Morice & Lakes IFPA

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Summary No. 69

Morice & Lakes Innovative Forest Practices Agreement

Project Summary

Morice & Lakes IFPA projects are exploring ways to enhance forest productivity through a better understanding of factors affecting productivity, through intensive silviculture treatments, by increasing the area of productive forest land, and by improving site productivity estimates.

A Multi-Block Stocking Standard

Introduction

This summary describes the results of a project undertaken by ML IFPA licensees to develop multi-block stocking standards. Multi-block stocking standards set out how regeneration in harvested areas should be performing at a specified assessment date. The standard applies to an entire population of blocks harvested in a given year. The whole population either passes or fails based on whether yield predicted for observed stocking conditions, is similar to the yield predicted in timber supply analysis.

Objectives

The analysis and recommendations in this report build on a multi-block feasibility study completed for the ML IFPA in 2007. Project objectives in the 2008/2009 study included:

- Expanding the analysis to more comprehensively reflect operational conditions.
- Assessing the risks involved in adopting a multi-block approach.
- Providing recommendations on whether a multi-block system should be used by IFPA licensees.
- Providing guidance on how a multi-block standard might be implemented.

Potential benefits in the multi-block approach include:

- Flexibility to invest first in those treatments/sites that will yield the greatest return.
- Better alignment of regeneration efforts with habitat and biodiversity objectives.
- A better link between regeneration practices and timber supply objectives.
- A potential reduction in survey and treatment costs.
- Reduced need for arbitrary rules on minimum stocking and stratum size.

Methods

At the conclusion of the feasibility study for the multi-block project, stakeholders were asked what information they would need in order to develop and implement the approach. The key questions that came out of this process are summarized below:

- When should regeneration performance be assessed?
- Which yield model should be used to simulate yield (TIPSY – Table Interpolation Program for Stand Yield, TASS – Tree And Stand Simulator (produces TIPSY values), or SORTIE, a forest simulator designed primarily for research purposes).
- Is it necessary to stratify the population and, if so, how?

Babine Forest Products
BCTS BC Timber Sales Babine
D.L.F.P.
Houston Forest Products
L & M Lumber Ltd.
Fraser Lake Sawmills
CANFOR

- How sensitive is predicted yield to stocking levels and stem distribution?
- Can stem mapping be used to address issues of stem distribution?
- Is the influence of deciduous trees important and how should they be addressed in the standard?
- What is the impact of forest health factors on predicted merchantable volume (PMV - yield simulated in a growth and yield model based on actual stand conditions versus TMV, target merchantable volume or the yield simulated using assumptions used in timber supply analysis).
- Should the influence of leave patches be addressed?
- How should statistical confidence be incorporated?
- What is the likelihood that a population will pass?
- What costs might be expected with this system?

These questions were used to develop a workplan and guide analyses. Key elements of the analysis included:

- Obtaining survey data from 67 cutblocks from three major licensees and nine survey contractors to use in testing the multi-block system.
- A review of pertinent literature.
- Acquisition of information from other licensees and government staff regarding multi-block standards in other jurisdictions.
- A review of historic "free growing" declarations and factors affecting them (a free growing tree is one that reaches a condition where it will continue growing free of brush competition or pests).
- The use of growth and yield models to predict future timber volume for various scenarios (see Table 1 below regarding the different scenarios tested).
- The use of GIS technology and high resolution aerial photographs taken in the winter to create stem maps to explore the influence of stem distribution on future yield (see Figure 1).
- Statistical analysis to determine: the significance of project results and to ensure that sampling and yield predictions were statistically valid.
- Expert advice on costs, tracking systems, and reporting requirements.

Categories of analysis and the components in each are summarized in Table 1.

Table 1. Analysis Categories and Elements

DATA — **Benchmark Date:** Historic time to FG, Timing of future FG declarations | **Acquisition & Transformation:** Choice of licensees, harvest year, and survey year

STRATIFICATION TESTS (TIPSY)

Stratification Method A (Spp/Stkg/SI Mapped)

PMV	TMV
• By species mix, stocking class, site index (SI) class • Strata were mapped • Inventory label based on total stems per hectare • Plot-based SIs • OAF1 actual • Effective age used (the age a tree appears to be, based on its height) • Pests subtracted	• TMV Basic - TSR species mix, plot-based SIs, yield at 90 yrs • TMV by AU (analysis unit) - AUs based on TSR SI breakpts, 3 species mix runs per stratum, 3 site index values per run: * Base Case * OGSI * Plot Based - AUs based on logical breakpts, 3 runs per stratum, 3 site indices per run (plot based)

Stratification Method B (Site Series)

PMV	TMV
• By site series • Strata not mapped • Pests not subtracted • Rest like Strat A	• TMV Basic- TSR species mix, AUs not used • Plot-based site index values

Stratification Method C (Analysis Units)

PMV	TMV
• By analysis unit • Strata not mapped • Rest like Strat A	• AUs based on TSR SI breakpts, 3 species mix runs per stratum • Plot-based SI values

