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# FOREST ANALYSIS AND INVENTORY BRANCH YOUNG STAND MONITORING PROGRAM

Prepared by: Tamara Brierley



*Bob Krahn, Ministry of Forests, Lands and Natural Resource Operations*

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## INTRODUCTION

The Forest Analysis and Inventory Branch of the British Columbia Ministry of Forests, Lands and Natural Resource Operations is implementing a monitoring initiative to observe the performance of young forest stands, especially in high-risk forest management units, such as timber supply areas and tree farm licences.<sup>1</sup> This program will address the significant information lag between the free-growing declaration for regenerated stands and the point at which these stands are re-inventoried many years later.

The key objective of the Young Stand Monitoring Program is:

*To check the accuracy of the growth and yield predictions (assumptions) of key timber attributes of young stands, which are used in the Timber Supply Review of a management unit, based on an independent random sample of permanent sample plots.*

Two of the Ministry's stated goals are "maximum productivity of forest and range resources" and "well-managed forest and range resources." To achieve these goals, accurate, defensible information on the actual growth of British Columbia's young stands is required. This information note provides an overview of sample design, analysis, and application of the monitoring data, as well as some empirical evidence from Tree Farm Licence No. 52.



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<sup>1</sup> B.C. Ministry of Forests, Mines and Lands. 2011. Why we need to monitor change in our managed forests. Forest Analysis and Inventory Branch, Victoria, B.C. [http://www.for.gov.bc.ca/hts/vri/monitoring/downloads/why\\_we\\_need\\_monitor\\_change.pdf](http://www.for.gov.bc.ca/hts/vri/monitoring/downloads/why_we_need_monitor_change.pdf) (Accessed November 2012).

## BACKGROUND

After the damaging mountain pine beetle infestation, existing and future managed stands will become increasingly important to the mid-term timber supply, creating an urgent need for accurate information on the actual health and growth of these young stands. Most provincial forest management decisions, including allowable annual cut determinations, silviculture investment decisions, biodiversity and future forest ecosystem planning, are partially based on assumptions of future stand growth.

To improve future forest management in British Columbia, timely investment in a well-designed monitoring program will provide a continuous feedback mechanism to forest resource decision makers. The intent is to establish and maintain a monitoring program for young stands, starting with high-risk units affected by the mountain pine beetle infestation, such as those in the province's Central Interior.

The Young Stand Monitoring (YSM) Program will complement current data collection programs, including the Vegetation Resources Inventory Phase II, Change Monitoring Inventory, National Forest Inventory, and permanent sample plots for model development. These other programs do not target young stands, lack remeasurements, contain bias (are subjectively located), or represent low sampling intensity.

An opportunity also exists to collaborate with the Forest and Range Evaluation Program (FREP) using results obtained with their Stand Development Monitoring Protocol. This protocol<sup>2</sup> was designed by FREP in conjunction with the provincial Forest Health Program. It is used to assess the condition of free-growing managed stands by measuring stand attributes and the impact of biotic and abiotic damaging factors on stand health, enabling a determination of whether the stands are meeting productivity expectations. Although this protocol evaluates a similar age cohort, its objectives and sample designs are different than those used for the YSM Program. Therefore, a joint analysis using both sets of data (where available) may be possible to evaluate the growth and yield and the productivity of stands important to mid-term timber supply.

<sup>2</sup> B.C. Ministry of Forests, Lands, and Natural Resource Operations. 2011. FREP Stand Development Monitoring Protocol. Resource Practices Branch, Victoria, B.C. <http://www.for.gov.bc.ca/ftp/HFP/external/!publish/FREP/Indicators/SDM%20Protocol%202011.pdf> (Accessed November 2012).

By providing feedback to timber supply analysts (to check mean annual increment and yield) and growth and yield modellers (to check stand growth curve shapes), monitoring information supplied by the YSM Program will identify opportunities for improving timber supply forecasting.

