



Forest Ecosystem Science Co-operative Inc.

Forest Co-op
“Boreal Forest Permanent Growth Plot
Program”

Final Report

Living Legacy Trust
(LLT Project No. 04-004)

April 30, 2004



Forest Ecosystem Science Co-operative Inc.

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Introduction

The Forest Ecosystem Science Co-operative Inc. (Forest Co-op) is an incorporated not-for-profit co-operative partnering industry, business, government, research institutes, and other organizations/institutions concerned with forest ecosystems. Our organization is committed to supporting the development and provision of scientific and technical knowledge that will contribute to the implementation of the best ecosystem management practices possible and thus ensure the environmentally sustainable development of renewable resources in the forest ecosystem.

The Forest Co-op Growth and Yield Business Unit (Forest Co-op GYBU) was established in 1999. Its mandate is to facilitate and standardize both the collection of stand-level data and the development of estimation tools that provide the means to accurately portray the growth and yield of commercial forests in Ontario.

The objectives of the Forest Co-op “Boreal Forest Permanent Growth Plot Program”, undertaken by the Forest Co-op GYBU, were:

- a) to complete the network of boreal permanent growth plots (PGP) for both natural and managed (IFM) forest conditions;
- b) to standardize growth and yield data collection methodologies across the boreal and maximize sampling efficiencies; and
- c) to create a shared accessible database and forest information system that fully integrates with other existing natural resource databases.

Program Implementation Plans

The Forest Co-op GYBU has built a framework for ongoing, collaborative work in forest growth and yield (G&Y) in Ontario — work that might not otherwise be undertaken if left to singular proponents. Through the Forest Co-op GYBU, resources are pooled and members collectively facilitate co-operative sampling and analysis. Components of the program include:

1. Preliminary Screening
 - candidate stand types are selected within the provincial stratification matrix
 - a random plot centre within each stand is selected
 - all office source materials are amassed and evaluated (FRI, photos, silvicultural records etc.) and
 - the boreal stratification is reviewed for sampling priority.
2. Training Procedures
 - all crews working on the program must go through a standardized training course that encompasses all aspects of the fieldwork to be completed
 - training includes use of equipment, filling out tally sheets, plot layout, safety, quality assessment, data entry and validation.
3. Location
 - organize groups of candidate stands into logical work areas
 - field visit to candidate stand to validate stratification
 - record stratification field information
 - begin plot measurement if selection criteria are met
4. Measurement
 - establish plot centre of 400 m² circular plot
 - define soils, vegetation, ecosystem classification and structural class to standardized methodology
 - obtain photo record and GPS location
 - diameter of all trees greater than 2.5 cm
 - sub-sample of all species by diameter class for heights and ages
 - apply damage and structural codes to each tree
 - measure and code all mortality within plot
 - permanent numbering of each tree (paint or tag)
 - mark plot centres and boundaries
 - check tallies and ensure plot completeness
 - ensure maps and plot package complete to hand into Quality Assessment team
5. Quality Assurance
 - every plot has a standardized quality assurance procedure applied to it
 - procedure samples a sub-section of all components of the plot
 - any variation from the minimum sampling standards is recorded and fixed
 - crew re-training on areas with re-occurring errors is required
 - a plot is not considered complete until it has received a quality assurance check.
6. Data Validation and Management
 - once a plot is complete, it is handed into the data manager for input and validation
 - validation consists of checking the electronic files for data entry errors and any measurement errors or omissions
 - data is then housed in a standardized relational database that has been designed to capture all growth and yield work being done in the province.

Year 1 (2000-2001)

In Year 1 of the “Forest Co-op Boreal Permanent Growth Plot Program” (April 1, 2000 - March 31, 2001), a total of 273 (two hundred and seventy-three) PGPs were established across a range of sites and stand conditions in both natural and managed forests. The location of PGPs on the landbase during this field season was relatively simple as very few existed and duplication of site and stand conditions were not an issue. However, it became apparent that greater effort would be required in future years to control PGP placement as the cells in the stratification matrix started to fill. This would have cost implications in PGP establishment for 2001-02 and beyond.

