree. Is the decline due to intrinsic changes in meristem behavior or is it due to the effects of increased tree size? Here we describe the results of long-term reciprocal grafting study where scions from juvenile, mid-age and old-growth red spruce were grafted onto rootstocks in each of these age classes in the spring of 2002. Total branch number, length and strobili/graft were recorded after 3 growing seasons in 2004 and again in 2008, at which time the grafts were harvested. The reciprocal grafting approach is designed to remove the confounding effects of size and complexity on the growth behavior of apical meristems.

After 3 growing seasons, juvenile scions produce significantly fewer strobili than old growth or mid-age scions (Table 1). After 8 growing seasons juvenile scions produced 10-fold fewer strobili than mid-age or old-growth. Although juvenile scions overall produced more branches and total branch length across all understocks, that tendency is less pronounced on the mid-age and old-growth understocks (Table 2). We have previously shown that increased leaf mass area with increased size is a function of intrinsic changes in meristem behavior that are independent of tree size. Thus reproductive development and branching frequency also appears to be a function of an intrinsic change in meristem behavior and is not solely a function of tree size.

Table 1. Female and male strobilus counts on grafted scions in the fall of 2004.

	# ♀, ♂ strobili by understock, scion combination					
	Juvenile scions		Mid-age scions		Old-growth scions	
Under stock	♀	♂	♀	♂	♀	♂
Mid-age	0.0	0.2	4.0	0.8	6.1	2.0
Old-growth	2.5	0.0	1.5	0.7	8.8	1.1
Total	2.5	0.2	5.5	1.5	14.9	3.1

Table 2. Branch number and total branch length of grafted scions in the fall of 2004.

	understock, scion combination					
	Juvenile scions		Mid-age scions		Old-growth scions	
Under stock	Branch #	Branch ln.	Branch #	Branch ln.	Branch #	Branch ln.
Juvenile	25.4	260.1	9.0	91.7	8.7	75.2
Mid-age	6.5	47.1	8.4	59.8	5.3	27.3
Old-growth	11.9	37.4	6.4	28.9	8.0	37.1
Total	43.8	344.6	23.8	180.4	22.0	139.6

Spatial tree mapping and angle count sampling (ACS) using photography

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Angle count sampling (ACS) is a widely used inventory technique favoured for rapid measurement of stand-level forest characteristics. Mapping spatial location of sampled trees is increasingly becoming an important metric as input to spatially dependant growth and yield models and for development of competition indices. We will present a technique for mapping tree locations and performing ACS from a series of photographs taken at a sample location. Our proposed technique utilizes off-the-shelf software to stitch a series of photographs taken at a sample point. Once the panoramas are obtained, several measurements useful to forest managers and researchers are easily obtainable. Photographs are also useful for visualizing change in plot conditions over time. The techniques were tested on 47 field plots (1398 sample trees) under a range of forest conditions and compared to traditional methods. Regressions of photo-measured distance and azimuth measurements to field measured distances and azimuths had R^2 of 0.99 and 0.98, respectively. Average distance error was 0.44±0.38 metres, and average azimuth error was 2.3±2.5 degrees. Calculation of k values for ACS had R^2 value of 0.94. An issue with photograph-based inventory techniques is how to deal with trees that are hidden behind others, or obscured by understory vegetation. Using mBAF1 and mBAF6 angle gauges, on average, 66% , and 89%, respectively, of trees were visible. We will discuss the degree to which this is an issue, and propose a ratio-estimator technique for dealing with hidden trees on photographs. While measurements from the photographs are currently done manually, we believe that existing technologies can be adapted to automate the process and making them practical for use.

Stochastic or deterministic individual-based models: is there any difference in growth predictions?

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Individual-based growth models encompass several submodels that aim to predict recruitment, mortality and increment. Like differential equations, these models provide predictions over predefined growth intervals. To obtain growth forecasts over longer periods, the predicted tree list is reinserted into the model for additional growth intervals.

Such models can be used either in a deterministic or a stochastic fashion. The stochastic approach attempts to illustrate the natural variability of a particular phenomenon (Vanclay 1994, p.7). Consequently it provides forest managers with an uncertainty assessment. On the other hand, the deterministic approach only provides a mean prediction. Although forest managers might be more interested in the variability of forest growth, individual-based models are generally used in a deterministic fashion.

Because estimated quantities are generally reinserted in the model, some concerns exist regarding the use of the deterministic approach with individual-based models. Actually, if some submodels rely on predictors such as the square dbh, the use of the square predicted dbh is a biased estimator of the true square dbh (Duan 1983). On the other hand, the stochastic approach is thought to be nonsensitive to such transformation biases because it reproduces the distributions of the variables, and the mean predicted values are calculated from these distributions.

In this presentation, we illustrate the differences between mean predicted basal areas obtained through both the deterministic and stochastic approaches. Because it can be reasonably assumed that the stochastic approach is unbiased, some correction factors are proposed to correct for the variable transformation biases in the deterministic approach.

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Formation quality evaluation of oriented strand composites

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Numerous studied factors are known to affect the mat formation of oriented strand composites (OSC); a concept that includes oriented strand boards (OSB) and its derivative, oriented strand lumber (OSL). Strand variability; loading ratio; free fall distance; orienting discs geometry; discs array and conveyor speeds are some of the mostimportant reported parameters affecting the effectiveness of the formation process. However, the diversity of response variables and methodologies utilized to acquire processing and final product data make it difficult to interpret the results in a comprehensive manner for monitoring purposes and in order to execute the necessary corrections to the process. Strand angular distribution, bulk density, horizontal density profile, and vertical density profile are the most conspicuous response variables suitable to evaluate the formation effectiveness in an on-line fashion. The objective of the present study was to determine a suitable combination of response variables that describe panel structure/property relationships. Three distinct geometrical distributions were induced by stranding aspen (*Populus tremuloides*), at three log conditions; namely frozen (-6.6°C),cold soaked (21.1°C) and hot soaked (60°C). Strands were produced, dried, blended and formed at the AEWC Center's oriented strand composite pilot line at the University of Maine. The formed mat was characterized by determining the degree of strand alignment (using von Mises distribution parameters) and bulk density; from the pressed 4'x8' panels a vertical density profile was obtained. A 16"x96" board was cut from each panel in order to perform Dynamic Mechanical Testing using a Metriguard Model 239A; subsequent samples were obtained from the same board in order to perform Mechanical Testing in bending and Linear Expansion according to ASTM D1037. Statistically significant relationships ($p<0.01$) were found between response variables and the characteristic matvariables originated by the different temperature treatments. Promisingly, the results demonstrate the feasibility of structuring a formation quality index by combining on-line and non intrusive measurements.

Reconstruction of the competitive dynamics of mixed oak forests

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Oaks are some of the most ecologically and economically important tree species in the northeastern United States. Regeneration of oak dominated stands has been problematic in this region, as young stands are often dominated by competitors such as red maple, black birch and black cherry. In some cases, young oaks are suppressed early in stand development by these faster growing competitors, resulting in new stands where oak is only a minor component. Other evidence suggests oaks are able to persist, and eventually emerge as a dominant canopy layer over these competitors. However, this has not been conclusively documented in the central Appalachians. We conducted a study to test whether or not oaks are able to switch dominance classes during the first thirty years of stand development. Sixty dominant and sixty subordinate seed origin oaks in central and northern Pennsylvania were felled along with their nearest two non-oak competitors of equal or greater crown class (red maple, black birch, black cherry). Each tree cluster was mapped, and stem cross-sections were collected every meter from the root collar to the top of each tree. Cross-sections were aged to determine height growth patterns through time. Results indicate that height growth rates of all species are variable, with red maple, and black birch proving most difficult to predict. Oaks typically displayed a more constant rate of height growth, although predicting later dominance from a seedling's height (i.e., of up to 3 m) appears to be problematic. All oaks, regardless of third decade crown class were equal in height to their competitors for the first ten years of stand development. In northern PA stands, future subordinate oaks began to fall behind by age twelve. In central PA stands, subordinate oaks remain nearly as tall as their competitors even at age thirty. Although some third-decade dominant oaks were able to recover from slight height deficits, on average, the emergence of oaks by the third decade was not readily observed. These results indicate that oaks that are overtopped early in stand development likely require release treatments by age ten in order to become canopy dominants in future Pennsylvania stands.

How will expensive oil affect Maine timberland: a preliminary sketch?

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We work for clients interested in topics such as biomass supplies for energy production, timberland valuation for investment, and the outlook for wood product markets. When crude oil prices reach unheard of levels, we have to ask ourselves if simple extrapolation of past relationships will work anymore. Are we in a totally new era? If so, what will change? Will the price of oil turn out to be more important than the price of stumpage? How will expensive oil change: the competitive position of our manufacturing base; the product mix of the pulp industry (e.g. pulp to biorefinery) land use patterns (sprawl vs concentrated); demand for remote northwoods leisure lots; demand for pulpwood and sawlogs; interest rates; stumpage values for biomass and mill residuals. Bottom line, how will expensive oil affect the investment value of Maine timberland?

In this paper we pose some simple scenarios to sketch out an answer to these questions. We will propose a simple screening analysis to rank the importance of these separate effects on Maine timberland owners and forest management. There are several interesting aspects. First, the experts say the story is less the future level of oil prices, than the certainty that they will be highly volatile. This introduces a question of investor posture toward risk. Next, the dynamics will be critical. How will oil prices affect mill expansions and shutdowns, trucking capacity, haul distances and hence competition. Lastly, how will Maine's competitive balance with competing timber investment regions? Clue: many Brazilian pulp mills haul 20-25 miles.

Wood to electricity: chip pile for electric plant.

Modern grinder in the woods for grinding biomass.

New findings from an 80-year-old northern hardwood silviculture study

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One of the most influential studies in northern hardwood silviculture is the Cutting Methods Study established by the U.S. Forest Service on the Dukes Experimental Forest (also called the Upper Peninsula Experimental Forest) in Michigan in 1926. This study was the source of the management recommendations made by Eyre and Zillgitt (1953) and Arbogast (1957), and has served as the basis of northern hardwood silviculture throughout the Northeast, Lake States and portions of Canada. Treatments evaluated include a number of variants of selection cutting, as well as thinning, clearcutting and diameter-limit cutting. Though active research was suspended in the 1960s, foresters at the Hiawatha National Forest continued to implement the silvicultural prescriptions. In 2007, scientists and staff from the U.S. Forest Service, Northern Research Station, in collaboration with the National Forest, re-established the original sample plots and collected data on stand structure, tree quality, species composition and regeneration. Though the treatments are unreplicated, the length of the data record makes the study invaluable.

The focus of our current analysis is the "Overmature and Defective" (OMD) treatments in which two stands were managed with single-tree selection cutting such that poor quality, low vigor, and otherwise commercially undesirable trees (i.e. "overmature and defective" trees) were removed. Eyre and Zillgitt (1953) recommended this treatment based on results observed 20 years after the study began and developed a target diameter distribution by combining the structures observed in the two stands; this target was reiterated in a marking guide by Arbogast (1957). Yet, the data from these stands have not been reexamined since the 1940s to test the stability of this widely used structure. Preliminary results show that, after 80 years of management, the diameter distributions in the OMD stands approximate the Eyre and Zillgitt (1953) target structure, though the degree to which the distribution has been maintained appears to be influenced by lapse time since cut. Long-term dynamics of these stands and growth over the intervening years will be reviewed.

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Variation in snowshoe hare densities as related to Canada lynx and forest management in eastern North America

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Snowshoe hares (*Lepus americanus*) are an important component of forests throughout the northern regions of North American, functioning in nutrient cycles as well as serving as prey for a variety of vertebrate species. While the dynamics of hare populations have been well studied in boreal forests, the population dynamics of this keystone species in the Acadian Forest of eastern North America is poorly understood. We have been measuring seasonal hare densities on two study areas in northern Maine to assess:

1) Seasonal hare densities by forest types, giving special attention to major forest practices;
2) The importance of stand- and landscape-level hare densities to the occurrence of Canada lynx (*Lynx canadensis*); and
3) The relative importance of vegetation succession versus population cycles in causing variation in hare densities.

While studies related to the latter two objectives are on-going, we have shown that lynx establish home ranges in areas of high landscape-level hare densities, and that these areas tend to occur in spruce-fir flats that were clear-cut following the spruce budworm outbreak of the 1970-80s. Even-aged regenerating conifer stands, contrary to previous reports, remain in high quality hare habitat for more than 30 years, with hare densities comparable to those in the boreal forest (approximately 2 hares/ha). In the Acadian Forest, landscape-level hare densities may be marginal for lynx and thus the effect on hares of the new harvesting paradigm in Maine (i.e., partial harvesting) is being studied. Also of critical importance to forest managers is the relative importance of vegetation changes (which forest managers effect) versus non-vegetation driven changes in hare densities (which foresters do not effect). The question as to whether or not hare populations near their southern range limit undergo population cycles requires long-term data, currently being collected. We will evaluate hare densities from two Maine study sites as compared to the boreal situation in terms of periodicity, magnitude, and synchrony. In addition to understanding hare densities as related to vegetation structure, we are also measuring temporal changes in vegetation (i.e., succession) to evaluate changes in hare densities due to vegetation succession versus non-vegetation factors (i.e., natural cycles).

Assessing disturbed soils through relative bulk density

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Cut-to-length forest operations rely on heavy equipment to harvest and transport wood from the felling site a landing. Our research explored the impacts of forest machinery, in particular forwarders, on soils when trafficking off-road through forest stands. More specifically, we assessed soil disturbance by compaction (soil density increase) caused during harvesting operations. This study had three objectives: 1. Determine whether forest machinery caused soil disturbance by compaction and if so, to estimate the severity of compaction by assessing soil specific relative compaction and its bulk density; 2. Explore the mitigating effect of slash (harvesting debris) on soil compaction; 3. Analyze the persistence of the disturbance over a multi-year period.

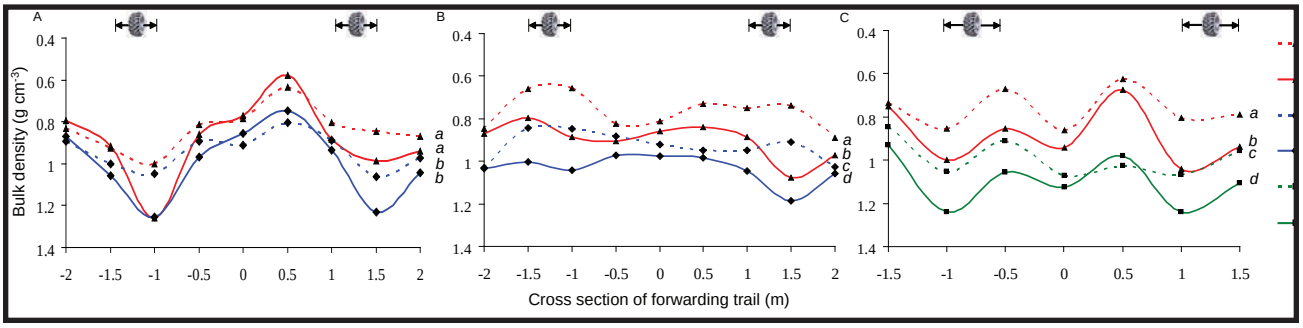
Our research was innovative in three respects; 1) We assessed soil density in-place at exact same locations pre- and post-impact with a nuclear moisture and density gauge. In this context, we understand impact as forest machinery (harvester and forwarder) trafficking on forest soil. 2) After the impact, we monitored changes of soil density (possible rehabilitation) at exactly these locations for over two years. 3) Besides absolute soil density measurement, we used relative bulk density (relative compaction) for assessing the impact severity on forest soils. Using the relative bulk density (RBD) approach to quantify soil disturbances enabled us to compare bulk density increases from different sites.

Our key findings showed that soil density increased on average by 19% in machine tracks. Moreover, machine impact was not limited to vehicle tracks since we noticed an increase of soil bulk density >10% in 14 of 65 (21.5%) outside-track locations (Figure).

Due to machine impact, RBD exceeded the 80% critical threshold at 38% of all track locations, mostly in deeper layers (20 to 30 cm), implying an insufficient amount of pores for gas and water exchange resulting in high potential for reduced tree growth at these locations.

A 21.2 kg m^2 slash mattress composed essentially of white spruce [*Picea glauca* (Moench) Voss.] branches helped to reduce soil compaction by 40% at a 5 cm depth up to 60% at a 30 cm depth compared to a thinner 10.2 kg m^2 slash mattress. While the mattress helped to reduce density increase over all layers, it helped in particular to keep the density of the 20 to 30 cm layer post-impact below the critical 80% RBD threshold. 5. Monitoring soil density for nearly three years after the impact indicated no rehabilitation (decrease) of the increased soil density.