## TARGET POPULATION

Young stand monitoring will target 15- to 50-year-old stands that are likely to contribute to a management unit's future timber supply. This target population will expand or contract over time as disturbed mature stands regenerate and attain a minimum age of 15 years, and as young stands mature (> 50 years old).

## MONITORING METHOD

The program will use a monitoring method similar to that currently used by the Change Monitoring Inventory protocol,<sup>3</sup> with some slight modifications. This method involves establishing and re-measuring a representative sample of YSM permanent sample plots in the target population within a management unit. A YSM framework document has been developed that discusses the design, analysis, data management, and implementation.<sup>4</sup>

### Sample selection

Monitoring plot locations are selected using a systematic sampling design with a random start from within the National Forest Inventory 20 x 20-km grid. The target population is not stratified before sample selection; however, if the sample is large enough to provide meaningful results, plots can be stratified for the desired subgroup during analysis.

### Data collected and field procedures

Table 1 provides a list of attributes to be collected through the YSM Program.

<sup>3</sup> B.C. Ministry of Sustainable Resource Management. 2005. National Forest Inventory – British Columbia: Change monitoring procedures for provincial and national reporting. Resource Information Branch, Victoria, B.C.

<sup>4</sup> B.C. Ministry of Forests, Lands, and Natural Resource Operations. 2012. A framework for implementing young stand growth monitoring in British Columbia. Forest Analysis and Inventory Branch, Victoria, B.C. [http://www.for.gov.bc.ca/hts/vri/monitoring/downloads/monitoring-framework\\_13Jan2012\\_ver2-2.pdf](http://www.for.gov.bc.ca/hts/vri/monitoring/downloads/monitoring-framework_13Jan2012_ver2-2.pdf) (Accessed November 2012).

**Table 1** *List of attributes to be collected*

Attribute
• Site height (m)
• Breast height age of site height tree (yr)
• Site index (m)
• Total height of all trees at least 1.3 m tall (m)
• Stand density (trees per hectare)
• Diameter at breast height of all trees at least 1.3 m tall (cm)
• Basal area (m <sup>2</sup> /ha)
• 5- year basal area growth (m <sup>2</sup> /ha per year)
• Gross/net merchantable volume (m <sup>3</sup> /ha)
• 5-year gross/net merchantable volume growth (m <sup>3</sup> /ha per year)
• Pest and disease incidence
• Tree mortality and cause

### Plot remeasurement

For consistency, plots will be re-measured every 5 years using the same procedures used at plot establishment. Plots will be added to the monitoring sample at re-measurement as stands attain the minimum age of 15 years (i.e., all the grid intersections falling in the stands attaining the minimum age). If all older plots are dropped, no monitoring information will be available on older stands, and yet this information is needed for stand modelling. Thus, all the plots in older stands will be retained over a limited period of two, 5-year re-measurements.



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**Data compilation, analysis, and reporting**

The monitoring data will be compiled using the Vegetation Resources Inventory and Change Monitoring Inventory procedures. To identify where large and significant differences occur, growth and yield estimates from the monitoring plots will be compared with model predictions. Graphical methods and simple test statistics such as the paired t-test will be used in the analysis and comparisons. The YSM Program plans to produce reports, including new plot establishment reports, and growth and yield comparison analysis reports following each plot remeasurement (every 5 years).

The following account (*see Tree Farm Licence No. 52: A monitoring case study*) provides an example of a growth and yield monitoring program installed on Tree Farm License 52 between 2006 and 2011 with the objectives of validating site index estimates and reducing the risk and uncertainty in second-growth stand yield predictions. It shows how analysis of YSM program data could improve timber supply forecasting or help assess silviculture investments and stand management practices.

