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**Interim Report:  
Monitoring Early Stand Development**

A Discussion Paper for the  
Expert Review Panel

The Expert Review Panel includes:  
John Barker, *PhD, RPF*, Jim Flewelling, *PhD*,  
Kim Iles, *PhD*, Peter Marshall, *PhD, RPF*,  
Don Munro, *PhD, RPF*, Steve Northway, *MF, RPF*,  
and Rod Willis, *MScF, RPF*.

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**J.S. Thrower & Associates Ltd.** Consulting Foresters  
Vancouver – Kamloops BC



## **Executive Summary**

This paper discusses ideas for monitoring growth and yield in the early stages of stand development. We recommend changes to the current silviculture survey process to provide information that will meet the requirements for growth and yield monitoring, VRI, and other uses. We also recommend that forest-level VRI-based monitoring plots be installed as soon as possible after disturbance, following the growth and yield monitoring protocols. This will provide continuity of data to older ages when these plots will be used to monitor forest-level growth and yield. We recommend that changes to silviculture surveys and databases be tested to evaluate the impact on current programs, and to ensure goals are met.

## **Acknowledgements**

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## 1. INTRODUCTION

### 1.1 PROJECT BACKGROUND

Early stand development<sup>1</sup> is monitored in BC through silviculture surveys to ensure stand establishment and early growth targets are achieved. Another objective for monitoring early stand development is to provide periodic feedback on stand growth and yield to check that predictions are within reasonable margins of error. This latter objective of growth and yield monitoring currently is not addressed in BC.

Several Ministry of Forests (MOF) initiatives are underway to improve collection, storage, and handling of spatial and attribute data. The Growth and Yield Monitoring Task Force (GYMTF) recommendations suggest modification to silviculture surveys and databases, which should consider these other initiatives. Details of the MOF initiatives, including the Integrated Corporate Spatial and Attribute Database (INCOSADA) project, the Forest Opening Data Dictionary (FODD) project, and the Data Analysis Working Group “Green-up Group,” are outlined in Appendix 1.

### 1.2 DOCUMENT OBJECTIVES

This discussion paper presents ideas for *growth and yield monitoring of early stand development*. The paper will be sent to the Expert Review Panel (ERP) for comments and discussion. The ERP input will be incorporated into a final report for Jon Vivian, *RPF* (MOF Resources Inventory Branch).

### 1.3 TERMS OF REFERENCE

The MOF GYMTF made recommendations relating to development of growth and yield monitoring protocols, which were accepted for implementation by the Forest Productivity Council (FPC) (Appendix 2). The MOF contracted us to further develop the GYMTF recommendations in six areas: 1) Volume and Decay; 2) Stand Growth; 3) Treatment Response; 4) Stand Yield; 5) Early Stand Development; and 6) Provincial-level Monitoring. This paper addresses monitoring of early stand development.

This discussion paper was prepared under contract to the MOF Resources Inventory Branch by J.S. Thrower & Associates Ltd. Our team included Ian Cameron, *MF, RPF*, Eleanor McWilliams, *MSc, RPF*, A.Y. Omule, *PhD, RPF*, Guillaume Thérien, *PhD*, and Jim Thrower, *PhD, RPF*.

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<sup>1</sup> Early stand development is defined as the period from time of establishment to free-growing.

## 2. BACKGROUND

### 2.1 WHAT IS MONITORING

Monitoring is the process of periodically checking some thing to see if it is as expected. For growth and yield, this is the periodic sampling of a stand or group of stands to determine if actual growth and yield estimates are as expected (or as predicted). The GYMTF defined growth and yield monitoring as:

*“The process of observing the growth and yield of a forest and comparing this with the predicted growth and yield of that forest to assess risk and uncertainty around predictions.”*

We define *early stand growth and yield monitoring* as:

*The process of periodically observing tree attributes from time of establishment to free-growing in a stand or group of stands to compare actual and predicted growth and yield.*

### 2.2 ROLE OF GROWTH & YIELD MONITORING

The role of growth and yield monitoring is to periodically check estimates to ensure they are within acceptable margins of error for the intended use. The accuracy of growth, yield, and other predictions decrease with time and length of the projection. Some projections may deteriorate over time to where they cannot be used with confidence; thus growth and yield monitoring provides retrospective checks on the precision of those projections. For early stand development, we envision growth and yield monitoring as providing periodic feedback of information to compare with growth and yield predictions in this stage of stand development (time of disturbance to free-growing).