Figure. Pre- and post-impact soil bulk densities across the forwarding trail. A. Gagetown, cycle 1, B. Gagetown cycle 3, and C. Black Brook.



Public participation in forest management: experiences, perceptions and expectations of social economy organizations in New Brunswick

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Public participation in forestry represents a way of opening a dialogue between managers and stakeholders who share interest in the same forestlands. In New Brunswick, forest industries are responsible for forest management planning and operations on public lands, following guidelines from the provincial government who is the steward of these lands. However, since the 1990's, this expert-driven and industrial approach to forest management is being increasingly challenged.

Throughout the province, public participation processes, such as advisory committees and public hearings, have become more frequent to discuss forestry issues. These provide new opportunities for individuals and organizations to present and advocate their ideas and concerns. However, the costs and benefits of these processes for participants, especially for groups without a financial stake in forest management, are not well understood. The term "social economy organizations" is used to describe groups such as forestry cooperatives, woodlot owners associations and environmental non-governmental organizations who are involved in forest management, but are excluded from the traditional planning process.

This exploratory study aims to determine the extent of participation by social economy organizations in different public participation processes in New Brunswick, analysing particularly their experiences and expectations in specific processes. As a first step, a data-base of past and existing public participation processes across New Brunswick was prepared. Description of those processes with the use of different attributes provides a better picture of the public participation processes used in forestry. Subsequently, a combination of postal surveys and semi-directed interviews with representatives of social economy organizations was used to document the experiences and expectations of these organizations in relation to their participation.

Qualitative analysis of the data is currently underway and will enable us to better understand how social economy organizations present and defend their interests, the factors that may facilitate or hinder their participation in discussions about forest policy and their suggestions to improve public participation processes related to forests in New Brunswick. Preliminary results show that social economy organizations have an important interest in management of public lands and the policy guiding it, but face serious challenges in having their ideas considered in the decision making process. Some suggestions for improving these processes include: diversification of the participatory processes, decentralization of the decision-making, technical support for organizations before and during the processes, and moving responsibility for participatory processes from the forest industry to another authority.

Long-term results from partially cut stands highlight concerns about northern white-cedar sustainability

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Northern white-cedar (*Thuja occidentalis* L.) is a companion species in mixedwood stands often harvested by partial cutting with different return intervals and cutting intensities. However, cedar sustainability is not the focus of silvicultural treatments in those stands. Previous research has demonstrated a decrease in the basal area and volume of cedar under some partial cutting treatments. Concerns have also been expressed regarding a decrease in the abundance of cedar regeneration in the northeastern United States and southeastern Canada. Possible reasons for this reduction include poor harvesting methods and increased animal browsing. Our objective was to determine the impact of partial cutting on the abundance and recruitment of cedar regeneration.

The Penobscot Experimental Forest (PEF), located in central Maine, was established in 1950 in the Acadian Forest Region for stand-level silvicultural research. The cedar component is small, but important to maintain the natural dynamics and sustain the forest industry. The silviculture experiment, including nine even-age and uneven-age regimes, was established between 1952 and 1957, and regeneration inventories began in 1964. For each commercial tree species, the number of seedlings (≥15 cm tall and DBH <1.3 cm) by height class is counted in 4 m^2 plots, and the abundance of saplings (1.3 cm ≤ DBH < 9.1 cm) is counted in 0.20 ha plots on a five-year interval. Our study focuses on the abundance of cedar regeneration under four treatments that incorporate partial harvests: fixed diameter-limit cutting and selection cutting with 5-, 10-, and 20-year rotations.

Total abundance of cedar seedlings has remained almost the same since 1960s, while abundance of saplings has decreased dramatically. Looking at the distribution of seedlings by height classes between 1965 and 2005, only 21.1% of seedlings of cedar are taller then 30 cm during that period, compared to 38.7% in 1965 and 75.5% in 2005 for balsam fir (*Abies balsamea* (L.) Mill). Thus, seedlings of balsam fir are getting larger, but cedar seedlings are not. Moreover, to increase the density of saplings, recruitment must be higher than turnover and mortality rates. For cedar saplings, recruitment rate is low, while turnover and mortality rates are very high. This suggests that existing saplings die (mostly killed by cutting or browsed) or grow to merchantable classes, but they are not replaced by seedlings growing to sapling size. Future research will address specific impacts of silvicultural treatments and site characteristics, and search best harvesting methods for growth of cedar regeneration.

Relationships between trust, public involvement and natural resource agency employee morale

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This research project investigated the perspective of natural resource managers in the New England region of the United States. It is widely recognized that public land managers face a difficult job balancing ecological, social and economic considerations. Newspapers reports and anecdotal evidence in New England suggests that some managers and agencies are better at managing those multiple considerations than others. Relationships between public land management agencies and local rural communities in the New England region vary from highly dysfunctional to extremely positive. While most public land management agencies integrate public opinion into decision making, the success of these public involvement strategies are largely unknown. The central research was, "What is the relationship between community trust, the public involvement process, and employee morale?" To better understand trust and the public involvement from the perspective of natural resource managers, we used social psychological concepts including conflict resolution, justice, and job satisfaction. Questionnaire data were collected using an internet-based survey. After presenting the results of the research, recommendations will be presented that suggest ways of improving public involvement strategies, increasing trust from local rural communities, resolving conflicts, and improving natural resource manager morale regarding public interactions.

Integration of remote sensing and land cover data to evaluate forest landscape change

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In Maine as in many other forested states, harvest patterns have evolved over the past several decades in response to natural disturbance events and changes in forest policy, ownership, and market conditions. The cumulative effects of these changes will determine the future condition and supply of forest resources and wildlife habitat, particularly for species that depend on early- or late-successional forest attributes. Yet existing statewide land cover maps may not adequately reflect landscape conditions relevant to current forest management applications because they fail to adequately depict forest harvest legacies and regeneration age class conditions, and because they quickly become dated due to harvesting activity. To better understand the long-term effects of forest management on landscape structure and wildlife habitat distribution, we have developed a 32-year time series (1975-2007) of forest harvest and land cover maps for a 1.6 million ha (4 million ac) study area in northwest Maine using Landsat satellite imagery. Coupled with contemporary and historic forest type data also derived from Landsat imagery, forest cover maps were produced by updating and backdating an older land cover map (1993 Maine GAP) using established change detection and GIS data integration techniques. The forest cover time series has been used to document changes in forest type, harvest patterns, and habitat distribution for Canada lynx (*Lynx canadensis*) and American marten (*Martes americana*). Lynx and marten have been proposed as umbrella species for landscape planning and biodiversity conservation in Maine because their large area requirements and habitat specificity (early successional forest and mature forest, respectively) provide for a range of ecological conditions associated with habitat occupancy. Using low-cost satellite imagery, our approach provides an accurate and efficient means of producing spatially explicit forest cover data needed to quantify and evaluate forest landscape change over large areas and long periods of time in support of a wide range of applications, including wildlife habitat modeling, forest inventory, and biomass or carbon stock estimation.

Regional variation in dominant height growth for balsam fir and red spruce in Maine

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Site index equations are needed for growth and yield projections, determine appropriate silvicultural regimes, and more accurate forest appraisals. Balsam fir and red spruce are two of the most common conifer species in Maine, but models of their dominant height growth pattern and its regional variation are still lacking. This study used an extensive dataset complied by Ralph Griffin to construct dynamic base-age invariant site index equations and test several key assumptions. First, several anamorphic and polymorphic Generalized Algebraic Difference Approach (GADA) forms were fit using the forward difference approach and evaluated. The best performing model form was selected and multi-level mixed effects were used to determine both species differences and regional variation in dominant height growth. The installation level random effects were correlated with several climatic and soil variables to determine the factors that influence dominant height growth. The results are compared to other existing site index equations in the region.

Land conservation in maine: a retrospective assessment and analysis of alternative land use futures

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At a time when development pressures and suburban sprawl are increasing throughout the Northeastern U.S., there is a growing need for improved decision-support tools to guide public investments in open space conservation. Maine currently contains a checkerboard of conservation easements and protected lands held by local land trusts, state agencies, and non-profit conservation organizations. These conservation lands exist in a matrix of suburban and rural lands that are experiencing rapid land use and ownership changes. In the coming years, important land use decisions will be made that will affect the quality of life and the balance of developed and undeveloped property in the Maine landscape. This paper examines historical statewide patterns of land conservation in Maine using GIS mapping, followed by a case study of the Lower Penobscot River Watershed (Figure) focused on developing a decision-support framework for setting future priorities for open space conservation.

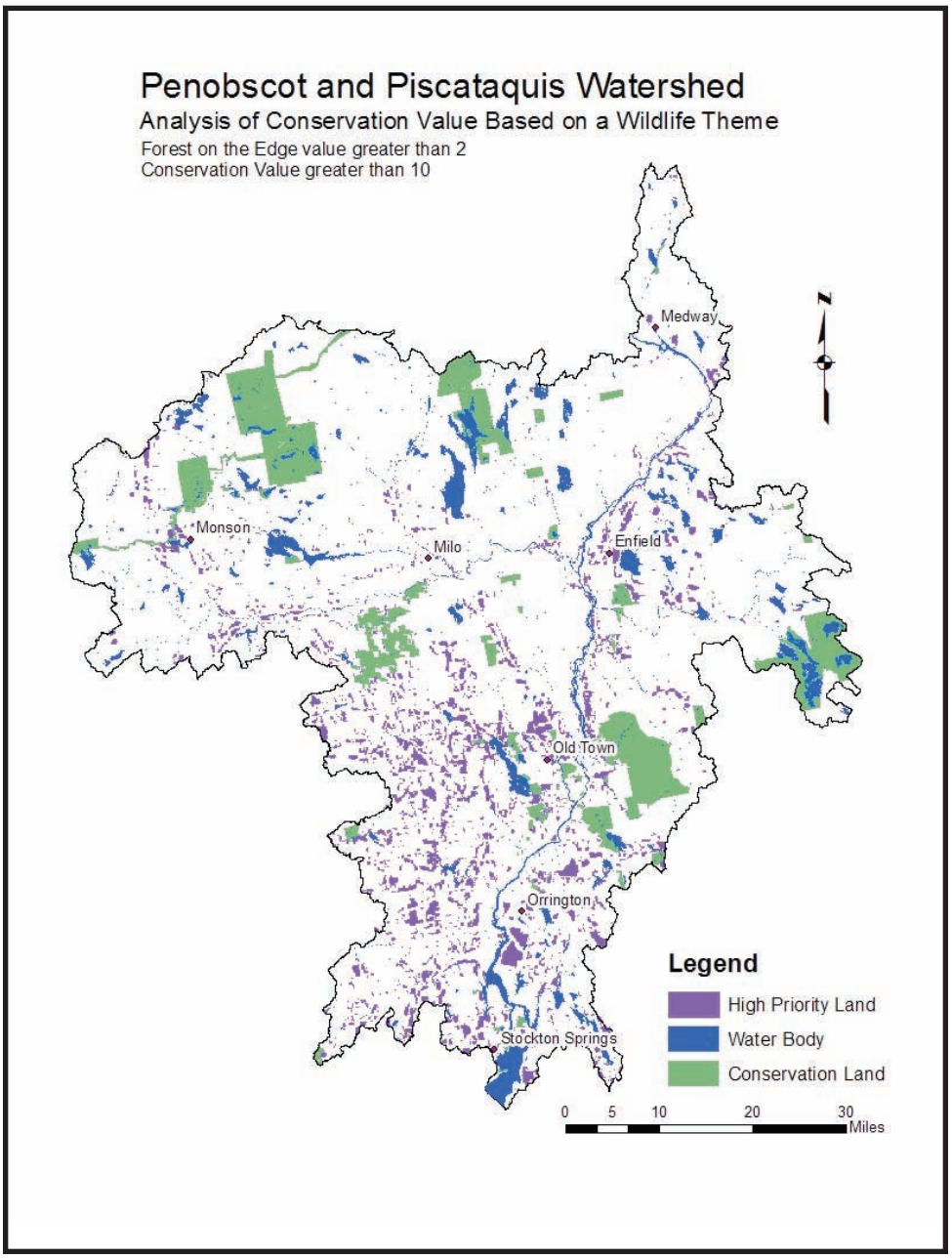

Figure. Areas of high conservation value at risk to future development.

Responses of herbaceous layer over nine years following different harvesting disturbance

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There are concerns that forestry practices have influenced herbaceous species diversity, since silvicultural methods shifted toward intensive management in the 1960's. However, little information exists on the effects of silivicultural treatments on the herbaceous layer in the Acadian Forest. The objectives of this study are to: 1) determine differences in understory species composition, abundance, and diversity over time following different clearcutting treatments; 2) investigate why these patterns occurred based on environmental influences; and 3) determine if patterns of plant functional group (life form, seed dispersal mode, reproduction mode) are related to responses to disturbance. We examined long-term changes in dynamics of the herbaceous species before harvest and for 9 years after clearcutting followed by natural regeneration and pre-commercial thinning seven years later (CC), and clearcutting followed by mechanical site preparation, planting, and aerial application of herbicide three years later (CS). We also monitored two unharvested areas adjacent to the harvest blocks: riparian buffer (BU) and upland forest (UC). Nine years after disturbance, there were large species changes (21 species that colonized and 4 species that disappeared from the pre-disturbance plots) in CC, and the greatest species changes (28 species that colonized and 19 species that disappeared from the pre-disturbance plots) occurred in CS, while BU and UC showed species changes within the range of natural variation. This may suggest that frequency and size of mechanically prepared sites should be reduced to minimize extirpations of species that are sensitive to disturbance. Exposed mineral soil influenced understory vegetation composition over time in CS, cones in CC, and overstory canopy cover in BU and UC, indicating that the amount of exposed mineral soil should be minimized because disturbed forest floor removes or destroys late-successional species and causes large colonization of dominant early successional species. Although the CC treatment showed no significant declines in the richness of plant functional groups from 1995-2004, the CS treatment showed significant declines in the richness of geophytes, chamaephytes, and of species with ballistic-dispersed seeds over 9 years, suggesting that species with perennating buds near or above the ground surface and with short-distance seed dispersal are sensitive to ground disturbance. I conclude forest-habitat species that disappeared will likely recover during short harvest rotation in CC, however, these forest-habitat species may be extirpated during rotation in CS, due to their sensitivity to ground disturbance.

Bryophyte-substrate associations and relationships to forest management responses in the Acadian Forest of southern New Brunswick

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The role of microhabitat in bryophyte community assembly is poorly understood, but many species are believed to have narrow ranges of substrate tolerance. Reduced species diversity, e.g. in disturbed habitats, has been attributed to reduced substrate diversity, assuming bryophyte-substrate specificity. However, few such claims effectively evaluate substrate associations, as they do not account for the relative abundance of substrates. This study rigorously tests bryophyte-substrate associations by abundance (% cover) and frequency of occurrence of species in the Acadian Forest in southern New Brunswick. Bryophyte species and substrates in 440 quadrats were subjected to randomization tests, in which the abundance and number of occurrences of 590 species-substrate combinations were compared to those expected, based on random occupancy of substrates. Of 80 bryophyte taxa, 66 were positively associated with at least one substrate. In total, 202 significant positive associations were found, significantly more than expected by chance ($p < 0.0001$): 92 in both abundance and occurrence, 52 in abundance only, and 58 in occurrence only. Similar patterns were shown in mosses and liverworts. This work confirms many previously reported associations, but 115 were new reports. These associations were related to the results of previous studies that have evaluated bryophyte responses to forest management. Many species (26), identified in other studies to decline under intensive forest management, are associated with substrates that also decline in these treatments, e.g. dead wood in late stages of decay. As well, the highest number of associations was with late stage dead wood. This study highlights the importance of substrate as a component of bryophyte habitat, and identifies species for which substrate is a potential limiting factor that must be considered in conservation efforts.

Automated high-resolution mapping in the northeast United States: capabilities, limitations, and possibilities

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In recent years, forest management companies, state, and federal agencies have been facing tight operating budgets and higher demands on a shrinking professional labor force. Although improvements in spatial technology (GPS, GIS, satellite and aerial imagery) have lead to more efficient forest information systems, forest stand maps are often outdated due to high costs of aerial photo acquisition, and lack of in-house expertise in traditional photo interpretation skills to perform accurate stand mapping, high-resolution digital imagery is becoming increasing affordable and available throughout the world and has the potential to provide land managers and researchers with new types of cost effective, detailed information about forest resources over large areas. However, the capabilities of high-resolution processing are sometimes overestimated leading to the dissatisfaction of the user. It has been repeatedly demonstrated that these new types of imagery require new processing techniques that are not only specific to the type of data but also to the scale and heterogeneity of the region from which the image was acquired. In general, the development of data processing techniques for operational use of the technology, in the northeast United States, has not kept up with the increasing availability and decreasing cost of this imagery. What is needed, to improve the use and acceptance of high-resolution digital imagery in forest management, is an efficient method that will lead to the rapid and relatively automated delineation of forest stands over large areas, similar to the results produced by a human aerial photo interpreter. Ongoing research at the University of Maine is examining the feasibility of adapting high-resolution image processing research methods that have been successfully applied to tree and stand delineation in other regions. High-resolution processing techniques that have been developed around the world will be discussed regarding their potential in the northeast region, as well as the new or adapted techniques that have been developed at the University of Maine. Forest land managers and researchers alike should be aware of what types of data products they can, and cannot, expect to attain from high-resolution digital imagery. Areas of research that appear to have potential to become operational techniques in the next several years will also be discussed.

