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Restricted to FERIC Members and Partners
Vol. 2 No. 34 June 2001

Contents

Planning and layout costs II: Tree marking costs for uniform shelterwood prescriptions

Abstract

In November 2000, the Forest Engineering Research Institute of Canada (FERIC) initiated a short-term study to estimate productivity and costs for operational tree marking activities in three uniform shelterwood cutblocks near Williams Lake, B.C. This report documents the results.

Keywords

Tree marking, Planning, Layout, Shelterwood, Productivity, Costs, Interior British Columbia.

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Introduction

Over the past few years, changes in forest practices and policies in British Columbia have led to an increase in the implementation of partial cutting systems and an associated increase in the costs attributed to planning and layout. To help planners schedule and budget activities associated with various harvesting prescriptions, it is important to document productivity and costs associated with operational planning and layout.

In November 2000, FERIC monitored operational tree marking activities in three cutblocks located near Williams Lake, in the interior of B.C. The three cutblocks were part of a uniform shelterwood system initially harvested in 1991, and were comprised of fifteen treatment units and three research buffer areas (Figure 1). Within each cutblock, three-step and two-step shelterwoods were prescribed. Six treatment units plus the buffer areas were part of the three-step shelterwood. Tree marking activities were performed in all six treatment units and one of the buffer areas. The second entry into the three-step shelterwood units is scheduled for 2001. The intention of both shelterwood prescriptions was to stimulate tree growth by addressing the need for continued frost protection, while

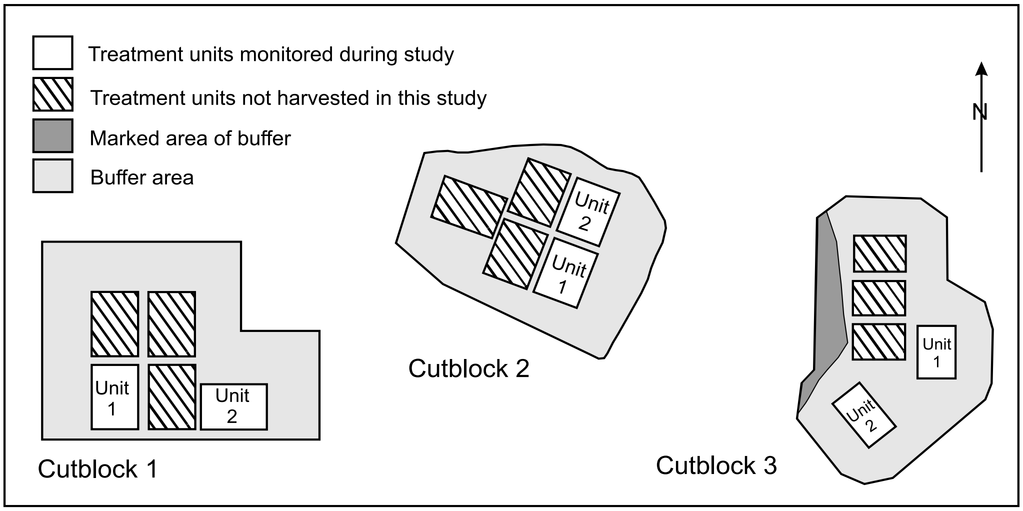

Figure 1. Location of the treatment units and buffer areas within each cutblock. Note: cutblocks are not presented in actual relation to each other.

increasing light to improve regeneration growth.

This study was performed in cooperation with the University of British Columbia/Alex Fraser Research Forest, Weldwood of Canada Limited and B.C. Ministry of Forests. This is the second in a series that documents case study productivities and costs of operational planning and layout activities for various harvesting prescriptions.

Site and stand description

The study area is classified as part of the dry/warm Sub-Boreal Spruce (SBSdw) biogeoclimatic subzone. The marked treatment units ranged in size from 1.3 to 1.4 ha and the buffer areas ranged in size from 12.3 to 23.3 ha. However, only a 2-ha portion of the buffer area in Cutblock 3 was marked and included in this study. The remaining buffer areas were left to faller selection.

Net merchantable volume in the marked treatment units and buffer areas ranged from 345 to 506 m^3/ha, with expected harvest volumes for these areas ranging from 184 to 283 m^3/ha. Terrain throughout the study area was gentle with ground slopes ranging from 0 to 25%. The treatment units and treated buffer zone were similar in tree species composition, consisting mainly of interior Douglas-fir *(Pseudotsuga menziesii)*, lodgepole pine *(Pinus contorta)* and white spruce *(Picea glauca)*.

Description of activities

Tree marking was carried out on a mark-to-leave basis with a focus on leaving the most vigorous Douglas-fir trees and removing trees with low vigor, indicators of suppression, and poor form or damage. Inter-tree distance, crown width and falling feasibility were also considered during marking. Additionally, wildlife trees were selected for permanent deferral.

Marking was done with a 3- or 4-person crew—two or three people measured diameters and marked the selected trees, and one person recorded the data. Only one crew member had previous experience with tree marking procedures. Leave trees were marked with blue paint on four spots evenly spaced around the bole of the tree at diameter at breast height. Basal area was calculated in the office at the end of each shift, and if basal area adjustments were required the crew would re-visit the site. To minimize marking costs, only a 2-ha section of the buffer area in Cutblock 3 was marked and used as a faller training area for the remaining 21.3 ha, which was left to faller selection.

Results

Table 1 summarizes site description, crew productivity and estimated cost for tree marking activities in the six treatment units and the marked portion of the buffer area in Cutblock 3. The cost analysis was performed on the basis of cost per hectare of area developed, cost per marked tree, and cost per cubic metre of expected harvest volume.

