Forest and Range Evaluation Program Stand Development Monitoring (SDM)

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FREP

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WHY DO WE NEED SDM?

Stand development monitoring (SDM), currently in the piloting stage, is designed to address a significant knowledge gap that currently exists in B.C.'s forest management framework, between the free-growing milestone and final harvest.

BACKGROUND

The milestone of free-growing is used to ensure that, at an early stage of development, young stands contain a minimum number of well-spaced, preferred and acceptable species above a minimum height. The obligation to achieve this early stand condition has been assigned to licensees for stands harvested after October 1987, while for stands harvested prior to then, the responsibility lies with the Crown. For stands regenerated under either management eras, the same assumption was made; once free-growing has been achieved, we have confidence, based on the tree species present, their health and level of stocking, that the stand would reliably provide a merchantable crop of timber at the next rotation. SDM is unique in that at present, there are no other mid-rotation checks of stand growth or health operationally implemented by the MFR.

Across the province, there are over 2.5 million hectares of stands designated as free-growing in the Reporting Silviculture Updates and Landstatus Tracking System (RESULTS) database. This data provides an invaluable benchmark of prior stand condition. SDM is being designed to look forward from the current stand condition and to look back to the stand's condition when it was last formally assessed at free-growing. The combination of the RESULTS database/silviculture opening files information and SDM provides assessments from two points in time. With the two similar measures it is anticipated that we will be able to assess the extent of change in free-growing stands over time and provide insights into the potential causes behind those changes. It is also the intent of SDM to provide a revised estimate of stand yield at rotation based on current mid-rotation tree and stand attributes. We will be able to look forward with a clear indication of where we came from. In this respect SDM is unique among FREP monitoring protocols. Either assessment, free-growing declaration or SDM, on their own, would be a single snapshot in time.

SDM sample stand, age 23, declared free-growing at age 16.

The FREP Mission:
To be a world leader in resource stewardship monitoring and effectiveness evaluations; providing the science-based information needed for decision-making and continuous improvement of British Columbia's forest and range practices, policies and legislation.
http://www.for.gov.bc.ca/hfp/frep/index.htm

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The potential exists to correlate SDM data from the stands we are able to assess to those of earlier free-growing declarations in RESULTS. Our random sample of declared free-growing stands within RESULTS may in the future allow us to generalize our findings to the larger population of managed stands in the provincial silviculture database. Through this and similar exercises, it is anticipated that the SDM protocol will provide a powerful tool for monitoring stand development and checking management assumptions and projections.

OBJECTIVES OF THE SDM PROCESS

When a stand is declared free-growing it is assigned an inventory label based on leading species composition, stocking, age, and site index. SDM is being designed to check each of those attributes and to derive a new inventory label that updates the label provided by the RESULTS milestones of regeneration delay and free-growing. The SDM protocol will also provide operational mid-rotation stand yield estimates to assist in refining MFR stand yield projections. A further objective is to check for significant changes in well-spaced, free-growing, and total density between declaration and the SDM assessment. Such changes can be an indication of compromised forest health and other potential stand development issues.

This protocol is not intended as a tool to evaluate licensee performance in meeting their obligations under the Forest and Range Practices Act (FRPA). SDM is designed to assess the timber productivity of free-growing stands 10+ years after the declaration of free-growing. In this respect SDM could also assist forest licensees in meeting sustainable forest management certification by addressing the monitoring aspect of industry certification while at the same time provide government resource agencies with improved managed stand productivity estimates needed for sustainable resource stewardship.

BASIC SDM METHODS

SDM data must be similar enough to free-growing survey data so that they can be reliably compared. Although this protocol is designed to re-examine free-growing stands, **this is not a free-growing survey**. Free-growing survey protocols were developed for use in stands aged 10-15 years. The SDM protocol assesses age class 2 and 3 stands, (i.e., age 20-60 years). SDM requires a balance between strict adherence to free-growing standards, which allows for back casting, and recognition that we are assessing stands later in their development. The SDM protocol acknowledges that competitive relationships between crop trees and brush species have had more time to be resolved in stands of this age. Also, whether a tree was designated as an acceptable species of conifer at the time of declaration is considered of less importance today, particularly in light of climate change and changes in species acceptability. To compare current free-growing stocking values to declaration values, however, trees must also be tallied following the preferred and acceptable designations used at the time of declaration. This is necessary to determine the growth trajectory of the projected crop trees. A full description of the SDM protocol can be found at: *http://www.for.gov.bc.ca/ftp/HFP/external/!publish/FREP/Indicators/FREP%20SDM%20Protocol_June15%202010%20final.pdf*

A core aspect of SDM involves an accurate assessment of current forest health conditions. SDM specific tree damage criteria have been developed which are based on free-growing damage criteria, but have been tailored for assessing the health of older even-aged stands. The SDM damage criteria have been developed with consideration for both future merchantability and survivorship. SDM damage criteria are, in general, more lenient than free–growing damage criteria as there is more confidence in a tree's continued survival by this point in their development. An early spin-off benefit from SDM has been the uptake of these mid-rotation damage standards for use by other programs such as Forests for Tomorrow. These criteria are expected to be revised as SDM matures and as we learn more about the health and productivity of managed stands post free-growing. Climate change will increase host stress in many areas making trees more susceptible to pests and pathogens, adding to the already clear necessity to monitor managed stand growth and productivity.