Mapping ecosystem and ecological resources of East Rock Park

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The biophysical resources, as represented by ecosystem types, of East Rock Park in New Haven, Connecticut are mapped using an innovative rapid assessment technique. In this technique, geographically informed comparable mapping units (CMUs) are generated using existing topographic and geologic data factors in GIS. CMUs are merged into ecosystem types based on expert knowledge and recognition in the field. High-resolution, multi-spectral satellite imagery and Global Positioning System (GPS) field data collection assisted as valuable tools. The mapping of ecosystem types contributes to management understanding of the area and is a critical part of the Human Ecosystem Model. It can also be powerful tool for park and natural resource manager in general. The general ecosystem map can contribute to community member understanding and recognition of biological resources.

Moving beyond stakeholders approaches: citizens views of forest policy and management in New Brunswick

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In recent years, a wide range of views have been expressed about the management of New Brunswick's forests, especially those on public lands. However, the voices that are most often heard are those of key stakeholder groups and it is difficult to tell the degree to which they reflect the views of the general public. Seeking a clearer understanding of how New Brunswickers use and value forests, what they think about forest management and policy, and how they wish to be involved in the future, New Brunswick's Department of Natural Resources sponsored a survey of the general population of the province. Stratified random sampling was employed to ensure that respondents from four targeted groups were equally represented. These groups are: major urban areas, and areas with low, moderate and high economic forest dependency. More than 1500 New Brunswickers participated in a mail survey during the winter of 2007. The results show that, with only a few exceptions, the values expressed by respondents were very similar despite where they lived: there is a strong support for environmental values but also support for use and harvesting of forests. Respondents also express a clear desire for inclusion in forest policy and forest management processes. Taken as a whole, the survey presents an assessment of public values and opinions that challenges some common assumptions made regarding "what people think" about the forests.

Re-mapping forest soils with improved precision and resolution

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New initiatives towards better and more efficient forest management practices have led to developing new tools to ascertain local soil conditions at high resolution, 10m or better, for a variety of reasons particularly pertaining to forest operations planning such as road and trail layout, cutblock design (borders and in-block features), year-round. The need for this increased resolution relates in part to the quickly varying soil conditions especially wetness conditions across the terrain, from wet to dry, shallow to deep, soft to hard, stony to non-stony, frozen and unfrozen. Current soils maps are not of sufficient detail to clearly delineate these variations.

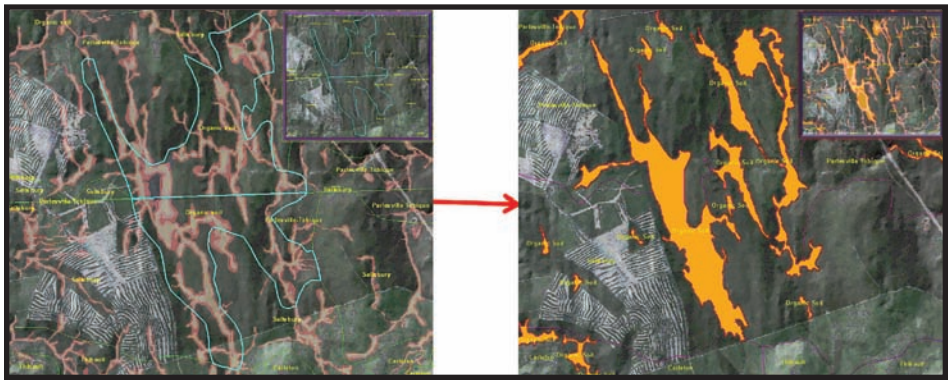
This presentation illustrates the soil data and soil remapping processes for a case study in New Brunswick. Involved are the following data layers:

1) the original soil map for the area of interest
2) the hydrographic data layer (streams, lakes, shorelines, wetlands)
3) bedrock and surficial geology layer
4) mosaic of air photographs (MrSID format), or high-resolution satellite image
5) the digital elevation model (DEM)
6) developing flow channels and the stream-corresponding cartographic depth-to-water index map (DWT) from the DEM, in raster as well as shapefile format

The data associated with the original soil map is examined for numerical completeness and consistency of various already listed soil-horizons attributes, by soil type. The following data are of special operational planning interest: soil depth to compaction, texture, coarse fragment and organic matter content, bulk density, pore space, field capacity, permanent wilting point, and hydraulic conductivity, and mechanical strength. Generally, there are many missing values, and these values need to be estimated through detailed pedological analyses. Once refined, the data are then used to assess the overall role of top- and subsoil conditions in forest operations, such as soil trafficability, compactibility, quality, wetness, erosion susceptibility, etc.

The re-mapping procedure involves a number steps, to ensure proper geospatial alignments of all mapped features. Doing so may involve detailed screen editing of polylines such as streams (to ensure that these are aligned with topographic flow expectations) and soil borders, and soil map units so that, e.g., water and organic soil map units actually conform to the corresponding features in the other data layers including the DTW map (Figure). All of these leads to a refined soil layer with map units closely corresponding to other already mapped surface features, topographically corrected soil associations, and expected soil drainage patterns (or soil wetness patterns), at 10 m resolution or less. Map verifications are in progress.

Figure. An example of an original and edited organic soil polygons.



Value of hardwood stands after selection cutting using positive and negative tree marking

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Northern hardwoods are a major source for forest products and non-timber values. One distinguishing feature between hardwood and softwood tree species is the importance of individual tree quality for value of timber products. A common silvicultural practice in the northern hardwood forests of eastern Canada is to select trees to be harvested and those to be retained either by certified tree markers or the harvest machine operators. Because of past poor harvesting practices, eastern Canada has an abundant occurrence of low quality and low value hardwood stands with scattered individuals of high quality. The balance of improving these stands while making a profit without further high-grading is challenging. To resolve this debate, a selection harvest experiment was established in shade-tolerant hardwood stands located in northern and central New Brunswick. These stands were dominated by sugar maple, yellow birch, American beech, and white ash. The experiment consisted of two types of tree marking (positive and negative) at two removal intensities (35% and 50% basal area removal) and an unthinned control. Positive marking identified high quality crop trees for retention. Negative tree marking identified trees to be removed. Trees were marked with paint. Where present, crop trees were identified at spacing of approximately between four and eight meters apart,. Mechanized harvesting was conducted in the winter of 2007 - 2008 using feller bunchers and grapple skidders to produce extraction trails 20-m apart. Preliminary analysis for the first harvest entry has shown the following results:

At the 35% basal area removal, positive tree marking resulted in a higher average value ($/m^3) of trees harvested than by negative tree marking. At the 50% basal area removal, no differences in the average value ($/m^3) of harvested trees were observed between positive and negative tree marking. The percentage of residual un-acceptable growing stock (UGS) was not significantly different between the positive and negative tree marking methods. As expected, the higher harvesting intensity treatments (50%) removed more un-acceptable growing stock than the 35% removal treatments. Positive tree marking was observed to release more crop trees on three or four sides than negative tree marking. Past studies have shown that at least three and preferably four sides of a crop three should be released in order for significant diameter growth to occur. More crop trees were released on three or four sides in the 50% removal than the 35% removal treatment.

Improving species composition of hardwood regeneration in beech-dominated understories

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Naturally regenerated hardwood stands in Maine are often plagued by an abundance of American beech that can dominate and competitively exclude more desired hardwood species following shelterwood and selection harvests. Our objective is to develop a low-cost method for improving the composition of beech-dominated northern hardwood stands that can shift species dominance from beech to more valuable maple and birch species. In August 2006, three recently harvested hardwood stands were treated with twelve combinations of glyphosate herbicide (Accord Concentrate®) and EnTrée 5735® surfactant. Regeneration measurements were made prior to treatment and for two subsequent growing seasons. Second year results indicate substantial differences in the susceptibility of beech and sugar maple to glyphosate herbicide. From 75 to 90% of beech stems can be selectively removed while only reducing sugar maple stems by 10 to 20% when using 0.5 to 1.0 lbs/A of glyphosate and 0.25 to 0.5% concentrations of surfactant. The five dominant hardwood species revealed substantial differences in their susceptibility to the glyphosate treatments, with the following order of susceptibility from highest to lowest: beech > yellow birch > red maple > striped maple > sugar maple. Thus, the treatments tested in this study are proving effective in shifting hardwood species composition toward sugar maple and red maple in the understory of beech-dominated stands. Glyphosate rate appears to be a more important factor than surfactant concentration for reducing beech abundance and preserving sugar maple, and the overall results appear to be robust for a wide range of glyphosate application rates.

Spatial associations among living and standing-dead balsam fir in two central Maine mixedwood stands

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The spatial associations among 4 classes of live and 1 class of standing-dead balsam fir (*Abies balsamea*) in two Acadian mixedwood stands in central Maine were tested using Mantel analysis. Tests of spatial association provided an analytical framework to better understand the spatial demography and ecology of the two balsam fir populations included in this study. Of the significant associations detected through Mantel analysis, four were common to both stands. In both stands, small and large regeneration and large regeneration and saplings were positively associated, indicating spatial congruity between each of the pairings. A negative association for small regeneration and saplings was another common association in both stands, suggesting a potential demographic conflict between balsam fir seedlings and sapling. Although the two stands are separated by a road less than 10 meters wide, the analysis indicated a degree of stand-level uniqueness in spatial associations among balsam fir groups included in this investigation. Results from this analysis suggest that spatial associations among classes of balsam fir are affected by the ecological context (e.g., overstory composition, stand structure, and disturbance history) in which fir populations occur.

The Acadian Forest Ecosystem Research Program (AFERP): 10-year results from the expanding-gap experiment

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Over the past few decades, ecological forestry has emerged in response to controversies about the effect of forest management on non-timber forest values. In response, the Acadian Forest Ecosystem Research Program (AFERP) was developed in 1995 by University of Maine. The focus of AFERP has been on the installation and maintenance of a long-term silvicultural experiment documenting the ecological effects of regeneration harvest methods designed after patterns of natural disturbance in the Acadian Forest. The AFERP experiment also was designed to complement a 50-year study of traditional even- and uneven-aged silvicultural methods by the U.S. Forest Service on the Penobscot Experimental Forest in Bradley, Maine. The AFERP experiment consists of two expanding-gap silvicultural treatments that create a 1% annual disturbance rate: (1) 20% removal on a 10-year cutting cycle, a 10-year regeneration window between expansions, and a 50-year rest period following the first five cycles; (2) 10% removal on a 10-year cutting cycle, 20-year regeneration window between expansions, and no rest period; and an unharvested control. Each treatment produces gap expansions of approximately 0.2 and 0.1 ha at each entry, respectively. In addition, a biological legacy of trees is provided using a network of permanent reserve trees that equal 10% of the original stand basal area. Experimental units are roughly 10 ha in size and replicated three times in a randomized block design.

Since its inception, the AFERP expanding-gap experiment has provided a template for addressing a variety of ecological questions related to gap disturbances. The influence of expanding-gap treatments on stand dynamics, understory vegetation, downed woody debris (DWD), songbirds, amphibians, arthropods, and epiphytes have been examined. Gap harvesting influenced the amount of DWD, and increased vegetation abundance and diversity relative to natural gaps and undisturbed canopy. Songbird communities were largely unaffected by the initial gap openings. Amphibian and arthropod communities, however, were affected by DWD piece size and location relative to harvest gaps. Epiphyte and associated invertebrate communities were influenced by whether the host tree was near a harvest gap. More recently, efforts have focused on using new methods of spatial analysis to better understand patterns of tree regeneration.

Adhesion issues of wood plastic composites surfaces (WPCs)

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Wood plastic composites (WPCs) consist of three or more materials, insoluble in one another, which are combined to form a useful engineering material possessing certain properties not possessed by the constituents. Each component plays a specific role for improving processing performance and mainly for improving mechanical properties of the final product. The adhesion properties of the individual components of WPCs are highly relevant in determining their compatibility and in case of Wood Plastic Composites boards to determine their potential application as structural components. Preliminary results indicate that WPCs have low surface energy or low wettability, which imply poor adhesive properties, mainly because of the migration of one of their components to the board surface (G. Oporto et al., Journal of Adhesion Science and Technology 21, 1097-1116(2007)). Different treatments were performed on the WPC to increase their wettability, and those included chemical, physical, mechanical and energetic modifications. Chemical analyses of untreated and treated WPC surfaces were performed using X-ray photoelectron spectroscopy. Macroscopic analysis of the specific components and WPC boards was performed through contact angle determinations and surface energy calculations using two different models. Besides that, surface energy determinations for individual components will be determined using Inverse Gas Chromatography (IGC). Microscopic analysis was performed using Atomic Force Microscopy (AFM) on composites and individual components before and after an atmospheric plasma treatment. Non functionalized and functionalized tips (hydroxyl, methyl, carboxyl and amine attached groups) were used to determine pull-off forces (adhesive forces) during an AFM contact mode experiment in air and in fluid.

OSB properties after hot water extraction

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The use of wood for the production of Ethanol or other chemical feedstock as a co-product within an existing wood industry is progressing rapidly. OSB industry is a good candidate due to minimal mass transfer of their thinness wood flakes and its increasing demand. USA and Canada OSB production in 2006 was 14.24 million tonnes, assuming a 15% weight removal by hot water would result in an annual production of 5.19 million barrels of Ethanol from hemicellulose extracted. This research was done using three Red Maple (*Acer rubrum* L.), three strand thicknesses (0.025", 0.035", and 0.045"), and two hot water extraction time of 45 and 90 min. at 160 C and control (unextracted). One OSB panel was manufactured for each of the 27 material combinations. Weight loss was significantly influenced by extraction time and tree source. The thickness swell and sorption isotherms of panels from extracted material was lower while its water absorption was significantly higher than the control. The high heating value was increased after hot water extraction while fungal deterioration was similar for control and extracted material. Modulus of rupture (MOR) was not significant statistically between the unextracted and 45 min. of extraction time but it was decreased at 90 min. Internal bond for both extraction time (wet and dry conditions) was significantly lower than the control. The distribution and size of porous within the cell wall increased as the extraction time increased. Contact angle indicated more pronounced liquid wetting and penetration for the extracted material. Inverse gas chromatographic identified that dispersive surface free energy and acid characteristics increases with extraction time. The percentage of crystallinity of cellulose increased as a function of the extraction time.

Back to the future: the new wooden urban village

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Having evolved in eras with less developed science, engineering, and energy resources, many traditional technologies were ecoefficient. These technologies used renewable resources and less energy, required less processing and produced fewer toxic by-products. As we look ahead into the 21st Century, the notion that traditional technologies may hold much to inform seems worth some attention. Indeed, back to the future could come to embody a new paradigm for the development of new wood technology. An example of utilizing traditional ecoefficient technology, today's wooden urban village, a low environmental impact, medium-density housing scheme, has been under development at the University of Oulu, Finland since the mid-1990s. It is a work in progress. Borrowing heavily from traditional Nordic wooden towns with their traditional "massive wood" building methods, the new wooden urban village reflects increasing awareness of ecological building, wood as a building material, and the need for "smart growth" alternatives to conventional low-density suburban housing. Design research and experience gained through the University of Oulu, Department of Architecture's Wood Studio and Modern Wooden Town Project have made it possible to consider transferring this technology to other regions with massive wood building traditions. However, as Heikkilä and Suikkari, two researchers at the University of Oulu, have noted, the development of wooden urban village methods "presupposes the knowledge of the history and the character of log construction." For this reason development of the wooden urban village model in North America requires an understanding of North American log building traditions. This is the focus of our current research. The paper presents: 1) the evolution of Nordic wooden towns (w/ examples of traditional towns and contemporary wooden urban village projects); 2) the early diffusion of European log building methods in North America; 3) our research into the history, geography, and technology of North American log building; and 4) a brief concluding discussion of traditional ecoefficient technologies as models for contemporary sustainability efforts.

Reference

Heikkilä, Jari and Risto Suikkari. 2002. "Log Structures in Finnish Architecture – Continuing the Tradition." Website of the Advanced Research Centre for Cultural Heritage Interdisciplinary Projects (Institute of Theoretical and Applied Mechanics of the Academy of Sciences of the Czech Republic). Accessed August 18, 2008www.arcchip.cz/w11/w11_heikkila.pdf.

