Western Boreal Growth and Yield Association

Annual Report 2012

Forest growth, yield, inventory and planning in western Canada

www.ales.ualberta.ca/rr/Research/WESBOGY.aspx

UNIVERSITY OF ALBERTA

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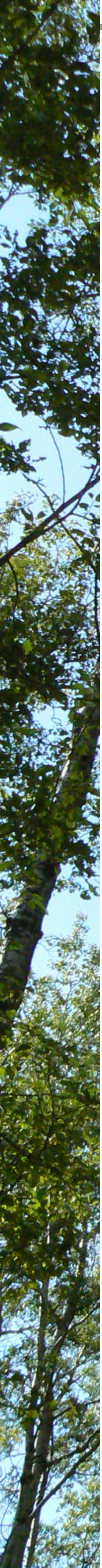

Executive Summary and Highlights

The Western Boreal Growth and Yield Association first met in the mid 1980's as an informal group of agencies involved in forest growth, yield, inventory and planning in western Canada. The association works to: encourage member agencies to work in a coordinated fashion to improve the efficiency of their research and development efforts; facilitate data sharing; and, provides a forum for communication. We are focused on development and dissemination of growth and yield modeling technology and information for both natural and regenerated stands in the western boreal mixedwood region, primarily aspen and spruce.

Current membership in the association includes seven forest companies, three provincial/territorial governments (Alberta, Saskatchewan and the Northwest Territories) and the federal government.

The association coordinates the maintenance, data collection, data storage and analysis for a long-term study designed to examine the effects of manipulating aspen density in young stands on growth and yield of mixedwood stands. Currently there are 11 experimental installations within the western boreal forest.

In 2011 work continued on MGM model development, model validation, the publishing of internal model relationships and results and the demonstration of MGM's utility in forest management planning.

In 2011 some studies were completed, several continue and a number of new projects initiated. All studies are designed to contribute to a better understanding of the growth and yield implications of managing mixedwood stands.

This Annual Report presents highlights of work accomplished during 2011 and briefly outlines plans for 2012.

June 2012

The past year has been another good year for the Western Boreal Growth and Yield Association.

We enjoyed a successful joint meeting with the Mixedwood Management Association in the fall. As always, the meeting and field trip were informative and packed with interesting discussion. Thanks to Mike and Gord for organizing an outstanding meeting and tour.

We continue to try to focus our activities on key issues that will help our members to make better and more cost effective decisions relating to the management of boreal forests.   Excellent progress has been made in preparation of the validation report for MGM which is now under revision for publication in "Forests" this fall.

Mike has also been working on detailed MGM simulations of Understory Protection. Results will be presented at the Boreal Mixedwoods 2012 conference being held in Edmonton in June. Dan MacIsaac and I are jointly chairing the organization of the conference. The conference is a WESBOGY and Canadian Wood Fibre Centre led initiative and is sponsored by Canadian Wood Fibre Centre, Alberta Environment and Sustainable Resource Development, WESBOGY, CIF-Forest Ecology Working Group, University of Alberta, and the Alberta Mixedwood Management Association.

In addition, work on application of LIDAR in the characterization of aspen, spruce and mixedwood stands was initiated during 2011 in collaboration with Barry White at ASRD, and work exploring growth and yield implications of site preparation initiated in Saskatchewan is continuing.

2012 will be another busy year as we continue with validation and demonstration of MGM, analysis of LTS data, participation in the Boreal Mixedwoods 2012 conference, internal discussions on topical issues, development of new projects relating to growth and yield applications of LiDAR and Wet Areas Mapping, and other activities.

Please contact me if you have any questions or ideas about WESBOGY projects and activities.

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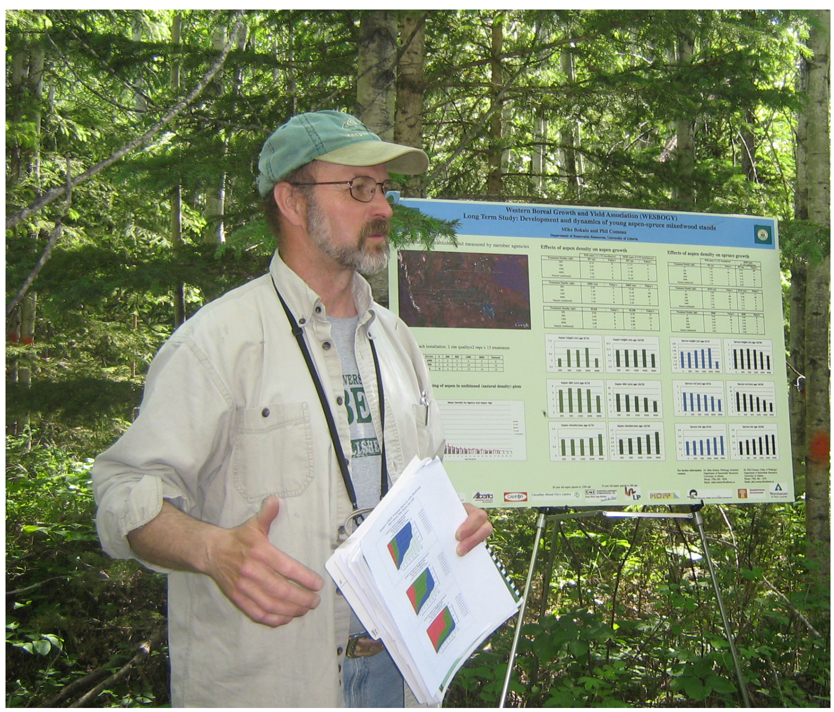
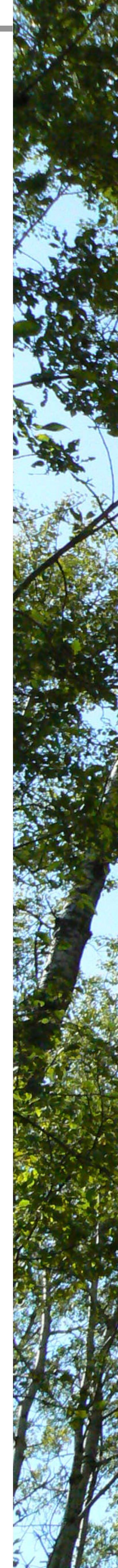




Mission Statement and Goals

The purpose of the WESBOGY Association is to conduct research projects that contribute to the development and dissemination of growth and yield information and modeling technology for both natural and regenerated stands growing in the boreal mixed wood region, primarily aspen and spruce.

Individual projects and/or students sponsored with Association resources should make progress in achieving this mission. Sponsored projects include those supported using Association resources. Associated projects are identified with the Association but are funded by individual (or groups of) Members or other sources. Business plans outlining project priorities and the allocation of resources to accomplish the mission are developed and periodically reviewed with the participation of Steering Committee Members.

GOALS

To develop and implement a program of research in the study of growth and yield and stand dynamics focused on problems of interest to Members of the Association. Projects will have defined goals and products, and will be completed in a timely manner.

To increase knowledge and awareness of growth and yield relationships, as they exist in western and northern Canada.

To foster communication, cooperation and exchange of information among the Members as well as various agencies and groups concerned with management and development of boreal forests.

To focus on the dynamics of mixed wood stands of aspen and white spruce growing in the boreal forest. Basic relations to be studied will include establishment, ingrowth, growth, and mortality. While the major species of interest are aspen and white spruce, other species such as balsam poplar, lodgepole pine, black spruce, and jack pine will also be studied. In developing simulation models based on these relations, provision will be made for projecting stands subject to multiple interventions (treatments) through the life of the stand. Differences between Natural Subregions (Ecoregions) and site productivity will also be evaluated where there is sufficient data.

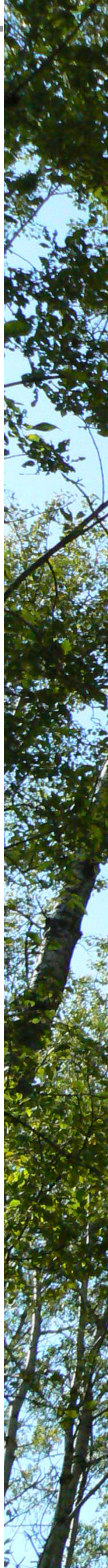
To encourage the establishment and continued monitoring of standardized permanent sample plots (PSPs) to quantify the effects of forest management practices in natural and regenerated stands, and in general to coordinate the acquisition of high priority growth and yield data;

To identify, evaluate, rank and address areas of research which are: of regional importance, of shared mutual interest, and most effectively approached cooperatively by the Association rather than by individual efforts;

To facilitate the dissemination of growth and yield data through the development of appropriate procedures, standards and databases for Members' use.