INDICATORS

There are several indicators that are used to assess managed stand development and stand-level forest health. The core indicators include:

- Leading tree species, height class, age and crown closure (Inventory label);
- Total trees;
- Well-spaced and free-growing tree density;
- Ratio of total trees to well-spaced trees (spatial distribution of stand);
- diameters at breast height (DBH) of all trees in the plot ≥ 7.5cm dbh;
- Pest incidence including live and dead trees by layer 1-3; and
- Current site index of the leading species

Some optional indicators include:

- Well-spaced density of preferred and acceptable tree species;
- Stand management treatments;
- Proportion of crop trees by layer 1-3, and
- Current stand volumes

SDM provides a mid-rotation check of stand conditions to see if stand density and species composition are following assumed trajectories.

WHAT ARE THE POSSIBLE IMPLICATIONS OF CHANGES IN CORE INDICATORS?

Leading Inventory species

Inventory labels provide the inputs used by MFR stand growth models and timber supply forecasters to project future stand productivity in timber supply reviews (TSR). Changes in leading species between the two assessments, free-growing declaration and SDM, can be driven by large amounts of natural ingress. Post free-growing ingress may likely have limited influence on the timber productivity if they are small size in comparison to the earlier established species. Changes in leading species can also be driven by competition or differing rates of susceptibility among tree species to pests and pathogens, such as mountain pine beetle and armillaria root disease. Changes in leading species due to these latter factors can affect projections of stand productivity and, by logical extension, the setting of AACs.

Total trees

Stands are generally expected to lose density between the time of stand initiation and final harvest. Free-growing declaration assessments and SDM both occur relatively early in the life of a stand, at a stage of development when stands are still expected to maintain a considerable number of stems. Large decreases in total density between free-growing declaration and SDM may indicate compromised forest health conditions or an inadequate assessment of stand risk at time of last harvest.

Selective removal of lodgepole pine by bark beetle attack can lead to changes in leading inventory species in managed stands

Well-spaced and free-growing tree density

Using the combination of early silviculture records and SDM we can assess changes in both well-spaced and free-growing densities over time. We can then compare any resulting changes to those projected by MFR growth and yield models. If those changes are significantly different than what is projected in the growth and yield model there may be implications for managed stand productivity estimates.

Assessing the density, health and distribution of well-spaced trees in a 39-year-old lodgepole pine stand in Rocky Mountain Forest District.

Ratio of total trees to well-spaced trees (spatial distribution)

Recent work on the ratio of total trees to well spaced trees will provide insights to help Timber Supply Review (TSR) analysts determine which spatial distribution yield models should use to generate stand yields in timber supply analyses. The spatial distribution of trees within stands can have a significant influence on managed stand productivity. Regular (planted) distribution stands can potentially produce more volume than stands with the same density but with a clumpy distribution. SDM data can provide a means to assess current spatial distribution as well as insights as to how spatial distributions can change as stands develop. A standardized approach for determining the appropriate spatial distribution to model managed stands during timber supply reviews could be one of the more influential outputs from SDM.

Proportion of crop trees by layer and health status

Tallying trees by layer[1] in SDM allows for a reconstruction of the volume contribution of each layer in a plot to the total plot volume. The use of 10 sample plots per stand allows for an estimate of variability in stand volume within stands. In addition, as trees are also tallied by tree layer and forest health agent, SDM allows for a more accurate assessment of forest health impacts. If damage agents are concentrated on the layer 3 trees, the future productivity impacts are far less than if the larger layer 1 trees are attacked. It is also intended that SDM will provide an operational mid-rotation yield estimate and inventory label that will help to refine TSR analyses.

Determining well-spaced trees using minimum inter-tree distance reference guide in a 25 year old Douglas-fir stand.

[1] Layer1, >12.5 cm dbh; Layer 2, 7.5-12.5 cm dbh, and Layer 3 < 7.5 cm dbh, but > 1.3m in height

Pest incidence including live and dead trees

SDM occurs at a later stage in stand development, when forest health agents such as root diseases have become more evident. Comparisons can be made between the pest incidence estimates at free-growing and those assessed during SDM but emphasis should be placed on the current SDM data which will provide refined input to Timber Supply Review.

Armillaria root disease caused mortality in a mixed Douglas-fir/ lodgepole pine stand in the Okanagan TSA.

Current Site Index

Site index (SI) is determined at every plot using the Growth Intercept method. SDM provides an unbiased assessment of SI that can be compared to current TSR estimates. To date, SDM and intensive FREP study estimates of SI have tended to be higher than those estimates in current TSRs.

Determining site index in a 20-year-old lodgepole pine stand in the Central Cariboo Forest District. SI is determined at each SDM plot; a total of 10 samples per stand.

CONSIDERATIONS FOR RESOURCE PROFESSIONALS

There are a number of key opportunities for both government and licensees through SDM, these include:

- Resource agency due diligence – confirming/validating the values of our investment in growing new forests,
- Resource agency planning – using SDM to update resource inventories, refining predictions of future forest harvest yields, planning investments and helping adapt managed forests for climate change,
- Sustainable forest management certification - contributing to monitoring requirements,
- Professional reliance – providing valuable information to inform forest management decision making.

Thank you

Special thanks to all the district and regional staff who have assisted in the development and testing of this protocol, and who have also made valuable input for ongoing improvements.

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