Inventory patterns and critical factors affecting pulpwood inventory levels in the northeastern United States

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Raw material inventory management is an area of concern for many pulp and paper companies in the northeastern United States and procurement managers for pulp mills are frequently faced with difficult decisions related to their wood fiber inventory levels. The objectives of this study were to determine the factors affecting raw material procurement decisions and to develop an understanding of how these factors influenced the inventory levels at 15 northeastern U.S. kraft and groundwood pulp mills. The factors affecting the demand for pulp and the supply of pulpwood were gathered using onsite interviews and a mailed survey instrument and data were collected showing typical inventory levels. Four inventory level patterns were developed using the mill data and it is clear that some of the patterns are strategic. Weather was the only factor that clearly influenced the shape of the inventory level patterns but procurement managers identified other the key factors affecting both purchasing decisions and price.

Improving natural regeneration of white spruce by coupling silvicultural techniques with a masting episode

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White spruce (*Picea glauca*) is one of the most important commercial tree species in North America. Its fiber properties are well suited for the production of pulp, paper, lumber and other timber products. However, in the boreal forest of Canada and the United States, white spruce has some difficulty attaining its original stocking levels after disturbances like fire and harvest cuts. Every two to six years, white spruce will mast, emitting a significant amount of seed, while little or no seeds are produced during the intermittent years. By prescribing silvicultural treatments prior to the actual masting episode, this study aimed to establish whether the natural recruitment of white spruce germinants could be improved in a seed-tree retention cut. At least five mature trees were left uncut per treatment. The four treatments, replicated in three separate blocks, are: 1) control (cut; with no prescription), 2) scarification of the ground, 3) chipping of the understory, and 4) a combination of scarification and chipping. Scarification has shown in previous studies to significantly increase recruitment due to the increased availability of mineral soil, which is one of the best seedbeds for white spruce germination. This study found that a combination of scarification and chipping significantly increased the amount of mineral soil available, resulting in the highest recruitment rate of germination of the four treatments. In addition, decomposed wood proved to be a very good seed bed for recruiting white spruce germinants. In light of the growing popularity of ecosystem management, forest managers might want to explore possibilities of better planning white spruce harvest cuts in light of masting episodes to diminish post-harvest planting costs and improve on the overall sustainability of forests today.

Explaining pipe model variations with sapwood taper

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Pipe model theory is often used as the basis for biomass partitioning in growth models. It states that the sapwood area (As) is directly proportional to foliage biomass (Wf). Several studies demonstrate that pipe model theory might not be as robust as originally thought. In jack pine, total tree foliage biomass to sapwood area at crown base ratio is influenced by stand density. This can be explained by sapwood area taper within the crown. Several sapwood area taper models were calibrated using non-linear mixed effect models. The tested models ranged from the original pipe model theory to non-linear equations, some of which included distance from stem apex. We found that a non-linear model best explained increment of sapwood area between two consecutive whorls with respect to whorl foliage biomass. Moreover, when comparing two whorls with the same foliage biomass, the one nearest to the base of the crown will add more sapwood area to the stem than the higher one. This result leads to different pipe model parameters (Wf/As) for different foliage biomass distributions and crown lengths. The influence of stand density can thus be explained by changes in crown length and foliage biomass distribution.

Calicioid lichens and fungi of the Acadian Forest region of eastern North America

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Extending from the Adirondack Mountains of northeastern New York, through northern New England and the Maritime Provinces of Canada, the Acadian Forest Region is an ecological transition zone between the eastern boreal forest and the temperate deciduous forest. As part of an ongoing effort to assess the ecological continuity of forested stands within this region, seventy-two species of calicioid lichens and fungi have been identified through vegetation sampling and investigations at regional herbaria. The habitat ecology and distribution of calicioid species within the Acadian Forest Region will be discussed, as will the roles they play in assessing ecological continuity.

Commercial thinning in pole-sized spruce-fir stands: 6-year results from the CFRU thinning study

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The CFRU Commercial Thinning Research Network (CTRN) was established in 2000 to study tree and stand responses to commercial thinning 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 are young (ages 25-40), have high site quality (60-80), and are dominated by balsam fir; treatments in this study are 33% and 50% removal (based on relative density) at three different timings five years apart. The NOPCT sites are middle-aged (55-70), low to average site quality (all but one is within the range 45-55), and most are dominated by red spruce; treatments in this study are 33% and 50% relative density reductions using low, crown and dominant thinnings. On the PCT sites, merchantable volume has more than doubled in only six years; periodic annual increments (PAIs) averaged 1.5-1.8 cords per acre per year, with no differences among density-reduction treatments for the early-entry treatments. Crop-tree growth in the PCT study was 1.9 and 1.5 times that of the untreated controls for the 50% and 33% density-reduction treatments, respectively. Wind-caused mortality was negligible on the PCT sites; one site suffered some top breakage from an early fall snowstorm. At the NOPCT sites, wind-caused mortality was significant in all but the low-thinning, 33% removal treatment, which did not differ from the control. Net PAIs for all other NOPCT treatments were significantly less than the untreated controls, owing to post-harvest windthrow on all but the youngest site.

Crop-tree silviculture of eastern white pine

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Growing white pines at low density after pruning appears to offer many advantages over more conventional silvicultural systems. This talk describes how to design and implement a low-density thinning schedule using published relationships between crown architecture and stemwood growth; empirically, appropriate crown development can be maintained by keeping Wilson's Spacing:Height ratio between 0.4 (before thinning) and 0.5 (residual stand). Short-term results from a replicated thinning study in east-central Maine show that diameter growth of heavily released crop trees was 2.8 times that of similar trees in the unthinned controls, and 1.6 times that of similar trees in plots thinned to the B line on the pine stocking guide. Despite the important differences in tree development between thinning methods, total stemwood volume growth per acre of the low-density treatment was only 5% less (and not statistically different) than the B-line treatment. Gross stemwood growth was strongly and linearly related to four parameters of stand density; no evidence of an optimum density zone (the Langsaeter hypothesis) was found. The traditional B line on the white pine stocking guide is shown to have little relevance to either low-density or high-production thinning schedules, and should be replaced by a more flexible, less prescriptive approach.

Modelling the decomposition rate of surface versus buried wood blocks and dowels, across a wide range of climate conditions in North America

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Data for mass remaining in decaying softwood blocks (Tsuga heterophylla, or Western hemlock, 5x2x10cm; oven-dry wood density = 0.46 g/cm^3; Canadian Intersite Decomposition Experiment CIDET) and in tropical hardwood dowels (Gonystlylus bancannus , or ramin, 61 cm long; 13 mm diameter; oven-dry wood density = 1.62 g/cm^3; Longterm Intersite Decomposition Experiment LIDET) were analyzed to determine the rate of wood decomposition as affected by climate and site conditions across North America. CIDET site types involved temperate to boreal forest locations, including 3 wetlands (peat bogs). LIDET sites involved tropical to boreal forest conditions as well as grasslands and tundra.

Altogether, wooden blocks and dowels were placed across a total of 49 sites, i.e., 21 in Canada (CIDET blocks; placed in 1991; retrieved each fall until 1998), and 28 in the United States (LIDET dowels; placed in 1990, 1991 and 1994; retrieved regularly each year at some locations or less often at others, until 2001). Dowels were placed vertically with one half below and one half above the ground. Blocks were placed on the ground and were also buried 30 cm below the soil surface. The data for mass remaining in the blocks and in either half of each dowel were analyzed by way of a simple exponential decay model, and a single climate function for the decay coefficient, with annual precipitation, and mean July and January temperatures as local climate indicators. The data for the dowels revealed that the rate of decay for the exposed halves was generally 2.5 times less than the below-ground halves. On average, the surface-placed and buried low-density CIDET blocks decayed somewhat faster than the below-ground portions of the high-density LIDET dowels. The rate of decay for the surface-placed CIDET blocks was only slightly less than that of the buried CIDET blocks. With and without site-specific moisture adjustments, the model captured about 72% of the mass remaining variations across both data sets. As to be expected, decomposition rates were lowest under cold and dry conditions, and fastest under warm and moist conditions (Figure). While most of the mass loss would be due to microbial (fungal) activities, some of it would also be due to physical change such as surface abrasion, especially for the exposed dowel portions under the harsh arctic winter conditions.

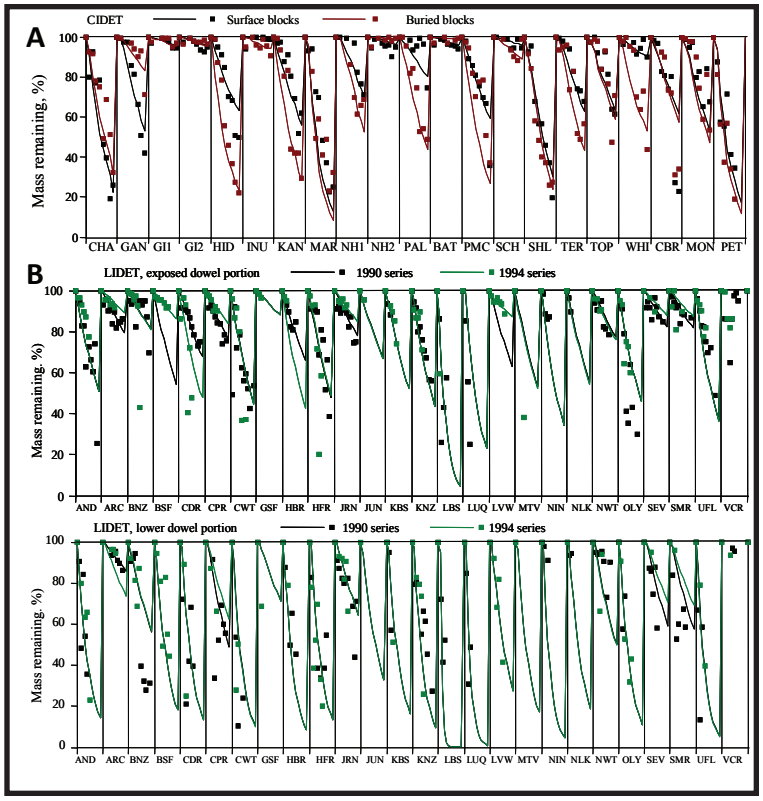

Figure. A: Best-fitted model results for mass remaining in CIDET blocks, surface-placed and buried, at 21 locations across Canada; lines: 9-year model predictions for each location, each starting in 1991; dots: average CIDET data for each location, by year. B: Best-fitted model results for mass remaining in LIDET dowels, in the above- and below-ground dowel portions, across 28 USA locations; lines: 12-year model predictions, starting with dowel placement at each location; dots: average LIDET data for each location, by year.

Biodiversity issues of ecosystem-based management in the Laurentian Highlands of eastern Québec

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In 2003-2004, an independent enquiry into forest management in Québec (the "Coulombe Commission") held public hearings in numerous towns across the province. The Commission tabled a report in December 2004; among the major shifts proposed was that ecosystem-based management (EBM) be central to public forest management in Québec. Ecosystem-based management is inspired by the natural dynamic of forest ecosystems; it is a way to conserve biodiversity and ecosystem integrity, while responding to socio-economic needs and respecting social values associated with forestlands. Its implementation implies stakeholder participation in decision making, and is based on the identification of critical issues. Pilot projects were launched throughout Québec to develop and test EBM before its implementation at the provincial level.

The Laurentian Wildlife Reserve (LWR) was selected as one of the locations to implement EBM. The LWR is situated between Saguenay-Lac-Saint-Jean and Québec City, within the eastern highlands of the Laurentian Plateau. It covers ~8000 km^2, and is characterized by an altitudinal gradient of ~1000 m and a variety of forest types. The complexity of the territory necessitated the input of a scientific committee, which included scientists recognized for their expertise in fields such as silviculture and ecology. The main role of this committee was to identify, describe, classify, and rank the critical biodiversity issues of this territory, and ensure that decisions and actions integrated the most up-to-date, relevant scientific knowledge.

Data from 1102 ecological observation plots distributed throughout the LWR underwent multivariate data analyses to study the relationships between the actual vegetation cover, potential vegetation, climate, permanent physical attributes and natural perturbations. An ecological classification of the area was produced at a resolution compatible with management; four "great" ecosystems of distinct structure, composition, and natural disturbance regime were identified and were the basis for all further analyses.

Using the coarse/fine filter approach, more than 40 biodiversity issues were identified and further classified in nine categories. The scientific committee ranked the issues based on their inclusive character, their scientific certainty, and their urgent and irreversible nature. The main biodiversity issues considered for this territory were: absolute loss of old-growth forests, the matrix inversion from old-growth-dominated to young- or mature-dominated forests, the quantity and quality of snags and coarse woody debris left in managed forests, the integrity of riparian zones and wetlands, and the uniformity of stand structure in managed forests. Work is in progress to identify management targets and develop a strategy that is compatible with these critical biodiversity issues and ecosystems.

Evaluation of the conservation value of post-harvest residual forest stands in the eastern balsam fir-white birch eco-region of Québec: a multi-taxa approach

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In order to develop forest ecosystem management guidelines to answer biodiversity conservation issues, we assessed the role of residual stands left in recent harvest operations in the managed forest of the York river watershed (1008 km^2– a representative sample of the eco-region). We surveyed five types of residual forest stands present in the landscape following harvest operations riparian forest strips (n=22), forest islands (n=21), inaccessible sites (slope > 40%) (n=11), mature forests (n=16) and recent cuts (9 to 22 years; n=22). We monitored three taxonomic groups with contrasting home-ranges and dispersal capacities: passerine birds, ground beetles and forest-floor plant species. Characteristics and spatial configuration of habitat such as structure (forest age, tree height, canopy opening, coarse woody debris, snag basal area, shrub and herb density, basal area), composition (tree, shrub and herb richness) and landscape metrics (river linear density, road linear density, island forest, inaccessible territory, edge in 500 meters of radius) were also used to analyze taxonomic assemblages. Avian sampling was carried out by 15 minutes point counts on 92 sites for 3 sampling periods. Ground beetles were captured on 45 sites using 135 pit fall traps.

Canonical redundancy analysis (RDA) was used in order to evaluate the effect of structure, composition and landscape variables on taxonomic assemblages. For bird community, the RDA illustrates the influence of mature forest characteristics such as snags basal area and conifer basal area. It also emphasizes the role of fragmentation and edge effect in forest islands and riparian forest strips.

The composition of the three taxonomic groups was evaluated in each residual forest type using a non-parametric multivariate analysis of variance (MANOVA) and we identified indicator species with the Indicator Value (IndVal) method. For the three taxonomic groups, the inaccessible sites were similar in composition to forest communities. The riparian forest strips host a an array of hygrophilous-minerotrophic forest-floor plant species that is site-specific. The forest islands seem to have important edge effect on the bird composition but not for the forest-floor plant community. These results suggest that residuals forests play an important role in biodiversity conservation issues in a managed landscape. Therefore, the long-term maintenance of an adequate amount of these structures appear as the most accessible way to manage the forest biodiversity in the study area.

Neighborhood-scale composition and growth in oak-pine species mixtures in Maine

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Mixed stands dominated by red oak (*Quercus rubra*) and white pine (*Pinus strobus*) are common on non-industrial private lands in New England. Such stands often have a history of irregular and partial disturbances, making them structurally complex and heterogeneous; the composition and arrangement of trees can vary greatly from one point to the next even within a few acres. Neighborhood-scale variation in structure and composition may have important effects on the growth and development of individual trees and, in aggregate, on whole stands, beyond what would be estimated from stand-wide structural/compositional averages. This study examined tree neighborhoods in oak-pine dominated parcels on the Massabesic Experimental Forest in southern Maine, where partial disturbances (a fire, followed by windstorms and salvage) 50 to 60 years ago created a complex mixture of species and cohorts. Objectives were to: 1) quantify small-scale structural variation 2) test for differences in growth corresponding to that variation. We established a grid of variable radius plots in 2006 as an initial survey of variability. A subset (121) of these points were selected for further data collection in 2007, covering a multi-dimensional gradient of species and cohort composition, from nearly pure, single species, single cohort neighborhoods, through multi-species, multi-cohort neighborhoods. Within the neighborhoods of several adjacent trees at those selected points, we gathered data on overstory tree locations, dimensions and growth rates (via increment cores), as well as on the density, composition, and recent height growth of regeneration. Several means of quantifying neighborhood-scale structure/composition were compared against measurements of both individual tree and neighborhood-scale growth. Quantifying relationships between tree growth and structure at the neighborhood scale may improve growth prediction and marking rules for complex stands. Management of oak-pine on irregularly managed, private parcels may benefit especially from better understanding of the silvicultural implications of the neighborhood scale.