### 2.3 EARLY STAND MONITORING

Early stand development is currently monitored in BC using silviculture surveys. These surveys are a series of independent audits to ensure management obligations are met, and to provide information for subsequent prescriptions. This process does not meet our definition of growth and yield monitoring. However, with some modifications, silviculture surveys could provide information to monitor growth and yield at the stand level in the early stages of development, and continue to meet their focus on management obligations.

### 3. RECOMMENDATIONS

The following sections are our recommendations for growth and yield monitoring in the early stage of stand development, for discussion by the ERP and review by the MOF.

#### 3.1 MODIFY SILVICULTURE SURVEYS TO PROVIDE INFORMATION FOR OTHER USES

The most important recommendation relating to monitoring early stand growth and yield is to modify silviculture surveys to provide information for other uses. Every harvested stand in BC is repeatedly surveyed in the early stages of development. Surveys currently focus on specific management obligations and do not provide information that is easily used for other purposes. Changes in these surveys and subsequent data management could provide an excellent resource for many purposes including growth and yield monitoring.

Modified silviculture surveys could provide information to:

- a) *Provide feedback on management obligations (e.g., free-growing).*  
These surveys should continue to provide feedback on management performance. The recommended changes should not compromise this purpose.
- b) *Summarize trends in stand development for groups of stands and at the forest level.*  
Data from repeated surveys could be analyzed to show trends in height growth, ingress, and other stand-level attributes. This information would provide feedback to silviculturists on stand performance.
- c) *Summarize trends in stand development for individual stands.*  
Trends in height or stand density over age could be generated to compare with existing assumptions and estimates. This would also allow for periodic assessment of existing standards and targets.
- d) *Develop Phase I Vegetation Resources Inventory (VRI) estimates.*  
Silviculture survey data can be used as highly reliable estimates for VRI Phase I. A recent analysis by Forest Practices and Resources Inventory Branches indicated that only height and age of secondary species need to be added to silviculture surveys to provide Phase I VRI estimates (Appendix 3).
- e) *Update the forest inventory.*  
Each silviculture survey is a detailed sample of the stand. This information could be used to periodically update the forest inventory.
- f) *Input to growth and yield models for timber supply analysis.*  
More precise definitions of stand conditions will provide improved inputs for VDYP and managed stand yield tables for timber supply analysis.

g) *Improve silviculture planning and investment analysis.*

More accurate stand descriptions will enhance silviculture planning through improved inputs to silviculture decision models and investment analyses.

h) *Develop models to predict early stand development.*

Data from modified silviculture surveys could be used to develop empirical models or calibrate process-based models of early stand development.

### **3.2 MODIFY SILVICULTURE SURVEYS TO MEASURE BASIC STAND ATTRIBUTES**

We suggest the following attributes and concerns be addressed in the modified surveys:

a) *Reconcile differences between silviculture openings and forest cover polygons.*

The differences between these two layers of information create confusion and discontinuity. This is being addressed by the INCOSADA and FODD projects (Appendix 1).

b) *Locate plots to adequately represent openings.*

Edges are often avoided in silviculture surveys. Plots should be located to adequately represent each opening for stand- and forest-level summaries.

c) *Measure height and age of secondary species.*

This is needed to meet VRI standards, and is being examined by the MOF (Appendix 3).

d) *Measure stand density, species composition, site height, forest health, brush competition, and spatial distribution of stems.*

Tree measurements should focus on stand conditions and not indices related to arbitrary standards. The use of different, often incompatible, indices over time makes it difficult to evaluate trends in stand development. Information to assess management targets and regulatory obligations should be calculated from the collected information.

e) *Design a database to retain stand- and plot-level information.*

The database should contain sufficient information to summarize tree- and stand-level attributes within and among openings. A linkage should be developed between plot data and opening history records. History records should include the targets and standards from silviculture prescriptions to compare performance with targets.

