



Forest Ecosystem Science Co-operative Inc.

Forest Co-op
“Ontario Growth & Yield
Historic Plot Data Reconstruction
& Spatial Compilation Project”

FINAL REPORT

Living Legacy Trust
(LLT Project No. 04-046)

April 25, 2004



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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 “Ontario Growth & Yield Historic Plot Data Reconstruction & Spatial Compilation Project” (Forest Co-op “G&Y Historic Plot Project”) is an excellent example of partners working towards the acquisition of important scientific data. This project sought to capitalize on past investments in growth and yield and inventory activities sponsored by Ontario’s forest industry. This was accomplished primarily through the re-location of fixed-areas plots, whose upkeep had been discontinued, and where a return on historic investments in growth and yield and inventory plots has effectively been negated. The Forest Co-op “G&Y Historic Plot Project” identified a pool of historic plot locations stratified in accordance with Ontario’s provincial growth and yield sampling matrix that could be selected in future years for re-sampling and/or the overlay of new plots.

The need for forest growth and yield data in Ontario has been well documented. One aspect of growth and yield that has been missing is the change in forest structure and composition that can be gained from plots established in the forest over the past 4 to 8 decades. These historic plots represent millions of dollars in capital investment by government and industry, and the members of the Forest Co-op embarked on this project to capitalize on these past expenditures recognizing that:

- There are thousands of abandoned or forgotten plots established throughout Ontario. Documentation still exists for most of these plots, although the location and meta-data information is often scattered, incomplete, and not available in a spatially explicit electronic form to assist managers in decision-making.
- The cost of re-establishing or re-creating these historic plots as new plots in today’s dollars is estimated at over 3 million dollars. These plots, however, are worth substantially more as they represent the only source of growth and yield and stand dynamics information in Ontario where multiple re-measurements, through a span of time, exist.

- Given the past investment, this project presented an opportunity for a large return on investment.
- As the models to evaluate sustainable harvest levels increase in complexity, so the need for immediate access to long-term growth and yield data has increased.
- Sensitivity analysis of wood supply modeling has shown that forest change over time (succession) is often the driving factor affecting allowable harvest area. Data from historic plots is key to defining yield curve and succession model inputs.
- There is a need to increase the precision and accuracy for projected harvest levels and wood supply based upon quantitative data of known source and pedigree in order to quantify and manage the uncertainty concerning wood supply and its impact on Ontario’s forest industry sector.
- Historic records and data sets continue to be misplaced or destroyed as people and facilities move. Although the records and data pertaining to many historic plots have been irretrievably lost, many plots still exist across the landscape and there is the opportunity to secure the necessary meta-data and plot-level data from these remaining plots for use in the development and calibration of growth and yield models and products. If these plots are not re-located, re-established and spatially referenced, they will eventually all be lost.
- Intact historic plots and their locations need to be mapped and identified as values to be considered for protection during the forest management planning process.
- Historic plots need to be described and classified using the current ecological, forest inventory and forest management information systems so they contribute to knowledge management activities which support forest management activities in Ontario’s current management framework.
- Location, identification & mapping of historic plots and description of meta-data properties will allow for future data collection (re-measurement). The re-location of historic plots capable of being re-measured to current growth & yield sample plot measurement stands provides a source of ‘new’ plots which can be sampled.
- It would be more cost-efficient and cost-effective for the forest industry and the OMNR to fill the gaps in the current growth and yield stratification matrix (sampling cells) using existing plots with long-term measurements.
- These plots represent a considerable opportunity for future research efforts (Provincial, Federal, University, etc.), and would be greatly sought after by the research community.
- Many of these plots were established in managed stand conditions – This links well to initiatives underway investigating Intensive Forest Management (PGP’s, NEBIE, etc.).

Project Objective

The purpose of the Forest Co-op “G&Y Historic Plot Project” was to identify, evaluate, re-locate and verify the continued existence of historic growth and yield plots and plot networks and their associated documentation and/or supporting data sets. Plot locations were geo-referenced and included in a spatially explicit relational database and landscape coverage for reference by forest managers in Ontario. Individual plot and plot network meta-data were described. All project objectives have been completed.

Project Overview

The one-year schedule of activities, as outlined in the detailed project proposal to Living Legacy Trust, identified five stages with a mutually exclusive and sequential timing of completion. In reality, the project was delivered in a repeated and iterative fashion – each time repeating the same linked stages detailed below. This allowed the process of assembling and re-constructing historic plot data to be undertaken on a network by network basis, ensuring an increased level of scientific rigor and attention to detail in meta-data and plot data recovery efforts.