The following table lists measurable objectives identified for the 2011-2015 Agreement. It also includes links to the overall goals of the WESBOGY Association.

5 – year Objectives	Related Goals
1. To maintain the WESBOGY long-term study designed to evaluate the effect of spruce and aspen density levels on the development of plantations from establishment to final harvest. Maintain and update the database for the WESBOGY long-term study. Complete analysis of data. Encourage new Members to participate in the long-term study.	Goal #1 and #5
2. To develop and refine growth and mortality relationships and incorporate these new relationships into the MGM growth simulator.	Goal #1 and #2
3. To expand the scope of the MGM growth simulator as a tool for the development of managed stand yield projections for the major commercial tree species in the region. This will also include providing support for studies required to develop models of tree and stand response to establishment, tending and harvesting practices.	Goal #4, #5, and #6
4. To maintain a website that will identify, evaluate and disseminate information on trends in growth and yield research	Goal #3 and #7
5. To hold annual technical meetings for dissemination of information obtained from ongoing Sponsored Research Projects as well as other speakers invited to address other relevant growth and yield issues	Goal #3 and #7
6. To expand the scope of WESBOGY activities by recruiting new Members and seeking opportunities to augment the research component by securing funding from other granting agencies.	Goal #1, #2, #3 and #6
7. To identify and summarize regional PSP database standards and protocols for data exchange and use with regional growth models.	Goal #2, #3, #5 and #7
8. To collaborate with other agencies and organizations in the development of research and acquisition of data to support a better understanding of and development of models to estimate effects of silviculture on yield.	Goal #1, #2, #3 and #4
9. To identify and prioritize research needs and to initiate new projects as appropriate under the direction of the Steering Committee and Members.	Goal #1, #2 and #6

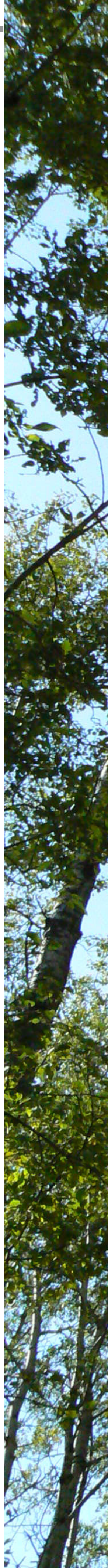


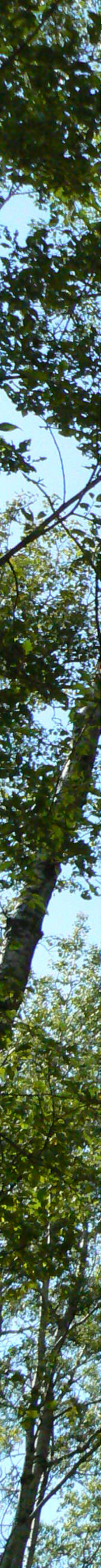
5-Year Program (2011-2015)

1. To continue analysis of the WESBOGY long-term study including:
   - Height, diameter, and density patterns for aspen in the natural plots;
   - Height and diameter growth of spruce and aspen in treated plots;
   - Mortality of spruce and aspen;
   - Recruitment (ingress) of new trees into natural and treated plots;
   - Preparation of manuals, reports, papers, extension notes and posters for distribution to Members and for journal publication;
2. To continue development of MGM to improve its ability to represent stand responses to silviculture. This will include:
   - Refinement of mortality, breakup and self-thinning functions for aspen;
   - Evaluation of model sensitivity to site index;
   - Natural regeneration and ingress of white spruce and aspen;
   - Refine calibration for lodgepole pine;
   - Calibrate MGM for black spruce, jack pine and balsam poplar;
   - Model Validation and publication of results;
   - Demonstration and training.
3. To update and maintain the WESBOGY long-term study data collection manual, the database, and the WESBOGY website and sharepoint site.
4. To seek to expand the scope of WESBOGY activities and influence.
   - To identify and approach potential new Members;
   - To seek opportunities and develop proposals for potential complementary funding from other agencies.
   - To work with other groups and co-operatives and to promote WESBOGY activities and information in growth modeling, silviculture practices and forest management activities.
5. To organize the WESBOGY Fall, Spring, and Steering Committee meetings each year. Prepare the meeting minutes and WESBOGY annual reports.
6. To review and update the list of priority and ongoing projects.
7. To undertake high priority Sponsored Research Projects as recommended by the Steering Committee and approved by the Members.
8. To work with Members in the development of proposals for high priority associated research projects.

Current Research Projects

	Subject/Title	Status and Priority
1.	Development of MGM	**Status:** Ongoing **Researchers:** Mike Bokalo, Ken Stadt, Steve Titus, Phil Comeau
2.	Validation of MGM2010A	**Status:** Manuscript under review **Researchers**: Mike Bokalo, Ken Stadt, Phil Comeau, Steve Titus
3.	Maintenance of Long Term Study Database	**Status**: Ongoing **Researchers**: Mike Bokalo, Phil Comeau, Susan Humphries
4.	Analysis of Long Term Study Data	**Status**: Ongoing **Researchers**: Mike Bokalo, Phil Comeau
5.	Effects of herbaceous and woody vegetation control on early boreal mixedwood stand development (Judy Creek Mixedwood Regeneration study)	**Status**: Initiated in 2002; ongoing **Researcher:** Doug Pitt, Phil Comeau, Dan MacIsaac. Paper published in CJFR in January 2010 (see list of recent publications)
6.	Stand Density Index and its relationships with productivity and understory vegetation	**Status**: Initiated in 2007 **Researcher**: Valentin Reyes-Hernandes, Phil Comeau
7.	Influence of silviculture on the successional dynamics of mixedwood stands.	**Status**: Initiated in 2011 **Researcher**: Kirk Johnson, Phil Comeau and Mike Bokalo
8.	The use of Lidar and Wet Areas Mapping in representing Stand Structure and Unproductive Gaps in Forest Stands	**Status**: Initiated in 2011 **Researcher**:Dan Jensen, Mike Bokalo, Phil Comeau and Barry White
9.	MGM-Volume Loss Factor development	**Status**: Manuscript in Prep **Researchers**: Cosmin Tansanu (PhD). Mike Bokalo and Phil Comeau
10.	Growth and Yield Implications of White Spruce Understory Protection and Other Mixedwood Silviculture Systems	**Status:** Completed 2009; 2 manuscripts in preparation **Researcher:** Dan MacIsaac, Ken Stadt, Mike Bokalo, Phil Comeau
11.	Benchmarking Natural (fire origin) stand regeneration.	**Status**: Completed in 2009; 3 manuscripts in preparation **Researcher**: Stefanie Gaertner, Mike Bokalo, Ken Stadt and Ellen Macdonald
12.	MGM Height, Diameter and Mortality Functions for black spruce and jack pine.	**Status**: To be initiated late 2012. **Researcher**: Mike Bokalo and Phil Comeau
13.	High precision prediction of site index and future yield by use of wet areas mapping and full feature LiDAR	**Status**: To be initiated late 2012. **Researcher**: Phil Comeau, Mike Bokalo, John Nash, Daniel Chicoine and Barry White
14.	Prediction of future forest productivity and silvicultural challenges using Full Feature LiDAR, Wet Areas Mapping and Landform: A case study using the 1968 Marten Hills Fire	**Status**: To be initiated late 2012. **Researcher**: Phil Comeau, Mike Bokalo, John Nash and Barry White
15.	Climate change response on Long Term Study Sites	**Status:** Initiated in 2009 **Researchers:** Ted Hogg, Mike Bokalo, Dan MacIsaac, Phil Comeau