Year 2 (2001-2002)

In Year 2 (April 1, 2001 – March 31, 2002), 361 (three hundred sixty-one) PGPs were established and 20 (twenty) plots were located for completion in Year 3 field season. The Forest Co-op Project Co-ordinator was hired in this year with the majority of his workload dedicated to the database management of this program. Data repository and data analysis work commenced in this year and the development of the field manual, entitled “Forest Co-op Field Manual for the Location & Measurement of Permanent Growth Plots” was well underway. These items are discussed further in the “Knowledge Gained and Technology Transfer” section of this report. (see page 4)

Year 3 (2002-2003)

A total of 366 (three hundred thirty-six) PGPs were established in Year 3 (April 1, 2002 – March 31, 2003). This included the 20 plots that were located in Year 2 field season. Data management and data analysis work was on-going and the Forest Co-op field manual was updated.

Year 4 (2003-2004)

In Year 4 (April 1, 2003 – March 31, 2004) of the Forest Co-op “Boreal Permanent Growth Plot Program”, 393 (three hundred ninety-three) PGPs were established, as in all years, across a range of sites and stand conditions in both natural and managed forests. Data management and data analysis work continued and further Forest Co-op field manual revisions were incorporated based on fieldwork experience.

Four-Year (2000-2004) Overview

Through the course of 4 (four) field seasons of the Forest Co-op “Boreal Permanent Growth Plot Program”, 1,393 (one thousand, three hundred ninety-three) PGPs have been established across the Province of Ontario. This is an additional 40 (forty) plots over the 1,353 (one thousand, three hundred fifty-three) plots originally targeted.

In addition, some 400 (four hundred) PGPs have been established through the Forest Co-op GYBU over the past four years at a rate of approximately 100 (one hundred) PGPs per year. While this effort is all part of the Forest Co-op GYBU, it is not included in the reports of the Forest Co-op “Boreal Forest Permanent Growth Plot Program” to Living Legacy Trust. Instead, it is reported to LLT through a separate agreement with the collaboration of Tembec Inc./Forestry Research Partnership and the Ontario Ministry of Natural Resources.

All plots established are compatible. The protocol for establishing growth plots was fashioned after an OMNR Permanent Sample Plot manual and thus the growth information in the OMNR database can be used interchangeably with the newly established PGPs.

The plots have been directed to fill a matrix of species, age and management conditions. Matrices of plots established (both year 4 [2003-2004] and all 4 years combined [2000-2004]) are included in Appendix 1 – Stratification and Plot Count. These matrices are useful for identifying where further plots should be established and where there are sufficient plots. As the data is used to extrapolate forest growth, more will be learned about the minimum number of plots needed to realistically give accurate predictions.

In addition, Appendix 2 – Plot Location illustrates the distribution of the plots over the eco regions of Ontario. It is important to have a relatively uniform distribution that will take into consideration the variance that occurs in the broad landscape.

Knowledge Gained and Technology Transfer

Both G&Y PGP digital and paper data are now stored in-house at the Forest Co-op office. A Forest Co-op G&Y PGP database has been established to hold all of the digital plot data following validation and cleaning. A paper library of all the original data has also been created. Development of a program for generating detailed G&Y PGP summary fact sheets for each plot in the Forest Co-op GYBU program is in progress and the resultant product will be available through the Forest Co-op office. Each plot will have a summary sheet that briefly described the plot characteristics including gross and net volume, diameter distribution, and stand structure. An example of the fact sheets is attached in Appendix 3 – Sample Fact Sheet. These sheets are most useful when validating and adjusting yield curves for the Forest Management Planning that occurs every 5 years for all Sustainable Forest Licenses. The summary sheets also provide a quick reference of the forest condition at that plot at a particular point in time.