### **3.3 PILOT TEST MODIFICATIONS**

Changing the primary objective of silviculture surveys has many implications including re-training of silviculture surveyors, possibly increased cost of surveys, and changes to field forms and database structure. These are not trivial and, therefore, the benefits of making changes must be clearly demonstrated. The proposed modifications need to be detailed and tested. This should be done in coordination with Forest Practices Branch and the INCOSADA project.

### **3.4 ESTABLISH FOREST-LEVEL G&Y MONITORING PLOTS INDEPENDENTLY OF SILVICULTURE SURVEYS**

Modified silviculture surveys will provide more than enough information to monitor early stand growth and yield at the stand- and forest-level. However, we recommend that the forest-level monitoring VRI-based plots also be installed in young stands as soon after harvesting as possible, following growth and yield monitoring protocols. This will be very useful to quantify trends starting from early stages of development, and will provide early development information that will be used to monitor forest-level attributes. Silviculture surveys should not be used as a replacement for growth and yield monitoring plots in young stands.

#### 4. APPENDIX 1 – RELATED MOF PROJECTS

##### **INCOSADA Project**

The intent of the Integrated Corporate Spatial and Attribute Database (INCOSADA) project is to integrate and rationalize the way the MOF captures, updates, manages, and uses geographic information (including spatial and attribute information).<sup>2</sup> Integration of information (which is currently divided by program area; e.g., inventory, silviculture, tenure, etc.) is needed to respond to public demands for sustainable forest management and to meet business needs under the Forest Practices Code. The INCOSADA project is a two-phase initiative:

1. “Phase 1 of the INCOSADA Project calls for improvements to the quality of the Ministry’s geographic information, the standardization, rationalization, and consolidation of the Ministry’s geographic information (spatial and attribute) datasets, the development and maintenance of spatial and attribute integration links, and the integration of the business processes and applications that use geographic information. These objectives will be piloted in head office and district office operations.”
2. “Phase 2 of the INCOSADA project calls for a province-wide information migration to the INCOSADA specifications, the implementation of a fully integrated spatial and attribute database in RDBMS data structure, and the development of business applications based on this new data structure and management system.”

##### **Forest Opening Data Dictionary (FODD)**

Historically, harvesting, silviculture, and inventory produced their own maps and databases. The FODD was developed by the Silviculture Inventory Technical Committee (SITC) to address the issue of a single forest opening boundary as identified under the INCOSADA project. The intent is to provide a rationalization of the information collection, storage, and transfer between inventory and silviculture. The following FODD recommendations<sup>3</sup> could affect the recommendations of the GYMTF:

1. Forest Practices Branch (FPB) accepts Resources Inventory Branch (RIB) vegetation inventory standards and use RIB data elements and definitions when developing silviculture survey standards to collect vegetation inventory data during ground surveys.
2. FPB is the steward of post-harvest vegetation data until the free-growing milestone.

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<sup>2</sup> <http://www.for.gov.gc.ca/isb/incosada/projects/St14M97.htm>

<sup>3</sup> Taken from “Forest Opening Data Dictionary (FODD) Overview” Draft November 18, 1998.

3. The silviculture reference file should have levels for culturally ascribed attributes (e.g., managed forest objectives) and for a vegetation inventory stand description as it exists on the ground.
4. The cutblock boundary should be the shared boundary between inventory and FPB within which silviculture surveys will collect detailed vegetation cover and inventory will accept ground-survey data.
5. Silviculture surveyed vegetation cover information in areas under management will supersede the vegetation cover in the inventory reference file.
6. Transfer of silviculture records from the Silviculture Reference File to the Inventory Reference File will occur at the free-growing milestone. Information could be superseded by more up-to-date data at some later point during re-inventory, should this prove necessary.
7. FPB and RIB will re-work the silviculture survey methods to provide vegetation cover both to vegetation inventory standards and with detail to feed stand models.
8. Inventory should not replace ground-based information with photo-interpreted information on areas where silviculture surveys have or will provide information.