Development of an Acadian Variant of the Forest Vegetation Simulator (FVS)

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The Forest Vegetation Simulator Northeastern Variant (FVS-NE) is a widely used growth and yield (G&Y) model in the northeastern region. Recent comparisons to permanent research plots in the Acadian region indicate a significant bias in FVS-NE. In addition, FVS-NE relies on direct observations of site potential such as site index and habitat type, which may limit its applicability for forecasting future conditions under alternative climate change scenarios. This project proposes to develop an Acadian Variant for FVS that is sensitive to various management activities and environmental factors. The project will compile existing regional G&Y datasets, develop a biophysical index of site productivity, refit individual tree equations by species (using both traditional and biophysical site index), estimate growth modifiers for typical management activities, and provide a new interface to the FVS model.

Late-successional attributes in stands of differing silvilcultural treatments in northern hardwoods and upland spruce-fir forest

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Although it has been suggested that ecological forestry better retains late-successional attributes than traditional silviculture, few studies have evaluated traditional silviculture ability retain LS attributes in the northeast. My objective was to compare LS attributes in silvilculturally treated, unmanaged, and old-growth (OG) stands of northern hardwoods and upland spruce-fir forest to assess the ability of different silviculture techniques to conserve old forest attributes. We sampled northern hardwood stands (NH) in the Bartlett Experimental Forest (BEF) and upland spruce-fir (SF) stands in Penobscot Experimental Forest (PEF). Nearby OG sites were sampled as references. In each stand we applied the LS Index protocol which includes sampling large trees, snags, deadwood, and selected LS species. We used univariate statistics to compare (1) even-age, and uneven age treatments and (2) various uneven-age selection treatments and unmanaged treatments. In SF stands, even-age treatments had significantly lower densities of LS attributes than OG. In NH stands, even-age treatments also had lower densities of LS attributes than OG but a 100 yr old commercial clear cut and a even-age treatment with retention had modest levels of many LS attributes. In both NH and SF stands, the density of LS attributes in the lightest uneven-age treatments were within the range found in OG. Major findings:

1) Even-age systems without retention will not retain LS attributes.
2) Retention of large hardwood tree species in any silvicultural system often also retained LS epiphyte species.
3) Light selection systems had LS attribute densities within the range of values found in OG forests.

Crossing boundaries: building a forest model for 14 contiguous townships in northern Maine

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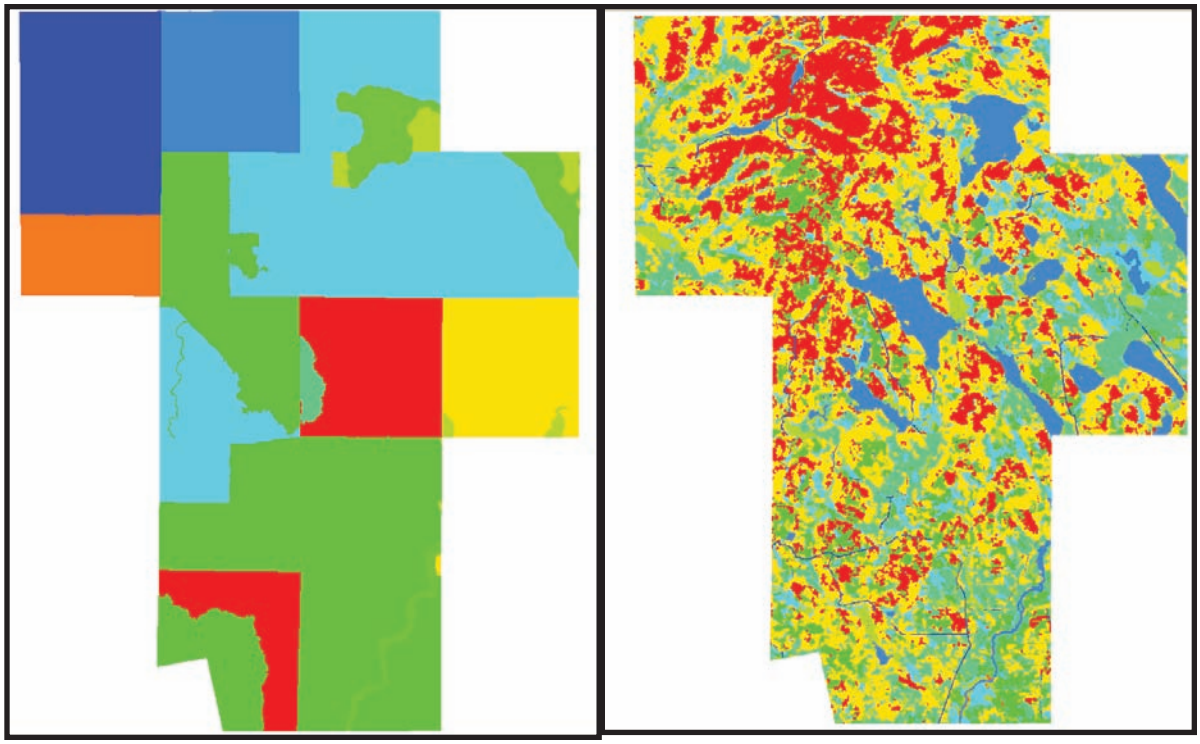
Most animals don't pay attention to property lines. This makes modeling future habitat for wildlife species that have large home ranges problematic in regions where there is a fragmented ownership pattern, like Maine. Forest data across diverse ownerships making up a contiguous block is inconsistent and sometimes unavailable. To overcome these data issues we utilized continuous forest information from a vegetation change detection series of northern Maine developed from 30+ years of satellite imagery by the Maine Image Analysis Laboratory (1970-2007). Creation of a proxy stand map for the 14 township study area involved several steps. Over 300 unique stand histories including harvest periods and intensities were combined to create a stand map that reflected species composition and harvest history. A measure of site quality for each stand polygon was derived from the topographic slope. All stands that had a stand replacing harvest between 1970 and 2007 were aged to the period of that harvest. FIA data from approximately 600 plots in northern Maine were used to provide an age distribution for stands that had not received a heavy harvest over the change detection series period. A spatial Woodstock model was built from the proxy stand map created in this process. Age-based yield curves were built for each stand type in the constructed stand map. Yield curves were developed from FIA inventories and projections using the Forest Vegetation Simulator, Northeast Variant. The Woodstock model is being used to evaluate a variety of future scenarios ranging from maintaining past harvest patterns within each ownership to maximizing sustainable harvests across all ownerships. Stanley is being used to develop spatial harvest plans for the first 6 periods, 30 years of each future scenario. Future forest scenarios are being developed to evaluate the impact of historic and potential future management approaches on habitat for Canadian lynx and American marten.

Figure. Ownership boundaries (left) and broad stand compositions (right) for the study landscape



The response of bryophytes to pre-commercial thinning in the Acadian Forest

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The Acadian Forest of New Brunswick, the interface between boreal and deciduous forests, supports a wide variety of bryophytes that are important in many aspects of the forest ecosystem. This primitive plant group is thought to be particularly sensitive to changes in their microhabitats and substrates, such as those caused by clear-cut forest harvest and subsequent tree-planting. Pre-commercial thinning (PCT) is a management approach whereby a clear-cut stand is allowed to regenerate naturally, and growth of target species is encouraged by removal of less desirable trees ("thinning") approximately 15 yrs after harvest. While this treatment reduces the mechanical substrate disturbance associated with site preparation and planting, it is difficult to predict the impacts of re-opening of the recovering tree canopy, addition of coarse wood and stumps, and decrease in trunks. This project compares bryophyte community characteristics of similarly-aged managed stands that have experienced PCT vs unthinned stands. Overall bryophyte composition was similar, and suggested less impact than other forest management scenarios. The implications of the relative impacts will be discussed in terms of other management practices and the responses of particular species of concern in this area.

First nations in New Brunswick's forest industry: what do harvesting agreements deliver ?

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Across North America, indigenous peoples are seeking and obtaining an increasing place in forest management and in forest industries. For indigenous peoples, major issues include land rights, economic benefits, forestry practices, consultation processes and access to forests. In 1998, the New Brunswick Department of Natural Resources launched a new policy initiative aimed at providing each of fifteen indigenous communities, or First Nations, with access to forest resources. A series of harvesting agreements allocate nearly five percent of the provincial annual allowable cut to First Nations, with volumes for individual communities ranging from 1,700 m^3 to 39,000 m^3. Although the provincial government collects and publishes some data concerning harvesting activities, little other information is available concerning the impacts of this policy, the possible benefits or the views of First Nations concerning this government initiative.

This study presents qualitative data concerning perceptions, comments and suggestions about these harvesting agreements, based on interviews with key informants in First Nations and the Department of Natural Resources. Semi-structured interviews examined three principal themes: the objectives and mechanisms of the program, participants appreciation of it, and their perceptions of results and suggestions for improvement. Interviews showed the importance of issues such as education and capacity, lifestyle, traditional knowledge, legal rights to forest resources and relations between the Department and First Nations. A number of weaknesses were identified by participants, particularly relating to the management of the program and the need for better collaboration between the parties. Overall, the study showed a generally optimistic view of the harvesting agreements with a number of benefits for communities involved.

Finding and removing barriers to sustainable harvest and primary processing of Massachusetts native woods

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Massachusetts is the third most densely populated state in the U.S. and has ready access to abundant forestland covering 62% of the land area. Although its current rates of forest growth exceed harvest rates by a significant margin, the state only processes 5% of the wood and wood products it consumes. Despite the high demand for wood products, the number of sawmills has been steadily shrinking for the past 30 years.

A USDA Federal State Market Improvement Grant, funded research that examined barriers to increased production faced by landowners, foresters, loggers, sawmills and wholesalers. For each of the stakeholders, a combination of interviews, focus groups and written surveys were conducted. A "gap analysis" was also conducted to explore the differences in perceived problems across stakeholder groups. Major findings include:

Landowner: Landowners value ecosystem services highest and economic objectives lowest. Pre-harvest education/information and post-harvest stand condition ranked highly when they make harvest decisions.

Forester: Foresters highlighted a need to develop markets for less desired/low value species including small-diameter logs and a biomass wood chip market. Massachusetts should promote and develop niche markets for its local wood products.

Logger: The Massachusetts logger workforce is aging, dominated by small scale operators with smaller scale equipment; thus, the operating costs are high.

Sawmill: Exported logs are being purchased at a price higher than MA sawmills are willing or able to pay. Their energy costs are high and value added production operations and support/training in marketing & sales are needed.

Gap Analysis: Foresters and loggers may be able to benefit by better educating landowners in regards to harvest operations. Foresters appear to underestimate the importance of logger reputation and fair stumpage price for landowners in their harvest decision.

Additional research will focus on:

1) Efficient methods for coordinating NIPF landowner harvest activities.
2) Developing markets for the niche products, certified lumber and less valued species.
3) Cutting costs at the primary processing level

Poster Presentations

A comparative life cycle assessment of FBRI modified pulp production (with consideration of near neutral hemi-cellulose extraction) and the conventional pulp production

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The U.S. pulp production contributes a major portion in forest industry income. However, according to UNEP, forest industry sector consumes about half of the resources taken from nature worldwide and that includes 25% of the wood harvest. Increasing societal awareness of environmental, health, and safety (EHS) issues of production and consumption has motivated the industries to become corporate socially responsible. Redesigning production processes and using environmentally preferred products are few of the strategies to reduce the negative environmental impacts. Environmental life cycle analysis (LCA) is becoming increasingly important nowadays which can be done by assessing the environmental impacts of an industrial system and using the results to improve its environmental performance.

Through the Forest Bio-products Research Initiative (FBRI), a technical-economic analysis of a modified pulp production process is done that also accounts the separation of hemi-cellulosic component from hardwood prior to pulp production. The idea behind this FBRI process is to modify the conventional pulp production in industrial ecology context by making use of the hemicellulose to produce value adding products such as bio-ethanol and acetic acid. The purpose of this study is to compare the potential environmental impacts of a modified pulp production that also extracted the hemicellulose relative to conventional pulp production. Pure hardwood pellets are used as raw materials, which come from the northeastern part of the United States. Site specific data and related data from literature and reliable databases are being used for life cycle analysis. These include resource and energy consumptions and environmental emissions to air, land and water associated with the conventional and FBRI modified pulp production processes.

Our initial results suggest that the conventional pulp production has greater potential environmental impacts than the FBRI modified process, particularly at the production stage. The fuel oil used in lime burning is found to be a significant contributor to the impact category of human toxicity to soil and air. FBRI pulp production with hemicellulose extraction process requires less fuel for lime burning. This is due to most of the smelt material from the recovery boiler is converted into green liquor. More steam is consumed in the conventional Kraft pulp than the FBRI pulp production, which contributes significantly to energy consumption. Overall, the most significant potential environmental impacts for both production technologies are human toxicity to air, water and soil, global warming and ozone depletion.

Logging residue quantities on sites in Maine following integrated whole-tree harvests of biomass and roundwood

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Logging residue, consisting of mostly harvested tops and branches, is currently an important feedstock for the bioenergy industry. Given the likely expansion of the bioenergy and bioproducts market, the industry's future will rely on a sustainable supply of biomass from the forests. Of the available supply of logging residue, not all is recoverable due to mechanical and economical constraints. This study seeks to quantify the amount of potentially recoverable residue remaining on site following an integrated whole-tree harvest of both roundwood and biomass. Using the line intersect method, down wood was sampled on 12 partially cut, whole-tree harvested sites in central Maine. Harvest operations on each site included a feller-buncher, grapple skidder, stroke delimber, and chipper. Forest types ranged from almost entirely softwood to almost entirely hardwood. All sites were cut in 2007 or 2008 as either an overstory removal or a selection cut. The objectives of this study are: 1) to determine the quantity of potentially recoverable biomass remaining on site after whole-tree harvests, 2) to determine the percentage of total logging residue that was recovered for biomass during the harvest, and 3) to develop residue recoverability prediction equations using site and harvest parameters for whole-tree operations. Additionally, the environmental impacts of integrated whole-tree harvest operations, with respect to nutrient supply, biodiversity, and water quality can be better assessed using information regarding volumes and sizes of debris remaining on site.

Public attitudes about forest pest outbreaks and control: case studies in two Canadian provinces

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A public mail survey was sent to a sample of New Brunswick (NB) and Saskatchewan (SK) residents in 2007 to investigate their attitudes about controlling two very different forest pests: spruce budworm (SBW) (*Choristoneura fumiferana*) and forest tent caterpillar (FTC) (*Malacosoma disstria*). Participants were asked a series of questions related to their knowledge of these pests and their preferences over control options and program extents. SBW was the most widely known forest pest in NB, and FTC was most widely known in SK. Both groups largely supported (at over 80%) controlling future SBW and FTC outbreaks with biological control. They generally agreed that ecologically sensitive areas and wildlife habitat were the top priority that should be protected during the next outbreak of either pest. However, provincial differences in attitudes were found over the rank order of forest-type priorities that should be protected and the rank order of control options. Socio-demographic factors found to positively influence the preferred SBW and FTC control extent included a high level of pest knowledge, family members working in the forest industry, residence in New Brunswick, male, aged 55 and over, education level beyond secondary school, and household income of $50,000 or more. Results of this study can be used to assist policy makers and forest managers to arrive at publically acceptable pest control policies and make better informed decisions about future pest outbreaks.

An assessment of residual stand damage following whole-tree biomass harvesting in central Maine

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Residual stand damage was assessed following an integrated biomass harvest at two trail spacings in mid-site hardwood stands dominated by small-diameter diseased American beech (*Fagus grandifolia* Ehrn.) trees. Three 1.2 ha (73.2 m x 165.0 m) study blocks were established near Springy Brook Mountain, in Township 32, Hancock County, Maine. Half of each block was treated with a mechanized whole-tree harvest using a trail spacing of 12.2 m while the other half was treated using a spacing of 18.3 m. Harvesting resulted in an average residual basal area of 5.7m^2/ha at the wider trail spacing and 6.4m^2/ha at the narrower trail spacing, representing a 74-87% decrease from preharvest basal area estimates.

Following harvesting and skidding operations all standing residual trees 2.54 cm or greater were inspected for damage from the harvest. Overall occurrence of wounds, occurrence of wounds in different size and severity classes, and wound locations were compared. The proportion of stems wounded averaged 32% at the wider trail spacing and 45% at the narrower trail spacing. Wounding patterns in regards to size, severity, and location were similar for both treatments. Overall there were no significant (α=0.05) differences in residual stand damage between the two trail spacings. While it appears that there is no substantial increase in damage to the residual stand when trail spacing is reduced from 18.3 m to 12.2 m in a mechanized whole-tree biomass harvest, the overall proportion of trees wounded at both spacings was less than desirable.