On average, the crew marked 37 trees per field hour or one tree every 1.6 minutes of field time. Tree marking cost, exclusive of travel and vehicle mileage, averaged \$281/ha, with average costs per marked tree and per cubic metre of \$2.35 and \$1.21, respectively. Treatment Unit 1 in Cutblock 3 achieved the lowest overall cost per hectare, cost per marked tree and cost per cubic metre at

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ISSN 1493-3381

Table 1. Crew productivity and estimated costs for tree marking activities

	Block 1			Block 2			Block 3		
	T.U.1	T.U.2	Buffer zone	T.U.1	T.U.2	Buffer zone	T.U.1	T.U.2	Buffer zone
Total area (ha)	1.4	1.4	12.3	1.4	1.4	13.5	1.3	1.3	23.3
Total area marked (ha)	1.4	1.4	0	1.4	1.4	0	1.3	1.3	2.0
Target leave tree basal area (m^2/ha)	20	15	20	20	15	20	20	15	20
Achieved leave tree basal area (m^2/ha)	20	12.8	n/a	15.6	15	n/a	22.3	22.1	23.7
Trees initially marked to leave (no.)	158	170		139	168		169	140	286
Trees adjusted to meet basal area requirements after initial marking (no.)	0	+29		+43	0		-20	-43	-21
Total trees marked to leave (no./ha)	113	142		130	120		115	75	133
Volume marked to leave (m^3/ha)	215	161		211	146		223	168	205
Expected harvest volume (m^3/ha) [a]	283	191		262	184		211	226	251
Productivity									
Initial field time (h)	3.0	3.2		3.2	3.8		3.0	2.0	6.0
Basal area adjustment time (h)	0.0	2.0		3.1	0.0		1.3	2.5	1.2
Office time (h)	1.0	1.0		0.9	1.1		0.6	0.5	1.0
Total time/ha (h)	2.9	4.4		5.1	3.5		3.8	3.8	4.1
Total time/tree (min)	1.5	1.9		2.4	1.8		2.0	3.0	1.8
Total field time/tree (min)	1.1	1.6		2.1	1.4		1.7	2.8	1.6
Trees marked/field hour (no.)	55	38		29	43		35	21	38
Costs [b, c]									
$/ha	169.62	269.84		306.96	202.21		322.98	285.36	372.56
$/marked tree	1.50	1.90		2.36	1.69		2.81	3.80	2.80
$/$m^3$ of expected harvest volume	0.60	1.41		1.17	1.10		1.53	1.26	1.48

[a] Expected harvest volume is based on cruise compilation information.
[b] Assumed that one forester with ten years' experience and two or three forestry technicians performed all field work. Wage rates include 38% wage benefit loading and were assumed to be $48.57/h for the forester and $31.53/h for each forestry technician (extrapolated from 1999 Association of B.C. Professional Foresters report on members' compensation and benefits).
[c] Cost estimates include labour, field equipment, and field consumables.

$169.62, $1.50 and $0.60, respectively. Conversely, the buffer area in Cutblock 3 achieved the highest cost per hectare at $372.56, while Treatment Unit 2 in Cutblock 3 acheived the highest cost per marked tree at $3.80. Treatment Unit 1 in Cutblock 3 achieved the highest cost per cubic metre at $1.53. The cost difference, in part, is likely a reflection of the difference in time required for basal area adjustments in each cutblock, as well as basal area target and stand density differences. Higher density stands may have resulted in the crew having to make more frequent and difficult judgement calls, thus reducing overall productivity.

In the past, FERIC's involvement in documenting tree marking costs has been limited. However, Bennett (1997) estimated tree marking costs for a coastal old-growth stand at $706/ha and $528/ha for a 65% and a 70% retention unit, respectively. The large difference in cost estimates for tree marking activites between the Bennett study and this study is likely due to the differences in terrain and tree size.

Discussion and implementation

- The tree marking procedures worked well operationally. However, tree marking may have been streamlined with the use of a handheld datalogger to monitor the marking process on an on-going basis in the field. The ability to calculate basal area on a continuous basis would have eliminated the need to re-visit a site if basal area adjustments were required.
- Employing an experienced marker likely reduced the learning curve for the inexperienced markers, and ensured basal area and residual tree quality objectives were met. Additionally, working in a crew rather than individually enabled judgement calls concerning leave trees to remain consistent throughout the study.
- Implementing faller selection in the buffer area in Cutblock 3 decreased the overall cost associated with the tree marking phase because direct marking costs were reduced. However, falling productivity in the marked and unmarked areas were not tracked and therefore, it is difficult to determine the effect tree marking had on falling efficiency and overall harvesting cost.
- Allowing handfallers to select leave trees may increase residual stand quality, particularly in dense stand conditions, because the fallers are able to see crowns more clearly once the stand has been partially opened up. However, practicing faller selection, whether manual or mechanical, requires conscientious fallers and a clear, well-defined set of criteria. Furthermore, marking a portion of the cutblock prior to faller selection, as done in the buffer area in Cutblock 3, allowed the feller-buncher operators to become familar with the stand characteristics and required retention levels.

Conclusion

Tree marking productivity documented in this report averaged 37 trees marked per field hour at an average cost of $1.21/m^3$. Productivity and cost may have been influenced by the amount of basal area adjustments required and differences in basal area targets and stand density.

Reference

Bennett, D.M. 1997. Partial cutting in mountainous old-growth forests in coastal British Columbia: harvesting productivity and cost, and residual stand impacts. FERIC, Vancouver, B.C. Technical Report TR-119. 20 pp.

Acknowledgements

The author gratefully acknowledges Mircea Rau and Ken Day of UBC/Alex Fraser Research Forest for their valuable assistance during the project. The author would also like to thank FERIC employees Doug Bennett and Ingrid Hedin for project advice and draft report review, and Shelley Corradini and Yvonne Chu for assistance with report preparation.