**Tree Farm Licence No. 52:  
A monitoring case study**

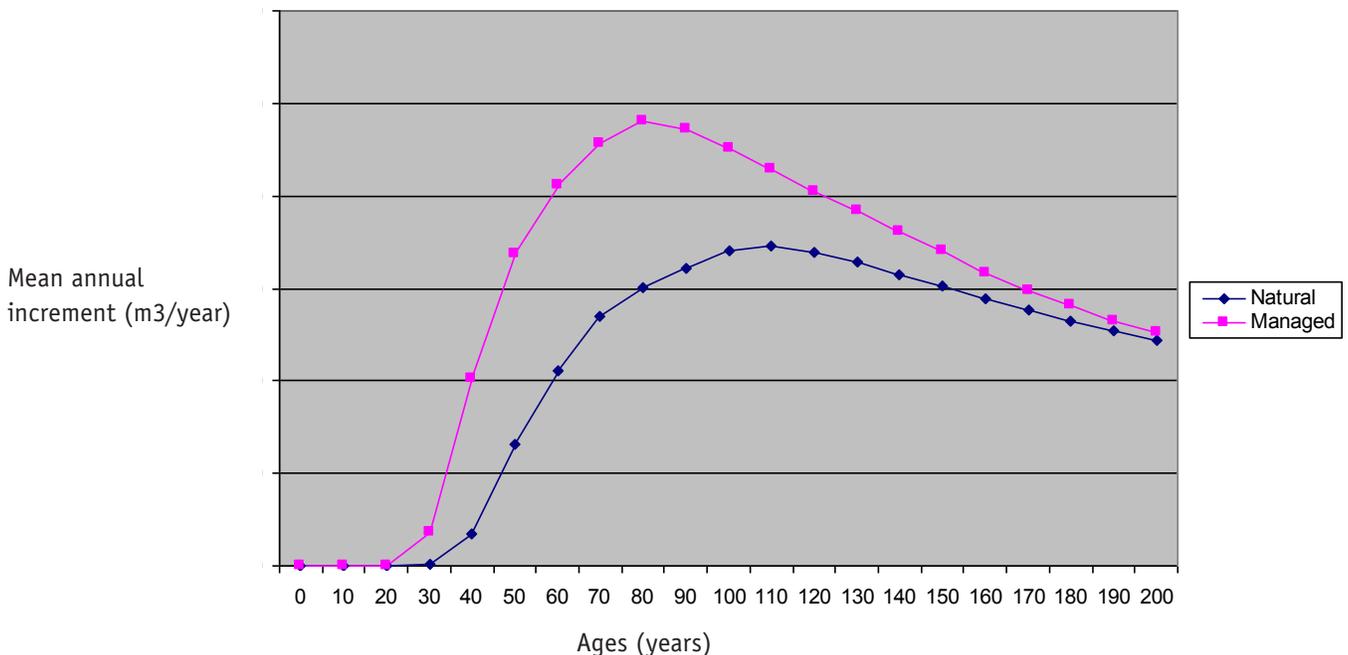
This case study is based on monitoring data provided by West Fraser Mills for TFL No. 52. <sup>5</sup> Please note: These results may not be representative of results achieved in other management units. We wish to thank Earl Spielman, West Fraser Mills, for his data and support.

**Monitoring Data**

Monitoring data for West Fraser Mills’ Tree Farm Licence No. 52 reveals the following information.

- Managed stands are growing as well or better than current yield predictions.
- Many managed stands greater than 20 years old have significantly greater volume than currently predicted.
- The impact of the mountain pine beetle on older, managed stand yields is not as high as the current predictions.

<sup>5</sup> For more information, contact Earl Spielman, Inventory Forester, West Fraser Mills Ltd., Quesnel, B.C. Phone: 250-992-0894; Email: [Earl.Spielman@westfraser.com](mailto:Earl.Spielman@westfraser.com)