Membership

Agency/Company	Current Membership
Alberta Sustainable Resource Development	Since 1985
Alberta-Pacific Forest Industries Inc.	Since 1990
Alberta Plywood	Since 1985
British Columbia Ministry of Forests	1985-2003
Canadian Forest Products	Since 1985
Daishowa-Marubeni International Ltd.	Since 1990
Wood Fibre Centre, Canadian Forest Service	Since 2009
Louisiana-Pacific Canada Ltd., British Columbia	Since 1997
Louisiana-Pacific Canada Ltd., Manitoba	Since 1996
Manning Diversified Forest Industries Ltd.	Since 1997
Northwest Territories Resources, Wildlife and Economic Development	Since 1985
Saskatchewan Ministry of Environment	Since 1985
University of Alberta	Since 1985
Weyerhaeuser Company, Alberta Forestlands	Since 1985

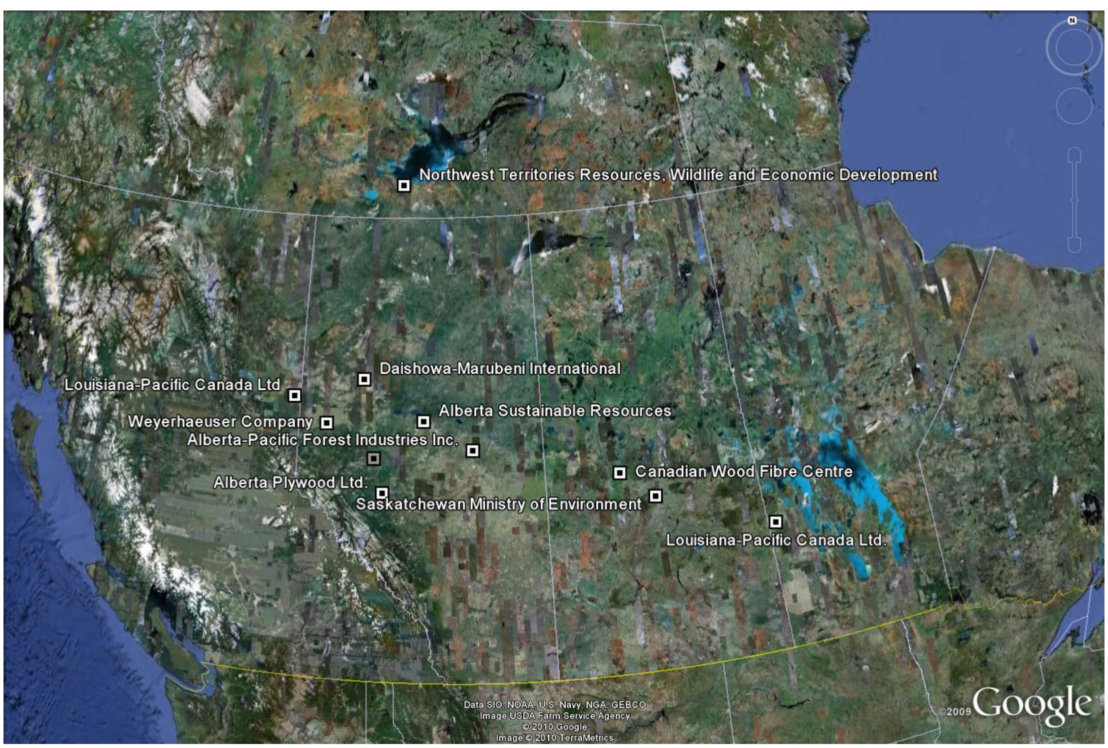
Steering Committee Members

A Steering Committee, consisting of three or four members elected to the Committee at the Annual Fall meeting, and the Chair and the Research Scientist sets policy, develops strategic objectives and priorities, reviews work plans, adjusts annual membership assessments in light of planned activities, and deals with other items which may arise.

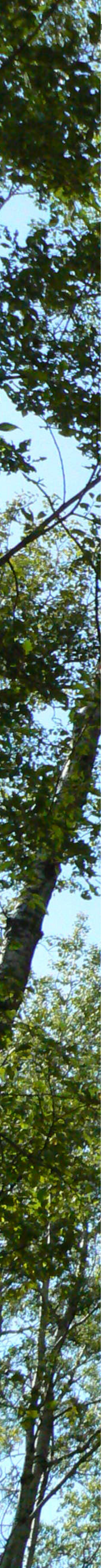
2000 Titus, Wang, Behuniak, Niemi, Weeks
2001 Titus, Behuniak, Niemi, Nichol, Ewan
2002 Titus, Bokalo, Comeau, Behuniak, Niemi, Nichol, Ewan
2003 Comeau, Bokalo, Titus, Behuniak, Niemi, Nichol, Ewan/Ashley
2004 Comeau, Bokalo, Titus, Behuniak, Nichol, Ashley, Whittaker
2005 Comeau, Bokalo, Titus, Behuniak, Nichol, Ashley, Whittaker
2006 Comeau, Bokalo, Behuniak, Nichol, Blue/Ashley, Whittaker/Whitmore
2007 Comeau, Bokalo, Nichol, Ashley, Whitmore, Morgan
2008 Comeau, Bokalo, Leblanc, Zaichkowsky, Whitmore, Morgan
2009 Comeau, Bokalo, Leblanc, Whitmore, Morgan
2010 Comeau, Bokalo, Leblanc, Whitmore, Morgan, Blue
2011 Comeau, Bokalo, Leblanc, Whitmore, Morgan, Blue

History and Locations of Long Term Study Installations

Company or Agency	Agency Code	Site	Year Spruce Established	Measurements Including 2011
Alberta Sustainable Resource Development	SRD	Med	1992	19
Alberta-Pacific Forest Industries Inc.	ALP	High Med	1994 2001	18 10
Canadian Forest Products Ltd.	CFR	High Med	2000 2001	11 10
Daishowa-Marubeni International Ltd.	DMI	High Med	1992 1992	19 19
Louisiana-Pacific Canada Ltd., Manitoba	LPSR	High Med	1998 1998	13 13
Louisiana-Pacific Canada Ltd., Dawson Creek	LPDC	High Med	2001 2004	10 8
Northwest Territories Resources, Wildlife and Economic Development	NWT	High Med	1993 1993	18 18
Alberta Plywood	WFR	High Med	1992 1993	17 17
Weyerhaeuser Company, Alberta Forestlands	WGP	High Med	1991 1991	20 20
Saskatchewan Ministry of Environment	SSK	High Med	1990 1990	21 21
Wood Fibre Centre, Canadian Forest Service	CFS	High Med	1992 1992	19 19



Locations of the 11 WESBOGY LTS Research Installations



Long Term Study of Aspen/Spruce Stand Development

Mike Bokalo, Phil Comeau and Susan Humphries

The WESBOGY Long Term Study is designed to advance our understanding of the dynamics of mixedwood stands following tending. The study, initiated in 1990, involved planting white spruce seedlings in recently clearcut areas where aspen regeneration had already been established. For the first 5 years, vegetation was controlled by clipping or using plastic mulch mats within a 40 to 50 cm radius of the spruce to minimize early spruce mortality. After a 5 year establishment phase, both the spruce and aspen were thinned to desired treatment densities shown in table 1.

The objective of the thinning was to achieve desired densities but retain potential crop trees at relatively uniform spacing. The study uses a randomized block design with each agency setting up and maintaining one block of two installations; one installation on a superior site and one on a median site. Each installation consists of two replications of 15 plots representing the different combinations of spruce and aspen treatment densities. Today, the study includes a total of 615 plots in Alberta, British Columbia, Manitoba, Saskatchewan and the Northwest Territories.

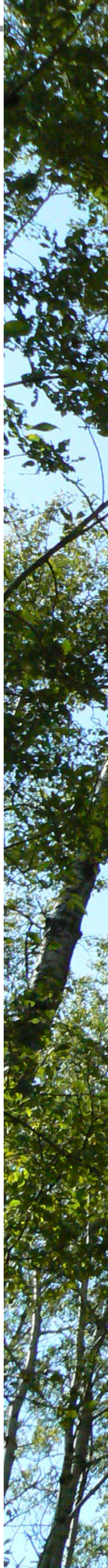
Self-thinning of aspen

Data from the four oldest installations (DMI, WGP, SBR, and SPA) indicate that after 21 years, regardless of initial establishment densities, the densities begin to converge, with high rates of mortality associated with high starting densities and low mortality (and even some ingress) associated with low starting densities.

Effects of precommercial thinning on aspen growth

At age 10, five years after spacing of the aspen, only the unthinned (natural) stands differed from the treated stands in top height (HT), DBH, slenderness (SLDR), or crown width. At age 10 height to crown base (HTLC) increased with increasing density but only the 200 sph and the natural densities differed significantly. At age 20 aspen mean top height was significantly lower in the unthinned (by 1.0 m or more) compared to the other densities. Strong and significant density related trends in DBH, SLDR, CW and HTLC are evident at age 20.

