



## **Forest, Stand and Tree Growth and Yield in British Columbia**

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**The Provincial growth and yield program is a central component of sustaining forest resources and ecosystem services. While the Provincial growth and yield program has had some significant achievements, particularly with the development of the Tree and Stand Simulator, the program has been in need of further upgrades to provide a better foundation for sustainability of forests and the communities that depend on them. Through a combination of shifts in government policies, organization and funding allocation there has been a sharp decline in support of growth and yield activities. The significance of these changes is outlined in this Background Brief.**

Forest management is predicated on the establishment, protection, utilization and sustainability of forests, forest resources and ecosystem services. Forests are by definition made up of stands of trees that are integrated with other organisms and the environment within a dynamic ecosystem context. Growth and yield is focused on describing how individual stands of trees change with time, primarily through processes of tree species reproduction, establishment, growth, mortality and interaction.

Biological processes and human interventions influencing tree reproduction, establishment, growth and mortality have a profound affect on those things we value most about forests. Our very well-being depends on knowledge of how the goods and services are distributed across space and through time and to what extent. Growth and yield is an essential component of the answer to two main questions: (1) how have forests arrived in their current condition, and (2) how are they likely to progress from here?

### **What is Growth and Yield?**

The basic process applied by growth and yield practitioners is to use the past as a guide to the future. In following this strategy two dominant kinds of monitoring programs are generally deployed: (1) monitoring changes in such a way as to ensure representation of the population and wide variety of stands in the forest inventory, and (2) conducting formal experiments to test hypotheses about site and stand level treatments and tree responses. A particularly important part of growth and yield is concerned with the estimation of differences in site productivity. The first kind of monitoring is devoted to characterizing broad patterns of change in the inventory. The second is devoted to determining the influence of causal chains of events and associated magnitudes of change in tree and stand characteristics in response.

### **A Brief History of Growth and Yield in British Columbia**

The British Columbia (BC) Government growth and yield program originated with the establishment of research stations starting in the early 30's. Since that time the BC Ministry of

Forests established a large number of experimental plots with treatments and controls in various forest types throughout the province and has maintained these installations and reported on the results as budgets permitted. The growth and yield program was subsequently expanded throughout much of the province with establishment and re-measurement of plots representative of a wide variety of “natural stand” conditions. These experimental and “natural stand” data have been used to produce several different kinds of growth and yield models that in turn are deployed in Timber Supply Analyses. Examples include the Tree and Stand Simulator (TASS), the Variable Density Yield Projection (VDYP) system, and PrognosisBC.

### **An Evaluation of the Current State of Growth and Yield in British Columbia**

The following is a critique of the current provincial growth and yield program.

1. The Province has no systemic process for observing the growth and yield of stands that are representative of the entire population of stands within each operating unit or Timber Supply Area<sup>1</sup>. Plots have been established to represent certain stand types, but not inventory populations as a whole. Instead the Province relies on periodic re-inventory, but this provides no information about how growth and development patterns of stands of trees influence changes in the inventory with time. Nor does it give sufficient indication of how stand development patterns and inventory are being influenced by climate change. The Province is engaged in the National Forest Inventory that includes permanent monitoring plots, but this initiative lacks the plot intensity necessary to support representation of inventories on the scale of individual operating units.
2. As mentioned above the Province has a network of permanent sample plots to represent the variety of stand types in various parts of the province. While the network continues to exist, it is not being maintained by way of carrying out re-measurements and by way of periodically reporting the actual results relative to forecasts made by models designed for this purpose, and accompanied by diagnoses as to potential or probable reasons for the discrepancies. There is no funding currently devoted to this program.
3. The Province has an extensive network of experimental plots related to growth and yield. However, the Research Branch of the Ministry of Forests has been closed permanently with the personnel transferred to other branches of the government. It is no longer clear how these installations will be maintained, whether they will be maintained and how the data will continue to be used for growth and yield model development and forecasting in the province.
4. The BC Ministry of Forests continues to support the development of their main model (TASS) to facilitate the forecasting of the development of a wider array of stand types, including complex stands. This work deserves continued support. However, as result of no program to observe the growth and yield of stands, there is little or no data available to link this model to the inventory for the purpose of timber supply analyses. The inventory does not contain tree level information regarding the numbers, sizes (height, diameter)

and species of trees in any one plot of land or stand condition as identified in the inventory. This problem is particularly acute in portions of the province where complex stand conditions predominate as a result of natural disturbances (or lack thereof) and/or a history of selection cutting. For these areas, there are no assurances that the current growth projections commonly used in Timber Supply Analyses are anywhere near being representative of reasonably expected patterns of future stand development. As a result, any claims about the sustainability of forest management practices are plagued with high levels of uncertainty.