Stratification Method D (Spp/Stkg/SI No Mapping)

PMV	TMV
• Same as Strat A but strata not mapped	• TMV Basic- TSR species mix, AUs not used • Plot-based SIs

OTHER TIPSY RUNS (using strata from Stratification Method A)

NSR	Deciduous	Leave Patches	Pests	Well Spaced
NSR Created • 3% on all stratific Method A strata • 5% 3 largest strat • 10% 3 largest strat • 15% 3 largest strat • 100% on the 3 smallest strat • Stocking 400 sph	TIPSY • PMV run with total trees instead of total conifers (and compared to total conifers) • Second scenario with total conifers and OAF2: - on strata with > 600 sph decid - Sx/Bl leading stands OAF = 20% - Pl leading stands OAF = 35%	• PMV determined using TIPSY Var. Retention Adj. Factor (VRAF) • 2 strata and 2 scenarios only • Air photos used to determine: average group size, proportion aggregated versus dispersed, and top height • Info used to decide how to model TMV	• PMV run with total conifers without subtracting pests • Compared to Strat A basic	• PMV run with well spaced trees instead of total conifers • No "m" value • Compared to Strat A basic
NSR Replanted • Failed areas fill planted w/1100 stems/ha • TMV species mix • Effective age recalculated	SORTIE • Yield with and without deciduous trees included • 2 strata with the most deciduous • 1 hypothetical stratum • PMV vs TMV			

STEM DISTRIBUTION TESTS

TIPSY Hypothetical	TASS Hypothetical	TASS Hypothetical Map	TASS Actual Stem Maps
• Pl and Sx • 18 runs each species • 6 stkg levels (400-2400) • clumped, nat, planted • SI 19, 90 years • No stem maps	• Pl only, 36 runs • SI: 12, 16, 21 • Stems/ha: 700, 1200 2000, 4000 • Clumpiness factor 1-3 • No stem maps	• 12 strata (method A) • PMV based on plot data • TMV based on TSR (plot SIs, TSR spp mix, no AUs • PMV Incl OAF1 and EA • Stem map of 1500 pltd +random ingress	• Input values same as TASS hypothetical except: - PMV run with stem maps based on high res air photos - Stem maps exact wrt sph but are a best match otherwise

STATISTICS
- Lower confidence limits (95%) for sph and effective age
- Analysis of variance for PMV and TMV
- Sample size

STAKEHOLDER ENGAGEMENT
- Public presentation
- IFPA licensee presentations and workgroups
- Meetings with District staff
- Meeting with Forest Practices Branch staff
- Many conversations with technical experts
- Power point presentation
- Report and recommendations

RISKS
- Ha of NSR at FG
- Impacts of NSR (see purple columns)
- Record keeping syst.

COST IMPLICATIONS
- Administrative costs for plan amendments, tracking, and reporting
- Training costs
- Potential impact on survey costs
- Potential impacts on treatment costs

Results and Discussion

Results and their implications have been summarized below under seven headings: assessment date, survey procedures and input data, stratification, simulating future yield, statistics, target performance, and costs.

Assessment Date

Despite the fact that planting is normally conducted 12 to 18 months after harvest, the free growing standards currently in use in the ML IFPA, are not being met, on average, until more than 12 years after harvest completion. IFPA licensees believe that if a stand has been established for a period of 12 years the effects of stand establishment practices will have been largely expressed. Licensees also believe that there will be an acceptable level of risk regarding future forest health factors, and that there will be a reasonable likelihood that future growth can be accurately modeled. Consequently, the multi-block assessment date was chosen to be 13 years after harvest completion.

Survey Procedures And Input Data

Statistical analysis revealed that the survey design already in use for silviculture surveys provides sufficient data to meet Ministry of Forests reporting needs, and provides a level of confidence in the data that is at least as good as the existing system.

Stratification

There are two main reasons to group (or stratify) related plots before undertaking data analysis: 1) to ensure that mean values generated for input into a yield model are not from such a broad range of conditions that they are meaningless, and 2) to better identify poorly performing areas. Four ways of stratifying data were explored in this study and it was found that the variation amongst them, in terms of predicted future yield, was less than 2%.

Simulating Future Yield

The strengths and weaknesses of TIPSY, TASS, and SORTIE were explored in relation to the multiblock standard and it was found that there were substantial differences amongst them. TASS 2.0 was found to be the most useful model currently available. It was also determined that pest-affected trees, stem distribution, and OAF1 (operational adjustment factor - used in TIPSY to reduce yield because of stocking gaps) make an important difference in yield and that these need to be adequately measured and accounted for when predicting future yield. Stem distribution can make as much as a 45% difference in yield in a given stand. The difference in yield using hypothetical stem maps generated by TASS and actual stem maps (see Figure 1) was much smaller (about 5%).

The impact of leave patches, deciduous stems, and poorly stocked areas was also explored. It was found that leave patches make a big difference in future yield but that the modeling algorithm used for them is not suitable for use in a multi-block standard. Deciduous tree impact can also be significant, but there is currently no effective way to model it. Conversely, the impact of not sufficiently restocked areas (NSR) was less than anticipated. Simulating 400 stems/ha on 5, 10, and 15% of the survey area in the three largest strata (representing 74% of the total area) resulted in 2, 4, and 6% reductions in population yield at age 90 respectively.

