Alternative silvicultural systems: Harvesting logistics and costs

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INTRODUCTION

Partial cutting is required in areas where forest cover must be maintained to meet silvicultural objectives or to support non-timber resources such as wildlife habitat or visual quality. The Forest Engineering Research Institute of Canada (FERIC) has conducted several studies to document harvesting techniques that can meet non-timber resource requirements, as well as maintain acceptable harvesting costs and minimal effects on the site, stand, and wildlife habitat. Here we focus on three FERIC studies that examine the effects of opening size, orientation, and retention level on regeneration, visual quality, and mule deer winter range. The emphasis is on the respective productivity and relative costs of the different phases of the harvesting operations and operating constraints.

In the first study (Horsefly Lake), the B.C. Ministry of Forests, in co-operation with the Williams Lake Division of Weldwood of Canada Limited and the B.C. Ministry of Environment (Williams Lake), examined the effects of harvesting trees from small openings on mule deer winter habitat in an area with high recreation values. In the second study (Sicamous Creek), the B.C. Ministry of Forests (Kamloops Forest Region), in co-operation with the Lumby Division of Riverside Forest Products Limited, explored the effects of five canopy opening sizes on regeneration of a high-elevation forest near Sicamous, B.C. In the third study (Cornish Mountain), the Quesnel Division of West Fraser Mills Ltd. investigated the effects of opening size, orientation, and retention level on visual quality in the Barkerville corridor near Quesnel, B.C. FERIC monitored the harvesting phase in all the studies.

Overall objectives in the three studies were to:

- determine the economic feasibility of harvesting timber from small openings;
- determine the productivity and costs of harvesting;
- evaluate the equipment and operating practices used during the harvesting phase; and
- identify operating constraints.

MATERIALS AND METHODS

To obtain shift-level information, FERIC installed Servis recorders on all harvesting machines and maintained daily crew records. To supplement the shift-level data, specific information on the falling, skidding, and processing cycles was obtained by detailed timing. Harvested wood volumes were obtained

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from the Licensee's weigh-scale receipts. Costs were calculated using FERIC's standard costing method, and were not those experienced by the contractor; these costs did not include supervision, overhead, profit, and risk allowances.

Study One (Horsefly Lake)

The study block was divided into four treatments based on canopy opening size: four 0.25-ha openings, four 0.50-ha openings, ten 1.0-ha openings, and two 2.0-ha openings, for a total of 20 openings (Waterhouse 1998). Approximately 20% of the total study block was harvested including roads, landings, and openings. Openings were located across and along topographical contours to provide varying amounts and intensities of light, and to cover the range of ecosystem associations and levels of frost drainage. After mechanical harvesting (feller-buncher and grapple skidder), eleven openings were site prepared and eight openings were left without site preparation. The remaining opening had root rot (*Armillaria ostoyae)* infections; one-half was stumped and the other half treated with a biological control fungus. Planting was done the following spring.

Study Two (Sicamous Creek)

The Sicamous Creek study area was divided into five treatment units based on canopy opening size: an untreated control, single-tree selection, 0.1-ha group selection, 1.0-ha patch cut, and 10-ha clearcut (Mitchell 1996). The treatments were replicated three times, for a total of 15 units. In all treatment units, except two of the single-tree selection units, mechanical harvesting systems (feller-bunchers and grapple skidders) were used. In the two remaining single-tree selection units, a conventional harvesting system (manual falling and line skidding) was used. After treatment, the units were subdivided to accommodate two treatments—mounding with an excavator and no site preparation. Planting followed.

Study Three (Cornish Mountain)

The study block was divided into 13 openings ranging in size from 2.0 to 9.8 ha. Only six openings (5 clearcuts and one with group selection for one-half of the opening and clearcut for the other half) were completed during the 1998 winter season and therefore only those were included in the study. The two contractors used a conventional harvesting system (manual falling and line skidding). In the group selection, the faller was guided by West Fraser Mills Ltd. in how many trees to fell, based on visual assessment from the main highway to Barkerville.

RESULTS AND DISCUSSION

Developing a block for partial cutting requires a long-term vision of the forest stand. Planning the location, shape, and orientation of the openings must consider multiple entries. Planning must also include the access roads, landings, and the skid trails or corridors within the openings and between them. The trail pattern must allow skidding without damage to residual trees, while maintaining acceptable levels of productivity. The layout and marking of boundaries for small openings require more time per cubic metre of wood harvested than for larger openings.

The significance of any cost increases will depend on the effect of the opening sizes and post-harvest treatments on regeneration performance and non-timber resources. The degree of success of the projects will not be known until the research components carried out by the other agencies are completed. The final decision on success or failure of harvesting by small openings can only be determined in the long term, after the future entries are completed.

Study One (Horsefly Lake)

The treatment with the highest falling productivity was the 2.0-ha openings at 108 m^3/productive machine hour (PMH) followed by the 0.25-ha openings at 107 m^3/PMH, the 1.0-ha openings at 97 m^3/PMH, and the 0.50-ha opening at 80 m^3/PMH. Skidding productivity, standardized to 200 m, was higher for the 2.0- and 1.0-ha openings (33 and 32 m^3/PMH, respectively) than the 0.25- and 0.50-ha openings (at 27 and 25 m^3/PMH, respectively).

There was a 2% increase in the cost of harvesting the 1.0-ha openings over the 2.0-ha openings, while the costs of harvesting 0.25- and 0.50-ha openings increased by 9 and 20%, respectively.

In this study, opening size had a minimal effect on harvesting productivity and costs. Harvesting of the block by small openings was feasible with some increase in cost (up to 20%) which could be reduced at the planning stage by adding another landing to shorten the skidding distances.

Study Two (Sicamous Creek)

Layout costs for the 0.1-ha group selection and 1.0-ha patch cut treatment units were almost double that of a conventional clearcut block because the smaller units had a greater length of boundary to mark than 10.0-ha clearcuts. Marking of the residual trees may be useful for training purposes, but is unnecessary with well-trained operators.

Harvesting productivity ranged from 2.1 to 9.6 m^3/ha and costs ranged from \$11.07 to \$30.66/m^3. Harvesting productivity and cost were affected more by the machine complement of the harvesting system, the harvesting procedure, and the harvested volume than by the treatment. Mechanical harvesting systems were more productive than conventional systems and the 10-ha opening had the highest productivity of the mechanical systems. The feller-buncher operator was able to maintain a high productivity in the single-tree selections units and placed the stems accurately for the skidding phase. This is only possible with an experienced operator who is committed to the operation.

Study Three (Cornish Mountain)

Block size, weather conditions, and operating procedure influenced falling productivity. The largest block had the highest falling productivity and the smallest block had the lowest (28.2 and 14.9 m^3/ha, respectively). The cold weather negatively affected the falling productivity. The faller who divided his time between falling and bucking had the higher productivity.

Block layout, distance, slope, and operating procedure affected skidding productivity.

Overall harvesting costs were affected more by skidding productivity than falling productivity. Openings with few landings, or that were irregularly shaped, required longer skid trails and had lower productivity. This should be accounted for in the planning and layout stages of block development. The increase in skidding cost may be acceptable if a block has fewer roads and landings, and visual impact is minimized.

West Fraser Mills had good communication with both contractors and members of the local community throughout the project. This communication, combined with the experience of the crews and their willingness to try new things, resulted in the treatment objectives being met.

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