	9/10 years (11 LTS installations)		19/20 years (4 LTS installations)	
Treatment Density (sph)	**HT (m)**	**Tukey's**	**HT (m)**	**Tukey's**
200	6.16	B	11.31	A
500	6.87	A	11.47	A
1500	6.85	A	11.46	A
4000	7.03	A	11.81	A
Natural (unthinned)	6.22	B	10.30	B
	DBH (cm)	**Tukey's**	**DBH (cm)**	**Tukey's**
200	6.94	A	15.36	A
500	7.46	A	14.45	AB
1500	7.39	A	13.39	BC
4000	7.18	A	12.25	C
Natural (unthinned)	5.26	B	9.39	D
	SLDR	**Tukey's**	**SLDR**	**Tukey's**
200	0.92	B	0.75	D
500	0.92	B	0.80	CD
1500	0.93	B	0.86	C
4000	0.98	B	0.98	B
Natural (unthinned)	1.21	A	1.12	A
	CW (m)	**Tukey's**	**CW (m)**	**Tukey's**
200	1.20	A	2.42	A
500	1.25	A	2.24	AB
1500	1.25	A	2.06	BC
4000	1.21	A	1.87	C
Natural (unthinned)	0.90	B	1.41	D
	HTLC (m)	**Tukey's**	**HTLC (m)**	**Tukey's**
200	1.54	C	3.12	D
500	1.71	BC	3.40	CD
1500	1.69	BC	3.98	BC
4000	1.88	AB	4.64	AB
Natural (unthinned)	2.05	A	4.82	A



Effects of aspen density on spruce growth

At ages 10 and 20 (5 and 15 years after thinning of the aspen) spruce are shorter in the unthinned compared to the thinned plots. Spruce root collar diameter (RCD) declines with increasing aspen density at both 10 and 20 years, with the magnitude of differences becoming larger with age. Spruce height to diameter ratio (HDR) increases with increasing aspen density. It is interesting to note that the difference in HDR between the 4000 and natural aspen densities evident at age 10 has disappeared at age 20, due to crown closure in the 4000 sph plots and self-thinning in the natural. Treatment density is also resulting in significant differences in spruce crown width at age 20 (however effects on height to base of live crown and live crown ratio are small).

	9/10 years (11 LTS installations)		19/20 years (4 LTS installations)	
Treatment Density (sph)	**HT (m)**	**Tukey's**	**HT (m)**	**Tukey's**
0	1.44	A	4.14	AB
200	1.43	AB	4.23	A
500	1.46	A	4.35	A
1500	1.48	A	4.18	AB
4000	1.50	A	3.75	B
Natural (unthinned)	1.31	B	2.98	C
	RCD (cm)	**Tukey's**	**RCD (cm)**	**Tukey's**
0	3.06	A	9.57	A
200	2.96	AB	8.88	AB
500	2.82	BC	8.50	B
1500	2.71	CD	7.31	C
4000	2.48	D	5.75	D
Natural (unthinned)	1.95	E	4.51	E
	HDR	**Tukey's**	**HDR**	**Tukey's**
0	0.44	E	0.44	D
200	0.46	DE	0.49	C
500	0.49	D	0.52	C
1500	0.52	C	0.58	B
4000	0.57	B	0.65	A
Natural (unthinned)	**0.62**	**A**	**0.66**	**A**
	CW (m)	**Tukey's**	**CW (m)**	**Tukeys**
0	0.45	A	1.11	A
200	0.44	AB	1.08	A
500	0.45	A	1.11	A
1500	0.45	A	1.02	A
4000	0.46	A	0.89	B
Natural (unthinned)	0.41	B	0.70	C

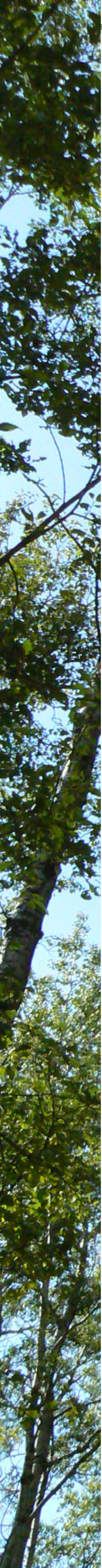
Conclusions

Data from four locations demonstrate that substantial variation can occur in initial aspen densities following clearcutting of aspen dominated stands. Re-measurement data also show that densities begin to converge after age 10 with the highest rates of mortality associated with high starting densities.

Results to date are consistent with expected responses to thinning. 15 years after spacing - aspen diameter and crown size decrease with increasing aspen density while slenderness increases. If they persist over time, increases in aspen crown size observed at the lower densities may reduce useable volume yield and may also increase physical damage (ie. "leader whipping") of the white spruce. These responses will be followed over the course of the study.

Aspen density is having significant effects on white spruce height, root collar diameter, hdr, and crown width. Spruce size and growth decline as aspen density increases. Except for effects on height and crown size, these effects were largely evident at age 10. HDR trends are similar at years 10 and 20, while the magnitude of treatment effects on diameter is greater at age 20. Observations indicate that crown biomass and branch size of the white spruce increase with increasing aspen density. The implications of this to spruce wood quality are being explored.

Long-term study data are being used in development and validation of the Mixedwood Growth Model (MGM), and will provide valuable quantitative information on the effects of precommercial thinning of aspen on stand dynamics and yield. We will also continue collecting supplementary data on these sites to improve our understanding of factors influencing mixedwood stand dynamics.



MGM Development

Mike Bokalo, Ken Stadt, Phil Comeau and Steve Titus

The development of MGM in 2011 focused a more user friendly user interface and on the migration of MGM to Visual Studio a professional software development platform that allows the integration of Excel with Visual Basic and C++ code. Under the new platform, MGM will be a compiled program which will be more portable, run faster and allow for better integration with other programs. The MGM documentation and model structure was ported over to a webpage that is more accessible and more easily maintained. The validation manuscript was submitted for publication to "Forests" and should be published in the fall of 2012. The validation compared model predictions against stand level data (average height, top height, DBH, volume, basal area and density) using 4 permanent sample plot databases; the ASRD mature PSPs and juvenile stand dynamics system plots (SDS), the juvenile WESBOGY LTS plots and the mature Saskatchewan PSPs. Residual plots and statistical tests (average mean bias, relative model bias, efficiency and equivalence testing) were used in the validation and show that the model validates well for both juvenile and mature stages of stand development for both pure and mixed species stands of aspen, spruce and lodgepole pine. In 2011, MGM presentions were made at several conferences including the Western Mensurationist's Conference in Banff, Alberta and a poster was presented at the North American Forest Ecology workshop in Roanoke, Virginia. The future plans for MGM development include: pursuing the approval of the model for use in management planning in Alberta, development of a "Best Practices" document for users and regulatory agencies, continued migration into Visual Studio, development of new jack pine and black spruce relationships, continued development and demonstration of MGM's capabilities to model different tending/treatments scenarios.

Modelling Understory Protection with MGM

In 2011 there was great interest in modelling and evaluating the future outcomes of different approaches of understory protection using MGM. The primary questions were:

1. Can MGM effectively model the complex stand structure created by understory protection harvesting?
2. How do the future yields from understory protection compare to natural stand development?
3. Can MGM develop composite yield curves for understory protection for use in management planning?
4. Does MGM show the expected aspen and white spruce responses?
5. Is the white spruce release response large enough to offset the area lost in carrying out understory protection harvesting.