The five (5) linked stages of activity, with associated deliverables, were:

a) Identify, Inventory and Document Historic Plot Networks (April 2003 to March 2004)

Government and forest industry “Old Trial Inventories” were identified and queried to identify historic growth and yield-related plot(s), trials and plot networks, meta-data descriptions, current plot (network) status, plot locations, etc. Member forest industry companies assembled hard copy maps and location descriptions from available documentation to facilitate subsequent field inspection and plot description.

The specific sampling locations were then prioritized based upon age of installation, probability of existence, ease of access, silviculture intensity, geographic locale, site productivity, and quality and type of plot. Office preparation of plot re-location packages and documentation of the historic plot datasets and meta-data occurred during the period May 2003 to January 2004.

To speed commencement of fieldwork as early in 2003 as possible, and following project approval, all a/spatial data pertaining to the historic Minnesota and Ontario Pulp and Paper Corp. (MANDO) Continuous Forest Inventory (CFI) plot network was immediately secured (natural, disturbed, and plantations). Acquisition of this dataset reflected in-kind contributions from Abitibi-Consolidated Company of Canada (Abitibi-Consolidated) and from Ontario Ministry of Natural Resources – Northwest Science and Information (OMNR-NWSI).

Portions of the OMNR’s historic Roebellin and Beckwith plantation PSP network (jack pine, black spruce and white spruce) and the historic American-Canadian Pulp and Paper (AM-CAN) CFI plot network were also re-located and documented for this project by OMNR-ONTAP (Growth & Yield) program.

Portions of the historic Kimberly-Clark Inc. (KC) Permanent Sample Plot (PSP) network, focusing on plantations and boreal mixwood conditions that currently represent lost investment, were acquired for this project. Acquisition of this data reflects in-kind contributions from KC.

Portions of the historic southern region OMNR Ecosystem Land Classification (ELC) / Forest Ecosite Classification (FEC) plot network pre-dating 1980 that represent partially-lost investment, were acquired for this project. Acquisition of this dataset reflected an in-kind contribution from the OMNR-Southern Science and Information Section and ONTAP (ELC) program.

Other historic data-sets of potential relevance and utility were also identified and located by the project team (eg. Lyon’s forest succession plots, Ghent eastern spruce budworm plots). Because of missing spatial data and meta-data descriptions or incomplete re-measurement data, further re-location work was not undertaken using project funding. For example, Weyerhaeuser Canada Ltd. identified a total of 31 potential trials on their Dryden licence that could have been of utility to the project. Documentation, including maps, was re-located for only 16 of these trials. In each and every case, plot trial and summary data was available but the individual plot/tree level data could not be re-located.

A relational database with geo-referenced information for each of the identified historic plots was established using current geomatics and forest resource inventory polygon description standards to aid in plot re-location and tracking of all plots thought to be still in existence and capable of being re-located. A hard copy of all plot tally sheets, meta-data information and sampling protocols and data standards was secured for future reference and archived. This information was used to develop a sampling framework and identify a broad geographic stratification of those plots (plot networks) and a priority for re-location and assessment.

b) Database Development (August 2003 – March 2004)

This stage of the project consisted of three (3) distinct database tasks:

August 2003 – February 2004

Development and documentation of universal meta-data and field assessment data structures accompanied by data entry and processing of collected data to current growth and yield standards for Ontario.

February 2004 – March 2004

Populating universal database with historic plot meta-data

February 2004 – March 2004

Populating universal database with current plot meta-data from OMNR’s and Forest Co-op existing Growth and Yield databases

Data structures which would allow regular, seamless updating of the plot geo-reference and attribute data into the Forest Co-op G&Y Historic Plot Viewer program (web-based tool) were developed to furnish application developers test data sets.

An electronic data capture program capable of being run in ArcPad with associated geo-spatial referencing hardware and software was also developed and tested using leased hardware and purchased software. The contractor, Geospatial Inc., produced electronic data capture (EDC) software, specifically suited to the re-location of historic plots. ArcMap software was purchased for use on the GPS units and Trimble ‘Geo-XM’ GPS units leased for the project.

The development and documentation of universal meta-data and field assessment data structures to current Ontario growth and yield standards was led by OMNR-NWSI. Ongoing development and improvements to the database structure will continue as an additional OMNR in-kind contribution.