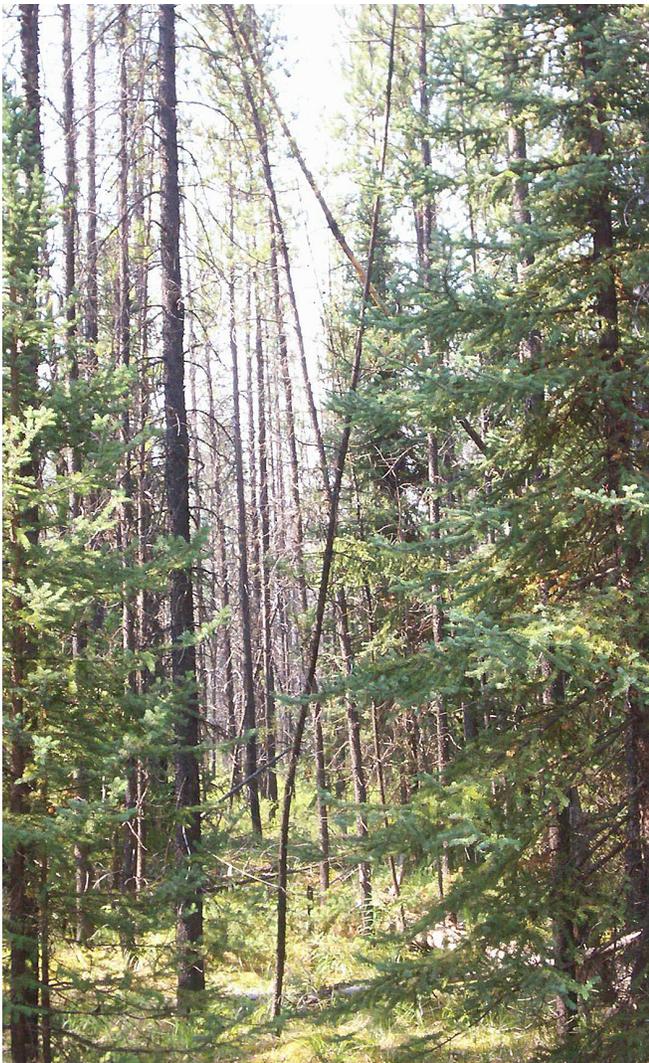


**Figure 1. Mean annual increment (m<sup>3</sup>/yr at 12.5 cm utilization standard) versus age for natural and managed stands.**

- Forest health incidence is generally low and does not significantly affect managed stand yields.
- Managed stand yield projections for the mid-term timber supply appear to be reasonable.
- Monitoring plots confirm that managed stands are growing at a faster rate than natural stands (see Figure 1). These plots were established in polygons assigned managed stand yield tables (based on Table Interpolation Program for Stand Yields [TIPSY]) in the timber supply analysis.

## Applications

Analyses of YSM monitoring data include estimates (and statistical comparisons) of the differences between actual and predicted growth and yield for the various timber



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attributes investigated. These statistics will not be used to adjust existing growth and yield predictions. Instead, the monitoring statistics will identify opportunities for improving timber supply forecasting by providing feedback to timber supply analysts and growth and yield modellers. These data could also be used to guide Timber Supply Review sensitivity analyses (see Table 2).

**Table 2. Example of YSM data applied in a Timber Supply Review sensitivity analysis**

Population	Attribute	Sensitivity setting	
		Magnitude	Direction
Managed stands	Net merchantable volume periodic annual increment (m <sup>3</sup> /ha per year)	1.9	▼
Managed stands (Spruce, Sxi)	Potential site index (m)	2.8	▲
Managed stands	Leading species correct ID: yield table assignment assumptions (%)	36.0	
Managed stands	Pests and disease volume loss (m <sup>3</sup> /ha per year)	0.3	▼

## Next Steps

Field data for the YSM Program were collected this year (2012) in Kootenay Lake, Morice, and Quesnel timber supply areas. Future YSM work will involve:

- Data analysis and reporting for the sampled areas.
- Development of compilation and estimation procedures for young stand monitoring data.
- Mountain pine beetle impact analysis and summary statistics for 62 monitoring plots collected across three other timber supply areas (100 Mile House, Okanagan, and Kamloops).
- Continued sampling of other priority management units.

## CONTACT INFORMATION

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