The analysis of PGP data collected through the Forest Co-op GYBU and the Forest Co-op G&Y PGP program is continuing along a number of fronts. Data is being used, under contract, for yield curve analysis by Dr. Margaret Penner. The data was used in a project to adjust yield curves for a sub-unit of stands that had suffered severe budworm infestations in the Longlac Forest. The data will be used by the OMNR in their recently approved progrid project to develop standard benchmark yield curves for northwest Ontario. This data will be the basis for growth and yield work well into the future. The Forest Co-op GYBU has linked plot data with a GIS system and is developing a website for ease of user access and review in conjunction with the historic plot project.

Through the Forest Co-op GYBU, a field manual that documents procedures for plot location, establishment and data standards has been developed and undergoes regular reviews and updating based on field season experience and new knowledge. The manual, entitled “Forest Co-op Field Manual for the Location & Measurement of Permanent Growth Plots” was most recently updated in April 2004 by the Forest Co-op GYBU partners for the 2004-05 field season in the area of plot re-measurement. Developed through the Forest Co-op “Boreal Forest Permanent Growth Plot Program”, this manual is designed as a subset of the OMNR Provincial Reference Manual. The OMNR plots will supplement the network and provide a more comprehensive coverage of the forested area of Ontario.

The Forest Co-op GYBU partners have a free and open data-sharing protocol. Given the long-term nature of growth & yield programs, a data repository is required. All information generated from the data will be available to all resource managers in Ontario, including the public. Products and information will be incorporated into Forest Management Plans, a public document. Initially, raw data will need to stay within the Forest Co-op GYBU until enough is collected to give it context. However, stand and Forest Unit-level summaries will be generated annually and available to all. As the Forest Co-op GYBU programs progress, it is the plan to make this information available on-line.

Forest Co-op Partnership and Implementation Team

Members of the Forest Co-op GYBU include:

Organization

Abitibi-Consolidated Co. of Canada (NW)
Abitibi-Consolidated Co. of Canada (Iroquois Falls)
Bowater Canadian Forest Products Inc.
Domtar Inc.
Forest Ecosystem Science Co-operative Inc.
Kimberly-Clark Inc.
Lake Abitibi Model Forest
Ontario Ministry of Natural Resources

Tembec Inc. (Canadian Ecology Centre)
Tembec Inc. (Spruce Falls)
Weyerhaeuser Company Ltd.

Representative

Paul Poschmann, Bruce Nichols
Rod Gemmell, Rob McLeod
John Lawson
Brian Nicks, Kandyd Szuba
Dianne Miller, Dave Wood
Ken Lennon
Sue Parton
Scott Jones, Mark Roddick,
Murray Woods, John Parton
George Bruemmer, Al Stinson
Jeff Leach
Janet Lane

The representatives listed above bring varied skills and expertise to the team and cover the continuum from field operations through to applied and basic science. In addition, the Forest Co-op GYBU brings in outside expertise to consult in specific areas (eg. specialized consultants, provincial and federal scientists etc.) Sumac Forest Information Services Ltd. was contracted to conduct the majority of the plot location and establishment field services for this program. Data management and financial and administration management services were provided by the Forest Co-op Project Co-ordinator and Forest Co-op General Manager respectively.

Summary

The Forest Co-op GYBU, through the Forest Co-op “Boreal Forest Permanent Growth Plot Program”, has established a highly successful, provincial network of growth plots. These plots will contribute enormously to the knowledge of forest dynamics in Ontario. It will be the foundation upon which forest modeling in Ontario will be built in the future. While other plot networks exist across Canada, this is more extensive and unique in the fact that it was built through a partnership of industrial organizations and government agencies. The input of funding by the Living Legacy Trust was the stimulus to move ahead rapidly with plot installation. In addition, this program has set the model for co-operative directed science and has spawned several self-funded partnership projects utilizing data generated by the Forest Co-op G&Y PGP Program.