Populating the database for the web-based application with the historic plot data commenced in February 2004 and was completed in March 2004. Populating the database for the web-based application with current meta-data from OMNR’s and the Forest Co-op’s Growth & Yield databases was also completed in this timeframe. This was the test data for the plot viewer.

Development of code which will permit the automatic updating of the database for the web-based application was not included as part of the deliverables of the Forest Co-op “G&Y Historic Plot Project”. However, this application is a necessity for ensuring that the web-based application remains useful and does not become stale-dated. This work was initiated in March 2004 and will be complete in about a month’s time.

c) Field Location and Verification of Plots and Plot Networks (June 2003 – February 2004)

Two contractors, Silvatech Services Co. (Silvatech) and Sumac Forest Information Services Ltd. (Sumac), were contracted to provide field services to this project including performing the field verification and validation of plot locations and assessing the accuracy of the meta-data associated with each of the plot(s) and plot networks.

These contractors located and described the following attributes and information for a priori-selected historic growth plots and buffer areas:

- Tenure and location as described using a global positioning system (GPS [NAD83])
- Plot information and status
- Ancillary observations on plot placement, anthropogenic or natural disturbances, condition of plot and tree markings
- Assessment of the potential of the historic plot to be re-established or upgraded to a Permanent Sample Plots (PSP) or Permanent Growth Plots (PGP).

The work also included :

- Re-location and marking of plot centre, plot boundaries and buffer zones
- Production of a PGP Locator’s Map
- Photographic records of the plot layout and stand condition
- Assemblage and transfer of summary data on historic growth plots and buffer areas.

Silvatech focused their efforts in central Ontario, relocating plots from the ELC/FEC plots network. As expected, Silvatech re-located plots with considerable success. Of 547 plots which were initially described, 418 were identified for assessment with 331 plots being successfully relocated, geo-referenced, assessed and documented.

Sumac focused their efforts in northwestern Ontario, relocating plots from the MANDO CFI plot network. Sumac’s efforts have met with moderate success; varying with the date since last complete measurement. A very large and spatially comprehensive database from the MANDO CFI was recovered. This CFI plot network consists of 4,035 plots. Of 600 plots identified for re-assessment, Sumac was able to relocate, geo-reference, assess and document 249 plots. Sumac continued re-location efforts through to March 2004. The AM-CAN and K-C plot networks were assessed with 145 K-C plots and 15 AM-CAN plots successfully re-located.

In total, 739 plots were re-visited and assessed via ground-truthing and inspections.

d) Summary Data Collection (June 2003 – November 2003)

The above-noted contractors located and described the following attributes and information for apriori-selected historic growth plots and buffer areas:

- Current stand condition information
- Forest ecosystem classification attributes (soil-type, vegetation-type, ecosite-type)
- General soil/site information and soil profile descriptions
- Forest cover/tree layer information and data including species, DBH, total height, height to base of live crown, DBH age, total age and tree status
- Ancillary observations on plot placement, anthropogenic or natural disturbances, condition of plot and tree markings

The contractors submitted all observations and notes on the applicable Forest Co-op “Growth and Yield Program” Plot Tally Forms and Forest Co-op “G&Y Historic Plot Project” tally sheets. All applicable mandatory data fields were completed according to the Forest Ecosystem Science Co-operative Inc. Field Manual for the Location and Measurement of Permanent Growth Plots – revised draft – April 2003] (Forest Co-op G&Y PGP Field Manual).

The data presented in the Forest Co-op “G&Y Historic Plot Project” tally sheets were verified via an independent field sub-sample of 10 percent of the collected information by OMNR-NWSI. A satisfactory independent review of the complete set of the tally sheets, for legibility and completeness, was also completed as part of the contractor audit and supervision. All identified measurement and/or procedural errors were corrected by the named contractor.

Two (2) complete sets of completed and verified Forest Co-op “G&Y Historic Plot Project” tally sheets, which includes GPS (Global Positioning System) location data taken using NAD 83 datum, and two (2) complete sets of electronic data were transferred by the contractors to the Forest Co-op. The Forest Co-op was also provided with all photographic records of those historic plots including any and all photos of the associated site and stand conditions.