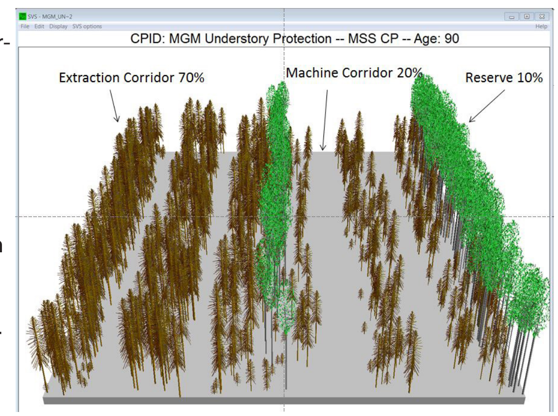


Figure 1: MGM Visuallization of a Strip Understory Protection Harvest

Figure 1 shows an MGM SVS image of the stand structure created after a strip understory protection harvest. This pseudo-spatial modelling approach accounts for the spatial arrangement of the sub-strata created: 1) the machine corridor, 2) the extraction corridor (spruce are protected) and 3) the retention corridor (aspen and spruce are left behind as a wind break). Figure 2 compares the natural stand development of spruce to the different area weighted yields from the machine corridor, the extraction corridor and the retention strip. The composite area weighted yield curve (Figure 3) shows that the future spruce yield from understory protection approaches the yields that would have been obtained under natural stand development. This is in part is due to the response of white spruce to the release from the aspen overstory. The analysis showed that there are many unknowns/assumptions (ie. post harvest natural regeneration and the loss due to harvest damage and blowdown) that must be estimated to accurately model these systems. Future modeling will use the MGM Adjaceny model to explore the effects of surrounding trees on growth of both spruce and aspen in removal strips and skid trails.

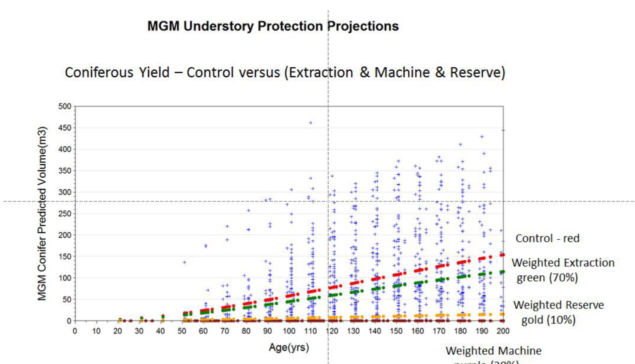


Figure 2:

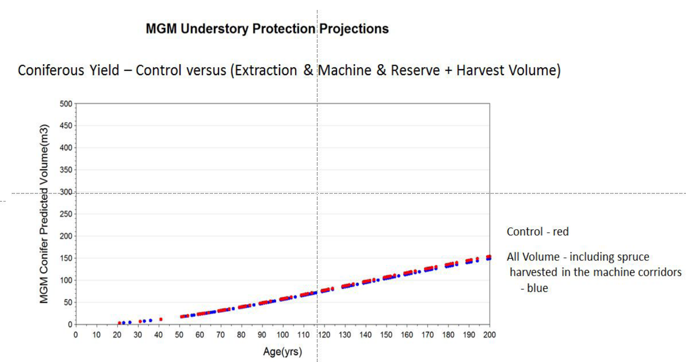


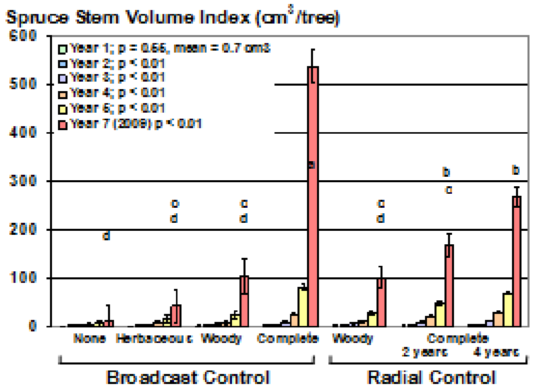
Figure 3:

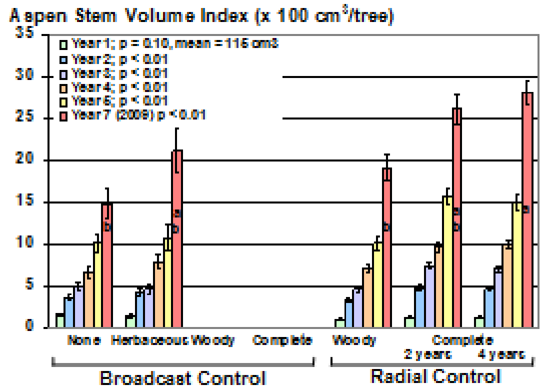
Effects of Herbaceous and Woody Vegetation Control on Early Boreal Mixedwood Stand Development (The Judy Creek Mixedwood Study)

Doug Pitt, Phil Comeau, Dan MacIsaac, Milo Mihajlovich,Michael Hoepting and Susan Humphries

In 2002 we initiated this study at Judy Creek to examine effects of planting spruce at 5-m spacing, tending them individually with 2-m radial treatments, and leaving aspen to regenerate naturally in the intervening area between the spruce. We also compared the effects of controlling only the woody component against control of both woody and herbaceous vegetation for 2 and 4 years after planting. The site is located 30 km northeast of Whitecourt Alberta Canada (54°03' N, 115°36'W; elevation: 1000 m).

At age 7 the best growth of spruce was observed in the broadcast complete control treatment. Radial treatments and herbaceous control have both resulted in increases in average stem volume index. Radial complete control treatments have also resulted in improved spruce growth compared to untreated. Removing only the woody vegetation stimulated herbaceous competition and reduced survival and growth of spruce. Untended plots contained the smallest spruce and aspen in the study. In 2008 and 2011 browsing by snowshoe hare has substantially reduced size of spruce in the untended and broadcast herbaceous control plots. Tenth year remeasurement and scheduled thinning treatments are planned for the summer and fall of 2012.





A detailed discussion of results is available in: Pitt, D.G., P.G. Comeau, W.C. Parker, D. MacIsaac, S. McPherson, M.K. Hoepting, A. Stinson, and M. Mihajlovich. 2010. Early vegetation control for the regeneration of a single-cohort, intimate mixture of white spruce and trembling aspen on upland boreal sites. Can. J. For. Res. 40: 549-564.

Aerial view of the Judy Creek research site

Modelling branching characteristics, ring density, and wood stiffness of aspen (Populus tremuloides) and white spruce (Picea glauca) in the western Canadian Boreal Forest

Derek Sattler, Phil Comeau and Alexis Achim

Stand density and composition have substantial effects on wood quality through their influences on crown and branch size, growth rates, stem form, and the size of the juvenile wood core. At present, our knowledge of the intrinsic and extrinsic factors that determine crown architecture of white spruce and aspen is limited. Moreover, models that relate crown morphology to wood quality characteristics for these species could increase the efficiency of wood fiber utilization by providing advanced knowledge of key wood quality traits.

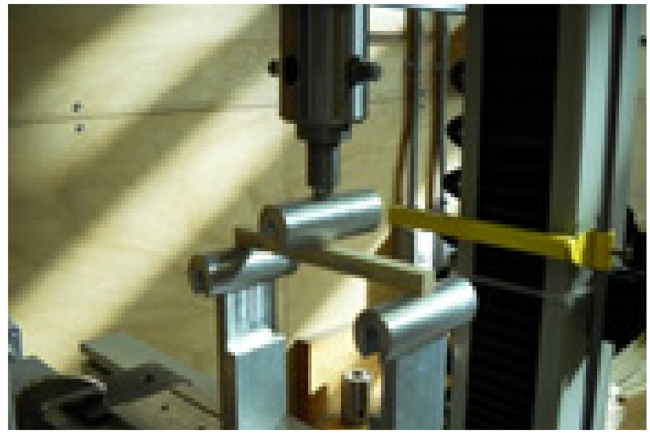


Figure 1. Bending tests to determine wood stiffness. A key wood quality trait being examined as part of the PhD study.

Preliminary analyses of radial patterns of wood stiffness in white spruce have been completed. Key findings to date are:

- It is possible to identify trees that are likely to produce high wood stiffness (i.e., high MOE) at a young age. Trees with high rates of increase in MOE during the juvenile stage tend to have overall high values of MOE when mature.
- Species composition within the stand influences the rate of increase and maximum MOE attained. White spruce in stands where roughly 20-40% of the total basal area is aspen had the highest MOE values at the juvenile and mature stages of tree development.
- Radial changes in wood stiffness followed more closely with an increase in distance from the pith than cambial age.
- Results are being used in development of models predicting radial patterns of MOE for individual trees and for populations of trees which will be useful in managing stands for wood quality, and by mill operators in maximizing recovery of high quality wood.