The Forest Ecosystem Science Co-operative Inc. and its many partners acknowledge, with gratitude, the outstanding work of the partner representatives involved in the Forest Co-op Growth & Yield Business Unit as well as their respective staff members and the contractors who have contributed significantly to this program in fieldwork planning and implementation. Particular recognition is extended to David Archibald, Mark Roddick and Janet Lane for their guidance, expertise and time in evolving this program, to Dave Wood for his major contribution to growth and yield data management and to Dave Carr and Todd Domney for donating technical support time and knowledge. The support of Living Legacy Trust is also recognized with appreciation. The collaboration of all program partners has contributed to this highly successful initiative.

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Stratification & Plot Count

Plot location for the Forest Co-op “Boreal Forest Permanent Growth Plot Program” follows the provincial Growth and Yield stratification design. This allows for the data gathered to be accumulative in value with the provincial growth and yield effort being undertaken. The basis for the design is the standard forest units that have been defined within the forest management planning process. From there the plots are broken down further by serial stage, productivity and management regime. This keeps the data in line with the sampling design being utilized by the province and allows for information gains and product development to take place at a larger scalable level as well as maximizing the local information gain. The provincial land base has been subdivided in to ecological regions and administrative regions and forest management units (FMU’s). A multi-scaled summary was conducted to analyze proportional distribution of the forest units by these groups to aid in the sampling effort. There is a trend to proportion a greater number of plots into managed stand conditions due to an increased interest by the industrial partners in quantifying the effects of various levels of silvicultural intensity on future wood supply. However, ongoing efforts are being made to address gaps in the ecological matrix, recognizing that cost implications need to be considered.

Year 4 (2003 – 2004) PGP Totals

PGP Establishment by Dominant Forest & Management Type					
Species	Northeast		Northwest		Totals
	Artificial	Natural	Artificial	Natural	
At	1	15	11	40	67
Bf	2	10	2	5	19
Bw	0	12	1	4	17
Cw	0	1	0	4	5
Pb	0	0	0	1	1
Pj	3	12	54	66	135
Pr	0	1	2	3	6
Pw	0	3	0	1	4
Sb	10	20	46	51	127
Sw	0	5	6	1	12
	16	79	122	176	393