Silvatech and Sumac were contracted to enter field data into electronic format in the field, and submit both electronic files and hardcopy originals to the Forest Co-op. All field data was submitted by the contractors.

e) Web-based User Interface Application (Forest Co-op Historic Plot View Application) (July 2003 – March 2004)

The OMNR-NWSI Geospatial Service Centre (GSC) developed the web-based user interface portion of the application. Work by the GSC is completed with a finished beta-version available for testing. This product permits the user to query by specific fields to select subsets of plots which may be of interest to them. The beta version of the online plot viewer is resident on the OMNR’s production server. The production version will be uploaded to the Confederation College Forestry Centre’s server in April 2004 once beta-testing is complete.

Knowledge and Technology Transfer

The very basis of the project is to provide a knowledge and information system to forest researchers and managers. A web-based repository of known and recently-rediscovered forest research plots and trials with accurate locations has been successfully developed and implemented. The database holds the location data in a constantly updated form. In addition, it holds ecological summary and meta-data information for each of the plots contained in the dataset. This product will be available on the Internet in a user-friendly, form-based query structure. To ensure awareness of this product, information will be disseminated to clients:

- through communications with the Forest Co-op membership
- via the Forest Co-op and LLT websites
- via OMNR-Science and Information network and various workshop and training programs offered annually by these staff.
- via OMNR science and resource management specialists assigned to support forest management planning teams.

Forest Co-op Partnership and Project Delivery Team

The Forest Co-op partner organizations involved in this project, which are also members of the Forest Co-op's Growth & Yield Business Unit (Forest Co-op GYBU) and whose representatives led this project, include:

Abitibi-Consolidated Company of Canada
Bowater Canadian Forest Products Inc.
Domtar Inc.
Kimberly Clark Inc.
Ontario Ministry of Natural Resources
Tembec (Forestry Research Partnership)
Weyerhaeuser Canada Ltd.
Confederation College (Forestry Centre)

Professional representatives from each of the above named organizations provided varied skills and experiences to the project which covered the continuum from field operations through to applied and basic science. Individual team members were responsible for ensuring the planning and co-ordination of fieldwork on their respective landbases. Specific task areas were addressed through focus teams (e.g. technical team, contract administration team, etc.). In addition, the Forest Co-op GYBU brought in outside expertise to consult in specific areas (e.g. consultants, provincial and federal scientists, etc.). The OMNR-NWSI were the lead implementation / delivery team for this project. OMNR-NWSI GSC, in conjunction with the OLID system, developed the web server for the web-based spatial search engine aspect of the project. The Forest Co-op General Manager provided financial and administration management services.

Summary

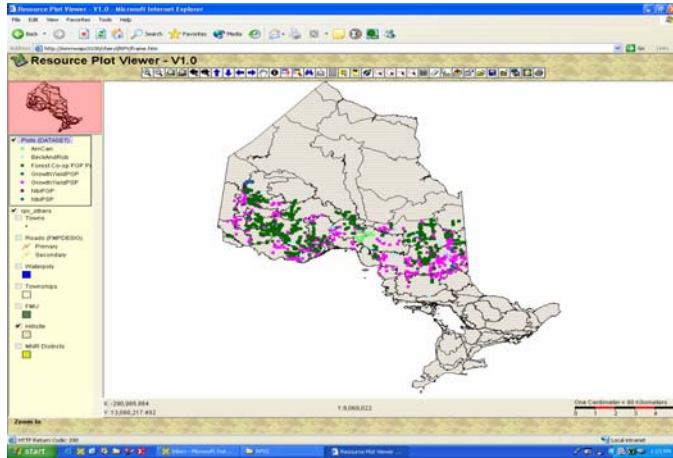
The Forest Co-op partners recognize the need for unified forest science partnerships. The benefits of obtaining forest data with long-term temporal inference will not only enhance and accelerate current monitoring and assessment and modeling projects, but will be of great benefit to any new science endeavors undertaken within the Province. The project is directly tied to the current Forest Co-op Growth & Yield Permanent Growth Plot (Forest Co-op G&Y-PGP) Program. It is also directly tied to the Ontario Government’s Provincial Terrestrial Assessment Program’s Growth and Yield and Wildlife assessment programs. This program and resulting products will help forest managers build the capacity to plan for sustainable development of the forest resource. Complete, accurate and easily assessable spatially-based information will be the key to developing sustainable management tools for our resources and ensuring that current and expected future investments in plot establishment, maintenance, re-measurement and the development of databases are not jeopardized through lack of knowledge concerning existing plot locations.