5. The use of growth and yield tools has been primarily focused on strategic level planning in the form of timber supply planning and the assessment of silviculture treatment options. As mentioned above, the lack of tree level details results in a weak link between actual stand conditions as they exist on the ground and the inventories used to represent those conditions, and the growth and yield projections used to forecast expected changes with time. This weakness severely constrains the use of these kinds of strategic level analyses for the purpose of designing prescription guidelines. To be effective, prescription guidelines should on one hand be tailored for each of the different stand structure types. On the other hand, all of the prescriptions should collectively be designed to meet forest and landscape management objectives according to a preferred scale and schedule of application. More detailed, tree level data are required to represent the variety of stand types in the inventory for the purpose of better establishing this connection.
6. There is no feedback loop to assess the veracity of forest level projections. This feedback loop would ensure that growth and yield forecasts are continuously checked against actual results on the ground with permanent monitoring plots, and that potential causes for differences identified. As a result ground level practices may be inconsistent with desired strategic level outcomes. The Ministry of Forests has a Forest and Range Evaluation Program (FREP) that might be used to fill this void, but this program cannot effectively do so without using permanent plots and without integrating the results into a holistic forest inventory, planning and management context to determine whether or not policies are producing their intended outcomes.

The community of growth and yield specialists has been declining. Industrial support for growth and yield was predicated on using this information as a tool to manage forest resources in such a way as to protect the availability of timber while sustaining multiple use values under tenure agreements within the province, particularly TFL agreements. Strong industrial support can be found where there is sufficiently secure and sustained access to timber accompanied by a commitment and where there is a corresponding responsibility for managing forest resources for agreed to public purposes, for example to

obtain social, economic and environmental sustainability. Investments in inventory and growth and yield help industry to exercise these rights and responsibilities in a more efficient and effective manner.

A number of factors have eroded confidence in the idea that private investment in growth and yield will produce the desired returns. To start with, for growth and yield to be most effective it has to be carried out over a long period of time, and requires considerable investment to get started. There was an initiative to overcome this barrier through establishment of regional growth and yield cooperatives that included both government and industry. The Southern Interior Growth and Yield (SIGY) cooperative was formed as a result but has since been disbanded. Cooperatives have been successful in other jurisdictions, usually predicated on significant industrial support spread across a number of companies in recognition of opportunities for achieving economies of scale.

The other factors that have led to the decline in industrial support and involvement in growth and yield are: (1) the instigation of policies that allowed governments to reallocate up to 5% of the cut from TFL's without compensation, (2) the shift from predominantly procedural forest management policies based on the development, submission and approval of plans, to a predominantly mandatory, substantive policy framework<sup>ii</sup> that began with the first forest practices code, (3) the continued battle to maintain industry profitability and market share, and (4) the lack of continuity of public funding (e.g. Forest Renewal BC, Forest Investment Account) historically set up to stimulate and support further work in this area (as well as other areas). In response to concerns about item number 2, efforts have also been made to allow greater discretion in local forest management decision making in the forms of professional reliance, results based forestry, defined forest area management, along with giving industry the ability to change the rules through use of stewardship plans, but none of these initiatives have been sufficient to spawn a renewed interest in private investment in growth and yield.

7. Most successful growth and yield programs have relied on Universities to train the expertise necessary to maintain them. Typically this means Universities have cooperated with government and industrial interests to produce graduate students in model development and growth and yield research. Often this leads to later employment either directly in growth and yield or in related forest inventory, management planning, silviculture and policy review areas of practice. How this might work in the future is currently uncertain given the recent reorganizations of the Ministry of Forests, the abandonment of Research Branch, and withdrawal of financial of support for maintaining the Permanent Sample Plot program. In addition to alliances with universities, participation with other provinces and cooperatives in both the US and Canada, and

involvement with organizations such as the Western Mensurationists have been important for supporting advances in this field and for obtaining economies of scale.

## **Conclusion**

Growth and yield is generally viewed as a long term program that is central to improving knowledge of forest and stand dynamics within a local forest management context. It is central to adapting to climate change, managing forests for carbon sequestration, identifying opportunities for production of bio-energy as well as for managing interfaces between trees and a wide variety of resource and ecosystem service values. British Columbia has had a successful growth and yield program, most notably with the development and deployment of the Tree and Stand Simulator (TASS). However there remain many outstanding issues that are central to sustaining resources and services in the intermediate to long term.

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<sup>i</sup> I am on record for having spoken about the importance of this issue:  
[http://www.for.gov.bc.ca/hre/sigy/pdf/monitoring/MON\\_moss.pdf](http://www.for.gov.bc.ca/hre/sigy/pdf/monitoring/MON_moss.pdf)  
Accessed

<sup>ii</sup> McDermott, C., Cashore, B. and Kanowski, P. 2010. Global environmental forest policies. An international comparison. The Earthscan Forest Library. Earthscan, London, UK.