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Stratification & Plot Count

Year 1 – 4 (2000-2004) PGP Totals

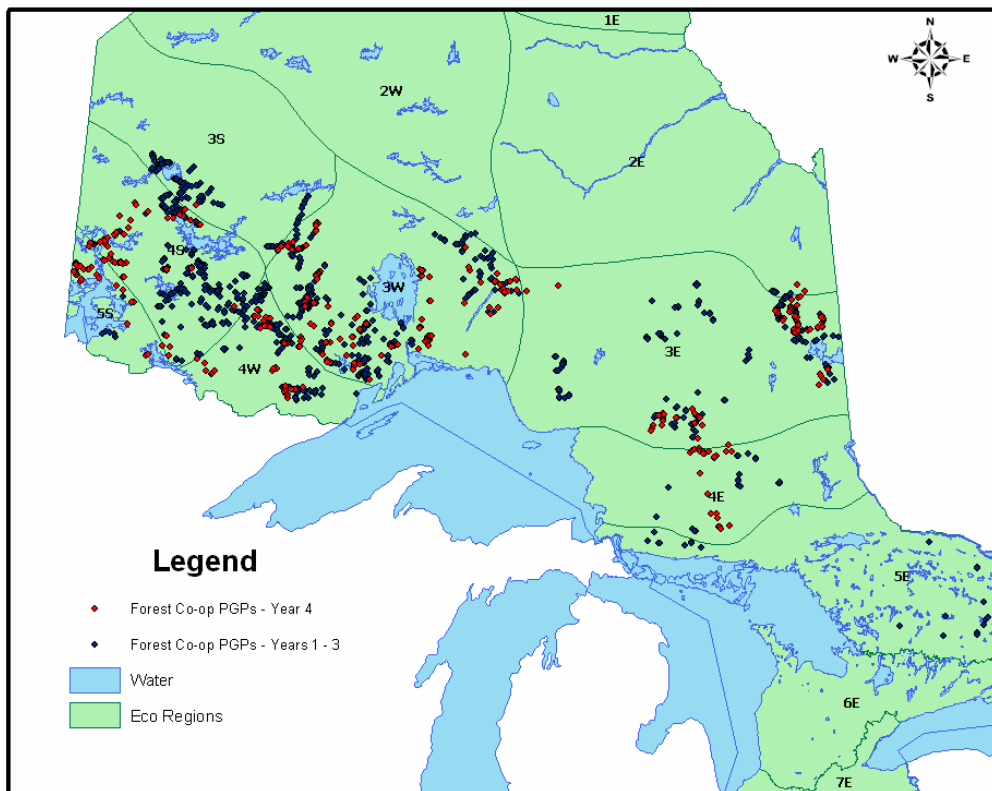
PGP Establishment by Dominant Forest & Management Type					
Species	Northeast		Northwest		Totals
	Artificial	Natural	Artificial	Natural	
At	3	24	24	153	204
Bf	6	27	11	30	74
Bw	0	16	7	40	63
Cw	0	1	0	11	12
La	0	0	0	5	5
Oh	0	23	0	0	23
Pb	0	2	0	1	3
Pj	65	39	230	187	521
Pr	1	1	10	5	17
Pw	4	5	0	2	11
Sb	32	38	111	237	418
Sw	6	7	26	3	42
	117	183	419	674	1393

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Plot Location

Spatial distribution of the plots within the stratification is on both an eco-regional level and an administrative level to deal with the different scopes of user information needs (eg. provincial vs management unit).

2000-2004 PGP Locations



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Sample Fact Sheet

After field and data validation have taken place, the data is stored within a relational database. The plots are individually summarized using an automated process that gains its information from the database. The Plot Summary Sheet is designed to provide the user with a useful overview of the underlying Permanent Growth Plot. The summary begins with general information about the plot including location and management. The summary also includes general site information such as site class, ecosite and vegetation types as well as soil types and depths. The summary gradually increases in specific detail about the composition of the plot in terms of species distribution and density and concludes with a species volume distribution.

Forest Co-op Boreal Forest Permanent Growth Plot Program - Plot Summary Sheet											
Plot Number	4S-2000-56	Measure #	1	Mgmt Unit	Wabigoon Forest	Management	Unmanaged				
Obs Year	2000	CEM	53552	Owner	Weyerhaeuser	Stand Desc	Natural				
Species Composition											
Plot		4S-2000-56		Grand Total							
Species	Comp	Comp									
At	5.07	5.07									
Pj	2.96	2.96									
Sb	1.01	1.01									
Bf	0.92	0.92									
La	0.04	0.04									
Grand Total	10.00	10.00									
Species		At	Site Class	2							
Average Age		26.5	SPH(<10cm dbh)	1075							
Average Height		14.4	SPH(>10cm dbh)	1175							
ES Type		ES19D	NMV/ha (m3)	18							
V Type		V10	Moisture Regime	2							
S Type		S3	Soil Depth	>120							
Regen Density		Species		Density							
		At	25								
		Sb	25								
		Grand Total	50								
Snag Density		Dia Class		12		Grand Total					
		Category	Density	Density							
		Hardwood	25	25							
		Grand Total	25	25							
Diameter Class Distribution (<10cm class)											
Dia_Class		2		4		6		8		Grand Total	
Species	Density	Density	Density	Density	Density						
At	25	25	100	100	250						
Bf		75	50	50	175						
La			25		25						
Pj		50	150	175	375						
Sb		25	50	175	250						
Grand Total	25	175	375	500	1075						

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Sample Fact Sheet - continued