Funding for this study is being provided by the ForValueNet NSERC Strategic Network. More information on ForValueNet is available at: http://www.forvaluenet-foretvaleur.ca/

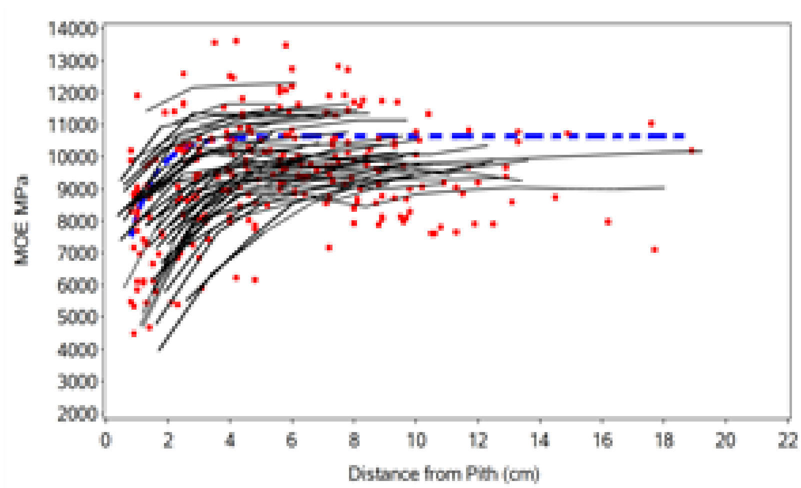


Figure 2. Model predictions of radial patterns of MOE in white spruce. Blue line is population a`verage, black lines are individual trees.

The use of LiDAR, Wet Areas Mapping (WAM) and 3D Aerial Photography in representing Stand Structure and Unproductive Gaps in Forest Stands

Mike Bokalo, Phil Comeau, Barry White and Dan Jensen

In Alberta the forest landscape is represented by Alberta Vegetation Inventory (AVI) polygons which use map type calls based on canopy cover class, species composition, polygon height, and origin to delineate the landscape. These AVI inventory polygons are often considered homogeneous and consistent with the biological definition of a stand, but in reality they are heterogeneous entities formed from many differently stocked sub-stands that on average represent the AVI forest stand structure. The homogeneity assumption is problematic when estimating yield since unproductive gaps, whether they are persistent (rock, water or wet areas), or are caused by stochastic biotic and abiotic events such as windthrow, insects and disease, decrease yield.

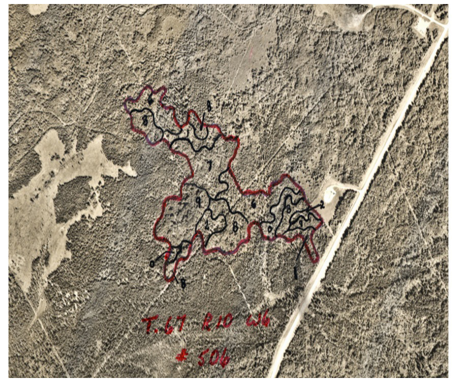
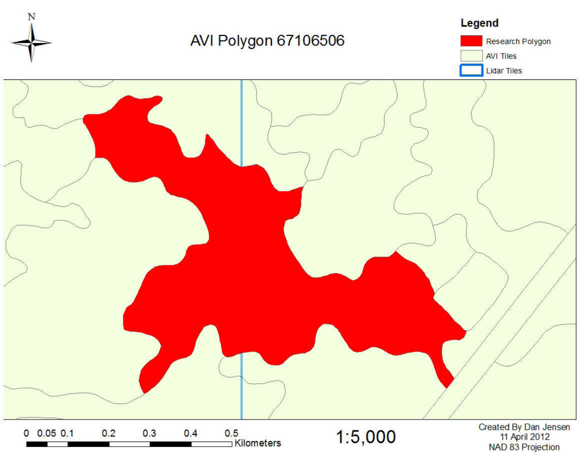


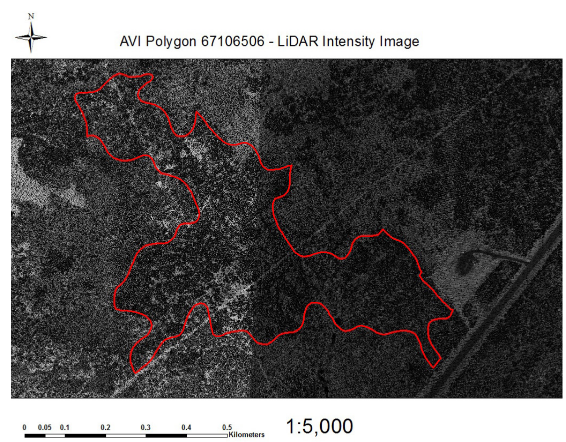
Photo of stand 506 in 10% canopy cover classes

LiDAR and Wet Areas Mapping (WAM) in Alberta has come to a point where the resolution may be sufficient to identify and estimate the percent area within a stand that is contained in unproductive or unmerchantable gaps and whether these gaps are related to topography and seasonal flooding. These estimates could then be used operationally, to directly adjust estimated yield into ranges that are indicative of the landscape level yields found in natural stands.

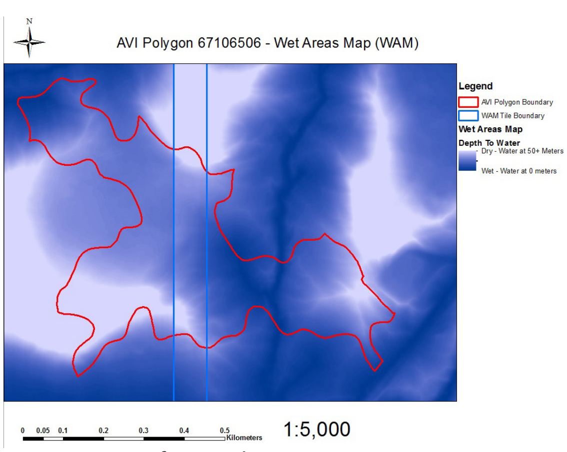
This project is evaluating methods for using LiDAR, WAM and 3D – Photography to quantitatively estimate and validate the percent gaps and forest structure in a sample of stands in Alberta. Results will highlight regional applicability of LiDAR and WAM and identify areas for future research while providing important information supporting sustainable forest management. This project Funded by Alberta Sustainable Resource Development



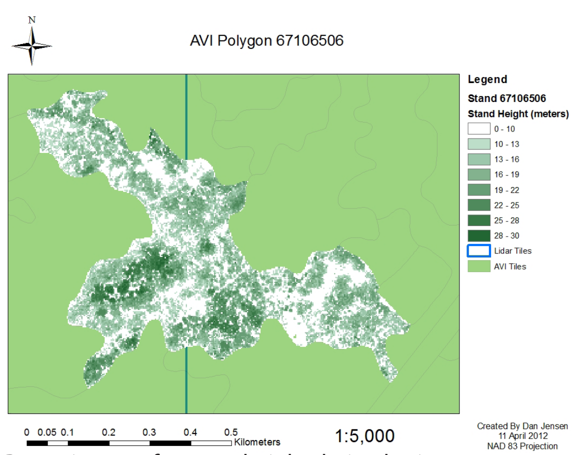
AVI boundaries for stand 506



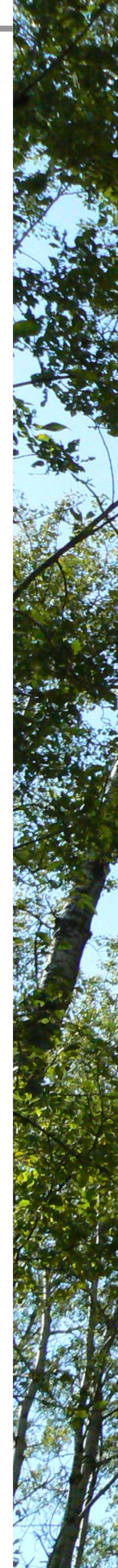
LiDAR Intensity for stand 506



Wet Areas Map for stand 506



Raster image of canopy height derived using LiDAR for stand 506



Application of LIDAR in Forest productivity estimation

Introduction

Accurate determination of site index is critical to determining potential yield of regenerating stands and is a key input into growth and yield models used in Alberta. However, determining site index in spruce or aspen stands that are less than 15 years of age is problematic. While site index could be estimated from measurement of the original preharvest stand, this may be inaccurate due to: 1) the advanced age of the original aspen regeneration on the site (making accurate age determination problematic due to decay); and, 2) the fact that naturally regenerated spruce are rarely dominant but instead grow up under aspen and other vegetation during the first 60 to 80 years after regeneration. The use of ecological information, including both climatic and site factors, is being pursued in other areas. However, reliance on ground based assessments or predictive ecosystem mapping has limited its use. LIDAR and Wet Areas Mapping (WAM) may provide cost effective ways to obtain the needed ecological information, but while prelimary evaluations show that this approach is promising, it does need further development and testing.

