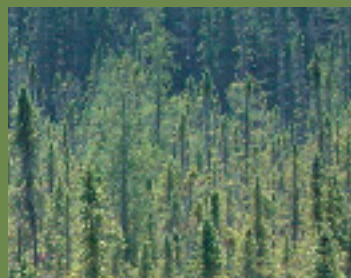


Enhancing Ontario's Forest Resources Inventory



The Ontario Forest Resources Inventory (FRI) provides resource managers with a snap shot of the state of the forest. This information is used to support a number of key business needs and applications including forest management planning, wood supply and habitat analysis, and provincial reporting. Today's users of the FRI require more current, timely and effective inventory data as applications dependent on the FRI become more demanding and complex in terms of their data requirements. To meet these increasing demands, the enhanced FRI Program, announced in 2005, proposed a number of improvements. These improvements include:

- Reducing the inventory cycle from 20 years to 10 years;
- Use of high resolution, digital airborne imagery and image products to produce the FRI;
- Use of technological advances in the geosciences, hardware, and software during inventory production processes;
- Introduction of new plot networks and an increased number of calibration plots;
- Introduction of a new post production inventory assessment component; and,
- Expansion of the area covered to include the southern portion of the Far North Planning Area, and national and large provincial parks.

To meet the challenges associated with implementing the enhanced FRI program, the Forestry Futures Trust Committee (FFTC) and the FRI group from the OMNR have undertaken a Knowledge Transfer and Tool

Development program. The program has sought input from Sustainable Forest License (SFL) holders, inventory contractors, academia, and government to identify the user needs and the ability of the inventory information to meet current and future business requirements. The FFTC has undertaken the majority of these tasks and has released a series of surveys, and held workshops and focus group sessions to gather the user needs and information requirements data. The initial summary of the data indicates the priorities related to FRI data are getting access to the data and training related to using the data. A number of possible forums have been brought forward as ways to impart this technical knowledge to those interested. These forums will be brought forward in the coming months and will be looking for those interested in attending.

The FRI and ELC program has implemented a required training program for both the field and image interpretation portions. To date, 103 participants have attended the photo interpretation training, with 71 becoming certified in the Boreal and 32 in the Great Lakes/St. Lawrence regions. The field program has trained over 250 people to complete the FRI Field Calibration Plots and many of these people are trained in multiple forest areas within the province. These efforts have resulted in trained production capacity throughout Ontario's forest area. To support the contracted inventory projects for 2011 over 50 people will be enrolling for photo interpretation training that will be located in Sault Ste. Marie and Thunder Bay.

Fall 2011 Update

Imagery Acquisition

Digital, airborne imagery is being acquired and used to produce the current cycle of inventories. The suite of imagery and image products includes the following:

- 20 cm resolution panchromatic stereo and orthoimagery;
- 40 cm resolution multispectral stereo and orthoimagery;
- Classified digital surface model;
- Supervised water classification.

Imagery acquisition began in 2007. Since that time imagery has been acquired for approximately 553,440 sq. km. of the planned inventory lands. The planned inventory lands include the Area of Undertaking as well as the southern portion of the Far North project area. Thus far, the areas that have been successfully captured account for approximately 99.7% of the

planned acquisition to date. Acquisition efforts in 2011 will continue to occur primarily in northwestern Ontario, north central Ontario, the southern portion of the Far North Planning Area, and additional areas assigned for the Permanent Forest Inventory Photo Plot (PFIPP) and National Forest Inventory (NFI) programs. These additional areas are the Northwest Boreal Shield, Lake Erie Lowlands, and Manitoulin/Lake Simcoe regions. The lack of favourable weather at the end of the 2010 production year made it necessary for the image collection to be extended and completed by the end of the 2011 production year. Unfortunately, the forest fire conditions in northwestern Ontario during July and August, 2011 resulted in a reduction in suitable image collection days leaving several PFIPP/NFI photo plots that still require imagery. The Ministry of Natural Resources' Information Access Section is responsible for managing and distributing imagery and image products to all interested parties. Individuals and organizations interested in obtaining FRI imagery and image products are advised to contact the Information Access Section by telephone (705) 755-1878 or by e-mail lio@ontario.ca

There are many other benefits of digital airborne imagery that have been incorporated into the FRI production. One example is the generation of a supervised water classification procedure to more accurately capture the boundaries of water features (excluding streams less than 10 metres continual width). The supervised water classification process uses the multispectral image data to delineate the boundaries of all water features. Multispectral image data allows the computer software to identify water from shadow and all other ground features, resulting in more accurate and consistent delineation of water resources. This process is referred to as "supervised," as a person must review the boundaries completed by the software; however the time and effort required to create the water information is significantly reduced. To date, supervised water classification has been delivered on the Quetico Provincial Park, Big Pic Forest, Pic River/Ojibway Forest, Black River Forest and the Lakehead Forest.