A very real and significant success of this project has been the heightened awareness of the importance of historic data and trial plots and the need for their protection. The successful enumeration and screening of several previously unknown permanent sample plot networks which still exist today, and that can furnish repeated measures data on forest growth, yield and stand dynamics, provides an alternative data source to that of continuing to establish new plots and having to wait. The successful acquisition and recovery of the MANDO CFI plot network consisting of some 4,035 plots with between 3 to 5 re-measurements each of data alone will permit a significant opportunity to synthesize data for an area of northwestern Ontario which is currently lacking permanent sample and growth plots. It also provides the program and the industry with the opportunity to upgrade existing plots of known pedigree at a minimum cost compared to locating, screening and establishing new plots.

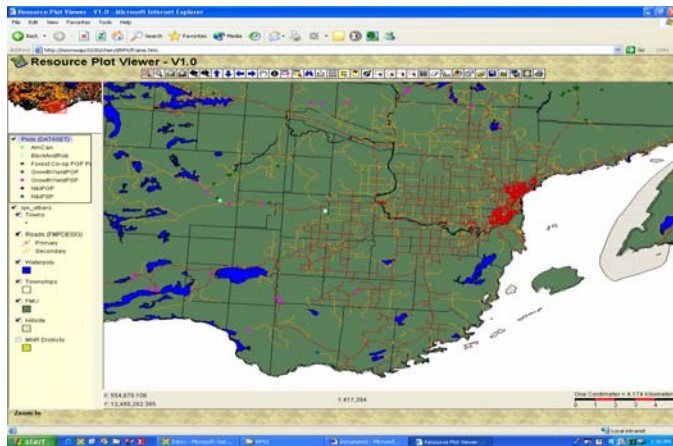
The accuracy and precision of a/spatial plot location information and co-ordinates for historic plots was found to be extremely consistent and of high quality enabling cost-effective re-location and assessment. Generally, the quality of the plot location and plot mega-data was also high and well organized. Many of the original plot specifications (layout, dimensions, etc.) from these historic plot networks and trials are remarkably very comparable to the minimum growth and yield standards employed in Ontario today. This provides a high level of comfort in deciding to use data from these historic plots in developing growth and yield products.

The Forest Ecosystem Science Co-operative, and its many partners, acknowledge with gratitude, the outstanding work of the Ontario Ministry of Natural Resources, Northwest Science and Information project implementation team, with particular recognition to the project leader, Mark Roddick, the project forester, Trevor Longpre, the database analyst, Kris Sawula, the information management specialists, Andy Smiegielski and Cory Lemieux, and the project co-ordinator, Bill Towill; the expertise and guidance of Janet Lane and David Archibald on behalf of the Forest Co-op Growth & Yield Business Unit; the significant contribution all industry partners who agreed to share company data and assist with fieldwork, in particular Abitibi-Consolidated for their wealth of recovered files; the fieldwork efforts of contractors and regional staff; and the support of Living Legacy Trust which, collectively, have contributed to the success of this major initiative.

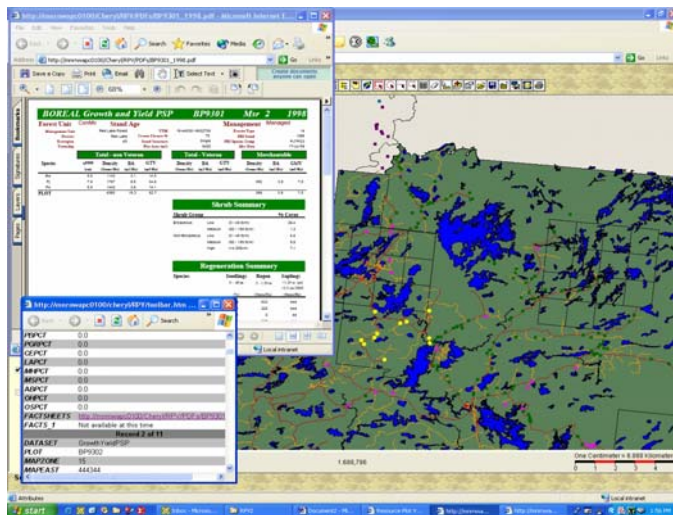
Forest Co-op – “Ontario Growth & Yield Historic Plot Data Reconstruction and Compilation Project”



1. Online Resource Plot Viewer (RPV) program opening screen.



2. RPV program showing greater detail.



3. RPV program showing hyperlink to PDF Plot Summary Factsheets