With support from Alberta Environment and Sustainable Resource Developmen (2012-2014) we are undertaking two projects to explore application of LIDAR in the estimation of site index.

A. High precision prediction of site index and future yield by use of wet areas mapping and full feature LiDAR
Phil Comeau (Univ. of Alberta), Mike Bokalo (Univ. of Alberta), John Nash (Greenlink), Daniel Chicoine (Incremental Forest Technologies) and Barry White (Alberta SRD).

Objective: The objective of this project is to evaluate the potential to use Alberta's extensive wet areas mapping and full feature LiDar datasets to estimate site index of aspen and spruce sites.
Approach: For this study we are using measurements collected at Alberta WESBOGY Long Term Study (LTS) sites (7 installations over 18 years old; 225 plots), Judy Creek Mixedwood research trial plots (40 plots, trees now 10 years old) and at other selected sites.

Site Index will be determined for Aspen and white spruce using measurements available for each site.

To verify the effectiveness of depth to water table measurements provided by WAM for estimating root zone soil moisture we will utilize data from existing microclimate stations installed at Judy Creek, and at the Fawcett Lake LTS site, and we will install microclimate stations to measure soil moisture in 5 selected plots at each of 7 selected installations (DMI Hines Creek, DMI Manning, SRD Fawcett Lake, Alpac, West Fraser Edson, Weyerhaeuser Grande Prairie) (treatments 1 (1000 spruce+0 aspen), 4 (1000 spruce+1500 aspen) and 6 (1000 spruce + natural-unthinned aspen), 13 (0 spruce+1500 aspen), and 15 (0 spruce + natural aspen). Daily volumetric soil moisture measurements will be collected at 15 cm depth in each instrumented plot and used to estimate degree and duration of drought at each site for comparison to WAM based estimates.

B. Prediction of future forest productivity and silvicultural challenges using Full Feature LiDAR, Wet Areas Mapping and Landform: A case study using the 1968 Marten Hills Fire
Phil Comeau (Univ. of Alberta), Mike Bokalo (Univ. of Alberta), John Nash (Greenlink), and Barry White (Alberta ESRD)

Objective: To evaluate the potential to use depth to watertable as well as slope, aspect, macro- and meso-slope position as informed by LiDAR to estimate soil moisture regime, aspen and spruce site index and competing vegetation potential.

Approach: For this study we will utilize data from in the 1968 fire in S17 with supplemental field sampling. We will use detailed inventory data based on LIDAR and 30cm digital photography, as well as field sampling to verify inventory estimates of site index.
A second part of this study will explore relationships between WAM estimates of soil moisture regime and the need for vegetation management treatments. This will involve selecting cutblocks and portions of cutblocks in the Slave Lake – Marten Hills area that have recently received vegetation management prescriptions (but which have not yet been treated) and examining relationships between soil moisture regime and species composition, cover and height of vegetation.

Results from these studies will form the basis for two M.Sc. theses and at least 2 papers in peer reviewed journals. Results will be presented to collaborating agencies and others as they become available.

Assessing site preparation effects and modelling long-term growth in Saskatchewan white spruce plantations

Phil Comeau, Mike Bokalo, and Kirk Johnson

Project Funded by Saskatchewan Ministry of Environment

In the boreal mixedwoods, mechanical site preparation (MSP) and subsequent tending are often used to establish white spruce (Picea glauca) plantations. These establishment techniques encourage plantation success through micro-site creation and competition reduction. Furthermore, MSP and tending can expedite stand establishment and forest succession: influencing growth rates, rotation length, and landscape management decisions. Given site preparation's critical role, how does MSP influence white spruce growth? Moreover, what are the long-term effects of MSP on spruce performance and stand dynamics, and how can these long-term outcomes inform forest planning? In 2011 and 2012, 16 juvenile white spruce plantations (13-18 years old) and 18 juvenile white spruce PSP's (20-29 years old) were sampled across the Prince Albert Forest Management Agreement of north-central Saskatchewan. Using these measurements, white spruce growth will be compared between 3 MSP treatments (disc trenching, bracke mounding, and v-blade scarification) and 1 combination MSP/tending treatment (disc trenching + thinning). Stand growth will then be projected using the Mixedwood Growth Model (MGM), assessing long-term treatment outcomes and MGM's performance modeling juvenile growth.

Further analyses will examine the application of historic Saskatchewan Regeneration Assessments to predict current forest conditions and inform MGM projections for long-term forest planning. Final data collection concluded in June 2012. Data management and analysis are ongoing. Target project completion set for early spring 2013.

26 year old managed stand PSP in Saskatchewan

Publications from the WESBOGY LTS

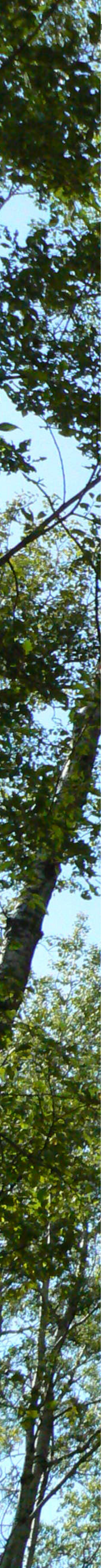
Bokalo, M., P.G. Comeau and S. J. Titus. 2007. Early development of tended mixtures of aspen and spruce in western Canadian boreal forests. For. Ecol. Manage. 242, 175-184.

Cortini, F., P.G. Comeau and M. Bokalo. 2012. Trembling aspen competition and climate effects on white spruce growth in boreal mixtures of Western Canada. Forest Ecology and Management 277:67–73.

Filipescu, C.N. and P.G. Comeau. 2007. Aspen competition affects light and white spruce growth across several boreal sites in western Canada. Can. J. For. Res. 37: 1701-1713.

Filipescu, C. and P. Comeau. 2011. Influence of Populus tremuloides density on air and soil temperature. Scand. J. For. Res. 26:5, 421-428.

Voicu, M. and P.G. Comeau. 2006. Microclimatic and spruce growth gradients adjacent to young aspen stands. Forest Ecol. Manage. 221: 13-26



Graduate Students Working on Projects in the Western Boreal

Valentin Reyes-Hernandez (PhD) - Stand Density Index and its relationships with productivity and understory vegetation in the boreal mixedwoods in Western Canada

Hongan Yan (PhD) - The effects of competition control treatments on white spruce (Picea glauca [Moench] Voss) height and diameter growth

Derek Sattler (PhD) - Effects of density, species composition, age, and tree dimensions on wood quality for aspen and white spruce in boreal mixedwoods of western Canada (FORVALUENet Project 1.2)

Diana Osika (MSc) - Reconstructed Height Growth Trajectories of White Spruce Following Hardwood Release

Claudia Rivera-Rios (PhD) – Role of understory vegetation and effects of management practices on C cycling and sequestration in boreal mixedwood ecosystems

Kirk Johnson (MSc) – Influence of silviculture on the successional dynamics of mixedwood stands

Dan Jensen (MSc) – The use of Lidar and Wet Areas Mapping (WAM) in representing Stand Structure and Unproductive Gaps in Forest Stands

2011 WESBOGY Annual Fall Meeting
Peace River, Alberta
October 4th and 5th

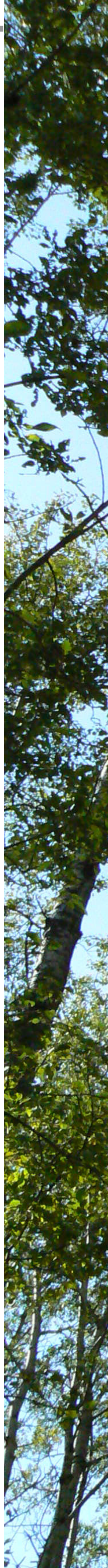
Sponsored by Daishowa-Marubeni International Ltd.