Digital airborne imagery also allows for the capture of digital surface models (DSM). It is important to note that the FRI program

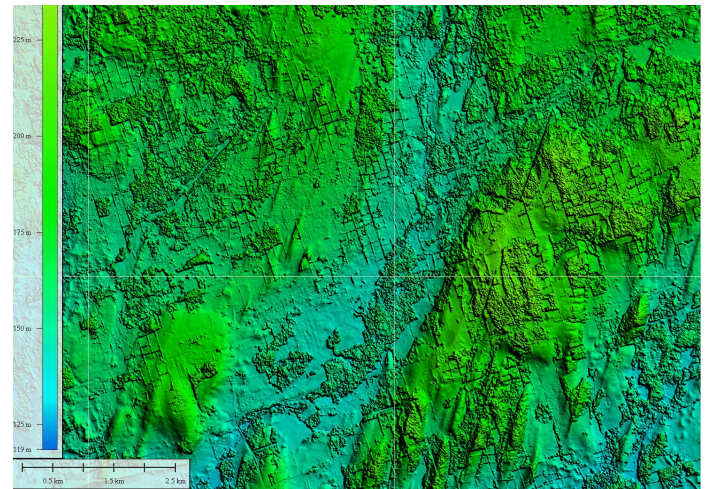


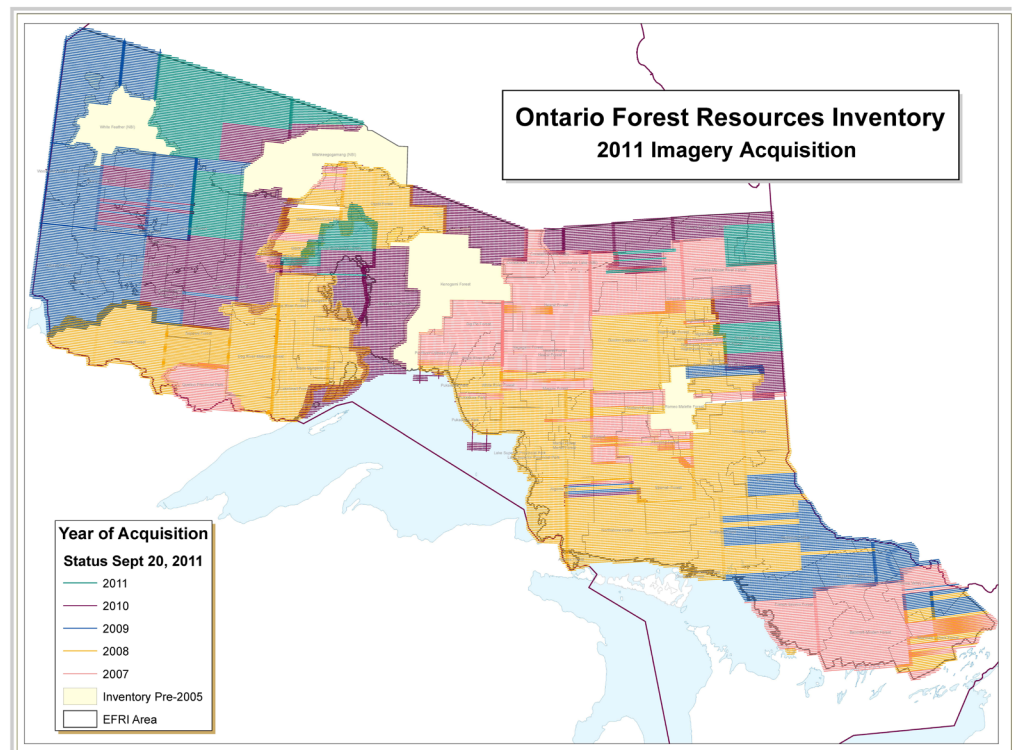
Figure 1: Classified Digital Surface Model derived from the FRI image data and displayed in Global Mapper software. The Digital Surface Model shows the elevation height of the earth surface and land cover, including tree height, etc.

is not capturing a Digital Elevation Model (DEM) as this refers to a bare earth model and this cannot be derived from imagery that is capturing 'leaf-on' conditions of the forest. The FRI must capture 'leaf-on' conditions in order to identify the attributes required of the FRI, like tree species, crown closure, age, and height.