Effects of *Sirex noctilio* in pine stands and silvicultural options to reduce its impact

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Sirex noctilio F. (Hymenoptera: Siricidae) was detected in North America during a 2004 exotic species survey conducted in New York. Since that time, detections have also occurred in Michigan, Pennsylvania, and Vermont. A large portion of southern Ontario is also positive for *S. noctilio*. This large geographical area of positive *S. noctilio* detections represents a region where several pine species grow including red pine (*Pinus resinosa* Ait.), white pine (*P. strobus* L.), jack pine (*P. banksiana* Lamb.) and the non-native Scots pine (*P. sylvestris* L.). While *S. noctilio* has been an aggressive invader in the commercial pine plantations of the southern hemisphere, it is unknown how it will behave in North American pine ecosystems.

Studies are currently underway to determine the impacts of *S. noctilio* on northeastern U.S. and southern Ontario pine stands. In addition, silvicultural treatments are being evaluated as a tool for reducing *S. noctilio*-caused tree mortality in high hazard stands. Preliminary results from retrospective stand assessments suggest *S. noctilio* is colonizing smaller diameter (< 16 cm dbh), suppressed trees in red and Scots pine stands. In thinning studies initiated in 2007, these smaller suppressed trees were targeted for removal by thinnings from below. The first year results from this study suggest that thinning from below, targeting smaller suppressed trees substantially reduced *S. noctilio* activity in Scots and red pine stands. Stands used for the thinning study will be evaluated annually for at least the next four years.

A proposal to assess the response of the red turpentine beetle to silvicultural treatments at the Massabesic Experimental Forest

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Largely known as a secondary pest in its native North American range, the bark beetle *Dendroctonus valens* LeConte (red turpentine beetle) has also been known to colonize and kill healthy trees when local populations increase. Adult *D. valens* are attracted to host volatiles emitted from freshly cut stumps, stressed, dying or damaged pines. As a result of this attraction, the beetle can become common in areas where silvicultural treatments are being practiced. In such areas, trees left as crop, seed or nurse trees can become targets for *D. valens* colonization and damage. To gain insight into the colonization behavior of *D. valens,* its activity in response to an 18 acre prescribed burn, a 4.5 acre shelterwood cut and a 4.9 acre clear cut will be assessed. Tree and stand characteristics, along with *D. valens* activity in each silvicultural treatment will be evaluated and analyzed to determine potential management practices to reduce *D. valens* activity. To this end, silvicultural treatments in *Pinus strobus* stands at the Massabesic Experimental Forest in southeastern Maine provide a unique opportunity to address this issue.

Area effects on tree species richness and composition in premontane tropical forests in Costa Rica

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In the Coto Brus Valley, Costa Rica, the agricultural landscape present nowadays is dominated by 1 to 30 hectares forest fragments. Gradually, fragmentation effects cause the degradation of these forest islands, shaping them into new altered ecosystems depleted from pre-fragmentation available resources. To accurately assess the effects of fragmentation six forest fragments (11-27 ha) were sampled and then compared to a control composed out of three large forests in the region (266-400 000 ha). In each of the 42-56 100 m^2 plots (some sites were sampled more intensively), the trees above 10 cm DBH were identified to family (84%), genus (7%), or family (6%), and unknown (3%). This study found that the number of species increased with area in a strong relationship. Forest-interior species are more typically found in larger fragments whereas pioneer species are more common in smaller fragments. The establishment of a biological corridor involving Las Cruces Biological Station is expected to result in the preservation of a greater number of species than would the preservation of several smaller, disjunct patches.

Carbon and nutrients in Maine forest soils

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Recent public concern surrounding climate change and greenhouse gas emissions has driven lively debate about approaches to fossil fuel offsets as well as carbon (C) sequestration in forests. The forest community sees the prospects of intensification of forest utilization for new markets ranging from forest products as fuel (e.g., wood) or fuel feedstock (e.g., ethanol) to a range of new bioproducts (e.g., plastics). The dialogue often is about more intensive harvesting and more complete forest utilization. This era is reminiscent of the emergence of whole-tree harvesting practices in North America and Europe 30+ years ago. In both cases, ecosystem consequences of various C extraction strategies have important impacts on nutrients, most notably N, P and Ca. These range from the risks of nutrient depletion to the potential for site improvement through C sequestration. Maine has established a somewhat progressive reputation in the greenhouse gas debate. In 2003 Maine passed the first law in the nation to set specific goals and a timeline for CO_2 emission reductions, and in 2005 Maine joined other states in the northeastern U.S. to form the Regional Greenhouse Gas Initiative. With ~90% of the land base in forests, Maine is moving to determine how forest management will help meet these C goals. We have learned a great deal about C in forests in recent decades, and even more about biogeochemical cycling of critical nutrients. This assessment utilizes a collection of Maine forest soil data sets to define the empirical relationships between forest soil C and nutrients that can be instructive for both management and policy discussions currently taking place.

Influence of low-density and conventional B-line thinning on the growth, leaf area, and growth efficiency of 60 year-old eastern white pine (*Pinus strobus*).

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An optimum even-aged silvicultural system for eastern white pine (*Pinus strobus*) has yet to become routine despite the tremendous research attention white pine has received in the northeastern United States and Canada. In 1991, an unresolved controversy between two silvicultural systems motivated the establishment of a direct side-by-side comparison of low-density and conventional B-line thinning of white pine. Within the thinning experiment, diameter, height, and crown length measurements have been taken four times: once in 1991 after the initial thinning at stand age 42, then again in 2001, 2006, and 2008. In addition, increment cores from every live tree were taken in 2001 (two cores per tree) and 2008 (three cores per tree) to measure sapwood basal area. The objectives of this study are: 1) to develop allometric leaf area equations from sapwood basal area, 2) to analyze the changes in apparent leaf area from 2001 to 2008, and 3) to compare the patterns of growth, growth efficiency, and leaf area between the silvicultural systems.

Hemlock looper induced mortality and growth loss of balsam fir in western Newfoundland, Canada

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Hemlock looper (Lambdina fiscellaria fiscellaria Guen.) is a major balsam fir defoliator that produces heavy tree mortality. Extensive hemlock looper outbreaks have been recorded in Newfoundland during the last century. Growth impacts and mortality caused by hemlock looper defoliation were quantified using data from Newfoundland Forest Service permanent sample plots (PSPs). 77 PSPs were analyzed and compared with aerial defoliation maps from 1998 to 2007. A reduction of 72.7 % in mean growth increment was recorded while comparing to pre-defoliation values for severely defoliated plots. A lower growth loss (43.2 %) was calculated for plots defoliated lightly by hemlock looper. WinBUGS, a statistical software used for Bayesian modelling was used to determine credible intervals of 0.95 posterior probability with uninformed priors in order to determine uncertainty while running 100000 iterations and discarding the initial 1000. Mean mortality from Newfoundland PSPs was calculated to be 58 % 3 years after hemlock looper defoliation with 24-92 % Bayesian credible intervals for the severely defoliated plots. With the use of prior information, mean and credible intervals were calculated more precisely. While older stands (> 67 years) had been defoliated severely compared to younger stands, balsam fir showed higher mortality in lower DBH classes. Impacts thus derived will be utilized to build a decision support system for hemlock looper following the framework of the Spruce BudWorm Decision Support System.

Can we solve two problems at once? Converting Department of Conservation buildings to biomass energy, and utilizing "defensible space" wood as fuel

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The Maine Forest Service has retained The Irland Group to support its efforts to convert DOC facilities to biomass based energy. Together with Biomass Commodities Corp, and Two Trees Forestry, our project team as assisting the MFS by:

- Assessing technical and economic feasibility of conversion of these facilities;
- Assessing supply potential and logistical and cost issues for generating biomass fuel from defensible space projects;
- Determining whether and under what circumstances a biomass fuel market an reduce costs for defensible space projects.
- Conducting a general assessment of wood heat potential for all state buildings.
- Assessing whether various forms of Carbon financing could assist with these goals.

As this project develops, the MFS plans to implement those projects found to be feasible. This will save taxpayer dollars, facilitate solving several problem at once, and develop a series of demonstrations that can be visited by municipalities, businesses, and others interested in determining whether conversion to wood based fuels are practical for them. A Governor's Task Force on wood energy has addressed major policy issues and is supping political momentum for action on these issues.

Landscape characteristics of a forest matrix raptor: northern goshawk (*Accipiter gentilis*) habitat distribution patterns in a changing landscape.

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New Hampshire has > 80% total land area forested (NH GRANIT) and contains known goshawk nesting territories (Yamasaki Unpublished data); a prime area to assess goshawk habitat relationships in New England. New Hampshire Land Cover Assessment (NHLC) conducted by the Complex Systems Research Center at the University of New Hampshire, is a 23-class digital land cover data set of vegetative and physical features of New Hampshire. NHLC, created from Landsat Thematic Mapper satellite imagery, acquired from 1990-1999 (Justice et al. 2002), was used to compare land cover types of goshawk nesting territories (n=44) to random sites (n=100) across New Hampshire. GRANIT data was entered into ArcMap 9.2 software to create circular polygon buffers at two landscape scales, 2000 acres and 4000 acres, for each goshawk territory and random site. Nest trees were used as center locations of territory polygons and computer generated random points were used as centers for random polygons. In territories with alternate nests the centermost or most active nest was used as the center point. Aggregated classification of NHLC data include: developed, agriculture, forest, wetlands, open water, other cleared and tundra. Landcover was analyzed using multivariate and univariate analysis in JMP 7.0 statistical software. Comparisons showed a significantly higher percentage of agricultural land present in random (R) sites (4.3%) then in territories (T) (2.4%) (p= 0.015) with similar results in single class analysis of hay/pasture (R -4.1%, T-2%) (p=0.012) but not row crops (R and T<1%) (p=0.418) or orchard (R and T<1%) (p=0.461). Aggregated forest classifications showed no difference between territories and random sites. Birch/aspen was significantly higher in territories (7.6%) than random sites (5%) (P=0.03) but should be interpreted cautiously due to degree of specificity in satellite data distinction between forest cover types (28.6% accuracy). Proportion of developed area was higher than expected in random sites (4.7%) compared to territories (2.6%) although this did not show statistical significance (p= 0.104). Distinctions of goshawk habitat characteristics compared to developed and agricultural landscapes seem evident but forest cover comparisons are ambiguous, probably due to high percentage of forested area across the state. Additional analyses are needed to assess topographical features of habitat and to further characterize differences between goshawk habitat and anthropogenic land use.

Soil-site influences on northern white cedar (*Thuja occidentalis*, l.) stem quality and growth

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The primary range of northern white cedar (NWC) extends from southern Canada east to Maine, and has been an important constituent of mixed hardwood forests since the Holocene period. Despite its high value as both raw materials for industry and as wildlife habitat, many aspects of its ecology are poorly understood.

It is often assumed that the preferred habitat of NWC is cool, moist, nutrient-rich lowland sites with moving groundwater. However, NWC is found growing in a variety of habitats from lowland swamps to xeric rock outcrops, showing that these assumptions may not always be valid. NWC stem quality and productivity varies among sites, but the mechanisms behind this are unclear. Over 80% of standing NWC contains some amount of decay in the bole. NWC basal area growth and stem soundness are poorly correlated with light exposure and soil drainage classes compared to balsam fir (Abies balsamea (L.) Mill.) and red spruce (Picea rubens, Sarg.).

The objectives of this study were to develop insights on soil contributions to NWC by building on an ongoing program of study about this important species. Specifically, this research was designed to (a) investigate the chemical properties of soils in actively growing mixed stands with a NWC constituent, (b) define the characteristic foliar chemistry of NWC, and (c) investigate relationships between soil properties and NWC foliar chemistry, stem quality, and growth.

Initial findings illustrate the diversity of site conditions to which NWC adapts. Surface horizons supporting NWC ranged in pH from 2.99 to 6.36, with organic matter contents from 8.61 to 48.1%. Exchangeable base cations and base saturation showed positive correlations with measurements of growth, while exchangeable acidity and metals were negatively correlated. Foliar composition generally reflected available nutrients dictated by soil conditions. Two significant and direct soil to foliage correlations were calcium and zinc. Stem soundness displayed weak inverse trends with growth, with the most notable negative correlations being foliar iron, phosphorus, and aluminum. Despite these correlations, it remains unclear whether these are direct and causative relationships, or are indicative of more complex physical (e.g., drainage, parent material, climate) and biological (e.g., microbial) processes.

Rehabilitation of cutover mixedwood stands: a silvicultural experiment

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Heavy partial cutting with selective removal of commercially valuable trees has long been common throughout northeastern North America. Harvesting practices of this type often result in degraded stands with limited silvicultural potential that present management challenges to landowners and practitioners. In 2007, we initiated a study to evaluate ways to precommercially rehabilitate northern conifer stands that had been degraded by commercial clearcutting (removal of all merchantable trees) in the U.S. Forest Service's long-term experiment on the Penobscot Experimental Forest in Maine. Four replicates of three rehabilitation options – 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 (TSI), and fill planting) – are being investigated in two areas with different lapse times since commercial clearcutting (20 years in block 1 and 25 years in block 2). We have completed block and experimental unit layout, pre-treatment inventory, and treatment application; preliminary results from block 1 are presented.

In 1950, the stand containing block 1 had 32.5 m^2/ha and 3,725 stems/ha ≥1.3 cm dbh; 27% of stems were merchantable-size (> 11 cm dbh). At that time, > 80% of stems were softwood (balsam fir, spruce species, eastern hemlock, and northern white-cedar). Commercial clearcutting was applied in 1957 and 1988. Prior to rehabilitation treatments in 2008, block 1 had about 20 m^2/ha and 9,500 stems/ha ≥1.3 cm dbh; < 2% of stems were merchantable-size. Only 30% of stems were softwood, and almost all of those were fir. Red maple (primarily in clumps of sprout origin), paper birch, pin cherry and aspen species were common. Crop trees were selected for release to improve species composition and growth of desirable stems. Objectives were to accelerate growth of good quality hardwoods for later removal in commercial thinning, and release softwoods to restore the coniferous component of the stand and provide seed trees for future shelterwood regeneration. Hardwood and softwood crop trees were selected at about 7.5- and 5-m intervals, respectively; all crop trees were >1.3 m tall. On average, we released 174 crop trees/ha (range 140 to 237) of spruce, aspen, hemlock, red maple, and eastern white pine; there were also a few red oak, white ash, red pine, and larch. Release and TSI were accomplished with a combination of mechanical and chemical treatments; fill planting is scheduled for spring 2009.

Pre- and post-treatment data will be used to assess future outcomes via the Forest Vegetation Simulator, calibrated with historic data for our study area. Outcomes will be evaluated based on changes in volume and percent of acceptable growing stock, species composition, crop tree growth, uniformity of stocking, and economic costs/benefits. Combining manipulative experiments with simulation will enable us to rapidly articulate probable outcomes, while establishing a baseline of information for comparison with remeasurement data. Findings will facilitate the development of guidelines for managing cutover stands.

Stakeholder views toward biomass harvests and the bioproducts industry in Maine

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The emergence of bioproducts industry that can augment and/or replace petroleum-based products is seen as a critical step in transitioning the U.S. economy toward energy independence and a more sustainable, renewable resource-based future. Interest in developing a bioproducts industry in Maine is growing given the state's abundant forestlands and need for sustainable economic development, particularly in resource-dependent rural areas. The social acceptability of bioproducts is distinct from its technological feasibility and ecological sustainability – all of which are critical to the ultimate success of the industry. As bioproducts harvest and processing technologies move into the implementation stage, support from stakeholders including forest landowners, the forest products industry, the interested public, and the general public is critical. A baseline understanding of stakeholder knowledge and beliefs relative to their acceptance of a bioproducts sector was identified as key in both planning and the outcome assessment aspects of development. We conducted a systematic analysis of the many stakeholders that will affect and be affected by the emergence of a bioproducts industry in the state. Our goal was to identify areas of concerns, willingness to accept, and other constraints to landowner, industry, and public support. We did this through a mixed methodology approach of newspaper/literature content analysis and qualitative interviews with key individuals. Our preliminary findings will present these results embedded within lessons already learned from the rich "social acceptability of forestry" literature. The seminar will also discuss the policy, education, and framing implications of bioproducts research and industry development. This material is based upon work supported by the National Science Foundation under Grant No. 0554545.