#### **Data Analysis Working Group – “Green-up group”**

The mandate of this group was to develop a methodology for improving the accuracy of determining green-up age. The group was informed of the recommendations regarding green-up from the GYMTF Mesachie Lake workshop. A consultant was contracted to produce tables showing ages when different green-up heights are reached using silviculture survey data from the six regions. This will be done by fitting height-age curves and using these to predict when stands will reach specific green-up heights. The report is due 31 March 1999.

## 5. APPENDIX 2 – GYMTR RECOMMENDATIONS

The following recommendations were made for monitoring early stand development at the Growth and Yield Monitoring Task Force Mesachie Lake workshop (17-19 June 1997).

### 1. Early height growth

- a) In the short term, check predictions of green-up height/age for units appropriate for timber supply analysis where early height growth is identified as a significant issue.
  - To do this, a sampling protocol specifying population and parameters should be developed with client input. This action was delegated to the Data Analysis Working Group – Green-up group.
- b) In the longer term, better information is needed to contribute to the development of height-age curves, and to check estimates of site index and years to breast height.
  - To do this, free-growing surveys should be modified as outlined in the GYMTR silviculture working group (SWG) report. Agreement is needed with Forest Practices Branch to undertake this recommendation.
  - The silviculture database structure should be reviewed and revised so it can be queried. The MOF is currently reviewing databases.
  - Some silviculture survey plots should be converted to permanent sample plots.
  - Identify whether trees measured in silviculture surveys qualify for site-curve development.

### 2. Free-growing

- a) Check whether the required number of well-spaced trees free of brush is achieved within the defined free-growing window.
  - To do this, free-growing surveys should be modified as outlined in the GYMTR SWG report. A contractor should test the modifications to the free-growing surveys.

### 3. Regeneration Delay

- a) Check whether regeneration is being achieved within the defined regeneration delay window.
  - To do this, modify the free-growing survey as outlined in the GYMTR SWG report.
- b) Check whether the regeneration delay numbers being used in timber supply review accurately reflect field performance.

## 6. APPENDIX 3 – SECOND GROWTH INVENTORIES AND SILVICULTURE SURVEYS

Second-growth inventories are currently underway using the VRI protocols. For example, the MOF is conducting an inventory of young coastal Douglas-fir stands by Landscape Units in Chilliwack. Silviculture information should be treated in the VRI as Phase I estimates (i.e., treated in the same manner as photo-interpretation estimates). These silviculture-based initial estimates will likely not be adjusted as much as the photo-interpreted estimates, based on the VRI Phase II (ground sampling) data.

Therefore, the question we considered was: Which Phase I attributes are not available from silviculture surveys, and can these be obtained by modifying the surveys? Our proposed approach was to:

- a) Complete a gap analysis of silviculture surveys to identify missing VRI (Phase I) estimates;
- b) Review the outstanding attributes to see if they could be collected with modified silviculture surveys or by other means; and
- c) Make recommendations on modifications.

Coincidentally, Forest Practices Branch and Resources Inventory Branch recently completed a gap analysis by comparing a list of all VRI Phase I attributes to silviculture data summaries.<sup>4</sup> They found seven items not collected in silviculture surveys that are required in VRI. Only two of these require ground measurements: height and age of the second species. FPB agreed that it would be possible and a good idea to incorporate height and age measurements for the second species into their silviculture surveys. Work is currently underway to document the necessary changes to silviculture surveys.

BC is currently the only province that has a separation between data collected for inventory and silviculture purposes.

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<sup>4</sup> This analysis was done by Tim Salkeld (RIB) and Paul Rehler (FPB) in January 1999. Paul Rehler is currently documenting and following up on the work.