The products being derived from the DSM are as follows:

- Raw 5 metre strips DSM for facilitating digital 3-dimensional viewing (crown surface level);

Figure 2: Status of 2011 FRI imagery acquisition.



- Classified DSM using a supervised classification (using the 40 cm multispectral data 1, 2, 3 bands) to stratify water, ground, and forest areas;
- Semi Global Matching (SGM) is new technology that creates a very detailed elevation dataset that is referenced exactly to the imagery (an 80cm resolution); and,
- National Forest Inventory and Permanent Forest Inventory Photo Plots that have been flown to date have SGM capability.

Inventory Production Projects

The FRI production process for individual forest inventories typically spans two years after imagery acquisition: field work, water classification and the interpretation occurs in the first year, and the second year of the production process involves the remaining field sampling, water classification, and the majority of the soft copy imagery interpretation. The inventory contractor has one calendar year to complete all components of the interpretation and deliver a compliant and acceptable product to the OMNR.

FRI production for the Lakehead Forest was completed for March 31, 2011. FRI production on the Ogoki, Crossroute, and White River Forests as well as other outstanding areas is expected to be completed by the end of the 2011-2012 fiscal year (Figure 1).

Six new inventory production projects (the Abitibi River Forest Phase One, Algonquin Provincial Park, French-Severn Forest, Pineland Forest, Red Lake, and Wabigoon

Forests) were tendered and awarded in the spring of 2011. Planning efforts and discussions with local stakeholder groups continue for production of the FRI for Wabakimi Provincial Park. The 2011 FRI production year is an ambitious year as these six inventory projects represent over 53,000 square kilometres of inventory lands and will see more than 10,600 calibration plots established and measured. As these new inventory projects begin, efforts to complete existing inventory projects continue.

Calibration Plots

Field calibration plots are generally established at a frequency of one plot for every 5 to 8 square kilometres of area within a given inventory project area. Data collected from the measurement of FRI calibration plots provide photo interpreters with valuable information concerning forest conditions associated with their respective inventory projects. Photo interpreters use this knowledge of local forest conditions as an aid in the interpretation of adjacent and surrounding lands which lack ancillary data. Over 20,000 calibration plots have been established and measured since beginning the new inventory cycle in 2005. Approximately 10,665 calibration plots will be established and measured during the 2011 production year.