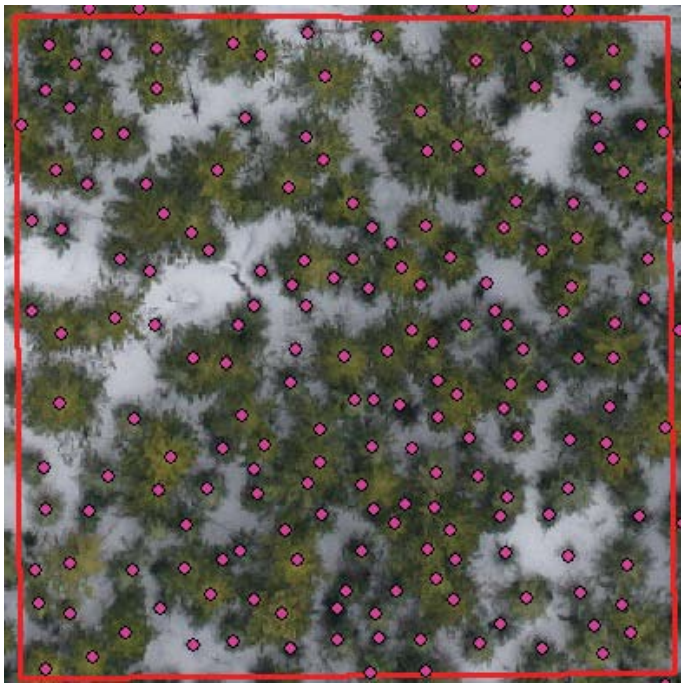

Figure 1. Example Stem Map.

Statistics

When lower confidence limits were used for modeling the input variables stems/ha and effective age (the age a tree appears to be, based on its height), the difference in yield between the base case and lower confidence scenarios was relatively large for some strata, but only a small difference was observed amongst population means. The largest difference was 1.6%. The significance of these tests, and others, was explored with analysis of variance and it was found that there was a statistically significant difference (relative to the base case) for the following tests: using a lower confidence limit for stems/ha, deducting pest-affected trees, using well spaced stems/ha as an input rather than total stems/ha, assuming a 15% failure on the three largest strata, and using TIPSY rather than TASS.

Target Performance

A regeneration performance standard must specify a threshold at which performance is considered to be successful. In this project, it was recommended that total predicted merchantable volume as a proportion of target merchantable volume be used as the threshold for the population of blocks being assessed. Two basic approaches to deriving target merchantable volume were tested. Relatively little difference in predicted yield was observed between the two methods although the approach in which plot-based site index values was used, was found to be most useful.

Costs

Because the proposed multi-block system has never been implemented, cost implications are largely speculative. Based on feed-

back from three major licensees within the IFPA it is expected that free growing survey costs will likely be reduced by about 10 to 20% and there may be cost savings for surveys conducted at an earlier stage in stand development as well. Planting and brushing costs could also be reduced by as much as $250,000 per year for an average licensee. It is not expected that the system will change tracking or reporting costs substantially, but some initial training costs will be incurred.

Recommendations

Multi-block regeneration performance standards have several advantages over the current stocking standards in use in much of the province and, as a result of the analysis that was described above, it was recommended that they be adopted in the ML IFPA. Specific recommendations are listed below.

1. The population of blocks to be included in the multi-block standard, should be all those blocks in which harvesting has been completed 13 years before the assessment date.
2. Field procedures must ensure that sample distribution will allow for the identification and mapping of any potential under-performing areas and that sample size and design will provide reliable estimates of mean volume at the 95% level of probability. Recommended modifications to data collection during silviculture surveys includes: collecting inventory age and height for at least three species, collecting better information on stem distribution and OAF1, and eliminating the collection of information on well spaced and free growing stems.
3. It is recommended that post-survey stratification of the plot data be completed using the following criteria: leading species (>65% pine, >65% spruce, >65% balsam, or mixed), stocking level (<1000 stems/ha, 1000 to 3000 stems/ha, > 3000 stems/ha), and site index class (<16, 16 to 20, >20).
4. It is recommended that TASS 2.0 be used to model yield until such time as TASS 3.0 is available.
5. PMV should be determined by stratum using: the lower confidence limit for total conifers/ha (after deducting pest-affected trees), average site index from corresponding plot data, observed average species mix, observed OAF1 value, actual genetic worth, and using the lower confidence limit for effective age for each stratum. It is not recommended that the effects of deciduous trees or leave patches be modeled at this time.
6. Target yield should be modeled to age 90 using the input values used in timber supply analysis and average site index values for each stratum from corresponding plot data.
7. Regeneration performance should be considered to be successful if PMV is 90% of TMV.
8. It is recommended that the late date for conformance to the standard (analogous to free growing date) be set at 20 years from establishment.

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