October 4th
Modeling Understory Protection Harvesting with MGM - Mike Bokalo
Moderated Discussion on Understory Protection Harvesting – Phil Comeau
MGM Update - Mike Bokalo
Dade Installation Update - Willi Fast
Retrospective analysis of competition in midrotation stands. - Jianguo Huang
Graduate Student Research Presentations
WESBOGY Research

WESBOGY Business Meeting – (3:30 – 5:00)

Evening Dinner - Sawridge Hotel (6:00)

October 5th - Field Tour - Florance Niemi (DMI)
Understory Protection
Lunch at Peace Country Ventures Camp
Tree Improvement Test Site
Murdoch Lake Agroforestry Demonstration Site



Planned WESBOGY Meetings in 2012

The 2012 Annual Spring Meeting is planned for May 31st , 2012 on the University of Alberta campus. The 2012 Annual Fall Meeting will be sponsored by Louisiana Pacific Manitoba, Swan River MB on September 11th and 12th, 2012.

History of WESBOGY Meetings

Date	Sponsor	Location
2011 Oct 4-5	Daishowa-Marubeni International Ltd	Peace River
2010 Sept 14-15	Manning Diversified Forest Products	Manning, AB
2009 Sept 15-16	University of Alberta	Whitecourt, AB
2008 Sept 8 -10	Alberta Plywood	Slave Lake, AB
2007 Sept 4-6	Alberta-Pacific Forest Industries	Lac La Biche, AB
2006 Aug 29-Sept 1	Louisiana Pacific Canada Ltd.	Dawson Creek, BC
2005 Aug 29 - Sept 1	Northwest Territories Resources, Wildlife and Economic Development	Hay River, NWT
2004 Aug 30 - Sept 1	Saskatchewan Environment – Forest Service	Prince Albert, SK
2003 Sept 9-11	Canadian Forest Products Ltd.	Grande Prairie, AB
2002 Sept 9-11	Louisiana-Pacific Canada Ltd.	Riding Mountain, MB
2001 Sept 9-11	Daishowa-Marubeni International Ltd.	Peace River, AB
2000 Sept 6-8	Weyerhaeuser Company, Drayton Valley	Edson, AB
1999 Sept 23-25	Weyerhaeuser Company, Prince Albert	Anglin Lake, SK
1998 Oct 7-9	Alberta-Pacific Forest Industries Ltd.	Athabasca, AB
1997 Oct 7-9	British Columbia Ministry of Forests	Dawson Creek, BC
1996 Nov 6-8	Daishowa-Marubeni International Ltd.	Peace River, AB
1995 Oct 11-13	Weldwood of Canada Ltd.	Hinton, AB
1994 Oct 12-14	Weyerhaeuser Company, Alberta Forestlands	Big River, SK
1993 Nov 4	University of Alberta	Edmonton, AB
1992 Oct 6-7	Weyerhaeuser Company, Grande Prairie	Grande Prairie, AB
1991 Oct 24-25	Weyerhaeuser Company, Prince Albert	Prince Albert, SK
1990 Nov 22	University of Alberta	Edmonton, AB
1989 Mar 15	Canadian Forest Service	Saskatoon, SK
1988 Nov 4	Canadian Forest Service	Whitecourt, AB
1998 Feb 4-5	Canadian Forest Service	HInton, AB
1987 Mar 27	Canadian Forest Service	Edmonton, AB
1986 Feb	Canadian Forest Service	Edmonton, AB
1985 Nov 15	Canadian Forest Service	Edmonton, AB
1985 Oct 24	Canadian Forest Service	Banff, AB
1985 Mar 23	Canadian Forest Service	Edmonton, AB

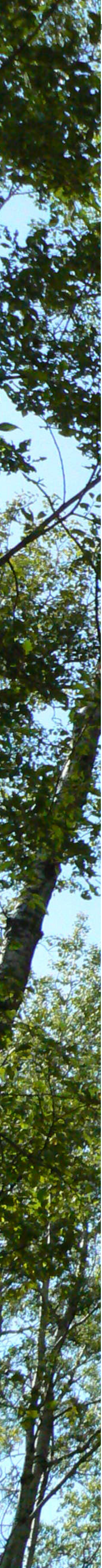
WESBOGY Website and Sharepoint Site

With the assistance of Judy Huck (U of A, Department of Renewable Resources Webmaster / Multimedia Technician) our new website is up and running. Changes include: having our own web address, a secure members area, and inclusion of both historical and current documents in readily accessible formats.

Check out our:

WEBSITE at: http://www.rr.ualberta.ca/Research/WESBOGY.aspx

Sharepoint Site at: https://portal.ales.ualberta.ca/wesbogy/default.aspx



WESBOGY Financial Summary For 2011-2012

Description	Budgeted Amount	Actual Expenditures	Difference
Salaries & Benefits			
Research Scientist	$80,000.00	$79,254.00	$746*
Field and office tech support	$12,000.00	$15,651.00	-$3,651.00
Grad students	$5,500.00	$0	$5,500.00
Professional (Programmer / Analyst)	$10,000.00	$10,400.00	-$400.00
Travel (Wesbogy Meetings, travel & Judy Creek)	$7,000.00	$8,488.00	-$1,488.00
Supplies, Equipment, Communication	$5,000.00	$4,901.00	$100.00
Overhead (15% of member contributions)	$18,750.00	$18,750.00	$0
TOTAL	$138,250.00	$137,444.00	$806.00
Balance at March 31, 2012			
Opening Balance April 1, 2011		$179,570.00	
Accounts Receivable (March 31, 2012)		$0	
Member Contributions (Jan-March 2012)		$125,000.00**	
Total Expenditures 2011/2012		$137,444.00	
Balance at March 31, 2012		$167,126.00	
WESBOGY - Budget for 2012/13			
Description	**Amount**		
Salaries & Benefits			
Research Scientist	$78,000.00		
Field and office tech support	$12,000.00		
Grad students	$4,000.00		
Professional (Programmer/Analyst)	$10,000.00		
Travel (Wesbogy Meetings, travel & Judy Creek)	$8,500.00		
Supplies, Equipment, Communication	$6,000.00		
Overhead (15% of $137,500)	$20,625.00		
TOTAL	$139,125.00		
Projected Balance at March 31, 2013			
Opening Balance April 1, 2012		$167,126.00	
Accounts Receivable		$12,500.00	
Member Contributions (in Jan-March 2013)		$137,500.00	
Expenditures 2012/2013		$139,125.00	
Account adjustment for double counting of ASRD 2010 contribution		-$10,625.00	
Estimated Balance at March 31, 2013		$154,876.00	

* Additional $8,800 comes from U of A for Mike's lectures in FOR 210

**CFS dues for 2012 received in 2010 and already included in opening balance

Company or Agency	Contact	Email
Alberta Sustainable Resource Development	Dave Morgan (780) 422-5295 Darren Aitkin (780) 644-5581	Dave.Morgan@gov.ab.ca Darren.Aitkin@gov.ab.ca
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Daishowa-Marubeni International Ltd.	Gord Whitmore (780) 624-7036 Florance Niemi (780) 624-7048	GWhitmore@prpddmi.com FNiemi@prpddmi.com
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Louisiana-Pacific Canada Ltd., Dawson Creek	Adam Campbell (250) 782-3302 ext 223 Rod Brooks (250) 782-3302 ext 239	Adam.Campbell@lpcorp.com Rod.Brooks@lpcorp.com
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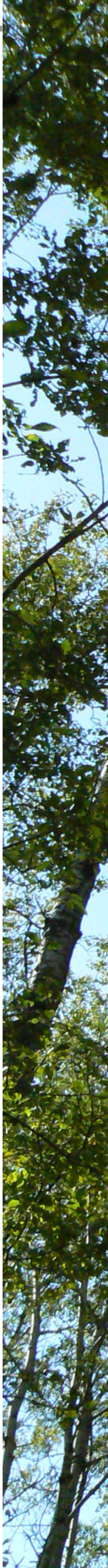
Wood Fibre Centre, Canadian Forest Service, Natural Resources Canada	Dan MacIsaac (780) 435-7332 Derek Sidders (780) 435-7355	Dan.MacIsaac@NRCan-RNCan.gc.ca Derek.Sidders@NRCan-RNCan.gc.ca



Western Boreal Growth & Yield Association (WESBOGY)

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University of Alberta
751 General Services Building
Edmonton, Alberta T6G 2H1

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www.ales.ualberta.ca/rr/Research/WESBOGY.aspx

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