Nest patch characteristics of two sympatric songbirds, *Catharus bicknelli* and *C. ustulatus*, in regenerating clearcuts

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Forest managers are increasingly sensitive to the need to manage for a diverse array of organisms. Some species are highly specialized in their habitat requirements. We define 'habitat specialist' as a species dependent on spatially or temporally rare environmental circumstances for some part of its life cycle. To conserve avian habitat specialists, it is essential to quantify the characteristics of nesting habitat. Bicknell's Thrush is a songbird that is internationally recognized as a species at risk. In north-central New Brunswick, Bicknell's Thrush breeds in high-elevation, 5- to 25-year old regenerating clearcuts. Previous studies have shown relationships between vegetation characteristics and occurrence and abundance of this species, but no study has described vegetation characteristics of the nest patch (area within 5 metres of a nest). We characterized vegetation composition and structure in 5-m radius patches around 8 nests in the Christmas Mountains in north-central New Brunswick. We also characterized nest patch habitat for 9 Swainson's Thrush nests. Swainson's Thrush is a relatively abundant songbird that may compete with Bicknell's Thrush for nest sites. We determined whether Bicknell's and Swainson's thrushes use similar nesting habitat and thus may be in competition for nest sites. Within each patch, we measured tree density, species composition and tree diameters. We compared characteristics of nest patches to those of control patches (n=17) that were spatially paired with each nest patch. Our nest sample size was small due to the challenge of locating nests in dense regenerating clearcuts. This study provides information on nesting habitat of Bicknell's Thrush and its relationship with Swainson's Thrush that will be useful for conservation of these species and management of regenerating clearcuts. Our results should be used with caution and further study of nest patch characteristics of both species is important.

Securing the future for families, forests, and foresters

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One of the main threats to keeping family forests in family hands is simple lack of planning and communication. Without plans and discussions, family forests are left at risk for conversion to house lots or other uses when the land changes hands. A complicating factor is that a forest is a functioning ecosystem that is not suited to traditional choices of dividing wealth equally among heirs. When the forest gets subdivided, it gets one step closer to going away forever.

For this reason alone, the U.S. Forest Service and State Forest Agencies ask that planning begin with an end in mind: keep the land intact. Families must make their own choices about the future of their land. Several options include: Do nothing (this option leaves the estate and the forest most at risk); Will; Sell or give the forest to heirs before death by gifting; Family partnerships; Qualifying conservation trusts; Closely-held S-Corporation; Limited Liability Company; Conservation easement; Land trust. Free information for starting succession and estate planning conversations with clients is available from the U.S. Forest Service. Detailed explanations of the options listed can be found at: http://www.na.fs.fed.us/stewardship/estate/estate.shtml. A good resource on estate planning is: Estate Planning for Forest Landowners – What will Become of Your Timberland? By Harry L. Haney, Jr. and William C. Siegel. USDA Forest Service, General Technical Report, SO-97. www.srs.fs.usda.gov/pubs/161

Spatial patterns of natural regeneration in northern hardwood stands in Maine

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Spatial pattern analysis has the potential to improve our understanding about the processes governing intra- and inter-specific interactions in natural forest regeneration. The objective of this study is to describe the spatial relationships among different tree species, height classes, and across different sampling scales of natural regeneration in recently harvested northern hardwood stands. American beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*) are the primary species of interest. At each of three recently shelterwood-harvested stands in central Maine, a 24 by 24 meter grid was established with 1 m^2 cells. Nested within each large grid were three smaller grids composed of 0.25 m^2 cells. Stem density and visual estimates of cover are being used to quantify patchiness and spatial dependence among distance classes. The species, stem diameter, and location of all trees ≥ 4 cm dbh in each grid were recorded to investigate the spatial relationships between overstory retention and understory density. To fully describe each site, the cover of shrubs, herbs, bareground, and slash also were assessed in each cell. To better understand the dynamics between pre- and post-harvest regeneration, a sub-sample of tree regeneration is being aged.

Long-term study on the influence of silvicultural intensity and composition objectives on the productivity of regenerating forest stands in Maine

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A mosaic of young, naturally regenerated stands of largely mixedwood (hardwood-conifer) composition dominate cutover areas within Maine's Acadian Forest. Tremendous opportunity exists to improve the composition, quality, and growth rates of these stands while they are in an early successional stage. Two factors determine the long-term outcome of stand development: silvicultural intensity and compositional objective. Silvicultural intensity is determined by the degree of investment in vegetation management and artificial regeneration. Compositional objectives are set by the manager and determine whether conifer, hardwood, or a mixture of species is desired in the final stand. A long-term study was established on the Penobscot Experimental Forest in central Maine in order to: (1) quantify the growth and development of early successional stands to varying intensities of silvicultural intervention and compositional objectives, (2) document ecophysiological mechanisms affecting the dynamics and productivity of young forest stands, and (3) compare the energy requirements and financial returns associated with early intervention in these cutover stands. A 3 x 3 + 1 factorial design with four replications of 30 m x 30 m (0.09 ha) treatment plots is being used. Three levels of silvicultural intensity (low, medium, high) and three compositional objectives (conifer, mixedwood, hardwood) are being compared with an untreated control. Silvicultural interventions vary from manual and/or chemical release of residual crop trees in low intensity treatments to complete removal of all residuals, and replanting with high-yield *Populus* clones and/or improved *Picea glauca* stock in high intensity treatments. Growth, survival, and stem quality of both planted and residual stems are being measured yearly; crown width and length are being measured biannually.

Lake development and recreation use of Maine lakes and ponds

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Carrying capacity, recreation user conflict, crowding/congestion, and coping behavior became relevant for study in outdoor recreation research when the 1950's and 1960's introduced a rapidly expanding interest in outdoor recreation and led to concerns over the ambiguity of an appropriate use level for outdoor recreation areas. As the development along the shores of Maine's lakes increase, so too does the number of access points and lake infrastructure, such as parking areas and boat launches, and the amount of people using the lake for recreation. The primary theme of the *Sustainable Lake Management in Maine's Changing Landscape Project* was to study sustainable lake development by combining ecological, economic, and social research in an effort to highlight the importance of land-use planning as a lake management tool. The *Sustainable Lake Management in Maine's Changing Landscape Project* recommended sustainable lake management as an effective technique to address the impacts of land use change on water quality and recreation of Maine's lakes and ponds. Due to the lack of landscape assessment or statewide data, the purpose of this study was to explore the previous recreational use concepts in adjunct to the *Sustainable Lake Management in Maine's Changing Landscape Project.* This study surveyed the lakeside development and associated recreational variables on 11 lakes in Maine to investigate possible linkages between an increase in lake development and recreational use. Town managers, lake association representatives and various community lake stakeholders were interviewed for further information on the area specific lake and the changes, if any, on development and recreation use. The analysis documented the GPS point for each lake development and measured nine dimensions of development and recreation: number of buildings; type of building; occupied status; type and number of recreational equipment; presence of dock, mooring, private landing, or lawn; and the degree of vegetative clearing to the water. Correlations were found between number of development sites and amount of recreational equipment. The findings support the notion that an increase in lake development does lead to an increase in lake recreation, although the results of a recreation increase may not necessarily lead to an increase in user conflict. Further research and specific recreation conflict data is needed to determine a relationship between an increase in lake development, recreation use, and user conflict.

Private property and public goods: a qualitative analysis of forest landowner values, stewardship, and management objectives in New Brunswick and Maine

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Healthy and intact forests contribute to a myriad of economic, ecological, and social functions. Throughout North America vast tracks of forest land are under the ownership of individuals and families. Roughly 40,000 forest landowners in New Brunswick, Canada, for example, occupy approximately 30% of the province's forested lands. The state of Maine has a large population of individual forest landowners as well; around 100,000 owners occupy approximately 33% of the state's forested land. Whether realized or not, individual private woodlot owners play a vital role in the long term function and sustainability of these ecosystems. Many of the forest landowners in each region however, have different opinions regarding stewardship, government involvement, and the scope and extent of their private property rights. These views lead them to make different decisions about appropriate land management. The diversity of landowner attributes (age, sex…) and their property characteristics (tenure time, level of management activity…) add to the complexity of this situation. In order to maintain viable forest ecosystems, it is essential to understand what private forest landowners value and consider important. To achieve this, we have chosen a qualitative approach that includes interviews of private woodlot owners from New Brunswick and Maine. The participants are being purposively selected based on criteria that will lead to the diversity of forest landowner attributes. Landowners are asked questions addressing five general themes regarding forest landowner views toward: their land, stewardship, private property, the role of the government, and the overall social implications of owning private forest land. Beginning in May of 2008, and continuing through December of the same year, we will conduct 20 interviews in each location; each interview is audio recorded and then transcribed using qualitative software. Using a grounded theory approach to analyze the coded data we will be able to inductively arrive at key concepts that are central to landowners own conceptions of stewardship, social responsibility, rights and property. The results of this research will establish a baseline of forest landowner values in both New Brunswick and Maine, and provide professionals with data relevant to forest landowner management objectives. This study will also create a cross-cultural comparison of forest landowner values and accompanying management techniques in each region.

Variations in seedbed and vegetation according to regeneration niches after cutting and scarification in mixed yellow birch – balsam fir stands

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Challenges are numerous for silviculturists practicing in yellow birch – balsam fir stands of Québec's temperate mixedwood forest. These stands are composed of a mixture of species such as yellow birch (*Betula alleghaniensis*), balsam fir (*Abies balsamea*), red spruce (*Picea rubens*), red maple (*Acer saccharinum*) and sugar maple (*Acer saccharum*), which have different shade-tolerances, growth rates, longevities and strategies of reproduction. These stands usually grow on rich sites that can be rapidly invaded by undesirable vegetation after severe canopy opening. In a context of restricted use of pesticides in Québec, new silvicultural approaches need to be developed in order to maintain the valuable species composing these stands.

The SSAM Project (Silvicultural Systems Adapted to Mixedwoods) was set up in 1999 to assess the effects of five treatments (four blocks): three combinations of gaps and single-tree selection cutting (8 x 20 m, 4 x 30 m and 2 x 40 m gaps), 1-ha patch clearcut and uncut control. Spot scarification was applied as a sub-treatment in half of the openings (1 x 2 m spots, density > 1000/ha). This communication has for objective to present relationships between seedbeds and regeneration establishment according to five regeneration niches: forest understory, southern border of opening, northern border of opening, non-scarified opening and scarified opening. Differences were tested by ANOVA of a superfactor "cutting_niche" made by concatenation of "cutting pattern" and "regeneration niche" classes (SAS 9.1). A series of ten pairwise comparisons were made by contrasts for six seedbeds (% coverage) and five species (stems/ha > 30 cm in height).

Results show that seedbeds were less modified in the borders than inside openings, however with an improvement of seedbed quality (increase in coverage of both H horizon, and mineral and mixed horizons). Borders constitute interesting regeneration niches since microclimate is favourable to germination of desired species. The southern border of openings was beneficial to balsam fir, while scarified opening was the least. Nevertheless, openings provided favourable regeneration niches for yellow birch when scarified (Figure). Regarding competitive species, pin cherry density was the greatest in openings, while density of the pre-established mountain maple was the lowest in scarified openings. Since borders of openings seem to play an important role in regeneration dynamics, we should opt for opening sizes that maximise the edge effect when the maintenance of the conifer component is an objective. Thus, large clearcut patches should be avoided.

Figure. Yellow birch and red spruce seedlings in a scarified spot within a 30 m gap (scarified opening niche), two growing seasons after scarification.

Monitoring fuel consumption in a cut-to-length harvest system

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Recent increases in energy prices have financially burdened logging contractors throughout the industry. Diesel fuel is largely responsible for powering the harvesting and transportation of forest products. Fuel efficiency, therefore, has become a primary concern, however, questions still remain for many contractors. *How much fuel do my machines burn? How does it change depending on various job site and wood conditions?* In response, this study's goal is two-fold. First, it aims to establish methods for logging contractors to easily monitor, and then display and analyze, fuel consumption in forest machines. This was largely undertaken by tracking the fuel consumption and production of a dangle-head harvester and a 12-ton forwarder, working together in Vermont during the summer of 2008. Secondly, this study is concerned with how job characteristics impact fuel consumption. Being a two machine system, two separate trials were conducted in varying working conditions during which production and fuel usage was monitored over a short period of time. Results show that 1.6 gallons/cord (g/c) or 2.8 liters/m^3 (l/m^3) was used to harvest and haul wood from stump to roadside during a job consisting of mostly spruce and white pine sawlogs. In comparison, efficiency decreased in a pure hardwood job to 2.4 g/c or 4.1 l/m^3. Preliminary analysis finds that this was largely due to increased forwarding as was necessary to facilitate a bid sale of the hardwood sawlogs. Individually, the forwarder operated at an average of 0.66 g/c (1.13 l/m^3) and 1.3 g/c (2.2 l/m^3) during the two jobs, respectively. The harvester operated at an average of 0.97 g/c (1.6 l/m^3) and 1.1 g/c (1.93 l/m^3), respectively. Hand felling and pre-processing of pine and hardwood stems larger than 16" DBH is thought to have contributed to the similarity in harvester efficiency.

Distribution of phosphorus in acidic soils of temperate forests

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Long-term acidification of forest soils through pedogenesis and atmospheric deposition of nitrogen (N) and sulfur (S) can result in the depletion of soil base cations, declines in pH, and the mobilization of aluminum (Al). Less is known about the influence of these alterations on soil phosphorus (P). Soils from eight forested watersheds in Maine, West Virginia, France and the Czech Republic were studied to better understand the chemical distribution of P in humid, temperate forests. Included in these sites are two long-term, whole watershed acidification experiments at the Bear Brook Watershed in Maine (BBWM) and the Fernow Experimental Forest in West Virginia (FEF). The BBWM and FEF sites are paired watershed studies offering side by side contrasts on the influence of soil acidification and P. Fractionation techniques were used to partition soil P into: labile P, Fe-P, Al-P, Ca-P, and refractory P. Despite significant differences in the total amount of P in the eight watersheds, the distribution among fractions is very similar. The Al-P fraction dominated at all sites including both experimental watersheds, being 74% of the total P at BBWM and 72% of total P at Fernow. The Al-P fraction was uniquely responsive to experimental acidification and decreased significantly in the A-horizon, and 0-10 cm depths at FEF. Likewise, Al-P was reduced by 44% in the 0-5 cm increment of softwood-dominated soils at BBWM. These results suggest that in these upland, acid forest soils the Al-P fraction represents the dominant secondary pool of soil P and is the most likely to be depleted during initial responses to acidification.

Mountain pine beetle and woodland caribou: a challenge for Alberta forest managers.

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Within the old growth forests of Alberta, Canada there exist a threatened charismatic creature on the landscape. The woodland caribou (*Rangifer tarandus-caribou*) has made Alberta its home for centuries, however due to industrial development such as forestry, agriculture, and oil and gas the species is now at risk of becoming extinct. However, there is a less obvious issue that has an even greater potential to influence the survival of the caribou.

Alberta's forests are maturing and the ìold growthî forest component is increasing every year. Traditionally these old forests burned, creating a mosaic of different age classes that were less susceptible to insects and disease. However, due to successful fire suppression tactics over the past ~50 years Alberta forests have become old, even-age targets for mountain pine beetle. Mountain pine beetle as already affected more than 9.2 million hectares of forest in British Columbia, thus creating major challenges for the forest industry. The recent influx of mountain pine beetle across the Rocky Mountains and into Alberta has especially created a challenge for forest managers in regions where woodland caribou exist.

If Alberta's forests face the same fate as their neighbours in the west, it could spell the end of woodland caribou populations even if all current industrial development is ceased. To prevent or limit destruction of the forest by mountain pine beetle and to minimize timber losses to industry, it may be necessary to utilize management tools, such as logging, within areas of prime caribou habitat. Current initiatives by the Albertan government focus on an increase in allowable cut by 30% to minimize spread of the beetle as well as to take advantage of existing timber before its commercial value is lost.

The objective of our poster will be to outline the circumstances leading to and potential management strategies of the pine beetle epidemic and then to tie these into the controversial issue of habitat management in the caribou zone.

Seasonal and inter-annual variation in photosynthetic activity and non-structural carbohydrate reserves: relationships to age-related changes in productivity

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Trees exhibit predictable trends in productivity related to tree age or size. Several hypotheses that link these trends to photosynthetic carbon fixation have been proposed over the past two decades. However, tests of these supply-side hypotheses have been equivocal. Our preliminary research suggests that age-related trends in productivity may be controlled not by assimilation but by demand for carbohydrates. In a test of multiple supply-side hypotheses in red spruce (*Picea rubens* Sarg.), we found a poor relationship between productivity and photosynthetic capacity or realized rates. In contrast, decreased productivity of old trees was linked to weaker carbon sinks, evidenced by robust age-related differences in accumulation of nonstructural carbohydrates (Figure). Since the principal carbon sinks in these conifers result from growth, our results suggest that growth consequent to meristematic activity may be a important mechanism controlling age-related trends in tree productivity. However, our data to date presents a growing season 'snapshot' of activity and carbon pools. Confirmation of this hypothesis will require an understanding of the annual cycles of carbon resource dynamics.