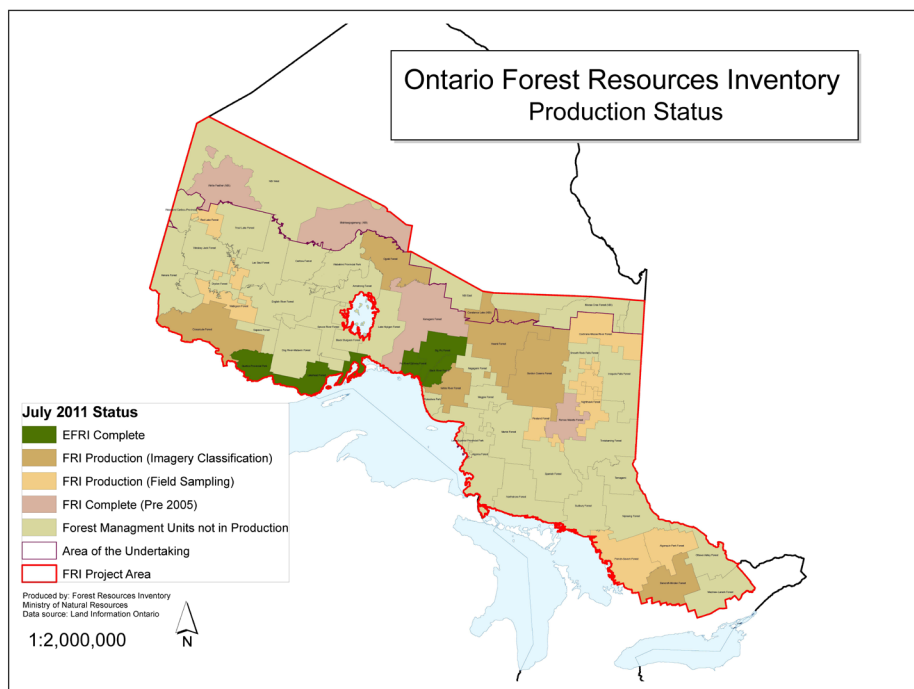
Post Inventory Assessment

Previous Forest Resources Inventories in Ontario did not include information describing the quality of the inventory product, however, the 2005 enhanced FRI Program addressed this, and now includes post inventory assessment activities as an integral part of the inventory process. This new enhancement is intended to provide

FRI end-users with a statistical evaluation of key forest inventory metrics, and promote continuous improvement in the FRI information product.

The FRI production process has now reached a stage at which post-assessment is possible on several first-generation products. To help define and design an appropriate methodology for use in Ontario, a consultant was awarded the contracted to develop the FRI post-assessment sampling protocol. The objective was to develop a sampling protocol that will provide FRI users with an information product describing the accuracy and overall quality of their respective FRI. In February, 2010, a four step process was used to develop the sampling protocol, specifically:

Figure 3: Status of FRI interpretation.



1. User needs analysis and assessment;
2. Development and discussion of sampling protocol options;
3. Development and review of draft sampling protocol; and,
4. Final review and approval of sampling protocol.

Personal interviews and surveys with both internal and external client groups were conducted in Timmins, North Bay, Thunder Bay, and Sault Ste. Marie. The project team is currently reviewing the draft version of the Plot Specifications Manual and the documents pertaining to the user needs analysis and assessment, and the assessment sampling design has been accepted. Project completion is scheduled for December 2011. Quetico Provincial Park, completed in fall, 2009 or the Lakehead Forest, completed in the spring of 2011, will be the first inventory projects to be assessed as part of this new FRI Program initiative.

Permanent Forest Inventory Ground Plots (PFIGP)

Permanent Forest Inventory Ground Plots (PFIGP) represent another component of the FRI field program. These plots consist of a network of 0.04 hectare ground plots systematically positioned on a provincial 20 kilometre by 20 kilometre grid, which corresponds with the grid required for the National Forest Inventory program. The current objective of the PFIGP program is to capture baseline land cover and ecological data for Ontario's industrial forest, Far North and southern regions of the province. The PFIGPs are an integral component of the enhanced FRI process and illustrate that the program has expanded its scope from only providing information about forest condition to forest industry groups. The FRI program now gathers a larger variety of information, and this data is being collected across the entire province. This will permit the direct evaluation of both traditional (forest growth and condition) and non-traditional (biodiversity, biomass, carbon, and climate change) trends in Ontario's forests. As the plots are permanent and measurements repeatable, this provides statistical rigour for the current inventory process; key to effective monitoring and reporting, and a means of validating the overall accuracy of the current inventory model. A multiyear contract has been awarded to a single contractor to help ensure that consistent data standards are achieved and to help build local competency and capacity in the growing area of natural resource monitoring. To date, over 130 PFIGPs have been successfully established by the contractor, and more than 410 plots are planned for completion during the next three years.

Permanent Forest Inventory Photo Plots (PFIPP)

Permanent Forest Inventory Photo Plots (PFIPP) are also a required component of the FRI Program and consist of two kilometre by two kilometre plots systematically positioned on the same 20 kilometre by 20 kilometre provincial grid as the PFIGPs. Similar to the PFIGPs, data collected from repeated measurements will provide the Province with statistically defensible, high value information suitable for monitoring, reporting, and modelling purposes. To date, over 445 PFIPPs have been interpreted and automated. Up to an additional 710 PFIPPs will be tendered for interpretation in the 2011-2012 fiscal year, although this is dependent upon favourable weather conditions for capturing the required imagery.

Please watch for future FRI updates concerning image acquisition and inventory production status.

More information:

For more information on the Forest Resources Inventory, please contact the Forest Resources Inventory Coordinator at (705) 946-7450.