We are currently testing this hypothesis in a multi-aged population of red spruce on the Penobscot Experimental Forest in Penobscot County , Maine. Photosynthetic activity, non-structural carbohydrate pools and carbon allocation to growth and reproductive sinks are being tracked in trees of three age-classes (juvenile, mid-aged, and old) over annual and inter-annual periods.

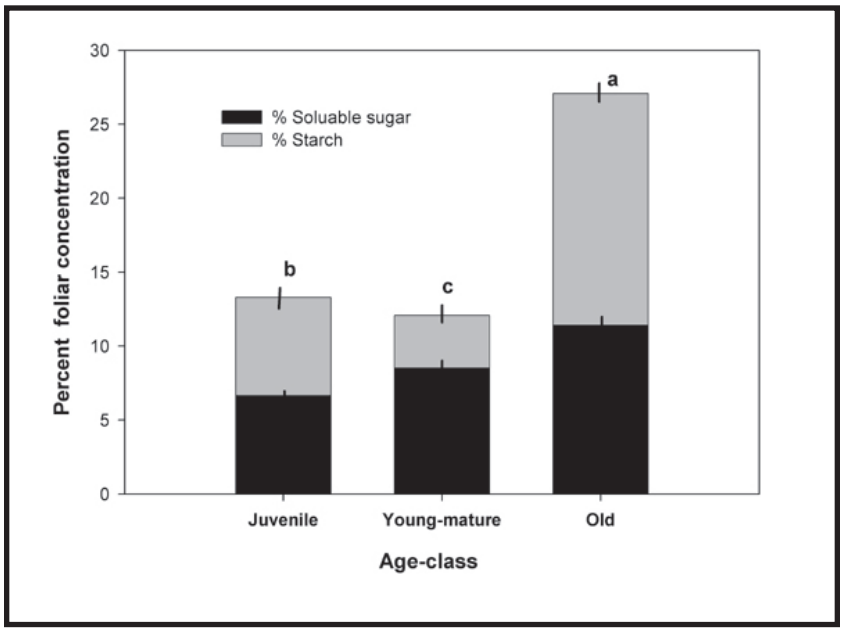

Figure. Midday nonstructural carbohydrate concentrations in the foliage of red spruce from juvenile, young-mature, and old trees. Higher NSC concentrations are indicative of 'excess' photosynthetic capacity over growth sink demands. Soluble sugar concentration provides a 'snapshot' of short-term carbon concentration, while starch shows an integrated status over a longer interval. Bars give standard errors and letters designate different classes for percent starch (Tukey's HSD $\alpha = 0.05$, $n = 30$).

Material properties of wood ash-filled polypropylene wood plastic composites (WPCs).

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Wood ash is a low cost residue material that may have potential as a replacement for traditional mineral fillers such as talc in wood plastic composites (WPCs). The experimental focus of this study was on the analysis and testing of wood ash-filled polypropylene wood plastic composites. The WPC samples were produced on the Davis Standard Woodtruder at the Advanced Engineered Wood Composites Center, University of Maine. The loading of wood ash was increased from 2.5 to 10 weight percent. Material property tests being performed on the composite board samples include: flexure, tensile, impact, coefficient of thermal expansion, and flame testing. Material property results will be compared against a control formulation of polypropylene WPC.

Landscape scale modeling of hemlock susceptibility to hemlock woolly adelgid (HWA) and drought stressors in New England

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Land managers need to effectively mitigate the potential stress complex of Hemlock Woolly Adelgid (HWA) and drought currently facing hemlock in the northeastern United States. The development of comprehensive landscape-scale, spatially continuous models of the hemlock resource and its susceptibility to HWA and drought stressors would greatly aid this goal. Multidiscipline research for this project, which began in May 2007, has the objectives of (1) developing field based models to predict the impacts of drought and HWA infestation on hemlock decline; (2) translating field based models to a landscape scale using GIS layers; (3) assessing the accuracy of the models by independent validation using new sample plots; and (4) disseminating information on methods and the potential of such approaches to other researchers, land managers, and GIS specialists.

Over 700 cores were collected from hemlock on 57 HWA infested sites in PA (3 sites), NY (22), NJ (3), CT (12), and MA (17) in 2007. Additional cores from hemlock on 7 noninfested sites in ME (2) and NH (5) were sampled in 2007 which can be added to an existing database of 36 noninfested sites sampled in ME in 2006. The same number of cores from non-hemlock trees were sampled on all infested sites to examine how hemlock responds to stress differently from its cohorts. Increment measurements have been completed on all hemlock cores and half of the non-hemlock cores from 2007. Cross-dating is currently in progress.

Trends in increment growth can be related to data currently available from these sites, including: site, soil, stand, HWA infestation levels, and climate variables.

Over the coming fall and winter, core data will be used to identify current and previous increment declines in tree chronologies, relationships between foliar symptoms and decreased increment growth, and quantification of how site variables vary with decline in increment growth. These field based models will serve the basis for developing GIS layers showing sites having characteristics associated with previous declines in hemlock increment.

Heritability of lodgepole pine defenses against mountain pine beetle: family does matter

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About 13 million ha of lodgepole pine, Pinus contorta var. latifolia, have been killed by mountain pine beetle (MPB), *Dendroctonus ponderosae* (Coleoptera: Curculionidae) and its symbiotic fungal complex in the current outbreak in British Columbia. Although most trees succumb to the MPB/fungal complex, some appear to escape, tolerate, or resist attack. The surviving trees may possess heritable traits that affect MPB host selection, reproduction, brood success, and fungal symbiont growth. We quantified the genetic variation of lodgepole pine chemical and physical defensive responses against MPB and a component of its fungal complex, *Grosmannia clavigera* in 45 open-pollinated pine families at two sites. The quantified responses included host hypersensitive response and levels of particular constitutive and induced terpenoid secondary metabolites. We also assessed other parameters related to tree condition and survival as well as for beetle host selection and reproductive success. Our data suggest that resin terpenoid constituents differ significantly among families both before and after simulated MPB attack. In addition, several other phenotypic traits in lodgepole pine affect MPB colonization and tree mortality. We calculated family mean correlations of such traits that also possessed significant heritability. Constitutive δ-3-carene was negatively correlated with family mean mortality and levels of several constitutive and induced terpenoids. The occurrence of hypersensitive reactions was negatively correlated with MPB gallery production, reproduction, and brood development. Thus heritable δ-3-carene levels and hypersensitivity reaction occurrence negatively impact MPB induced tree mortality and insect reproductive success.

Strategies for applying the water recreation opportunity spectrum (WROS) to Maine's lakes

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Lakes are an important attraction in the state of Maine's (USA) landscape for fishing, boating, canoeing and other recreational activities. Maine's lakes vary from remote ponds with no motorized access or recreation permitted, to large lakes popular among motorized boaters. The expectation of the users varies according to physical, social, and managerial settings. Policy makers and planners must consider the expectation of the user along with the other resource properties. Maine is lacking a strong inventory system to incorporate all salient planning factors. In the late 1980s the Land User Regulatory Commission (LURC) created a classification system to aid in lakeshore planning within the unorganized territories. However, this system was nearly twenty years old and in need of an update. The State Planning Office attempted to apply this system to lakes within organized communities, but this report highlighted only a few major lakes and was of little value for planning purposes. The Water Recreation Opportunity Spectrum (WROS) could help define the position of each lake in Maine's landscape. The Bureau of Reclamation developed the WROS as a planning tool for mangers. It includes six classifications: urban, suburban, rural developed, rural undeveloped, semi primitive, and primitive. These classifications determine what sort of recreation is appropriate after examining the physical, social and managerial attributes a site. This poster explores the feasibility of applying this system for classifying lakes in Maine. Eleven diverse lakes from throughout the state made up the pilot study. Data from summer field visits as well as state agency data are combined within geographic information system (GIS) software to determine the suitable WROS classification.

A regional protocol for monitoring the implementation and effectiveness of forestry best management practices for protection of water resources

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Monitoring of Best Management Practices (BMP) on forestry operations has historically been sporadic and anecdotal, and the procedures used have varied widely. Inconsistencies in the rigor and objectivity of the monitoring have caused the public to question the degree of protection afforded water resources by the Clean Water Act. As a result, the "silvicultural exemption" which exempts forestry operations from the permitting requirements of the Clean Water Act if BMP's are used has been challenged by the public and the US Environmental Protection Agency (USEPA) has expressed interest in improved monitoring of BMP implementation and effectiveness.

Traditionally, monitoring has focused on individual BMP practices in terms of their prescriptive state guidelines (e.g., were road cross drains installed within prescribed distances of one another). To improve consistency and allow for a more universal method of BMP monitoring while maintaining state control of BMP specifications, a protocol was developed that focused on the underlying principles of BMPs (e.g., controlling water in small amounts) and the outcomes of those principles (e.g., did sediment reach the stream). Formal protocol development was funded by the USDA Forest Service and the US Environmental Protection Agency, and it was created cooperatively with input by a wide variety of state forestry and watershed agencies, industrial land owners, and university and federal scientists. The protocol has been field tested by state forestry and industry personnel in 11 states across the northeastern United States. Testing provided information for improvements to wording and data recording equipment and automated report generation.

The BMP Protocol consists of a branched question set and data recorder program prompting the user to gather appropriate data based on field conditions from discrete geo referenced sample units. A quality control re-sampling procedure and user controlled statistical sample design assure the collection data that is accurate and representative of field conditions. The sampling procedure can be carried out by either single or multiple assessor teams in a single visit.

The data can then be uploaded directly to a desktop computer and sorted by state, county, watershed or other geographical boundary. Preprogrammed queries and data summary reports can be generated from all or any subset of the data for use in analysis and preparation of reports for various publics. Additional queries and reports can be constructed by the user.

Field Manual, Desk Reference and associated software are available free of charge from the USDA – Forest Service, Northeastern Area State & Private Forestry website at http://www.na.fs.fed.us/watershed/bmp.shtm#FieldGuide.

Plasticity in response to rapidly changing light environments in red spruce and balsam fir seedlings: productivity and photoprotective mechanisms

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Red spruce is a major component of the Acadian Forest and an important timber resource. Unfortunately, populations are decreasing, with red spruce often replaced by balsam fir. As the 'gate-keeper' for the success of tree species is usually the more vulnerable seedling life-stage, we have focused our attention on physiological differences between seedlings and how they might relate to silvicultural practices. Previous studies suggest balsam fir is a competitive stress on red spruce during early development. It is possible that more shaded understory light environments produced by current stand thinning practices favors balsam fir. In this study we are evaluating how seedlings of the two species perform after a simulated overstory removal, with light environments rapidly changing from relatively closed canopy understory to open sky.

We grew first-year and two-year-old seedlings in an understory light environment (10% of 'above-canopy' sunlight). In mid growing season we relocated half of the seedlings to full sunlight for approximately a month. Growth components, photosynthetic parameters, and xanthophyll content were measured. Fluorescence and xanthophyll levels will provide insight into the effects of changing light environments on photosynthetic performance. The xanthophylls are pigments that dissipate excess sunlight and in turn help protect the plant from photoinhibition. The xanthophyll cycle is a major component of non-photosynthetic quenching, and in high sunlight the plants have higher concentrations of zeaxanthin and antheraxanthin than violaxanthin. Using fluorescence, we looked at stress on photosystem II resulting from the experimental treatments, as well as the relative amounts of intercepted sunlight dissipated through photochemical and non-photochemical pathways for both shaded and sun-treated seedlings.

Fluorescence data (Table) indicates that the two species have similar ratios of photochemical (qP) and non-photochemical (qN) quenching of absorbed light energy in both high and low light treatments. Fv/Fm, used to asses damage to photosystem II, suggests that fir suffers a lower decrease photochemical efficiency when exposed to the high-light environment than red spruce. However, this may be compensated for by the increased leaf area of spruce seedlings.

Treatment/Species	**Fv/Fm**	**qP**	**qN**
Shade/Spruce	0.768625	0.186625	0.817375
Shade/Fir	0.786563	0.166563	0.805313
High-light/Spruce	**0.6315**	0.269625	0.896667
High-light/Fir	**0.716125**	0.242	0.884

Table. Fluorescence parameters of both species under high andlow light environments Fv/Fm = maximum efficiency ofphotosystem II, qP = photochemical quenching coefficient, and qN = non-photochemical quenching coefficient. Significant factors in boldface.

Growth, log characteristics, and financial maturity of isolated archetypal eastern white pine (*Pinus strobus* l.) trees

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Traditional silvicultural systems that result in large diameter trees that yield knot-free lumber can maximize financial returns, yet often involve significant investments in precommercial thinning and pruning operations, especially when grown in pure, even-aged stands. Recent research has shown that white pine can display high quality stem form when grown in stratified mixed stands with shade tolerant conifers such as spruce, fir, and hemlock. Eastern white pine's ability to continue high growth rates and remain windfirm longer than other species allows for the retention of isolated pines through a second rotation of the associated species. The high stand density found in such mixed conifer stands also promotes natural branch shedding, which may reduce the need for pruning operations.

The Spruce Budworm salvage cuts of the late 1980's and early 1990's resulted in stands of isolated white pines with a mixed conifer regeneration stratum, as outlined in the above silvicultural system. Ten such sites were located throughout the state of Maine. At each site, ten trees were selected representing the range of diameters of the supercanopy white pines. Each of these trees were measured for growth rates, stem class form, leaf area, sapwood area, as well as conventional mensurational measurements. The objectives of this study include:

1) To model the growth response and efficiency of heavily released white pine trees growing in isolation;
2) Examine the external log characteristics with respect to product recovery; and
3) Create a financial maturity guideline at the tree and stand levels for several future market scenarios, using a range of guiding rates of return.

Patterns of regeneration of eastern white pine (*Pinus strobus* L.) as influenced by large isolated crop trees and precommercial thinning

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The spruce budworm epidemic of the 1970s and early 1980s led to the salvage harvesting of spruce-fir stands from the mid-1970s. During this time, landowners commonly left unaffected immature eastern white pines to harvest at a later date. These pines had the benefit of being released, as the spruce and fir was cut, and are now growing as large isolated crop trees, above the regenerating stand. It is known that large dominant trees contribute a disproportionately large amount of seed to a stand. This offers a unique opportunity to study the effects of such large isolated reserve trees on the composition of the regenerating stratum. It is ideal to determine these effects, and define the species composition that maximizes stand value.

Precommercial treatments are often employed in white pine stands in an effort to increase stand value. However, it is not known what precommercial schedules should be implemented in mixed conifer stands. While many approaches have been tried, the optimum density and spacing of eastern white pine saplings within these mixed conifer stands is still unknown. It is ideal to determine guidelines to maximize the financial returns from potential pine crop trees, as well as the regenerating stratum, while minimizing damage from the white pine weevil, in an effort to benefit both landowners and industry.

The overall goal of this research is to assess the potential for management of future pine crop trees in developing sapling stands, including those stands with large pine reserve trees. Specific objectives include:

1) Determine the composition and structure of the young stands in response to leaving pine reserve trees;
2) Determine the quality of the young pines relative to white pine weevil attack, blister rust infection, and natural branch shedding;
3) Determine any effect the presence of large pine reserve trees may have on the developing regeneration stratum of all species; and
4) Determine if any precommercial treatments might optimize the value of the entire stand (pine plus other conifers) and facilitate the development of high-quality pine crop trees.

Understanding belief systems of the forestry community and the public: implications for education and outreach

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A public that possesses basic knowledge of Northern Forests is desirable. People are inundated with voting initiatives and community decisions about this valuable and multiple use resource. The public makes these choices using a combination of their current forestry knowledge, and values and beliefs. This poster will present a proposal for research that will increase understanding of the role of values and belief systems in both forest resource educators and the public. Values are cross-situational beliefs that are hierarchically organized and make the ground for our behavior. Values are not descriptive or evaluative beliefs but prescriptive beliefs. A belief system provides a core set of values on which the forestry community and public make decisions concerning the forest. The combination of qualitative and quantitative methods to be employed will be reviewed. In-depth interviews will be used with the forestry community and a mail survey will be utilized for the public. We anticipate an outcome of this research to be improved understanding of the factors, including values and belief systems that influence forest-related education throughout Maine and the Northern Forest. The identification of consensus areas among the forestry community about what should be taught to the public will lead to a better foundation for educating the public about forestry issues. We also anticipate that results from the public survey will suggest ways of improving teaching and learning effectiveness about forests and forestry. More efficient and effective use of resources will benefit foresters, loggers, forest researchers, forest products industry, environmental/conservation state agency employees, and environmental/conservation non-profit organizations. The public at large will also benefit from improved forest and forestry education. Academic researchers will benefit thorough the new and innovative pairing of values and belief systems theory with adult learning and environmental education research.

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